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Pesticide Deaths in California, 1990 - 1996

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Executive Summary

California maintains surveillance for human health effects of pesticide exposure. By law, doctors must report any patient that they know or have reason to believe suffers from any disease or condition caused by a pesticide. This study investigated mortality following exposure to pesticides in the State of California from 1990 through 1996. Fatalities were identified through death certificates and the State surveillance program for pesticide illnesses. A sample of hospital records and poison control consultation logs were reviewed for the years 1994 – 1996, which identified three suicides not located among death certificates or surveillance records. Duplications were avoided by collecting individual identifiers from each source, which permitted probabilistic linkage confirmed by operator review. The study characterized deaths by the types of pesticides involved and the circumstances of exposure, and used the results as a measure of the State surveillance program's success in identifying fatalities.

Since the 1960s and 1970s, the total rate of unintentional pesticide mortality has decreased ten fold, while the proportion of childhood victims has dropped from more than half to less than one fifth of the total. In the seven-year period of this study, two children, a boy and a girl, died of unintentional pesticide ingestion. Both were less than two years old, and both ingested common household insecticides: mothballs in one case, flea dip in the other. The next youngest victim was a 16-year-old suicide.

Of 59 total fatalities, 36 were documented as suicides, and another four may have been suicides. Insecticides (18 cases) and rodenticides (9 cases) were the pesticide classes most frequently used to commit suicide. Twelve of the 18 suicidal insecticide ingestions involved organophosphates, specifically chlorpyrifos, diazinon, malathion, and three deaths in which the particular organophosphate was not identified. Of the nine suicides that involved rodenticides, five involved products that contained strychnine.

Unintentional pesticide deaths were caused primarily by antimicrobials (i.e. disinfectants, 8 cases) and by the toxic atmosphere inside fumigated buildings (7 cases). Inadvertent antimicrobial exposures occurred in two ways: Six mentally compromised people, ranging from 71 to 98 years old, drank lethal amounts of home-use sanitizers. Two younger adults, both of whom had serious preexisting health conditions, were fatally overcome by fumes generated when they mixed antimicrobials for home use. The specific mixtures involved could not be identified.

The surveillance program had records on all seven deaths from structural fumigants, all three deaths that followed occupational exposures, and four of the five that involved agricultural-use pesticides. It had recorded only five of the 36 definite suicides, and had received no notification of the two deaths in childhood, or of any of the 12 deaths from antimicrobial exposure.

We recognize that this procedure could not accomplish a complete ascertainment of pesticide deaths. Since death certificates and PISP records failed to identify three pesticide suicides (located in our sampling of hospital and poison control records), we must expect that additional cases escaped detection. The sampled sources, however,

augmented our ascertainment by only three suicides over a three-year period, and those cases had been sampled with probability greater than 50 percent. We conclude that we overlooked relatively few pesticide deaths, and that most if not all of those we missed were suicides.

To cover the full spectrum of pesticide fatalities, the surveillance program should cultivate cooperation with coroners. Its staff plans to offer assistance in investigating any death in which pesticide exposure is suspected.

Introduction

Data on the epidemiology of pesticide toxicity remain so sparse that regulators continue to rely on studies performed during the 1970s for information about morbidity and mortality[1]. In March, 2000, the U.S. General Accounting Office (GAO)[2] concluded that "Comprehensive information on the occurrence of acute and chronic health effects due to pesticide exposure does not exist." This GAO report identifies the California Pesticide Illness Surveillance Program (PISP) as one of four important sources of information on pesticide toxicity. It references an earlier GAO survey[3] that describes the California program as "by far the most effective and well-established monitoring system".

The work described here attempts quantitative evaluation of the PISP program. It also presents descriptive information on the full range of pesticide-related fatalities identified by review of California death certificates, hospital records, and poison control logs, as well as PISP data.

The literature on pesticide toxicity provides few parallels for this effort. Previous publications have summarized automated data collected nationally[4] and several have reviewed data from multiple sources to develop profiles of pesticide toxicity for specific areas and time spans[5-7]. To our knowledge, the only previous attempt to link files was performed at a regional poison control center[8], which identified consultations about occupational exposures during a six-month period and attempted to locate them manually among surveillance records.

This work was performed by the PISP lead scientist as part of a doctoral dissertation, with the assistance of a committee of faculty of the University of California at Davis. Funding was supplied by the U. S. Environmental Protection Agency and the National Institute of Occupational Health and Safety. Investigation focused on the period 1994 through 1996 because of data availability. We supplemented these data with a limited review of data from 1990 through 1993. For the supplementary period, we had access only to death certificates and to fatalities reported to the PISP.

Materials and Methods

The World Health Organization's International Classification of Diseases (ICD) codes provided the mechanism to recognize death certificates and hospital discharges concerning fatalities potentially related to pesticides. During the study period, the National Center for Health Statistics assigned codes from the ninth revision of ICD (ICD-9) to all U.S. fatalities. California hospitals coded their discharges using the clinical modification (ICD-9-CM), which is fully compatible with ICD-9, and identical to it with respect to the codes used in this work.

Case identification and selection has been fully described elsewhere[9]. Briefly, we sampled records with general codes for toxicity or chemical injury (general codes, tabulation available upon request) as well as reviewing as many as we could of those that received codes that represent specific pesticide products (nature of injury codes 989.1 – 989.4 and external cause of injury codes E861.4 and E863.0 – E863.9). We included code E861.4

(accidental poisoning by disinfectants) as a specific code because disinfectants are regulated as pesticides.

The California Office of Statewide Health Planning and Development provided a file of all 12,830 hospital discharge records from 1994 through 1996 that carried ICD-9-CM codes of interest in any of 25 diagnosis fields. These included all records that carried any of the general codes as well as those with pesticide-specific codes. We selected a stratified random sample of the hospitals identified in this file. Within selected hospitals, cases were sampled from strata defined by the diagnostic codes that triggered record retrieval.

We purchased multiple cause of death tapes for 1990 through 1996 from the California Department of Health Services' Center for Health Statistics, and then purchased hard copies of all death certificates that carried pesticide-specific ICD-9 codes in any of 41 diagnosis fields. For the period 1994 – 1996, we reviewed a sample of deaths with general codes for toxicity or chemical injury. We also reviewed samples of death records from 1990 to 1993 that carried certain uncommon general codes. We requested coroners' investigations of all reviewed deaths for which the hard copy death certificate did not clearly document a cause other than pesticide exposure.

Of the six poison control centers that served California during the period of interest, only two used software that captured necessary information about exposure, symptomatology, and clinical course. The center that served the heavily agricultural San Joaquin Valley contributed records from 1994 – 1996. The center that served the Northeast quadrant of the state provided records from September 1995 through 1996. Poison control records were selected based on generic codes used within the poison control system.

PISP records were available for 1982 through 1997. We extracted data on fatalities that occurred between 1990 and 1996.

We reviewed death certificates, hospital charts, and poison control records individually to identify the toxicants involved and to determine the source of exposure. The first author had participated in abstracting data on the PISP cases as they were collected, and converted those records electronically to a format compatible with data from the other sources. Codes were assigned to represent pesticide categories, intentional or unintentional exposure, occupational or non-occupational exposure, and agricultural or non-agricultural pesticide use. Records from different sources were linked by means of a probabilistic matching function, which presented a list of potential matches to a human operator for final determination.

Results

Data Source Comparison

We had access to hospital and poison control records only for the period 1994 through 1996. Consideration of data source characteristics consequently is limited to that period. We identified a total of 24 California deaths associated with pesticide exposure during those three years, including five that involved antimicrobial (disinfectant) products. Seventeen of the 24 deaths were suicides.

Of the 24 pesticide-related fatalities, death certificates were located for 17, including 6 of the 13 located in other data sources (Table 1). We found overlap between death certificates and each of the other sources, but none among hospital, poison control, and PISP records of pesticide-related deaths.

The three pesticide-related deaths found among poison control records were all suicides, as were two of the three located using hospital discharge data. Both death certificate coding and the PISP identified the two deaths caused by entering structures under fumigation; dates and names of decedents confirmed that these recorded the same two events.

Supplementary Data

Additional data from 1990 through 1993 were available from the PISP and from death certificate review. Thirty-five pesticide-related deaths were identified from this period. Death certificates identified 29, of which three were also located among PISP records. The PISP had records of six fatalities not retrieved among death certificates, of which four involved entry into fumigated buildings.

The following descriptive statistics cover all fifty-nine California deaths following pesticide exposure identified from 1990 through 1996. The deaths are described individually in an appendix to this report. Hospital and poison control records, which were consulted only for the latter part of the period, contributed three deaths (all of which were suicides) not located among death certificates or PISP records.

Age and Sex

Two children, a boy and a girl, died of pesticide ingestion (Table 2). Both were less than two years old, and both ingested common household insecticides: naphthalene mothballs in one case, flea dip containing rotenone and pine oil in the other. These tragedies were located by retrieval of death certificates. No other source identified any deaths from pesticide poisoning during childhood. The next youngest victim was a 16-year-old suicide. Males constituted 74% of the victims (43 of 59). Twenty-two (37%) of the victims were 65 years old or older.

Except for the absence of any pesticide-related fatalities among children two to 15 years of age, the estimated annual rate of pesticide-related mortality increased consistently with

age. Rates showed an upward trend with age for both intentional and unintentional pesticide fatalities.

Pesticide Class and Intention

Among the 36 suicides, 18 involved insecticides (Table 3), of which 12 contained organophosphates (three each chlorpyrifos, diazinon and malathion, as well as three deaths in which the particular organophosphate was not identified). Nine involved rodenticides, including five that contained strychnine. The remaining nine suicides involved various herbicides, fumigants, fungicides, and antimicrobials. Except for those listed above, no pesticidal ingredient was implicated in more than two suicide cases.

Unintentional deaths occurred primarily by exposure to methyl bromide or sulfuryl fluoride in buildings under fumigation (seven), or to antimicrobial products (eight). Inadvertent antimicrobial exposures occurred in two ways: Six mentally compromised people, ranging from 71 to 98 years old, drank lethal amounts of home-use sanitizers. Intention could not be determined for one other 75-year-old who ingested a sanitizer. Two younger adults, both of whom had preexisting health conditions, were fatally overcome by fumes generated when they mixed antimicrobials for use:

Case 1: A 58-year-old woman with a history of cerebral vascular accidents as well as asthma and emphysema developed severe shortness of breath and began gasping while working with pool chemicals. Rescue personnel who arrived about ten minutes later reported that they used breathing apparatus to enter the residence because chlorine fumes were so heavy.

Case 2: A 33-year-old man with end-stage alcoholic liver disease, renal failure and pancreatitis spent all day cleaning a bathtub using four products, at least one of which was a sanitizer. He developed weakness, difficulty breathing, headache, and substernal pain. He was admitted to the hospital the next day, where he died of sepsis 32 days later.

Exposure Circumstances

Five of the decedents, including two suicide cases, were exposed to agricultural-use pesticides. The PISP had records on four of these, two of which were also retrieved among death certificates. Poison control data recorded the suicide of a farm resident by ingestion of an unidentified product thought to be a pesticide; this event was not identified by any other source.

The PISP identified three decedents occupationally exposed to pesticides. All three worked in agriculture. One of the three, an applicator who somehow swallowed some of the parathion he was applying, was also found among death certificates. The other two provided less persuasive evidence of pesticide involvement. A pilot made an unexpected maneuver that caused a fatal collision while applying pesticide, and a laborer was found dead in proximity to some anticoagulant bait he had been assigned to apply. No additional evidence linked these deaths to pesticide exposure, but the PISP retained them because pesticide contribution had not been disproved.

Summary

For the years 1990 – 1996, we located a total of 59 California deaths associated with pesticide exposure, of which 36 were suicides. Death certificate review located the largest number of deaths (46), followed by review of PISP records (16). Hospital and poison control records each identified three fatalities from 1994 through 1996. We found no other source for one of the hospital deaths or for two of those from poison control. The PISP had records of all seven known deaths from fumigants, all three occupational exposures, and four out of five in which agricultural pesticides were implicated. It received reports on just five of 36 suicides, and had received no notification of either of the two deaths during childhood or on any of the 12 identified cases in which people died from exposure to antimicrobials.

Discussion

To identify individual toxicants and locate information about circumstances of exposure and clinical course, we included only those cases for which we could review source documents (coroners' reports, hospital charts, and poison control notes). This decision limited us to a sampling of events, and to records from two of the six poison control centers that served California during the study period. It greatly expanded the detail we were able to collect, however. In particular, records collected using the enhanced poison control program provided narrative descriptions of the clinical course, including laboratory results, which were very helpful in evaluating the cases. This avoided many of the misclassification problems described in previous work[1, 10, 11].

We recognize that this procedure could not accomplish a complete ascertainment of pesticide deaths. Hospital and poison control data were available for only part of the period and from only certain institutions. Since death certificates and PISP records failed to identify three pesticide suicides (2 identified by poison control and 1 from hospital records), we must expect that additional cases escaped detection. Because the sampled sources augmented our ascertainment by only three suicides over a three-year period, and those cases had been sampled with probability greater than 50 percent, we conclude that we overlooked relatively few pesticide deaths, and that most if not all of those we missed were suicides.

Our results agree well with those reported by Klein-Schwartz and Smith[4], who based their figures on nationwide death certificate coding retrieved for the years 1985 – 1990 by the CDC Wonder search facility for public health data. In addition to near-perfect agreement on crude rates of unintentional death and proportion of children (Table 4), we found that 61 to 68 percent of pesticide-related deaths were suicides; Klein-Schwartz and Smith reported 63.6 percent.

If we had duplicated Klein-Schwartz and Smith's methodology, we would have identified 6 rather than 11 unintentional pesticide fatalities, including 3 that we determined from coroners' records had not involved any pesticide. If we had relied on death certificate data alone, but still reviewed additional toxicity codes and verified pesticide involvement, we would have found 5 rather than 11 unintentional fatalities involving pesticides other than

antimicrobials. In that case, we would have estimated the crude annual fatality rate as 0.024 per million of population rather than 0.05. This might have put us in agreement with Hayes[13], who commented with respect to 1969 fatalities (without giving particulars) that "The relatively small number of cases in California was remarkable, in view of the extensive use of pesticides in that state."

Our results reflect a substantial change in the profile of unintentional pesticide deaths since the 1960s and 1970s. The total rate of unintentional pesticide mortality has decreased by an order of magnitude, while the proportion of childhood victims has dropped from more than half to less than one fifth of the total (Table 4). Identities of pesticides involved have changed, also. As recently as 1974, arsenic and strychnine were the pesticide ingredients most commonly identified in unintentional deaths, and cyanide continued to be used as a fumigant (resulting in the deaths of three applicators in 1973 and 1974). The predominant mechanisms of unintentional death identified in this work--illegal entry into structures under fumigation and ingestion of household sanitizers--are not identified in earlier studies. Those studies did not attempt to investigate health effects of sanitizers.

The small numbers of pesticide-related deaths identified, along with limited overlap among data sources, precluded capture-recapture estimation of the true total number of events. Although both death certificates and the PISP are population-based, they define the populations they cover differently: Death certificates are assigned to the jurisdiction where the decedent maintained legal residence, while the PISP collects information about pesticide exposures that occur in California and does not record the victims' residence status. This may explain our failure to identify death certificates for several unequivocal pesticide fatalities documented in the PISP. Additionally, the PISP pursues investigation of all medically documented health effects that occur in association with pesticide exposure. It maintains records even on those cases with only a tenuous connection.

Although we were unable to fulfill our original intention of estimating the true total number of pesticide-related deaths, we found that characteristics of the cases located suggest some directions to explore to improve ascertainment. The PISP's success in locating cases related to agricultural pesticides and structural fumigants probably reflects information transmission from business operators through their regulatory agencies. Surveillance staff should be alert to the possibility of developing additional resources of this sort.

Coroners appear to be the primary untapped resource for collecting poisoning fatalities. The Department of Pesticide Regulation plans to communicate with coroners and offer assistance in investigating any death in which pesticide exposure may play a role. By establishing cooperation with coroners, surveillance personnel can maximize opportunities both to learn of events and to collect specific information needed to identify intervention options.

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Table 1: Sources of Identification of California Fatalities Associated with Pesticide Exposure, 1994 – 1996				
Source of Identification	Documented Suicides	Other Deaths	Total	Source Total
Death Certificates Only[a]	9	2	11	
Hospital Records Only[b]	1	0	1	3
Hospital Records and Death Certificates[b]	1	1	2	
Poison Control Only[c]	2	0	2	3
Poison Control and Death Certificates[c]	1	0	1	
Surveillance Records Only[d]	2	2	4	7
Surveillance Records and Death Certificates[d]	1	2	3	
Total	17	7	24	

a) We reviewed all 1994 – 1996 California death certificates that received any code that identified any pesticide-related fatality.

b) Hospital records reflect a two-stage stratified random sample of hospital discharge summaries. One of the cases, which was also located among death certificates, had a sampling weight of 11.65. The other two had sampling weights less than 2.

c) Poison control records were received from the Central Valley Regional Poison Control Center for 1994 – 1996, and from the University of California Davis Medical Center Regional Poison Control Center for September, 1995 through 1996. All fatalities were reviewed.

d) Surveillance records refer to data collected by the California Pesticide Illness Surveillance Program (PISP). All PISP records of fatalities from 1994 – 1996 were included in this review.

Table 2: Summary by Age and Intent of California Fatalities Associated With Pesticide Exposure, 1990 – 1996					
Age Range (years)	Intention of Decedent			State population 1990 Census[a]	Annual rate per million population
	Suicide	Unintentional	Undetermined		
0 – 4	0	2	0	2376474	0.12
5 – 14	0	0	0	4218954	0.00
15 – 24	4	1	0	4469094	0.16
25 – 34	3	3	1	5739293	0.17
35 – 44	4	4	1	4646815	0.28
45 – 54	7	1	0	2955981	0.39
55 – 64	5	1	0	2231551	0.38
65 – 74	8	3	0	1865417	0.84
75 – 84	3	1	2	967997	0.89
85 +	2	3	0	288445	2.48
Total	36	19	4	29760021	0.28

a. http://homer.ssd.census.gov/cdrom/lookup/99713514 accessed 2/27/01

Fatalities were identified by review of death certificates selected by ICD-9 coding, of hospital discharge summaries selected by ICD-9-CM coding, of poison control logs, and of records of the California Pesticide Illness Surveillance Program (PISP). All 1990 – 1996 fatalities known to PISP were included in this summary. Death certificates were also reviewed from 1990 – 1996. Among death certificates, one fatality from disinfectant ingestion was identified by a code that was sampled; it had a sampling weight of 3.4. All other pesticide-related fatalities identified through death certificates carried codes for which all death certificates were reviewed. Hospital records derive from a two-stage stratified random sample of hospital discharge summaries from 1994 - 1996. One of three hospital cases, which was also located among death certificates, had a sampling weight of 11.65. The other two had sampling weights less than 2. Poison control records were received from the Central Valley Regional Poison Control Center for 1994 – 1996, and from the University of California Davis Medical Center Regional Poison Control Center for September, 1995 through 1996. All fatalities among poison control entries were reviewed.

Table 3: Summary by Pesticide Category and Intent of California Fatalities Associated With Pesticide Exposure, 1990 – 1996				
	Intention of Decedent			Total
Pesticide Category	Suicide	Unintentional	Undetermined	
Fumigant	0	7	0	7
Fungicide	1	0	0	1
Herbicide	4	0	0	4
Insecticide	18	3	3	24
Rodenticide	9	1	0	10
Antimicrobial	3	8	1	12
Multiple Categories	1	0	0	1
Total	36	19	4	59

Fatalities were identified by review of death certificates selected by ICD-9 coding, of hospital discharge summaries selected by ICD-9-CM coding, of poison control logs, and of records of the California Pesticide Illness Surveillance Program (PISP). All 1990 – 1996 fatalities known to PISP were included in this summary. Death certificates were also reviewed from 1990 – 1996. Among death certificates, one fatality from disinfectant ingestion was identified by a code that was sampled; it had a sampling weight of 3.4. All other pesticide-related fatalities identified through death certificates carried codes for which all death certificates were reviewed. Hospital records derive from a two-stage stratified random sample of hospital discharge summaries from 1994 - 1996. One of three hospital cases, which was also located among death certificates, had a sampling weight of 11.65. The other two had sampling weights less than 2. Poison control records were received from the Central Valley Regional Poison Control Center for 1994 – 1996, and from the University of California Davis Medical Center Regional Poison Control Center for September, 1995 through 1996. All fatalities among poison control entries were reviewed.

Table 4: Summary of Reviews of Unintentional Pesticide-Related Fatalities					
Author[a]	Population	Year(s)	Number of Deaths	Crude Annual Death Rate per Million	Percentage of Decedents Less than 10 Years Old
Hayes[12]	USA	1961	111	0.62	51
Hayes[13]	USA	1969	87	0.43	43
Hayes[14]	USA	1973 – 1974	113	0.26	30
Klein-Schwartz[4]	USA	1985 – 1990	97	0.06	19
Mehler	California, Excluding Antimicrobials	1990 - 1996	11	0.05	18
Mehler	California	1990 - 1996	19	0.09	11

a. Superscripts identify the cited references from which data were derived. This publication is the source of information on California fatalities.

Appendix: Individual case descriptions of deaths that occurred in association with pesticide exposure in California, 1990 - 1996

Summary of Pesticide-Related Deaths in California, 1990 - 1996				
Year of Death	Age at Death	Sex of Victim	Information Source(s)	Case Description
Suicides				
90	28	Male	PISP only	A man committed suicide by ingesting malathion and an unknown herbicide. He was found on the bathroom floor with 2 pint-sized bottles nearby. Emergency response personnel disagreed on the amount of material left in the bottles.
90	29	Female	Death certificate only	A depressed young woman was found dead beside a pesticide bottle. She had left a suicide note.
90	29	Female	Death certificate only	A young woman was found dead. Diazinon was identified in her stomach contents and in her blood.
91	71	Male	Death certificate only	A man committed suicide by ingesting an insecticide. Malathion was detected in his stomach contents and in his blood.
91	89	Male	Death certificate only	An elderly man acknowledged drinking chlordane. He survived the ensuing renal failure, but succumbed to pneumonia.
91	49	Male	Death certificate only	A man left a suicide note, drank a quart of malathion, and cut his wrist and ankle. He was taken to a hospital and treated, but died without regaining consciousness.
92	52	Male	Death certificate only	A depressed man told a family member that he had ingested insecticide. He was admitted to a hospital, but treatment was unsuccessful.
92	22	Male	Death certificate only	A young man committed suicide by ingestion of Cyanogas ant poison.
92	47	Male	Death certificate only	A man committed suicide by drinking alcohol and an unidentified weed killer.
92	35	Male	Death certificate only	A man committed suicide by drinking moss killer. The retail clerk who sold it to him saw him drink it.
92	40	Male	Death certificate only	A man in business difficulty committed suicide by ingesting lye and rat poison. The rat poison probably contributed little to the outcome.

Summary of Pesticide-Related Deaths in California, 1990 - 1996				
Year of Death	Age at Death	Sex of Victim	Information Source(s)	Case Description
93	47	Male	Death certificate and PISP	A 47-year old man committed suicide by ingesting strychnine-coated seeds. He also shot himself in the forehead with a .22 caliber weapon (which caused minimal damage). His body was found in advanced state of decomposition. The exact date of death could not be determined.
93	75	Female	Death certificate only	A recent widow was found by her family intoxicated and smelling strongly of insecticide. She was admitted to a hospital, but treatment was unsuccessful.
93	57	Female	Death certificate only	A woman told her husband she had drunk insecticide. Diazinon was identified in her blood.
93	69	Female	Death certificate only	A woman committed suicide by insecticide ingestion. Diazinon was identified in the contents of her stomach and in her blood.
93	42	Male	Death certificate only	A man told his sister by telephone that he had drunk chlordane. After his death, chlordane was detected in the contents of his stomach and in his blood.
93	69	Male	Death certificate only	A self-employed landscape gardener committed suicide by ingesting flea spray
93	43	Male	Death certificate only	A disabled man was found dead in his back yard. His family identified a bottle of organophosphate insecticide as the likely cause.
93	16	Female	Death certificate only	A teen-ager was brought to the hospital for repeated vomiting. She then acknowledged ingesting zinc phosphide rodenticide. Treatment was unsuccessful.
94	65	Male	PISP only	A despondent 65-year old man drank an unknown amount of malathion. He was hospitalized for eight days before dying. Four emergency response personnel became ill from exposure to the odor and vapors.
94	60	Female	Death certificate only	A woman committed suicide by ingestion of Hexol disinfectant.
94	56	Male	Death certificate only	A man committed suicide by ingesting gopher bait. After his death, strychnine was detected in the contents of his stomach and in his blood.

Summary of Pesticide-Related Deaths in California, 1990 - 1996				
Year of Death	Age at Death	Sex of Victim	Information Source(s)	Case Description
94	49	Female	Death certificate only	A woman committed suicide by ingestion of a household disinfectant.
94	74	Male	Death certificate only	A terminally ill man was found in the bathroom with several empty bottles of household products, including a sanitizer. He died after several days in the hospital.
94	65	Male	Death certificate only	A man was found unconscious near a suicide note. After his death, 2,4-D was identified in his blood.
94	45	Male	Death certificate and poison control	A grocery clerk committed suicide by injection of boric acid and paraquat.
95	56	Female	Death certificate only	A woman committed suicide by ingesting rodenticide. After her death, strychnine was detected in her blood.
95	80	Female	Death certificate and hospital records	A woman told her daughter that she had taken poison. Arsenical rodent poison was found at her residence, and arsenic was detected in her blood after death.
96	67	Male	PISP only	A despondent stroke victim drank almost one pint of 50% malathion. His blood was found to contain 1.21 ppm malathion product. Three paramedics and two firefighters attempted to resuscitate him.
96	24	Male	Death certificate and PISP	A 24-year old man committed suicide by drinking an unknown amount of fungicide. Upon arrival at the hospital, he was unconscious and on a ventilator. He died 14 days later.
96	73	Male	Death certificate only	A man in failing health committed suicide by ingesting a lawn care product.
96	87	Male	Death certificate only	An elderly, ailing widower left a suicide note and ingested gopher bait containing strychnine.
96	58	Female	Death certificate only	A woman was found dead in her apartment by the property manager. She had left a suicide note. Strychnine was detected in the contents of her stomach and in her blood.

Summary of Pesticide-Related Deaths in California, 1990 - 1996				
Year of Death	Age at Death	Sex of Victim	Information Source(s)	Case Description
96	77	Male	Hospital records only	A cancer patient ingested insecticide. He did not develop characteristic signs of toxicity, and did not receive specific diagnostic tests or therapy. He died five days later.
96	46	Male	Poison control only	A farm resident committed suicide by ingestion of an unidentified substance. Pesticides were readily available to him. The family identified chlordane and endosulfan as likely toxicants.
96	22	Female	Poison control only	A disturbed young woman repeatedly ate rat bait. She was admitted to the hospital and treated several times, but eventually died of an intracranial hemorrhage.
Unintentional Exposures				
90	68	Male	PISP only	A pilot loaded his plane through a closed system, later turned right when expected to turn left at the end of a pass, colliding with the second plane treating the same field. Possible toxic impairment was not tested. Emergency response crew members were affected by pesticide fumes.
90	32	Male	Death certificate and PISP	A body was found underneath a tarp during the aeration of a residence. It was hypothesized that the person had entered the tarp to escape the cold weather. The investigator reported the coroner's cause of death to be methyl bromide intoxication.
90	98	Male	Death certificate only	A blind, elderly alcoholic was found unresponsive beside an empty bottle of household sanitizer. He died an hour later.
91	41	Male	PISP only	While untarping a fumigated house, the SPCO found the owner of the house dead in a back room. The man apparently forced entry into his house by kicking in a back door. His blood bromine level was 64 mg/dl.
91	47	Male	PISP only	An SPCO noticed some tarp closure clips had been removed. While untarping the fumigated apartment building, the work crew found a dead man between the apartment building and the fumigation tarps. The cause of death was "MeBr intoxication."

Summary of Pesticide-Related Deaths in California, 1990 - 1996				
Year of Death	Age at Death	Sex of Victim	Information Source(s)	Case Description
91	58	Female	Death certificate only	A woman with chronic pulmonary disease mixed pool chemicals at her home. Her sister found her collapsed in the yard. When fire fighters arrived, they used breathing equipment to protect themselves from the chlorine fumes.
92	37	Male	PISP only	A fumigator allowed residents to return to their apartments prematurely after fumigation. Fifteen apartment residents developed symptoms. This man was the only one to stay in the building all night. He had seizures the next morning and died 16 days later from bronchopneumonia and sepsis.
92	38	Female	PISP only	A woman died 4 months after being exposed to methyl bromide in her apartment. The coroner listed the cause of death as fatty hepatomegaly due to chronic alcoholism. Methyl bromide exposure is a possible contributing factor.
92	89	Male	Death certificate only	While waiting in the car during a shopping trip with his daughter, a mentally compromised old man mistook a bottle of household sanitizer for a soft drink. He died after 15 days of hospital care.
92	1	Male	Death certificate only	A father awoke to find that his twin toddlers had got past the gate on their room and had ingested flea and tick dip they found in the bathroom. One of the boys survived.
92	87	Male	Death certificate only	A mentally compromised old man was found unresponsive beside a glass of household sanitizer that resembled one of his accustomed beverages. He was stabilized at a hospital, but expired soon after transfer to a convalescent facility.
93	72	Male	Death certificate only	An Alzheimer's disease victim drank a household sanitizer when his wife, who was using it, briefly left the room. He developed respiratory distress and died after six days in the hospital.
93	33	Male	Death certificate only	A man with chronic diseases spent all day cleaning a tub with multiple household products, including sanitizers. He was admitted to a hospital the next day, and died 32 days later.

Summary of Pesticide-Related Deaths in California, 1990 - 1996				
Year of Death	Age at Death	Sex of Victim	Information Source(s)	Case Description
94	22	Male	Death certificate and PISP	A tenant entered his apartment through a front window while the building was under fumigation. The SPCO found his body while untarping the building. Analysis of his blood found a blood fluoride level of 3,800 mg/dl (normal is 30 mg/dl).
94	1	Female	Death certificate only	Her guardian stopped a 15-month-old girl from eating salt. A little later, she was found chewing on moth balls, which the guardian also took from her. Within an hour, she became feverish and lethargic and was taken to a hospital. She died on her third day in the hospital.
95	40	Male	Death certificate and PISP	A transient entered a room of a motel that was under fumigation. He was apparently seeking shelter from the rain. His blood fluoride level was 3,200 mcg/dl. The SPCO found his body while untarping the building.
95	71	Female	Death certificate only	A victim of Alzheimer's disease drank a household sanitizer while alone at her daughter's home. She did not aspirate it, but underwent total sloughing of her gastric esophageal mucosa. She died after 20 days in the hospital.
96	34	Male	PISP only	A farm employee assigned to trap gophers was found dead in his room. Finding a bucket of bait in decedent's van suggested exposure. By phone, the coroner said 1)autopsy found no bleeding; 2)pesticide detection in liver sample proved erroneous.
96	82	Male	Death certificate and hospital records	A senile man drank a household sanitizer that his family kept in the bathroom. He was brought to the hospital comatose and vomiting, and died there eight days later.
Undetermined Whether Exposure Was Intentional				
90	25	Male	Death certificate and PISP	An applicator used all appropriate protective equipment to spray almonds with parathion. He died of parathion ingestion within 3 hours of telling his supervisor he was ill. Parathion poisoning was confirmed by lab results, but the manner of exposure could not be determined.

Summary of Pesticide-Related Deaths in California, 1990 - 1996				
Year of Death	Age at Death	Sex of Victim	Information Source(s)	Case Description
92	37	Male	Death certificate only	A man with chronic diseases told a neighbor he had mistakenly drunk some insecticide, but would be all right. Ten hours later he began vomiting and was taken to a hospital, where he died nine days later.
93	75	Male	Death certificate only	A stroke victim ingested a household sanitizer that was kept beside his bed. He was pronounced dead an hour after being discovered unresponsive.
94	77	Male	PISP only	A 77-year old man drank an unknown amount of malathion. His red blood cell cholinesterase was severely depressed. He died fourteen days later. It is not known whether this is an accidental ingestion or a suicide.