TX SENSOR Surveillance : Occupational Pesticide Poisoning
FINAL PROGRESS REPORT
September 30, 2002-September 29, 2006

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Environmental & Injury Epidemiology and Toxicology Branch
Pesticide Exposure Surveillance in Texas (PEST) Program
http://www.dshs.state.tx.us/epitox/pest.shtm
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*Texas Department of Health to 9/2004

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List of Abbreviations

CDC: Centers for Disease Control

EPA: Environmental Protection Agency

DSHS: Texas Department of State Health Services

FIFRA: Federal Insecticide, Fungicide and Rodenticide Act

FTP: File Transfer Protocol

GIS: Geographic Information System

IPM: Integrated Pesticide Management

IRB: Institutional Review Board

MOU: Memorandum of Understanding

MS: Microsoft

MMWR: Morbidity and Mortality Weekly Report

NASS: National Agricultural Statistics Service

NIOSH: National Institute for Occupational Safety and Health

OSHA: Occupational Safety and Health Administration

PEST: Pesticide Exposure Surveillance in Texas Program

PPE: Personal Protection Equipment

SENSOR: Sentinel Event Notification System for Occupational Risk

SPCB: Structural Pest Control Board

SPIDER: SENSOR-Pesticides Incident Data Entry and Reporting

SPSS: Statistical Package for the Social Sciences

TDA: Texas Department of Agriculture

TPCN: Texas Poison Control Network

USGS: U.S. Geological Survey

WPS: Worker Protection Survey

ABSTRACT

Background Given Texas' mild climate and the resultant nuisance and destructive pests, farmers, commercial exterminators, golf course managers, parks and recreation departments, schools, highway departments, public health agencies, utility companies, and others often use pesticides. The public health impact of occupational related pesticide exposures has largely been unknown since occupational pesticide poisoning cases had historically been under-ascertained. This purpose of this project was to enhance a systematic occupational pesticide exposure surveillance system to collect, analyze, interpret, and disseminate occupational pesticide exposure data. The timely collection and dissemination of such data are vital to preventing occupational pesticide exposure-related illness.

Methods From 2002 to 2006, the Texas Department of State Health Services (DSHS) Pesticide Exposure Surveillance in Texas (PEST) Program, as part of the Sentinel Event Notification System for Occupational Risks (SENSOR) program collected data on occupationally related pesticide exposures. Occupations at-risk and associated risk factors for occupational pesticide exposure were identified and outreach efforts ensued; relationships with appropriate partners were made and data were collected and analyzed in a standardized manner. As of January 1, 2004, the PEST Program added disinfectants to its case definition. In addition to the pesticide surveillance activities a survey of Texas Farmworkers was conducted to assess whether they had received Worker Protection Standards (WPS) training and whether those who received the training understood the pesticide training objectives.

Results During the 4-year funding period, fiscal years 2002-2006, the Pesticide Exposure and Surveillance in Texas (PEST) Program processed 1,501 reports of suspected pesticide exposure; 76% of which were work-related. The majority of reports (79%) were obtained from the Texas Poison Center Network (TPCN). From 2002-2005 there were 524 confirmed (acute pesticide exposures classified as definite, probable, possible or suspected) work-related exposures. Three-fourths of the exposures were classified as low-severity and severity was high in 1.5% (8) of the exposures; three of the eight high-severity cases involved pyrethroids. The agricultural industry had the most exposures (18%) with Farmworker as the occupation with the most pesticide-related illnesses (n=38). With respect to pesticide-related illness, Janitors/Cleaners (n=36) and Pest Control Occupations (n=36) both were a close second. Disinfectants were associated with 29% of confirmed work-related exposures. Eighty-six percent of pesticide exposures involved exposure to 1 chemical class. Of these, the chemical class Other accounted for 131 exposures, followed by Pyrethroids and pyrethrins, which together accounted for the 94 single-chemical class exposures, but were involved in the highest number of illnesses associated with 2 or more chemical classes (28%). Inorganic Compounds and Organophosphates each were associated with 14% of all pesticide exposures. Reports of confirmed acute occupational pesticide exposures that occurred in calendar years 2002-2005 increased from 106 in 2002 to 157 in 2005. This increase was attributable to improved ties with the Texas Poison Center Network (TPCN) which also enabled the capture of disinfectant related exposures. Conducting surveillance on disinfectant related exposures also captured exposure information on an entirely different worker population, the Service Occupations – primarily cleaning (16%) and food preparation workers (11%). Further, the number of females identified in occupational pesticide exposures increased; 71% of the people exposed to disinfectants in the Professional and Related Service industry were female. Improved coordination with the TPCN also reduced the median latency between when an event took place and the report was received. The median latency was reduced from 202 days in 2002 to 3 days in 2005. With respect to the Farmworker survey, 29% of the workers interviewed reported that they had received safety training in pesticide use with 23% indicating that they had received Worker Protection Standard training. Only 17% of the Farmworkers interviewed reported that they had been trained in pesticide use or safety in the last five years.

Conclusions Incorporating data from Poison Centers can enhance the ability to capture cases of occupational pesticide exposure. Improved reporting can reduce the time interval from when the exposure occurred until the report is received; thereby, improving the ability to triage cases in a timely manner. Timely triage – which improves the capacity to conduct follow-up interviews, obtain medical records, and conduct field investigations – is critical to identifying the causes of exposure so effective prevention strategies can be developed and implemented. The involvement of pyrethroids and pyrethrins in a large number of exposures and in 37% of the exposures classified as high-severity is concerning. These pesticides often are marketed as a "safe" alternative. Precautions may be ignored when dealing with a pesticide considered "safe" compared to other "less safe" alternatives. The inclusion of disinfectants exposures revealed an entirely different worker population that was being exposed to pesticides; many disinfectants are classified by EPA in the highest toxicity class-I. The ubiquitousness and familiarity of disinfectant products likely serves to increase the potential for misuse; familiarity may lead to a perception of "safe" which in turn results in a general lapse in the taking of precautions. Surveillance findings from disinfectant exposures underscore the need for education regarding the health risks associated with the improper use of bleach and chlorine products. Funds used to support this project enabled the identification of emerging pesticide problems such as pesticide poisoning in retail establishments, unintentional lindane ingestions, and pesticide poisonings among working youth. The data collected under this cooperative agreement were used to generate numerous bilingual educational materials for targeted workers as well as a brochure to assist healthcare providers recognize and identify acute pesticide-related illness. Data collected under this cooperative agreement also contributed to the publication of 8 articles, and 1 in-press, over the 4-year funding period. Pesticide exposures that met the criteria for field investigation lead to interventions to change pesticide use practices and/or modify regulation (Calvert G., et. al., 2001).

HIGHLIGHTS/ SIGNIFICANT FINDINGS

Publications

Calvert GM, Petersen AM, Sievert JS, Mehler LN, Rupali D, et al.: [March/April 2007] Acute Pesticide Poisoning in the U.S. Retail Industry, 1998-2003. Public Health Reports, in press

Calvert GM, Barnett M, Mehler LN, Becker A, Rupali D, et al.: [2006] Acute pesticide-Related Illness Among Emergency Responders, 1993-2002. AJIM 49:383-393

Alarcon WA, Calvert GM, Blondell JM, Mehler LN, Sievert JS, Propeck M, et al.: [2005] Acute Illnesses Associated with Pesticide Exposure at Schools. JAMA 294:455-465

Centers for Disease Control and Prevention: [2005] Unintentional Topical Lindane Ingestions—United States, 1998-2003. MMWR 54:533-535

Calvert GM, Plate DK, Das R, Rosales R, Shafey O, Thomsen C, Male D, Beckman J, Arvizu E, Lackovic M [2004] Acute occupational pesticide-related illness in the US, 1998-1999: surveillance findings from the SENSOR-pesticides program. *Am J Ind Med* 45:14-23

Forrester M, Sievert J, Stanley S : [2004].Epidemiology of Lindane Exposures for Pediculosis Reported to Poison Centers in Texas, 1998-2002. *Journal of Toxicology Clinical Toxicology* 42, 55-60

Calvert GM, Mehler LN, Rosales R, Baum L, Thomsen C, Male D, Shafey O, Das R, Lackovic M, Arvizu E : [2003] Acute pesticide-related illnesses among working youths, 1988-1999. *Am J Public Health* 93:605-610

Centers for Disease Control and Prevention: [2003] Surveillance for Acute Insecticide-Related Illness Associated with Mosquito-Control Efforts—Nine States, 1999-2002. MMWR 52:629-632

Osorio AM [2002] Surveillance systems for pesticide intoxications. *Into J Occup Environ Health* 8:1-13

Significant Findings

Pyrethroids

Pesticides in the "Other" category, which encompasses a wide variety of pesticides, were involved in 28% of work-related exposures. Individually, Pyrethroids and Pyrethrins were involved in 23% of all exposures, and of the work-related pesticide exposures involving more than 1 chemical class, pyrethroids and pyrethrins were the most commonly reported pesticides (28%). The high percentage of exposures associated with these pesticides is of particular concern as they often are perceived as a "safe" alternative to other pesticides. This perception of "safe" may be related to the natural origin of these pesticides – pyrethrins are extracted from dried chrysanthemum flowers and pyrethroids are synthetic chemicals structurally similar to pyrethrins; both are classified as insecticides of biological origin. People who perceive natural chemicals as "safe" may disregard standard precautions, thereby increasing their risk of exposure. Many pyrethroid formulations may cause moderate to sever health effects; this is evidenced by the fact that three of the eight high-severity cases that were investigated involved pyrethroids. While they may be less toxic than some other choices, they still can be toxic when not used properly. Increased education on the potential hazards associated with the improper use of these products is warranted.

Worker Protection Standards Training

Based on the results of the Texas Farmworker Protection Survey that the program conducted, the majority of Texas farmworkers do not appear to be receiving the required EPA Worker Protection Standards training. Only 28.6% of the farmworkers surveyed reported ever having received training in pesticide use and safety. Additionally, only 17% of the farmworkers interviewed in this survey reported that they had been trained in pesticide use or safety in the last five years. The results of the survey also suggested that agricultural employers did not appear to be following some of the guidelines of

WPS such as providing pesticide application and emergency notification. Communication barriers between farmworkers and supervisors, farm owners, and/or crew chiefs were identified as contributing to poor pesticide management.

Case Ascertainment

During the 4-year period from 2002-2005 there was an overall improvement in case ascertainment which we attribute to the improved ties with the Texas Poison Control Network (TPCN). The number of confirmed occupation pesticide exposures rose from 106 in 2002 to 157 in 2005. Another factor which contributed to the apparent increase in case ascertainment was the inclusion of disinfectant exposures in the case definition. The inclusion of these products provided exposure information on an entirely different worker population – Wholesale/Retail workers and Professional and Related Service industry workers – the percentage of total pesticide related exposures among each of these populations differed from those received by agricultural workers by only one percent. The inclusion of disinfectant exposures also increased the number of females found to be occupationally-exposed to pesticides as 71% of the people exposed to disinfectants in the Professional and Related Service industry were female. This outcome is also evidenced by the increase of disinfectant-related exposures in service occupations 2004-2005.

Improving ties with the TPCN also resulted in a marked reduction in the time interval from when the event took place until the report of the event was received with a reduction in the median latency between when the event took place and the report was received from 202 days in 2002 to 3 days in 2005. The reduction in the latency period enabled PEST staff the ability to triage cases in a timely manner thereby improving the capacity to conduct follow-up interviews, medical record ascertainment, and field investigations.

Education and Partnerships

In March 2006, PEST staff alerted NIOSH and EPA partners regarding an increase in pesticide exposures among Wal-Mart employees around the state. Program staff then notified Wal-Mart Corporate Safety and Risk Management staff by phone and written communication. Staff provided Wal-Mart with aggregate data regarding exposures in the retailer's stores; the 2 groups met to discuss prevention strategies in July 2006. Currently, Wal-Mart staff plans to present pesticide safety talking points to garden store managers in the Southwest region of the U.S. The corporation also plans to improve training and raise awareness among employees about chemical safety in general.

The first Regional Ad-hoc Pesticide Exposure Surveillance Steering Committee was created in 2004 to address pesticide exposure in a tri-state region. The committee is comprised of public health, agriculture, industry, labor, and academic representatives from El Paso, New Mexico, and NIOSH. Two representatives from Juarez, Chihuahua joined the committee in 2005.

PEST staff created a semi-bilingual (English-Spanish) brochure to serve several audiences including health providers and workers in high-risk occupations. Additionally, 4 postcards (2 bilingual

English/Spanish) were created for healthcare providers, occupations that use disinfectants, agricultural labor and home safety for persons who work with pesticides. Staff also presented and participated in health fairs, seminars and other conferences around the state. In the past 4 years, the PEST Program has met with migrant clinicians, several farmworker unions, and increased communication with the TWCC Occupational Safety Outreach Coordinator to share industry and occupational information. Outreach has also targeted children of agricultural workers, who often work in the fields themselves.

TRANSLATION OF FINDINGS

The inclusion of disinfectant exposures in the case definition provided exposure information on an entirely different worker population – Wholesale/Retail workers and Professional and Related Service industry workers. Additionally, the inclusion of disinfectant exposures also increased the number of females found to be occupationally-exposed to pesticides as 71% of the people exposed to disinfectants in the Professional and Related Service industry were female. Identifying worker populations at risk is necessary to develop intervention strategies and activities for prevention. Improved labeling as well as educational outreach activities that emphasize the hazards associated with improper use of disinfectants and that target these worker populations would serve to reduce exposures.

Involving Poison Center Networks in the surveillance of occupational pesticide exposures was found to be critical to improving case ascertainment. Additionally, the marked reduction in the time interval from when the exposure occurred until the report is received improved the ability to triage cases in a timely manner; improving the capacity to conduct follow-up interviews, medical record ascertainment, and field investigations. Timely follow-up is important to identify the causes of an exposure which is critical to the development of effective prevention strategies.

Identifying the involvement of pyrethroids and pyrethrins in a large number of exposures and in 37% of the high severity exposures that were investigated is of particular concern. These pesticides often are perceived as a "safe" alternative pesticide and the biological "natural" origin of these pesticides may contribute to this perception. While they may be less toxic than other pesticides, many pyrethroid formulations may cause moderate to sever health effects and can cause harm when not used properly. Activities that emphasize the potential hazards associated with the improper use of these products would help reduce exposures.

OUTCOMES/RELEVANCE/IMPACT

This project has demonstrated the value of including Poison Centers in the surveillance of occupational pesticide exposures. Enhancing the relationship between the Poison Centers and the pesticide surveillance system not only improves case ascertainment it also improves the timeliness of case identification which is critical to case follow-up.

Including disinfectants in the case definition identified additional worker populations – a large portion of which are female – that could be targeted for interventions. Exposures associated with these products (which often are misused) are not captured under the historic case definition for pesticide exposure. The ubiquitousness and familiarity with these products only serves to increase the potential for misuse as precautions may be circumvented if a chemical is perceived as safe. Precautions also may be ignored when dealing with pesticides considered "safe" compared to other "less safe" alternatives. Educating workers and the public on the potential hazards associated with improper use of any pesticide – including disinfectants and pesticides advertised as "safe" could reduce exposures.

BACKGROUND

According to the National Agricultural Statistics Service (NASS), in 2002, Texas had 130 million acres of total farmland with the largest amount of farmland designated as cropland (38 million acres) in the U.S. (NASS, 2004). Agriculture is a major industry in Texas with the market value of agricultural products worth more than 14 billion dollars (NASS, 2004). Texas also ranks number one nationwide in the production of cotton. To maintain the large agricultural industry in Texas most farm owners find it necessary to use pesticides. Further, pesticide application to cotton is three to five times greater per hectare compared to other products (USGS, 2003). In Texas, the potential for workers to be exposed to pesticides is not limited to agricultural occupations. Given the mild climate and the resultant nuisance and destructive pests, many commercial exterminators, golf course managers, parks and recreation departments, schools, highway departments, public health agencies, utility companies, and others often use pesticides. Although there are 3,000 licensed pest control applicators in Texas, applications often are made by untrained personnel who are unfamiliar with the pesticide. The public health impact of occupational related pesticide exposures has largely been unknown since occupational pesticide poisoning cases had historically been under-ascertained. The purpose of this project was to enhance a systematic occupational pesticide exposure surveillance system to collect, analyze, interpret, and disseminate occupational pesticide exposure data. The timely collection and dissemination of such data are vital to preventing occupational pesticide exposure-related illness. Additionally, the surveillance of occupational pesticide exposures can serve as an early warning system for any harmful effects not detected by the manufacturer during the testing of pesticides.

From 1987 to 2006, the Texas Department of State Health Services (DSHS) received funding from the National Institute for Occupational Safety and Health (NIOSH) under SENSOR cooperative agreements to conduct surveillance of occupational pesticide exposures. With technical guidance and funding support provided by NIOSH, the Pesticide Exposure Surveillance in Texas (PEST) Program collaborated with NIOSH, EPA, and other states to identify occupations at-risk for occupational pesticide exposure and to collect data on occupational related pesticide exposures. This project enabled the PEST Program to improve its ability to systematically collect, analyze, and interpret information on occupational pesticide exposures by enhancing case ascertainment through strengthened ties with other entities. The information collected through this project was used to produce educational materials pertaining to methods of prevention and the fully bilingual staff (Spanish-English) enabled DSHS to conduct culturally appropriate presentations to and establish dialogue with at-risk populations that are traditionally overlooked (migrant farmworkers). Exposures identified through the surveillance activities that met the criteria for field investigation produced information necessary to identify interventions necessary to change pesticide use practices and/or modify regulation (Calvert G., et. al., 2001). Funds used to support this project also enabled the PEST Program to identify emerging pesticide problems such as pesticide poisoning in retail establishments, unintentional lindane ingestions, and pesticide poisonings among working youth. This report summarizes the final SENSOR funding period beginning September 30, 2002 and ending September 29, 2006.

SPECIFIC AIMS FOR THE FINAL GRANT PERIOD (2002-2006)

The five specific aims for the PEST Program for the 2002-2006 final SENSOR funding period pertain to three main categories: I) Case Ascertainment, II) Data Collection and Analysis, and III) Education and Partnerships.

I. Case Ascertainment

- Enhance and perfect case ascertainment methods by strengthening existing ties with Texas Department of Agriculture (TDA) and Texas Poison Control Network (TPCN) and establishing partnerships with migrant clinics.

II. Data Collection and Analysis

- Conduct a follow-up interview with reported case and collect medical information associated with the exposure (if treatment was sought).

- Continue to conduct rapid follow-up field investigations (in collaboration with partnering agencies) and use the results for targeted prevention efforts.
- Conduct ongoing data analysis and distribute summary reports, including professional journal publications.

III. Education and Partnerships

- Develop new bilingual and culturally sensitive educational materials and provide pesticide safety training and other interventions to targeted populations and at-risk communities.

PROCEDURES/ METHODOLOGY

I. Case Ascertainment

The PEST Program has adhered to the same case definition and classification for acute pesticide-related poisoning since 1998, the year that this definition was finalized [Calvert et al., 2001]. To summarize the case definition, specific information regarding the pesticide involved, health effects and consistent association between health effects and the known toxicology of the pesticide is required to determine a classification status of definite, probable, possible, or suspicious; an exposure is considered confirmed if it has one of these 4 classifications. A classification of *Suspicious* is limited to exposure reports lacking toxicological association data to the pesticide because there are fewer than 2 published cases or epidemiologic studies linking health effects to exposure available [CDC, 2000a]. The PEST Program actively collects suspected work-related pesticide exposures. Non-occupational pesticide exposures are processed with the exception of poison control reports. The PEST Program queried poison control reports regardless of occupational status when investigating potential hazards or emerging trends [Alarcon, 2005; CDC, 2003; Forrester, 2003].

Prior to 2004, PEST limited surveillance to the FIFRA definition of pesticides, which includes but is not limited to herbicides, insecticides, rodenticides, repellents, fumigants, and fungicides. The PEST Program incorporated disinfectant exposure in its case definition in 2004. California was the only state conducting surveillance for acute occupational disinfectant exposures until the Michigan and Louisiana surveillance programs began collecting data on disinfectants in 2002. Results from a study of US and California data for 1993-1998 identified a major data gap (presented by poison control data) and strongly recommended that states monitor these exposures, which were found to present a higher risk to working youths than adults (Brevard et al., 2003).

Reporting and Investigatory Authority for Occupational Pesticide Poisoning

The Texas Occupational Conditions Reporting Act, Health and Safety Code, Chapter 84, House Bill 2091, passed in 1985 and the accompanying Texas Administrative Code Chapter 99 requires physicians, laboratory directors, and other health professionals to report acute occupational pesticide poisoning to the state public health agency (Appendix A). In addition to authorizing DSHS to collect information including medical records, the law authorizes collection and analysis of environmental and biological specimens. Medical records are crucial in providing key health related information and often identify the pesticide agent, occupational and contact information critical to successful follow-up interview, and ultimately complete case classification. At the same time, workers who seek care often do not provide the physician with a history of pesticide use and often the presenting symptoms may be nonspecific mimicking other illnesses such as the flu, a stomach virus or food poisoning.

The Texas Poison Center Network (TPCN)

The TPCN is a network that consists of six poison control centers located in Amarillo, Dallas, El Paso, Galveston, San Antonio, and Temple. DSHS funds the 6 centers, and through language in the contractual agreements requires reporting of pesticide exposures to the PEST Program. From 2002-2004, TPCN reports were received quarterly, and depended on the technological capability of 1 center to combine all 6 centers' data. This information would be posted to an FTP site, which PEST accessed to download reports in MS Access. In 2005, the PEST Program began receiving TPCN reports twice weekly, with the exception of technological problems and absence of personnel.

In addition to DSHS, which has some regulatory authority related to vector control, the Texas Department of Agriculture (TDA) and the Structural Pest Control Board (SPCB) are state agencies with pesticide regulatory authority in Texas. DSHS has a formal memorandum of understanding (MOU) with both of these agencies (Appendix A). TDA is the state's primary pesticide regulator. In addition to regulating pesticide labels, use, and applicator's training, TDA regulates agricultural pesticide applications in Texas. TDA pesticide inspectors often are the first to receive notification of agricultural-related human pesticide exposures. SPCB regulates structural pesticide applications, enforces the state's public school Integrated Pesticide Management (IPM) policy, and licenses commercial applicators. PEST staff continued to work reciprocally with SPCB enforcement staff by referring human exposure cases and following-up on their agency's reports to PEST. Reporting reminders and current staff contact information were faxed to TDA offices statewide annually, from 2002-2006. Staff also met with TDA and SPCB central office (Austin, TX) staff annually to discuss reciprocal reporting needs and methods to improve communication between agencies to enhance investigation outcomes and information exchange. The PEST Program has also worked with the Occupational Safety and Health Administration (OSHA) for occupational health referrals and inquiries.

Other Reporting Sources
Data reporting relationships exist between DSHS PEST and *the Texas Workers' Compensation Commission, DSHS Vital Statistics,* the *Texas Boll Weevil Eradication Foundation,* and the 11 federally funded migrant clinics. These clinics are potential sources of case reports in a population of particular interest -- migrant farm workers. Although TDA reports exposures of migrant workers, many migrant workers will not report pesticide exposures related to misuse, misapplication, or violation of the worker. Other DSHS programs have reported exposures. Self-reports are rare, but are accepted in the surveillance system.

II. Data Collection and Analysis
Upon receiving a report, staff initiated contact with the exposed individual or a proxy for a brief interview to obtain details on the event. If the individual sought medical care, records were requested. In August 2006, NIOSH required Institutional Review Board (IRB) review of states' surveillance protocols. The PEST Program received IRB approval, and interviews were then preceded with a summary of the surveillance initiatives and a request to participate according to IRB protocol.

Interviews were conducted using a questionnaire developed from the SPIDER surveillance database, which organized information for approximately 148 standardized variables. The questionnaire is continually updated as variables are modified systematically (Appendix B). Staff conducted interviews in Spanish as needed. Health effects data from medical records were transcribed into the questionnaire according to signs and symptoms. Information was then evaluated according to the 3 case classification categories: exposure, health effects, and cause. The exposure also was evaluated to determine illness severity (full definition: CDC, 2001). The 4 severity categories are: low severity, for minimal exposures that resolve quickly; moderate severity for exposures that are not life threatening, but that are more pronounced with systemic health effects; and high severity for exposures that are life threatening or that result in significant residual disability. The high severity category also includes fatalities.

During the interview, staff requested permission to contact the individual's employer or supervisor, as needed. Occasionally, employers were contacted to discuss prevention and/or training needs in the workplace. A staff toxicologist was available for consultation with workers or employers. For exposure events that involved potential regulatory violation, PEST staff facilitated contact between individuals/employers and the appropriate regulatory agency.

Exposure events involving 4 or more workers, hospitalization or death, or that represented a repeating problem at the same workplace, met the NIOSH criteria for consideration for field investigation. Additionally, an event involving injured workers despite adherence to pesticide labeling instructions also met these criteria (Appendix B). During field investigations, pesticide safety consultations and workplace evaluations were provided to employers and workers to enhance overall worker safety and prevent future occurrence.

Evaluation of EPA's Worker Protection Standards (WPS)
As part of our SENSOR Pesticides project, we received supplemental EPA funds to evaluate the Worker Protection Standards (WPS). The revised federal WPS, which took effect in 1995, sets requirements for employers of pesticide handlers and agricultural workers. We surveyed 210 farmworkers in 3 regions of the state between 1999 and 2001. Data analysis and presentation of the survey results were concluded in 2004.

Data Analysis
Pesticide exposure data were collected, queried, and organized in MS Access and Excel and entered into the SPIDER Visual FoxPro database. Flat files from SPIDER were analyzed in Excel and SPSS for reports and data requests. All data were sent electronically to NIOSH on an annual basis and contributed to the national aggregate database (http://www2.cdc.gov/niosh-sensor-pesticides/search.asp). Personal identifiers were removed automatically by reporting mechanisms integrated in the SPIDER database. Occupational and Industry information were collected and coded according to the 1990 Bureau of the Census codes. Agriculture industry codes are defined as 010 *farming*; 011 *livestock*; or 030 *agriculture services*. All pesticide exposures reported during the final funding period September 30, 2002 to September 29, 2006 were used to evaluate case ascertainment. Data were confined to work-related pesticide illness classified as definite, probable, possible or suspicious that occurred during the calendar years 2002-2005 for the remainder of analyses in this report unless otherwise stated. Disinfectant exposures were formally included in follow-up protocol beginning January 1, 2004.

III. Education and Partnerships
We developed working relationships with the regulatory agencies responsible for worker safety and health and pesticide misuse/misapplication. When a report is received from the TPCN, a health care provider, or another (non-regulatory) source, PEST staff notified the appropriate regulatory agency if any information obtained during the course of follow-up suggested the presence of imminent danger, misuse, misapplication, or potential violation of the worker protection standard. The field investigation initiative demonstrated that intervention was feasible and has provided unique opportunities for prevention. Conducting telephone interviews with all reported cases provided frequent opportunities for individual education and providing tips on prevention of pesticide illness in the future. Pesticide-specific informational letters, written for lay people were available and offered to individuals during the interview. Letters were translated to Spanish as needed.

The first Regional Ad-hoc Pesticide Exposure Surveillance Steering Committee was created in 2004 to address pesticide exposure in a tri-state region. The committee was comprised of public health, agriculture, industry, labor and academic representatives from El Paso, New Mexico, and NIOSH. Two new representatives from Juarez, Chihuahua joined the committee in 2005. The steering committee has met approximately twice a year to discuss program updates, emerging trends and ideas for effective outreach to the region's farmworker population.

PEST staff developed bilingual educational literature for reporting partners and the general public. A Pesticide Poisoning Reporting brochure providing detailed information on how to recognize and report incidents of pesticide exposure was developed specifically for health care providers (Appendix C). Our website is in English and Spanish. A second reporting brochure providing guidance on what should be done in the event of a pesticide exposure was developed for the general public. To facilitate reporting we developed a bilingual pesticide incident report form that health care providers could submit by fax 24 hours a day. Finally, we developed bilingual safety and prevention materials for workers who routinely handle pesticides as part of their job. We also worked with the Farmworker Justice Fund on an additional project to provide bilingual pesticide prevention training to migrant clinicians and promotoras (lay health care providers) throughout Texas.

RESULTS AND DISCUSSION

I. Case Ascertainment

Over the 4-year period September 30, 2002 through September 29, 2006, the PEST Program processed 1,501 reports of suspected pesticide exposure. Seventy percent of these reports were work-related. There were 639 confirmed work-related pesticide illnesses reported for the 4 fiscal-year period (report year, Figure 1). Unless otherwise stated, results and discussion from this point forward will address confirmed acute occupational pesticide exposures that occurred (N=524) during calendar years 2002-2005 (Figure 2).

Figure 1. Case Ascertainment for Pesticide Exposure in TX, Reported 9/30/2002-9/29/2006 (FY 03-FY 06)

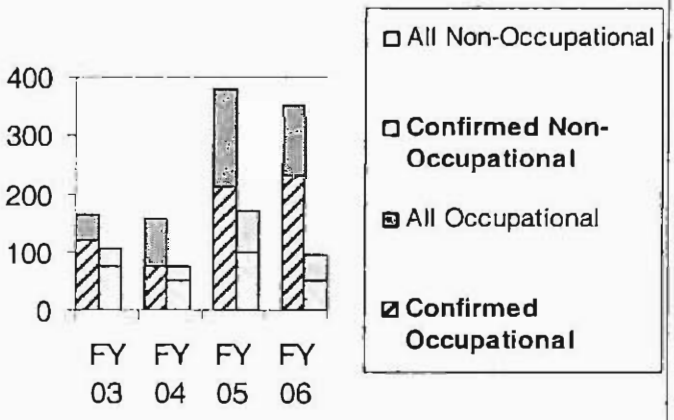
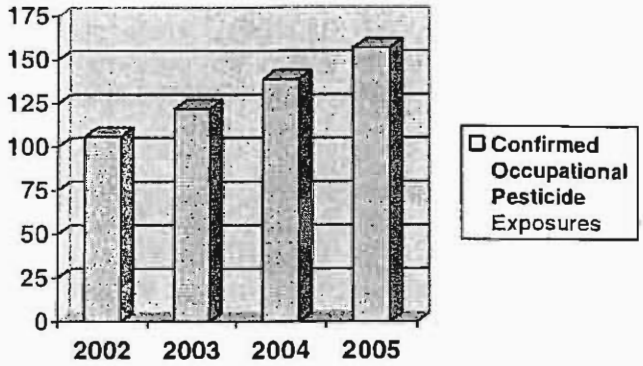
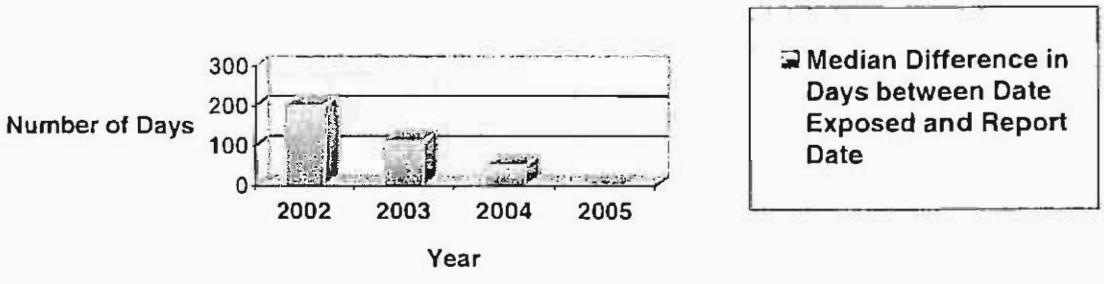


Figure 2. Confirmed Acute Occupational Pesticide Exposures in TX, Event Years Calendar Years 2002-2005



TPCN reported the majority (79%) of these confirmed cases. The Texas Workers' Compensation Commission (TWCC) was the second-highest (8%) reporting source, followed by the TDA (6%). All other sources were responsible for less than 2% of the confirmed work-related illnesses. Figure 3 shows the improvement made in decreasing lag time between exposure and report dates. In February 2005, PEST began receiving TPCN reports approximately twice a week. Previously, we received TPCN reports between 3 and 6 months following exposure date. The median difference between exposure date and report date for persons exposed in 2002 was 202 days, compared to 3 days in 2005.

Figure 3. Median Latency between Event and Report Dates by Exposure Year

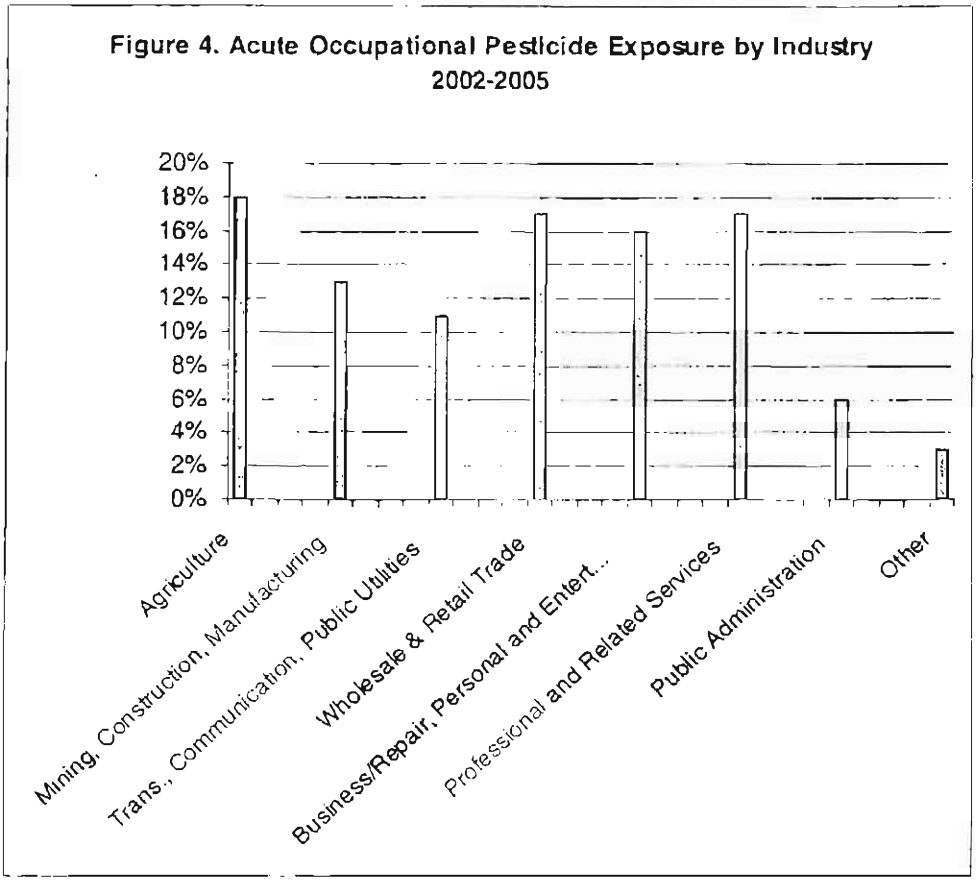


II. Data Collection and Analysis

Industry information was unknown for 17% of the cases. For those employees whose industries were known, 18% were employed in the agriculture industry (figure 4). The wholesale and retail industry (collapsed) represented the second highest industry, along with the Professional and Related Services industry with 17%

of the cases each. The occupation with the most pesticide-related illnesses was farmworker (n=38), followed by Janitors/Cleaners (n=36) and Pest Control Occupations (n=36).

Figure 4. Acute Occupational Pesticide Exposure by Industry 2002-2005



Fifty-eight percent of the cases sought medical attention (medical care was unknown for 2% of the cases), with 37% going to the emergency room, and 5% required hospitalization. Eight percent (n=40) of the cases did not seek healthcare, nor did they consult poison control; the industry with most workers not seeking healthcare was agriculture (33%). Sixty-eight percent of agricultural employees sought medical attention. Within the next 3 industries with highest incidence of exposure illness, 61% of workers in the Business/Repair, Personal and Entertainment Services sector sought medical care; 58% of employees in the Professional Services sector sought medical care; and only 42% of wholesale and retail industry workers sought medical care. Overall, the health effects category reported most was neurological (57%), followed by gastrointestinal effects (42%), and respiratory effects (40%). Ocular and dermal health effects were reported in 32% and 28% of the exposures respectively.

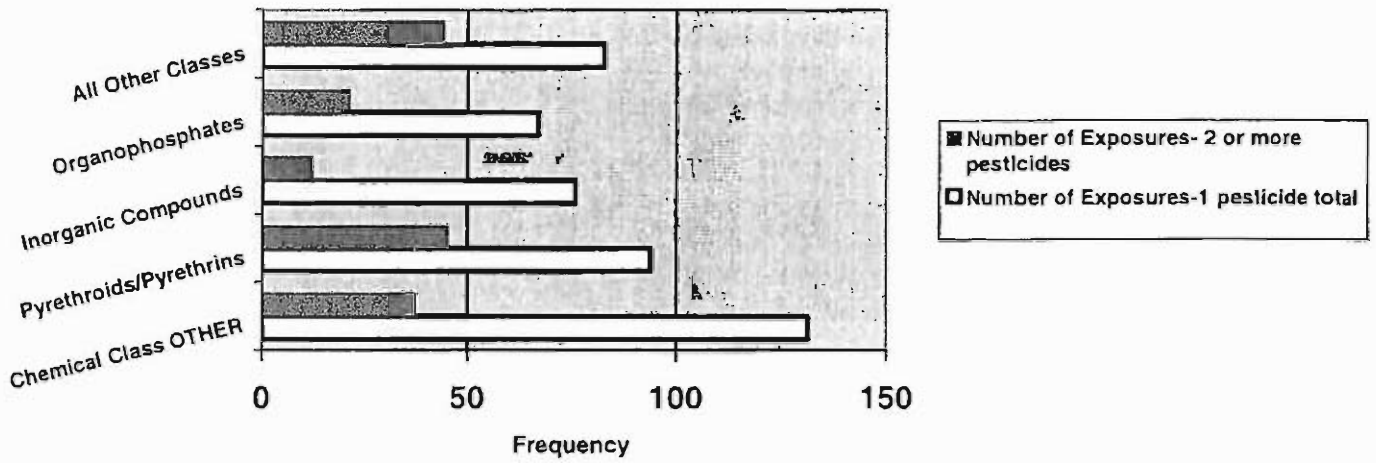
DEMOGRAPHICS

The mean age for all workers was 34 years. Age was unknown for fewer than 6% of all workers. Thirty two percent of all workers were females. The Professional and Related Services industry was the sole industry where females outnumbered males (71%). Exposure was distributed somewhat evenly for all exposed workers, up to age 44 (range 22-25% of all cases), yet there were industry differences. Thirty-five percent of workers age 19 and under were employed in the wholesale/retail industries. The youngest worker was age 14 and employed in agriculture. Employees aged 65 years and older comprised 2% of all cases. The agriculture industry had the largest percentage of workers age 55-64 (28%). Race and ethnicity were unknown for 15% of the cases. The majority of workers were white (79%), and 30% of workers reported Hispanic ethnicity. Four percent of employees were African-American, and 1% (n=6) were Asian or Pacific Islander.

Eighty-six percent (n=451) of the work-related pesticide illnesses involved exposure to 1 pesticide chemical class (Figure 5) The chemical class "Other" includes pesticides ranging from the EPA toxicity class 1

disinfectant Ster-Bac, commonly used in the food service industry, to the insecticide Termidor SC (active ingredient Fipronil), commonly used for termite applications. Pesticides in the "Other" category were involved in 28% of work-related exposures. Exposures to Pyrethroids and Pyrethrins (separately) were involved in 23% of all exposures, and of the work-related pesticide exposures involving more than 1 chemical class, pyrethroids and pyrethrins were the most commonly reported pesticides (28%). Both Inorganic Compounds (which include sodium hypochlorite, chlorine, etc.) and Organophosphates were involved in 14% of work-related exposures.

Figure 5. Acute Occupational Pesticide Exposure by Chemical Class, TX 2002-2005



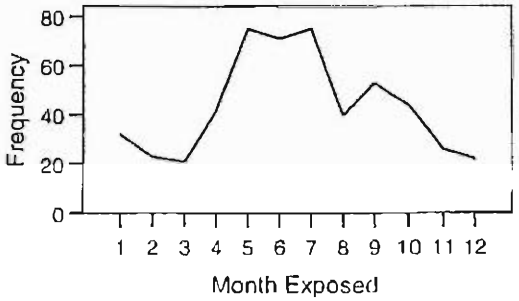
Case activity was unknown for 9% of all exposures. Workers were conducting regular work activities not involved with pesticide application, transport or mixing/loading in 45% of exposures; workers involved with pesticides accounted for 47% of exposures. Personal Protective Equipment (PPE) use was collected for 218 workers. Forty-four percent of workers directly involved with pesticides were not wearing any PPE. Among the Service occupations and Farm, Forestry, and Fishing occupations work activity at time of exposure that consisted of pesticide application, transport or mixing/loading was greater than regular work duties not involved with pesticide application (61% and 78% respectively). Exposure during regular work duties not involved with pesticide application, transport, etc. was greatest in the Managerial, Professional and Administrative and Technical Sales occupations (n=83, 75%).

LOCATION AND DATE

Table 1. Exposures by Application Site

EVENT SITE	N	%
Agricultural	97	19%
Private Residence	32	6%
Institutions	49	9%
Manufacturing	42	8%
Commercial Facilities	111	21%
Other	63	12%
Unknown	130	25%
Total	524	100%

Figure 6. Frequency of Confirmed Acute Occupational Pesticide Exposures by Month 2002-2005



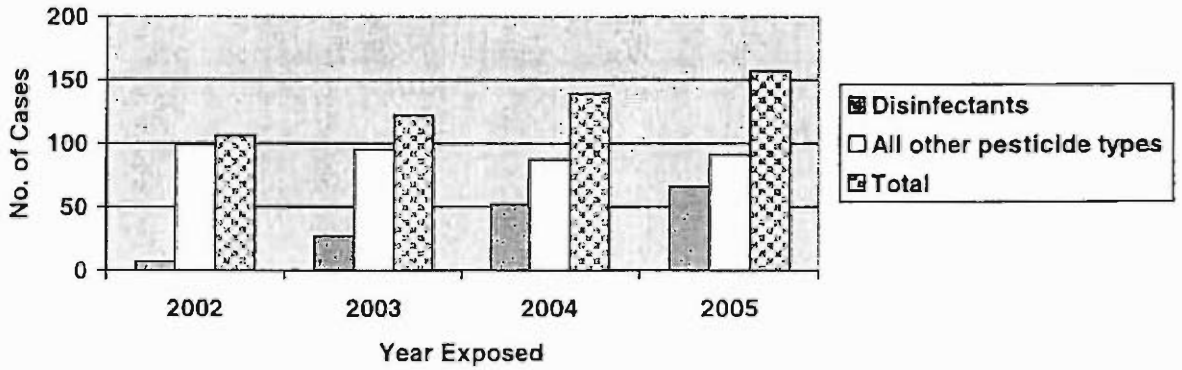
The sites of pesticide application and exposure can identify potential exposure risk for persons at both sites, although in most cases application and exposure site are the same. Table 1 lists the pesticide application sites. Commercial facilities were the event site of 21% of occupational pesticide exposures. Of the commercial facilities, 17% of all occupational exposures occurred in retail and service establishments. Pesticide applications at agricultural sites accounted for 19% of occupational exposures. The majority of agricultural site pesticide applications affected on-site workers (80%), however, there were ten occupational (and over 60 non-

work-related) exposures at an elementary school and 9 occupational exposures at other non-agricultural sites. There were 30 exposures in schools, and 12 work-related exposures in hospitals. Application site was unknown in 25% of the cases. Figure 6 above shows frequency of exposures by month for the 4-year period. Exposures increased dramatically in April and peaked in May, with fluctuation a slight spike in August. A final increase occurred again in September, and decreased to fewer than 40 in the winter.

DISINFECTANTS

Follow-up for disinfectant-related exposures began for work-related reports dated January 1, 2004. Despite the inclusion of all confirmed disinfectant exposures reported during the final 2 years of this project period, disinfectants were responsible for 29% of all cases. Figure 7 shows the impact of the consistent inclusion of follow-up for disinfectant-related exposures beginning in 2004, when disinfectant-related exposures doubled from the previous year.

Figure 7. Case Ascertainment for Disinfectant-Related Exposures 2002-2005



Case Studies for Disinfectants

An 18 year-old male busboy at a national franchise restaurant was overcome by fumes as he cleaned the restroom toilet with bleach and a toilet bowl cleaner. He was only wearing gloves. He experienced burning eyes, tears, coughing, nausea and vomiting. He went to the hospital 2 days following the exposure, and signs were wheezing/rhonchi, and difficulty breathing; the diagnosis was toxic effect other gasses. The physician directed that he return to work in 3 days. Medical records showed no indication of workers' compensation notification.

A 47 year-old female cleaning technician at a hospital placed an open bottle of Quat 256 (active ingredient quaternium 12) on a cart and it splashed in her eyes, face, hair and tongue. She rinsed her eye immediately with water. Signs and symptoms from the exposure included erythema to eyelids and eye irritation; sclera/cornea reddened, and dermal pain to her face. She was diagnosed with corneal abrasion

Table 2 shows a breakdown of occupational category with respect to disinfectant and other pesticide exposures. Service occupations, which include custodians and cooks, were impacted the most by disinfectant exposures (n=58) and overall accounting for 24% of all exposures; and disinfectant exposures increased over 300% from 2003 to 2005.

The majority (60%) of disinfectant-related exposures occurred during activity directly involved with pesticides: either application, mixing/loading, transporting, repairing equipment, or a combination of these. This is consistent with the type of disinfectant exposure: 48% of exposures occurred through contact. Thirty-six percent of exposures were indoor air-related. Twenty-six percent of cases involved exposure while completing regular work duties not involved with application.

Table 2. Exposure to Disinfectants 2002-2005 by Occupational Category										
Occupational Categories (BOC 1990)	2002		2003		2004		2005		TOTAL	%
	All Other	Disin-fectant	All Other	Disin-fectant	All Other	Disin-fectant	All Other	Disin-fectant		
Managerial, Professional, and Admin Tech Sales 003-389	14	1	25	2	19	7	34	9	111	21%
Service Occupations 403-469	**19**	**0**	**15**	**8**	**17**	**21**	**16**	**29**	**125**	**24%**
Farm, Forestry, Fishing Occupations 479-499	27	2	18	4	10	2	17	6	86	16%
Production, Craft, Repair 503-699	7	1	5	3	8	4	2	3	33	6%
Operators, Fabricators, Laborers 703-889	16	3	17	8	25	10	11	7	97	19%
All Other Occupations	7	0	3	2	2	8	8	12	42	8%
Unknown	9	0	12	0	6	0	3	0	30	6%
Total	**99**	**7**	**95**	**27**	**87**	**52**	**91**	**66**	**524**	**100%**

SEVERITY

Of all 524 exposures, there were eight cases classified as high severity and 67 cases were classified as moderate. More than three-fourths of the cases were low severity.

High severity cases not involved in pesticide application

Among three of the eight high severity cases, the individuals were not involved in the pesticide application process. The first case was a 46 year-old male prison maintenance worker who was exposed to Suspend SC after an exterminator fogged a work area. Exposure occurred when the worker entered the contained area and become ill. He was hospitalized for three days with signs and symptoms of fatigue, dyspnea, chest pain, headache, memory loss, muscle pain, nausea, and vomiting.

Another case involved a 46 year-old male construction contractor working at a small airport where the pyrethroid permethrin had been applied 2 days earlier for termites. The worker was exposed to the still-wet pesticide on the floor of the hangar through clothing and skin contact. He sought medical treatment at his physician's office with signs of dyspnea, upper respiratory tract irritation, blurred vision, diarrhea, nausea, pain, and vomiting. He subsequently missed 2 weeks of work. Prior to developing symptoms, the worker was not aware of the application. He specifically requested no follow-up with personnel at the airport.

The third case involved a meter reader who was investigating a gas leak in a residential area. Cans of the organophosphate Malathion had been put into the trash and then collected by a nearby garbage truck. While being compacted, the cans spilled and leaked on the ground, releasing a pungent odor in the neighborhood. The meter reader neared the spill site several times during his 3-hour investigation. He developed mydriasis, hematuria, chest pain, confusion, and nausea and was hospitalized for 6 days.

High severity cases involving pesticide application

A 45 year-old female school janitor mopped the walls of the school (in July) with a mixture of Comet, Bleach, Measure Up and White Drum (for stripping floors) that another janitor had mixed in a bucket. In the process of mopping the walls, she was exposed from head to toe and stayed in the wet clothes all day. The janitor was

hospitalized for 3 days and experienced an asthma attack (she previously had asthma). She was not able to find her supervisor to request leave and indicated that she knew the mixture was against rules. This case was reported by workers' compensation 18 months after it occurred.

According to medical records, an 18 year-old male laborer was spraying weeds at work with the herbicide Tordon 22K (Picloram), when the barrel containing the herbicide bounced off the forklift and the laborer ran over it. He experienced corneal abrasion and burns, conjunctivitis, and dermal rash. Discussion with the employer revealed that the laborer had not properly secured the load and did not follow instructions.

A 36 year-old male operating engineer was exposed to chlorine and hydrochloric acid after pouring the chemicals into a pool. He was admitted to the hospital for 3 days with signs of fainting and headache.

A 55 year-old female bookkeeper sprayed STOMP (Resmethrin, Pyrethroid) all over her office and on her leather chair and developed a severe allergic reaction. She initially went to the emergency room and was released. Two days later, the bookkeeper returned and was hospitalized for three days with edema, hives, pruritis, rash, redness, anxiousness, weakness, and nausea.

The most severe case reported involved a 56 year-old unlicensed supervisor at a peanut production facility. The case entered the peanut warehouse to supervise after the building was fumigated with aluminum phosphide for rodent control. The peanuts were covered with plastic and the supervisor was first exposed when the other workers removed the plastic. To our knowledge, no other employees were exposed. Wearing leather gloves, the supervisor then transferred the pellets to 5-gallon drums. As he stood over the drums, the pellets were activated by moisture from the humidity outside (misting). The supervisor conducted these processes for the restricted use pesticide "under supervision of a licensed applicator" as the label permits; though the licensed applicator was not on site. The supervisor was hospitalized for 8 days with edema, weakness, anorexia, cough and wheezing. Because the supervisor did not initially inform medical personnel about the pesticide exposure, his signs and symptoms were confused for a new heart medication for several days. X-rays taken after notification of the pesticide exposure demonstrated acute pulmonary infiltrates.

WORKPLACE INTERVENTION

One of the criteria for conducting a field investigation is a pesticide exposure event involving more than four workers. In June 2004, the PEST program received seven pesticide exposure report forms faxed by hospital reporting staff. Seven employees of a pet-food manufacturing company entered their workplace (warehouse) where a pesticide applicator had applied aluminum phosphide 3 days earlier. They entered before the pesticide applicator was able to clean the residue, test the air and ventilate the facility. Two employees had been sent home ill before management transported all seven to the local hospital emergency department. PEST staff conducted an on-site field investigation and collaborated with the company risk manager to develop a written protocol for pesticide applications (Appendix D).

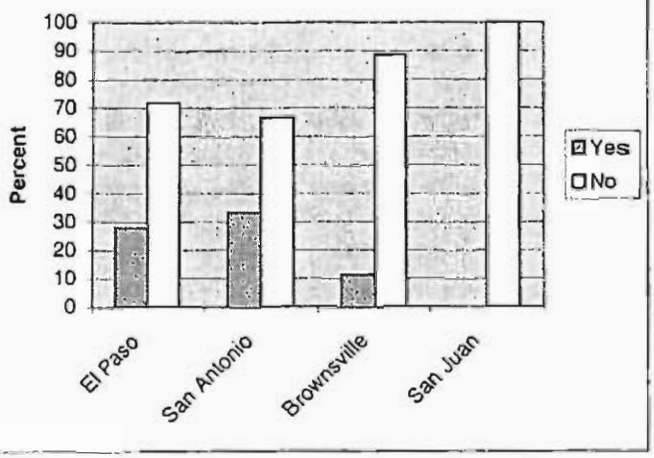
WORKER PROTECTION STANDARDS (WPS) EVALUATION

The PEST program conducted the Texas Farmworker Protection Survey to assess whether farmworkers in Texas received WPS training and whether those who received the training understood the pesticide training objectives of the training. Twenty-nine percent of the workers interviewed reported that they had received safety training in pesticide use with 23% indicating that they had received WPS training. Less than 20% reported having the WPS "blue card" in their possession at the time of the interview. Of the workers who received WPS training 91% indicated that they understood all of the training; 79% indicated that the training was useful; and 94% indicated that they plan to use WPS training in the future. Training was provided via video (19%), manual (31%), and flipchart (19%) with 68% of the respondents indicating that the training was provided in Spanish.

Table 3. TX Farmworker Survey—Health-Related Questions

Question	%
How would you get to the doctor	
Walk	3.9
Own Car	16.2
Friend's Car	27.0
Farmer / Supervisor	32.3
Other	20.6
Any health symptom experienced in previous year	
Yes	71.9
No	28.1
Ever seek medical care for health problems	
Yes	41.1
No	58.9
Given transportation to medical facility	
Yes	45.0
No	55.0
Ever miss work because of health problems	
Yes	43.3
No	56.7

Figure 7. WPS training received (by location)



Comparing the 4 geographic sites, more farmworkers from the San Antonio National Farmworker Conference population received pesticide training (41%) compared to the other populations. Only two of the 24 farmworkers interviewed during the San Juan survey indicated receiving any pesticide training; none reported receiving any pesticide training (Figure 7).

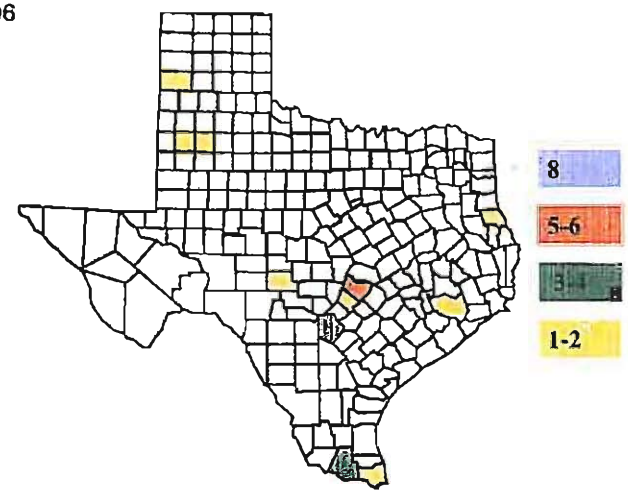
Twenty-six percent of the farmworkers indicated that they had at some time mixed or applied pesticides to fields or crops and 75% indicated that they had worked in fields treated with pesticides. With respect to WPS compliance in the workplace, although 67% indicated that there was no central posting area for notification of recent pesticide applications, 53% indicated that they received pesticide application information from their boss. Fifty-eight percent reported that emergency numbers were not posted and 54% indicated that pesticide safety posters were not displayed. Twenty-nine percent of the respondents indicated that they or their co-workers had been in a situation in which their safety was at risk due to pesticides.

The results of this survey indicate that the majority of Texas farmworkers do not appear to be receiving the required EPA WPS training. The percentage of farmworkers in this survey who reported ever receiving training in pesticide use and safety (28.6%) was lower than the percentage of farmworkers in a North Carolina survey (35.2%) who indicated that they received such training (Arcury et al. 1999). Only 17% of the farmworkers interviewed in this survey reported that they had been trained in pesticide use or safety in the last five years. Additionally, agricultural employers do not appear to be following the guidelines of WPS such as providing pesticide application and emergency notification. Fewer than 27% of the farmworkers indicated that they would tell a supervisor about health problems experienced on the job and 59% denied ever seeking medical care for the health problems that they experienced (Table 3). Communication barriers between farmworkers and supervisors, farm owners, and/or crew chiefs can lead to complications or affect treatment, particularly if the farmworker doesn't seek necessary medical attention and/or does not know the name and active ingredient of the pesticide to which he or she may have been exposed. The final report for this survey is in the final review stages for submittal to a peer-reviewed journal (Appendix E).

III. Education and Partnerships

PEST staff created a semi-bilingual (English-Spanish) brochure to serve several audiences including health providers and workers in high-risk occupations. Additionally, 4 postcards (2 bilingual English/Spanish) were created for healthcare providers, occupations that use disinfectants, agricultural labor and home safety for persons who work with pesticides. Staff also presented and participated in health fairs, seminars and other conferences around the state (Figure 8, Appendix C). In the past 4 years, the PEST Program has met with migrant clinicians, several farmworker unions, and increased communication with the TWCC Occupational Safety Outreach Coordinator to share industry and occupational information. Outreach has also targeted children of agricultural workers, who often work in the fields themselves.

Figure 8. Educational Outreach Activities by County, FY 2002-FY 2006



Texas data contributed to an article regarding pesticide exposures at schools, which found that incidence rates for children increased significantly from 1998-2002. After association with insecticides (35%), most illnesses were associated with disinfectants (32%) (Alarcon WA, 2005). From 2002-2003, with supplemental funding from EPA to address environmental health issues along the US-Mexico border, the PEST Program prepared bilingual skits to teach pesticide exposure prevention and raise awareness of the occupations at-risk for exposure. Outreach targeted elementary schools located within ¼ mile from potential agricultural fields where pesticides might be applied. DSHS staff from the Art Department and the Geographic Information System (GIS) program assisted in the development of bilingual educational posters. The posters were disseminated in three US-Mexico border regions where outreach took place. The PEST program educated more than 3,000 people about pesticide exposure, including school children, teachers, school nurses and public health professionals.

In 2003, PEST collaborated with the TPCN epidemiologist to write an article looking at Texas poison center data for exposure to the pesticide lindane (Forrester M, Sievert J et al. 2004). PEST data contributed to another lindane article, providing follow-up data from TPCN reports on accidental ingestions (MMWR 2005). Both articles contributed to the growing literature regarding this dangerous organochlorine pesticide that is banned in California for head-lice use, but is still prescribed by physicians in Texas and most other states where it is legal. EPA announced in December 2006 actions to ban all FIFRA registrations of lindane (Federal Register, 2006).

In 2004, the PEST Program presented NIOSH and other states with data that showed an increase in exposures among retail employees, especially stockers. NIOSH collected and analyzed eight states' data for the years 1998-2003 and a draft publication is in press (Calvert GM, in press). In March 2006, PEST staff alerted NIOSH and EPA partners regarding an increase in pesticide exposures among Wal-Mart employees around the state. Program staff then notified Wal-Mart Corporate Safety and Risk Management staff by phone and written communication. Staff provided Wal-Mart with aggregate data regarding exposures in the retailer's stores; the 2 groups met to discuss prevention strategies in July 2006. Currently, Wal-Mart staff plan to present pesticide safety talking points to garden store managers in the Southwest region of the U.S. The

corporation also plans to improve training and raise awareness among employees about chemical safety in general.

The first Regional Ad-hoc Pesticide Exposure Surveillance Steering Committee was created in 2004 to address pesticide exposure in a tri-state region. The committee is comprised of public health, agriculture, industry, labor, and academic representatives from El Paso, New Mexico, and NIOSH. Two representatives from Juarez, Chihuahua joined the committee in 2005.

CONCLUSIONS

During the 4-year period from 2002-2005 there was an overall improvement in case ascertainment which we attribute to the improved ties with the Texas Poison Control Network (TPCN). The number of confirmed occupational pesticide exposures rose from 106 in 2002 to 157 in 2005. Improving ties with the TPCN also resulted in a marked reduction in the time interval from when the event took place until the report of the event was received. The median latency between when the event took place and the report was received was reduced from 202 days in 2002 to 3 days in 2005. The reduction in the latency period enabled PEST staff the ability to triage cases such that follow-up interviews, medical record ascertainment, and field investigations could be accomplished in a timely manner; all of which enable timely interventions where appropriate.

Another factor which contributed to the apparent increase in case ascertainment was the inclusion of disinfectant exposures in the case definition. The inclusion of these products provided exposure information on an entirely different worker population: primarily cleaning and food service occupations. Occupational pesticide exposures to workers in the Wholesale/Retail industries and Professional/Related Service industries differed from pesticide exposures among the Agricultural workforce by only one percent. The inclusion of disinfectant exposures also increased the number of females found to be occupationally-exposed to pesticides as 71% of the people exposed to disinfectants in the Professional and Related Service industry were female. This outcome is also evidenced by the increase of disinfectant-related exposures in service occupations 2004-2005.

The fact that pyrethroids and pyrethrins together were involved in the greatest number of exposures (with the exception of the broad Other Chemical Class) is concerning as these chemicals often are advertised as the "safe" alternative. While they may be less toxic than some other choices, they still can be toxic when not used properly. Increased education on the potential hazards associated with the improper use of these products is warranted.

Four of the 8 high severity exposures could have possibly been prevented or minimized with better communication in the workplace. Of the three cases where the exposed individuals were not involved in pesticide application, two were pyrethroids and one was an organophosphate. Of the five cases where the exposed individuals were involved in pesticide application two involved disinfectants, the other three involved an herbicide, a pyrethroid, and a rodenticide, respectively. Two of cases where the person who was exposed was not an applicator involved poor notification of application by the pesticide applicator and one case involved improper disposal of a pesticide. Four of the cases where the person who was exposed was involved in the application of the pesticide involved improper usage and one case involved not taking proper precautions.

The results of the Texas Farmworker Protection Survey that the program conducted suggest that the majority of Texas farmworkers do not appear to be receiving the required EPA Worker Protection Standards training; only 28.6% of the farmworkers surveyed reported ever having received training in pesticide use and safety. Additionally, only 17% of the farmworkers interviewed in this survey reported that they had been trained in pesticide use or safety in the last five years. The results of the survey also suggest that agricultural employers did not appear to be following some of the guidelines of WPS such as providing pesticide application and emergency notification. Communication barriers between farmworkers and supervisors, farm owners, and/or crew chiefs were identified as contributing to poor pesticide management.

The data collected over the last four years demonstrate the extent to which human pesticide exposure is a public health problem. As evidenced by the surveillance of disinfectant products, pesticides are not only an

agricultural problem. Many health practitioners are not familiar with the symptoms associated with pesticides affecting the identification of cases. Many employers do not always orientate their employees on the proper use of pesticides. Additionally, workers often ignore the warning labels and do not protect themselves by donning the proper PPE; actions which increase the potential for exposure.

Publications

Calvert GM, Petersen AM, Sievert J, Mehler LN, et al.: Acute Pesticide Poisoning in the US Retail Industry, 1998-2003. Public Health Reports, in press

Related Specific Aim: Data Collection and Analysis; and Education and Partnership
Pesticide poisoning incidence rates were significantly elevated for the following occupations: janitors, stock handlers/baggers, bakery/deli clerks, and shipping/receiving handlers. Recommendations were made regarding tear-resistant packaging and unbreakable containers and education to store managers, employees and customers regarding pesticide poisoning prevention.

Alarcon WA, Calvert GM, Blondell JM, Mehler LN, Sievert JS, Propeck M, et al: [2005] Acute Illnesses Associated with Pesticide Exposure at Schools. JAMA 294:455-465.

Related Specific Aim: Data Collection and Analysis
Despite Integrated Pesticide Management laws (Texas has law), children and school employees continue to be exposed to pesticides as a result of pesticide use in the schools and from pesticides used on farmland near school facilities.

Centers for Disease Control and Prevention: [2005] Unintentional Topical Lindane Ingestions—United States, 1998-2003. MMWR 54:533-535

Related Specific Aim: Education and Partnership
This article addresses unintentional ingestions of the pesticide and pediculicide lindane. Educational outreach programs can be created to increase awareness among health-care providers, pharmacists, on the use of this product.

Calvert GM, Plate DK, Das R, Rosales R, Shafey O, Thomsen C, Male D, Beckman J, Arvizu E, Lackovic M [2004] Acute occupational pesticide-related illness in the US, 1998-1999: Surveillance Findings from the SENSOR-Pesticides Program. *Am J Ind Med* 45:14-23

Related Specific Aim: Data Collection and Analysis Aim
A total of 1,009 individuals with acute-occupational pesticide-related illness were identified among several state programs. Surveillance is an important tool used to assess acute pesticide-related illness.

Forrester M, Sievert J, Stanley S [2004] Epidemiology of Lindane Exposures for Pediculosis Reported to Poison Centers in Texas, 1998-2002. Journal of Toxicology Clinical Toxicology 42: 55-60.

Related Specific Aim: Data Collection and Analysis
Poison control data was analyzed for lindane exposure incidents. There were 528 reported human exposures. The majority of these exposures were due to misuse or abuse of the lindane product. Also during the analysis of data it was discovered that the number of reported lindane exposure had decreased from 1998-2002.

Calvert GM, Mehler LN, Rosales R, Baum L, Thomsen C, Male D, Shafey O, Das R, Lackovic M, Arvizu E [2003] Acute pesticide-related illnesses among working youths, 1988-1999. Am J Public Health 93:605-610

Related Specific Aim: Data Collection and Analysis
This article was written to address the need for more information on the effects of pesticide exposures among working youths. Recommendations were made for the prevention of these types of exposures.

Centers for Disease Control and Prevention: [2003] Surveillance for Acute Insecticide-Related Illness Associated with Mosquito-Control Efforts—Nine States, 1999-2002. MMWR 52:629-632

Related Specific Aim: Data Collection and Analysis
Pesticide surveillance information was analysis and used in this article by the CDC to make recommendations that would reduce risks from insecticide exposure. It recommends the use of integrated pest management strategies.

Osorio AM [2002] Surveillance systems for pesticide intoxications. Into J Occup Environ Health 8:1-13.

Related Specific Aim: Case Ascertainment

This article provides information regarding investigating pesticides incidents and includes a list of informational sources for pesticide toxicology and medical monitoring of pesticide-exposed workers.

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Calvert GM, Petersen AM, Sievert J, Mehler LN, et al.: Acute Pesticide Poisoning in the US Retail Industry, 1998-2003. Public Health Reports, in press

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Federal Register Online, Volume 71, Number 239, Notices.
http://www.epa.gov/fedrgstr/EPA-PEST/2006/December/Day-13/p21101.htm [Accessed December 18, 2006]

Forrester M, Sievert J, Stanley S. [2004] Epidemiology of Lindane Exposures for Pediculosis Reported to Poison Centers in Texas, 1998-2002. Journal of Toxicology Clinical Toxicology 42: 55-60

National Agricultural Statistics Service (NASS): [2004] 2002 Census of Agriculture State Profile. [On-line]. Available at http://www.usda.gov/nass/tx

U.S. Geological Survey: [2003] Fate and Transport of Cotton Pesticides in the Southern United States. [On-line] Available at http://toxics.usgs.gov/regional/cotton.html

INCLUSION OF WOMEN and MINORITIES

Women were included in the data collected based on the proportions of identified individuals for Texas. Based on the demographics of Texas, the population included was approximately 45% women and 55% men (2002 Bureau of Labor Statistics Data).

Women – 45%
Men – 55%

Minorities were included in the data collected based on the proportions of identified individuals for Texas. Based on the demographics of Texas (based on 2002 BLS DATA), the study population was likely comprised of the following approximate percentages:

Ethnic Category	Hispanic or Latino – 32.9% Not Hispanic or Latino – 67.1%
Racial Category	American Indian/Alaska Native, Asian, Native Hawaiian or Other Pacific Islander – 4.5% Black or African American – 11.2% White – 84.3%

INCLUSION OF CHILDREN

Reports of children under the age of 21 years who were exposed to pesticides or some other type of chemical were likely received by the Texas Poison Control Network (TPCN); some of these reports were work-related. The work-related cases were included in this project and likely mirrored the demographics of Texas.

Appendices

Appendix A: Laws & Memorandum of Understanding (MOU)

Appendix B: Questionnaires

Appendix C: Educational Materials

Appendix D: Investigation Criteria and Written Protocol

Appendix E: Worker Protection Survey (WPS)

Appendix F: Publications

Appendix A

Laws
Memorandum of Understanding

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TITLE 25	HEALTH SERVICES
PART 1	TEXAS DEPARTMENT OF HEALTH
CHAPTER 99	OCCUPATIONAL DISEASES
RULE §99.1	**General Provisions**

(a) Purpose. This section implements the Texas Occupational Conditions Reporting Act, Health and Safety Code, Chapter 84, House Bill 2091, 69th Legislature, 1985, which authorizes the Texas Board of Health to adopt rules concerning the reporting and control of occupational conditions.

(b) Definitions. The following words and terms, when used in these sections, shall have the following meanings unless the context clearly indicates otherwise.

(1) Case--A person in whom an occupational condition is diagnosed by a physician based upon clinical evaluation, interpretation of laboratory and/or roentgenographic findings, and an appropriate occupational history.

(2) Commissioner--The commissioner of health.

(3) Department--The Texas Department of Health, 1100 West 49th Street, Austin, Texas 78756.

(4) Local health authority--The chief administrative officer of a public health district or a local health department, or the physician who is to administer state and local laws relating to public health.

(5) Occupational conditions--Those diseases, abnormal health conditions or laboratory findings that are caused by or are related to exposures in the workplace.

(6) Reportable occupational condition--Any occupational disease, condition or laboratory finding for which an official report is required. See subsection (d) of this section.

(7) Report of occupational condition--The notification to the appropriate authority of the occurrence of a specific occupational disease in a human, including all information required by the procedures established by the Board of Health.

(8) Suspected case--A case in which an occupational condition is suspected, but the final diagnosis is not yet made.

(c) Reporting requirements.

(1) It is the duty of every physician holding a license to practice in the State of Texas to report promptly to the local health authority each patient she or he shall examine and who has or is suspected of having any reportable occupational condition. The local health authority may authorize a staff member to transmit reports.

(2) It is the duty of every person who is in charge of a clinical or hospital laboratory, blood bank, mobile unit, or other facility in which a laboratory examination of any specimen derived from a human body yields microscopical, cultural, serological, chemical, or other evidence suggestive of a reportable condition to report promptly that information to the local health authority.

(3) The reporting physician or laboratory director shall make the report in writing. A local health

authority may authorize one or more employees under his or her supervision to receive the report from the physician or laboratory director by telephone; use of this alternative, if authorized, is at the option of the reporter. The local health authority shall implement a method for verifying the identity of the telephone caller when that person is unfamiliar to the employee.

(4) The local health authority shall collect the reports and transmit the information at weekly intervals to the Noncommunicable Disease Epidemiology and Toxicology Division, Bureau of Epidemiology, Texas Department of Health, 1100 W. 49th Street, Austin, Texas 78756. Transmission may be made by mail, courier, or electronic transfer.

(A) If by mail or courier, the reports shall be placed in a sealed envelope addressed to the attention of the Noncommunicable Disease Epidemiology and Toxicology Division, Bureau of Epidemiology, Texas Department of Health, 1100 W. 49th Street, Austin, Texas 78756, and marked "Confidential Medical Records."

(B) If by electronic transmission, including facsimile transmission by telephone, it shall be in a manner and form authorized by the commissioner or his or her designee in each instance. Any electronic transmission of the reports must provide at least the same degree of protection against unauthorized disclosure as those of mail or courier transmission. The commissioner or his or her designee shall, before authorizing such transmission, establish guidelines for establishing and conducting such transmission.

(5) When an occupational condition is reported to a local health authority, and the person diagnosed as having the condition resides outside his or her area of local health jurisdiction, the local health authority receiving the report shall notify the appropriate local health authority where the person or persons reside. The department shall assist the local health authority in providing such notifications if requested.

(d) List of reportable occupational conditions. Occupational conditions reportable by name, address, age, sex, race/ethnicity, method of diagnosis, and relevant occupation(s) and employer(s) of the case, and identity of the reporter, are: asbestosis, silicosis, blood lead levels at or above 25 micrograms lead/100 milliliters of blood in persons 15 years of age or older, and acute occupational pesticide poisoning.

(e) General control measures for reportable occupational conditions. The commissioner or his or her duly authorized representative shall, as circumstances may require, proceed as follows:

(1) investigation shall be made for the purpose of verifying the diagnosis, ascertaining the source of the causative agent, obtaining an occupational and employment history and discovering unreported cases;

(2) collection of specimens of the body tissues, fluids, or discharges and of materials directly or indirectly associated with the case, as may be necessary in confirmation of the diagnosis, and their submission to a laboratory for examination;

(3) obtaining samples of air or materials from the current or former business or place of employment of a case, as may be necessary to ascertain if a public health hazard exists. If a hazard is found the commissioner or his/her designee shall make appropriate recommendations concerning the hazard.

(f) Confidential nature of case reporting.

(1) All case reports received by the local health authority or the Texas Department of Health are confidential records and not public records. These records will be held in a secure location and accessed only by authorized personnel.

(2) The department may use information obtained from reports or health records for statistical and epidemiological studies which may be public information as long as an individual is not identifiable.

Source Note: The provisions of this §99.1 adopted to be effective October 11, 1985, 10 TexReg 3766; amended to be effective March 1, 1998, 23 TexReg 1581.

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HEALTH & SAFETY CODE

CHAPTER 84. REPORTING OF OCCUPATIONAL CONDITIONS

§ 84.001. SHORT TITLE. This chapter may be cited as the Occupational Condition Reporting Act.

Acts 1989, 71st Leg., ch. 678, § 1, eff. Sept. 1, 1989. Amended by Acts 1997, 75th Leg., ch. 245, § 2, eff. May 23, 1997.

§ 84.002. DEFINITIONS. In this chapter:

(1) "Health professional" means an individual whose:

(A) vocation or profession is directly or indirectly related to the maintenance of health in another individual; and

(B) duties require a specified amount of formal education and may require a special examination, a certificate or license, or membership in a regional or national association.

(2) "Occupational condition " means a disease, abnormal health condition, or laboratory finding that is caused by or is related to exposures in the workplace.

(3) "Reportable condition " means a disease, condition, or laboratory finding required to be reported under this chapter.

Acts 1989, 71st Leg., ch. 678, § 1, eff. Sept. 1, 1989. Amended by Acts 1997, 75th Leg., ch. 245, § 2, eff. May 23, 1997.

§ 84.003. REPORTABLE CONDITIONS; RULES. (a) Asbestosis and silicosis are occupational conditions that are reportable to the department.

(b) Blood lead levels in adults are laboratory findings that are reportable to the department as provided by board rule.

(c) The board may adopt rules that require other occupational conditions to be reported under this chapter. Before the board requires another occupational condition to be reported, the board must find that the condition:

(1) has a well-understood etiology;

(2) results predominantly from occupational exposures; and

(3) is preventable.

(d) The board shall maintain a list of reportable conditions.

(e) The board shall adopt rules necessary to administer and implement this chapter.

Acts 1989, 71st Leg., ch. 678, § 1, eff. Sept. 1, 1989. Amended by Acts 1997, 75th Leg., ch. 245, § 2, eff. May 23, 1997.

§ 84.004. REPORTING REQUIREMENTS. (a) The following persons shall report cases or suspected cases of reportable conditions to the department:

(1) a physician who diagnoses or treats the individual

with the condition;

(2) a person who is in charge of a clinical or hospital laboratory, blood bank, mobile unit, or other facility in which a laboratory examination of any specimen derived from a human body yields microscopical, cultural, serological, or other evidence suggestive of the condition; and

(3) a health professional.

(b) The department may contact a physician attending a person with a case or a suspected case of an occupational condition.

(c) The board shall prescribe the form and method of reporting. The board may require the reports to contain any information necessary to achieve the purposes of this chapter, including the person's name, address, age, sex, race, occupation, employer, and attending physician.

Acts 1989, 71st Leg., ch. 678, § 1, eff. Sept. 1, 1989. Amended by Acts 1997, 75th Leg., ch. 245, § 3, eff. May 23, 1997.

§ 84.005. POWERS AND DUTIES OF DEPARTMENT. (a) The department may enter into contracts or agreements as necessary to implement this chapter. The contracts or agreements may provide for payment by the state for materials, equipment, and services.

(b) The department may seek, receive, and spend any funds received through appropriations, grants, or donations from public or private sources for the purpose of identifying, reporting, or preventing those occupational conditions that have been determined by the board to be injurious or to be a threat to the public health, subject to any limitations or conditions prescribed by the legislature.

(c) Subject to the confidentiality requirements of this chapter, the department shall evaluate the reports of occupational conditions to establish the nature and magnitude of the hazards associated with those conditions, to prevent the occurrence of those hazards, and to establish any trends involved.

(d) The department may make inspections and investigations as authorized by this chapter and other law.

Acts 1989, 71st Leg., ch. 678, § 1, eff. Sept. 1, 1989. Amended by Acts 1997, 75th Leg., ch. 245, § 4, eff. May 23, 1997.

§ 84.006. CONFIDENTIALITY. (a) All information and records relating to reportable conditions are confidential. That information may not be released or made public on subpoena or otherwise, except that release of information may be made:

(1) for statistical purposes, but only if a person is not identified;

(2) with the consent of each person identified in the information released; or

(3) to medical personnel in a medical emergency to the extent necessary to protect the health or life of the named person.

(b) The board shall adopt rules establishing procedures to ensure that all information and records maintained by the department under this chapter are kept confidential and protected from release to unauthorized persons.

Acts 1989, 71st Leg., ch. 678, § 1, eff. Sept. 1, 1989. Amended by Acts 1997, 75th Leg., ch. 245, § 5, eff. May 23, 1997.

§ 84.007. INVESTIGATIONS. (a) The department shall investigate the causes of occupational conditions and methods of prevention.

(b) In performing the commissioner's duty to prevent an occupational condition, the commissioner or the commissioner's designee may enter at reasonable times and inspect within reasonable limits all or any part of an area, structure, or conveyance, regardless of ownership, that is not used for private residential purposes.

(c) Persons authorized to conduct investigations under this section may take samples of materials present on the premises, including samples of soil, water, air, unprocessed or processed foodstuffs, manufactured items of clothing, and household goods. If samples are taken, a corresponding sample shall be offered to the person in control of the premises for independent analysis.

(d) Persons securing the required samples may reimburse or offer to reimburse the owner for the materials taken, but the reimbursement may not exceed the actual monetary loss sustained by the owner.

Acts 1989, 71st Leg., ch. 678, § 1, eff. Sept. 1, 1989. Amended by Acts 1997, 75th Leg., ch. 245, § 6, eff. May 23, 1997.

(1) race, ethnicity, and sex of the claimant;

(2) classification of the injury;

(3) amount of wages earned by the claimant before the injury; and

(4) amount of compensation received by the claimant.

Acts 1993, 73rd Leg., ch. 269, § 1, eff. Sept. 1, 1993.

Historical and Statutory Notes

Prior Laws:
Acts 1983, 68th Leg., p. 2818, ch. 483, § 2.
Vernon's Ann.Civ.St. art. 8307, §§ 3a, 3d.
Acts 1989, 71st Leg., 2nd C.S., ch. 1, § 2.13.
Vernon's Ann.Civ.St. art. 8308-2.13(e).

Library References

Workers' Compensation ⇐1096.
WESTLAW Topic No. 413.
C.J.S. Workmen's Compensation § 385.

§ 402.083. Confidentiality of Injury Information

(a) Information in or derived from a claim file regarding an employee is confidential and may not be disclosed by the commission except as provided by this subtitle.

(b) Information concerning an employee who has been finally adjudicated of wrongfully obtaining payment under Section 415.008 is not confidential.

Acts 1993, 73rd Leg., ch. 269, § 1, eff. Sept. 1, 1993. Amended by Acts 1995, 74th Leg., ch. 76, §§ 9.42, 14.49, eff. Sept. 1, 1995.

Revisor's Note

The source law refers to an employee adjudicated of "wrongfully obtaining payment under Section 10.04 of this Act," meaning V.A.C.S. Article 8308-10.04. The pertinent part of Section 10.04 is revised as Section 415.008, and the revised law reflects this change.

Historical and Statutory Notes

The 1995 amendment, to conform to Acts 1993, 73rd Leg., ch. 900, § 1.01, in subsec. (b), following "415.008", deleted "of this code or Section 32.51, Penal Code,".

Prior Laws:
Acts 1977, 65th Leg., p. 2005, ch. 801, § 3.
Acts 1981, 67th Leg., p. 2152, ch. 501, § 2.
Acts 1987, 70th Leg., ch. 1052, § 1.18.
Vernon's Ann.Civ.St. art. 8307, § 9a.
Acts 1989, 71st Leg., 2nd C.S., ch. 1, § 2.31.
Vernon's Ann.Civ.St. art. 8308-2.31(a), (b).

Library References

Records ⇐30, 31, 33, 58.
Workers' Compensation ⇐1096.
WESTLAW Topic Nos. 326, 413.
C.J.S. Criminal Law §§ 449 to 450.
C.J.S. Records §§ 60, 62 to 63, 65, 74 to 93, 95, 104 to 105, 107 to 110.
C.J.S. Workmen's Compensation § 385.

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§ 402.090. Statistical Information

The commission, the research center, or any other governmental agency may prepare and release statistical information if the identity of an employee is not explicitly or implicitly disclosed.

Acts 1993, 73rd Leg., ch. 269, § 1, eff. Sept. 1, 1993.

Historical and Statutory Notes

Prior Laws:
Acts 1977, 65th Leg., p. 2005, ch. 801, § 3.
Acts 1981, 67th Leg., p. 2152, ch. 501, § 2.
Acts 1987, 70th Leg., ch. 725, § 1.
Acts 1987, 70th Leg., ch. 1052, § 1.18.
Vernon's Ann.Civ.St. art. 8307, §§ 3e, 9a.
Acts 1989, 71st Leg., 2nd C.S., ch. 1, § 2.38.
Vernon's Ann.Civ.St. art. 8308-2.38.

Library References

Workers' Compensation ⇐1076.
WESTLAW Topic No. 413.
C.J.S. Workmen's Compensation § 378.

§ 402.091. Failure to Maintain Confidentiality; Offense; Penalty

(a) A person commits an offense if the person knowingly, intentionally, or recklessly publishes, discloses, or distributes information that is confidential under this subchapter to a person not authorized to receive the information directly from the commission.

(b) A person commits an offense if the person knowingly, intentionally, or recklessly receives information that is confidential under this subchapter and that the person is not authorized to receive.

(c) An offense under this section is a Class A misdemeanor.

(d) An offense under this section may be prosecuted in a court in the county where the information was unlawfully received, published, disclosed, or distributed.

(e) A district court in Travis County has jurisdiction to enjoin the use, publication, disclosure, or distribution of confidential information under this section.

Acts 1993, 73rd Leg., ch. 269, § 1, eff. Sept. 1, 1993. Amended by Acts 1995, 74th Leg., ch. 980, § 1.18, eff. Sept. 1, 1995.

Historical and Statutory Notes

The 1995 amendment, in subsec. (d), deleted subd. (1), and removed the designation from subd. (2). Prior to amendment, subds. (1) and (2) read:

"(1) Travis County; or

"(2) the county where the information was unlawfully received, published, disclosed, or distributed."

Section 1.58 of the 1995 amendatory act provides:

"(a) The change in law made to Subtitle A, Title 5, Labor Code, by this Act applies only to a penalty or sanction for an offense committed on or after the effective date of this Act.

"(b) For purposes of this section, an offense is committed before the effective date of this Act if any element of the offense occurs before that date.

"(c) An offense committed before the effective date of this Act is governed by the law in effect

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and may be forfeited to the Department of Public Safety in the manner provided for disposition of seized property by Article 18.18, Code of Criminal Procedure."

Cross References

Punishment, state jail felony, see V.T.C.A. Penal Code, § 12.35.

Notes of Decisions

Station message detail recording system 1

1. Station message detail recording system

Use by a county of any mechanical or electrical device that attaches to a telephone line and is capable of recording outgoing numbers is prohibited by this section. Op.Atty.Gen.1988, No. JM-983.

Regardless whether a device is a pen register, the use of such device to protect state property by recording the origin of incoming communications as well as outgoing numbers called in order to prevent the public from paying for private calls is permissible under subd. (d) of this section (Op.Atty.Gen.1988, No. JM-983, withdrawn). Op.Atty.Gen.1989, No. JM-1073.

§ 16.04. Unlawful Access to Stored Communications

(a) In this section, "electronic communication," "electronic storage," "user," and "wire communication" have the meanings assigned to those terms in Article 18.21, Code of Criminal Procedure.

(b) A person commits an offense if the person obtains, alters, or prevents authorized access to a wire or electronic communication while the communication is in electronic storage by:

(1) intentionally obtaining access without authorization to a facility through which a wire or electronic communications service is provided; or

(2) intentionally exceeding an authorization for access to a facility through which a wire or electronic communications service is provided.

(c) Except as provided by Subsection (d), an offense under Subsection (b) is a Class A misdemeanor.

(d) If committed to obtain a benefit or to harm another, an offense is a state jail felony.

(e) It is an exception to the application of Subsection (b) that the conduct was authorized by:

(1) the provider of the wire or electronic communications service;

(2) the user of the wire or electronic communications service; or

(3) Article 18.21, Code of Criminal Procedure.

Added by Acts 1989, 71st Leg., ch. 958, § 3, eff. Sept. 1, 1989. Amended by Acts 1993, 73rd Leg., ch. 900, § 1.01, eff. Sept. 1, 1994.

Historical and Statutory Notes

Another § 16.04 as added by Acts 1989, 71st Leg., ch. 1166, § 7 was renumbered as § 16.05 by Acts 1990, 71st Leg., 6th C.S., ch. 12, § 2(24).

The 1993 amendment, in subsec. (c) and in the introductory paragraph of subsec. (e), following references to subsections, deleted "of this section"; and rewrote subsec. (d), which previously read:

"If committed for purposes of commercial advantage, malicious destruction or damage, or

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(13) "Electric utility" has the meaning assigned by Subsection (c), Section 3, Public Utility Regulatory Act (Article 1446c, Vernon's Texas Civil Statutes).

(14) "Harm" includes partial or total alteration, damage, or erasure of stored data, interruption of computer services, introduction of a computer virus, or any other loss, disadvantage, or injury that might reasonably be suffered as a result of the actor's conduct.

(15) "Owner" means a person who:

(A) has title to the property, possession of the property, whether lawful or not, or a greater right to possession of the property than the actor;

(B) has the right to restrict access to the property; or

(C) is the licensee of data or computer software.

(16) "Property" means:

(A) tangible or intangible personal property including a computer, computer system, computer network, computer software, or data; or

(B) the use of a computer, computer system, computer network, computer software, or data.

Amended by Acts 1997, 75th Leg., ch. 306, § 1, eff. Sept. 1, 1997.

Historical and Statutory Notes

1997 Legislation

Acts 1997, 75th Leg., ch. 306, in the definition of "access", substituted "computer network, computer program, or computer system" for "computer system, or computer network"; inserted a definition of "aggregate amount"; and deleted a definition of "computer security system", which read:

"'Computer security system' means the design, procedures, or other measures that the person responsible for the operation and use of a computer employs to restrict the use of the computer to particular persons or uses or that the owner or licensee of data stored or maintained by a computer in which the owner or licensee is entitled to store or maintain the data employs to restrict access to the data."

Section 7 of Acts 1997, 75th Leg., ch. 306 provides:

"This Act takes effect September 1, 1997. The changes in law made by this Act apply only to an offense committed on or after the effective date of this Act. An offense committed before September 1, 1997, is covered by the law in effect when the offense was committed, and the former law is continued in effect for that purpose. For purposes of this section, an offense was committed before the effective date of this Act if any element of the offense occurred before that date."

§ 33.02. Breach of Computer Security

(a) A person commits an offense if the person knowingly accesses a computer, computer network, or computer system without the effective consent of the owner.

(b) An offense under this section is a Class B misdemeanor unless in committing the offense the actor knowingly obtains a benefit, defrauds or harms another, or alters, damages, or deletes property, in which event the offense is:

(1) a Class A misdemeanor if the aggregate amount involved is less than $1,500;

(2) a state jail felony if:

(A) the aggregate amount involved is $1,500 or more but less than $20,000; or

(B) the aggregate amount involved is less than $1,500 and the defendant has been previously convicted two or more times of an offense under this chapter;

(3) a felony of the third degree if the aggregate amount involved is $20,000 or more but less than $100,000;

(4) a felony of the second degree if the aggregate amount involved is $100,000 or more but less than $200,000; or

(5) a felony of the first degree if the aggregate amount involved is $200,000 or more.

(c) (Blank).

(d) A person who his [1] subject to prosecution under this section and any other section of this code may be prosecuted under either or both sections.

Amended by Acts 1997, 75th Leg., ch. 306, § 2, eff. Sept. 1, 1997.

[1] So in enrolled bill.

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TEXAS WORKERS' COMPENSATION COMMISSION (TWCC)
STATEMENT OF CONFIDENTIALITY
AND
USER INFORMATION SECURITY AGREEMENT

RE: Information obtained from TWCC records during the course of employment with the Texas Department of Health (TDH).

I, _____ the undersigned, an employee of the Texas Department of Health, a state agency, hereby declare in this statement that any and all information from the TWCC files obtained by me during the course of my employment with TDH shall be kept privileged and confidential. I understand that I shall not disclose any information contained or derived from any TWCC claim file of data file. Should any information be requested from a file by any person not a party to this agreement nor authorized to access the system, then, such request shall be directed to TWCC. I understand that I will be/have been assigned a personal user ID which I will use to activate access to the TWCC computer system. I understand that I will be held personally accountable for my actions and any activity performed under my user ID. Under no circumstances will I allow my user ID and confidential password to be used by any other individual, nor will I use one belonging to someone else. I will not enter any unauthorized data, make any unauthorized changes to data or disclose any information without prior written authorization.

Unauthorized access to a computer, computer network, or computer system without the effective consent of the owner is a criminal offense. Such an offense is a Class B misdemeanor under Chapter 33 of the Texas Penal Code, which is punishable by a fine not to exceed $2,000; confinement in jail for a term not to exceed 180 days; or both. If in committing such an offense, the actor knowingly obtains a benefit, defrauds or harms another, or alters, damages, or deletes property, the punishment may range from a fine not to exceed $4,000 and/or one year in jail to a fine of not more than $10,000 and confinement in the state penitentiary for a period of not less than five years nor more than ninety-nine years, depending on the aggregate amount involved. (See attached copies of Texas Penal Code)

I understand that it is a crime to access unlawfully or allow someone else to access unlawfully any stored communication and in doing so I may be charged with a Class A misdemeanor, and i the crime was committed under certain circumstances (see attached copy of Texas Penal Code §16.04), then the offense would be classified as a state jail felony.

I understand that TWCC records are confidential under Texas Labor Code §§402.082-402.092, and that should I violate the provisions of this statute I would be committing an offense under Texas Labor Code §402.091 in which I may be charged with a Class A misdemeanor. I also understand that I shall not tamper with any record and have been informed that to do so is a criminal offense in which I could be charged with Tampering with a Governmental Record which is a Class A misdemeanor. If tampering occurs with the intent to defraud or harm another, then the offense is classified as a third degree felony.

I have read the above statement, understand it fully and will abide by it. I have also received a copy of the above mentioned statutes and have read them. I also understand that if I violate any of these standards I may be subject to disciplinary action up to and including immediate termination and/or prosecution under one or more applicable statutes, and in doing so I may jeopardize the agreement between TDH and the Texas Workers' Compensation Commission.

Signed this _____ day of _____ of _____.

_____ _____

Employee Signature SS Number (not mandatory - for identification only)

STRUCTURAL PEST CONTROL BOARD
9101 FM 1325, Suite 201
Austin, Texas 78758-5280
Telephone: (512) 835-4066
Fax: (512) 837-7722

Benny M. Mathis, Jr.
Executive Director

November 9, 1995

Dr. David R. Smith, M.D.
Commissioner of Health
1100 West 49th Street
Austin, Texas 78756-3199

Dear Dr. Smith:

Please find enclosed the executed memorandum of understanding between the Structural Pest Control Board and the Texas Department of Health, Bureau of Epidemiology. If any further information or clarification is required, contact June Ann Moncrief, Deputy Administrator at (512) 835-4066.

Sincerely,

Benny Mathis
Executive Director

cc: Roger Borgelt

Enclosure

NOV 02 1995

MEMORANDUM OF UNDERSTANDING
BETWEEN
STRUCTURAL PEST CONTROL BOARD
AND
TEXAS DEPARTMENT OF HEALTH
BUREAU OF EPIDEMIOLOGY

I. Purpose

The purpose of this Memorandum of Understanding is to formalize a working relationship between the Texas Department of Health, Bureau of Epidemiology and the Structural Pest Control Board, to reduce occupational illnesses and to assure a safe and healthful workplace. This agreement describes the information needed from the Structural Pest Control Board that will allow the Texas Department of Health, Bureau of Epidemiology to provide appropriate follow-up of occupational pesticide poisoning.

II. Background

The Legislature of the State of Texas and the Congress of the United States have enacted employee protection legislation intent upon identifying and eliminating hazardous exposures to employees. Pursuant to Title 25, Texas Administrative Code, 99.1, physicians and laboratory supervisors in the State of Texas must report the following occupational conditions to the Texas Department of Health: blood lead levels at or above 40 micrograms lead/ deciliter of blood in persons 15 years of age or older, asbestosis, silicosis, and acute occupational pesticide poisoning.

The Environmental and Occupational Epidemiology Program, Texas Department of Health, Bureau of Epidemiology collects and analyzes worker exposure data from various reporting sources. This data is used to implement intervention activities for reducing work-related illnesses, injuries and hazards. This is accomplished through contact with the physician, employer, and employee.

III. Procedure

To better meet its legislative mandate, the Texas Department of Health, Bureau of Epidemiology will contact the Structural Pest Control Board when it is notified of a suspected or confirmed case of pesticide poisoning related to structural application. The notification will provide as much information as can be made available to include laboratory analysis, physician examination, or information provided by the employee. Patient identifiers are confidential and will be maintained by the Texas Department of Health, Bureau of Epidemiology.

When the Structural Pest Control Board is notified of human pesticide exposure, the Texas Department of Health, Bureau of

Epidemiology will be contacted and provided with the information as required by the Texas Administrative Code. Coordinated investigations of occupational pesticide poisoning cases will be conducted jointly between the Texas Department of Health, Bureau of Epidemiology and the Structural Pest Control Board whenever possible. The Texas Department of Health, Bureau of Epidemiology staff would be available to conduct employer, employee and family member interviews and answer other health related concerns. The Texas Department of Health, Bureau of Epidemiology staff can assist in the on-site investigation to gather epidemiological information from the employee, employer or other personnel as appropriate. This information would be useful when modifications to existing pesticide applications and procedures are reviewed.

IV. Period of Agreement

This Memorandum of Understanding shall continue in effect indefinitely, unless, and until, modified in writing by mutual consent of both parties or terminated by either party upon 30 days advance written notice.

This Memorandum of Understanding does not preclude either party from entering into separate agreements setting forth procedures for other programs which can be addressed more efficiently and expeditiously by special agreement.

David R. Smith, M.D.
Commissioner of Health
Date: November 1, 1995

Benny Mathis
Executive Director
Date: 11/9/95

STRUCTURAL PEST CONTROL BOARD
9101 FM 1325, SUITE 201
AUSTIN, TEXAS 78758
Telephone: 512-835-4066 Fax: 512-837-7722

fax

● To: David R. Smith, M.D.

● From: Benny Mather

Date: 1/25/96
Number of Pages: 2
Phone: (512) 835-4066
Fax: (512) 837-7722

● Remarks:

Copy of letter dated 11/9/95.

TEXAS DEPARTMENT OF AGRICULTURE

November 24,1993

RICK PERRY
Commissioner

Dr. David R. Smith, M.D.
Commissioner of Health
Texas Department of Health
1100 West 49th Street
Austin, Texas 78756-3199

Dear Dr. Smith:

Enclosed is the Memorandum of Understanding (MOU) that was developed to enhance the flow of information between the Bureau of Epidemiology, the Texas Department of Health and the Texas Department of Agriculture regarding reported cases of adult elevated blood lead levels, occupational pesticide poisoning, silicosis and asbestosis. We have reviewed and signed the MOU that we found provides the necessary language to achieve the consistent and ongoing exchange of information between our agencies.

We have also enclosed a copy of our Human Exposure Policy that was given to our inspectors October 1, 1993, and highlighted the section requiring them to report all confirmed cases to your agency. If any further actions need to be attended to before finalizing this MOU, please contact Donnie Dippel at 512/475-1621.

Sincerely,

Rick Perry

Rick Perry
Commissioner of Agriculture

RP/DD/co

Enclosures

A17

MEMORANDUM OF UNDERSTANDING
BETWEEN
TEXAS DEPARTMENT OF AGRICULTURE
AND
TEXAS DEPARTMENT OF HEALTH
BUREAU OF EPIDEMIOLOGY

I. Purpose

The purpose of this Memorandum of Understanding (MOU) is to formalize a working relationship between the Texas Department of Health, Bureau of Epidemiology (TDH-BE) and the Texas Department of Agriculture (TDA), to reduce occupational illnesses and to assure a safe and healthful workplace.

This agreement describes the procedure used by TDH-BE to inform the TDA of workplaces where occupational exposures to pesticide result in occupationally related illness or injury. A coordinated effort between TDH-BE and TDA will use the resources of each Agency and in combination will more effectively identify and reduce occupational pesticide poisoning. Through this cooperative effort, the goals of each Agency to reduce work-related illnesses and to assure safe and healthful working conditions will be met.

II. Background

The Legislature of the State of Texas and the Congress of the United States have enacted employee protection legislation intent upon identifying and eliminating harmful employee exposures.

Pursuant to Title 25, Texas Administrative Code, 99.1, physicians and laboratory supervisors in the State of Texas must report the following occupational conditions to TDH: 1) blood lead levels at or above 40 micrograms lead/deciliter of blood in persons 15 years of age or older, asbestosis, silicosis, and acute occupational pesticide poisoning.

The Environmental and Occupational Epidemiology Program in the TDH-BE collects and analyzes worker exposure data from these sources. This data is used to implement intervention activities for reducing work-related illnesses, injuries and hazards. This is accomplished through contact with the physician, employer and employee.

III. Procedure

To better meet its legislative mandate, the TDH-BE will contact TDA when this agency is notified of a suspected or confirmed case of pesticide poisoning. The notification will include as much information as can be made available to include laboratory analysis, physician examination, or information provided by the employee. Patient confidentiality will be maintained by TDH-BE.

Compliance and Quality Assurance. The Austin staff person receiving the update from the field will immediately update the human exposure contact programs listed above.

INFORMING TDH

When the inspector has determined that a possible human exposure has occurred, he/she should contact the Texas Department of Health, (TDH), at 1-800-252-8239 within seventy-two (72) hours from the time the complaint was received. The TDH contact person is Theresa Willis.

Attached is a copy of the Texas Department of Health Case Report Form that inspectors should give to a person(s) who has been exposed to a pesticide. The Case Report Form should be filled out by the person filing the complaint and sent to the address on the form. The form also contains a telephone number for the person(s) to call and receive medical advice pertaining to their specific type of pesticide exposure. The TDA inspector is still required to contact TDH and notify them of the human exposure.

INFORMING TDA

The Office of the Assistant Commissioner for Pesticide Programs will notify the lab that they will be receiving samples involving a human exposure case. The analysis of these samples will be initiated within a twenty-four (24) hour period from the time the samples were received.

SHIPPING SAMPLES

All samples that are collected in connection with a human exposure complaint must be identified as such by indicating "Human Exposure Incident" in the remarks section of the sample collection report.

Samples involved in a human exposure complaint must be sent to the Brenham Lab within twenty-four (24) hours from the time the samples are collected. In the event that enough information regarding the type of analysis to perform or the pesticide involved or suspected is not known, the sample must still be sent to the lab within the twenty-four (24) hour period. A note to the lab should be included in the remarks section of the sample collection report informing the lab that this is a human exposure sample, and that no analysis should be performed until instructed to do so by the inspector. This instruction will be received by the lab no later than forty-eight (48) hours from the time the sample was shipped. When enough information is gathered, the inspector must fax that information to the lab, and follow-up by telephone call and mailing a hard copy of the information. If for some reason this time specification cannot be met, contact regional director/senior inspector and document attempts made and reasons for failure.

("Office of " these programs may be satisfied by contacting Deputy Assistant Commissioner, or Administrative persons /Attorneys reporting directly to Assistant Commissioner/ Chief of Enforcement)

REGIONAL OFFICE

When received from the Austin office or a direct call from the complainant to the regional office, the information should be given to the senior inspector, the regional director, or the person in charge if both are not available.

If the complaint was called directly to the regional office, the Austin staff in one of the following programs should be notified immediately who will in turn notify the other divisions immediately.

* Office of the Chief of Enforcement
* Office of the Assistant Commissioner for Pesticide Programs
* Office of the Assistant Commissioner for Field Operations
* Office of the Assistant Commissioner for Communications

PROCEDURES FOR HANDLING THE HUMAN EXPOSURE COMPLAINT

TELEPHONE CONTACT

The inspector assigned to the complaint or the senior inspector should make telephone or personal contact with the complainant as soon as possible, but within six (6) hours from the time the complaint was received by TDA.
If the complainant can not be reached by phone, document the time the call was made and continue trying to contact the complainant.

PERSONAL CONTACT

The inspector will visit the complainant within the twenty-four (24) hour period after the complaint is received. If for some reason this time period cannot be met, contact the regional director/senior inspector and document the reason why these time constraints are not being met.

UPDATING TDA STAFF

The Case Preparations Officer for Pesticides in the Office of the Chief of Enforcement is lead contact person to receive update information. The inspector should relay the information to the Austin staff on an as needed basis, with a minimum of every two (2) days. If the Case Preparations Officer is not available, the Pesticide Enforcement Attorneys or Chief of Enforcement should be contacted. If legal staff are unavailable, contact should be made to Office of the Assistant Commissioner for Pesticide Programs or the Coordinator for

TEXAS DEPARTMENT OF AGRICULTURE

PESTICIDE PROGRAMS DIVISION

POLICY STATEMENT

POLICY NUMBER: PPD-93-006

SUBJECT: The handling of human exposure complaints

REPLACES: Any previous department policy

EFFECTIVE DATE: October 1, 1993

HUMAN EXPOSURE COMPLAINT IS RECEIVED

AUSTIN

The Austin staff on the TDA Information Sources lists responsible for Human Exposure, the Office of Chief of Enforcement, the Office of the Assistant Commissioner for Pesticide Programs or Office of Field Operations should immediately call the regional office and make contact with the senior inspector, regional director, or person(s) in charge of the office if both are out. If no other person(s) can be contacted, the inspector can be contacted directly to facilitate the investigation. If a complainant contacts the department during a time there is no one available at the regional office, then telephone the senior inspector, regional director, or inspector by pager or home number until contact has been made. Do not leave the complainant waiting until the next business day for a contact from the department.

The Complaint Information Form should immediately be hand delivered to field operations to be faxed to the person contacted at the regional office. If no one from field operations staff is available, the individual taking the information will fax the Complaint Information Form to the regional office and leave a copy for field operations staff.

The individual receiving complaint should make sure the following programs in Austin are aware of the complaint immediately:

* Office of the Chief of Enforcement
* Office of the Assistant Commissioner for Pesticide Programs
* Office of the Assistant Commissioner for Field Operations
* Office of the Assistant Commissioner for Communications

When TDA is notified of human pesticide exposure, TDH-BE will be contacted and provided with the information as required by the Texas Administrative Code. Coordinated investigations of occupational pesticide poisoning cases will be conducted jointly between TDH-BE and TDA whenever possible. TDH-BE staff would be available to conduct employer, employee and family member interviews and answer other health related concerns. TDH-BE staff can assist in the onsite investigation to gather epidemiological information from the employee, employer or other personnel as appropriate. Whenever TDH-BE is notified of a human pesticide exposure, the circumstances surrounding the exposure would be reported to TDA. This information would be useful when modifications to existing pesticide applications, procedures, re-entry times, etc., are reviewed.

IV. Period of Agreement

This MOU shall continue in effect indefinitely, unless, and until, modified in writing by mutual consent of both parties or terminated by either party upon 30 days advance written notice.

This MOU does not preclude either party from entering into separate agreements setting forth procedures for other programs which can be addressed more efficiently and expeditiously by special agreement.

David R. Smith, M.D.
Commissioner of Health

Date: 9/10/93

Rick Perry

Date: 11-30-93

DOCUMENT NO. 2322389763-2002
ATTACHMENT NO. 01

PERFORMING AGENCY: NORTHWEST TEXAS HEALTHCARE SYSTEM INC

RECEIVING AGENCY PROGRAM: BUREAU OF EPIDEMIOLOGY

TERM: September 01, 2001 THRU: August 31, 2002

SECTION I. SCOPE OF WORK:

PERFORMING AGENCY shall promote public safety and injury prevention through well-coordinated poison control activities within the State of Texas by providing:

1. 24-hour toll-free telephone referral and information services for the public and health care professionals according to the requirements of the American Association of Poison Control Centers (AAPCC). Referral and information services shall be provided directly or through coordination with the other centers in the Poison Center Network;

2. Information and educational programs for communities and health care professionals;

3. Poison prevention education;

4. Technical assistance to state agencies requesting toxicology assistance; and,

5. Consultation services concerning medical toxicology.

All activities shall be performed in accordance with RECEIVING AGENCY'S guidelines listed below, and PERFORMING AGENCY'S objectives, activities, work plan, and detailed budget as approved by RECEIVING AGENCY. All of these documents are adopted by reference as part of this Attachment. Any revisions to said documents shall be approved by RECEIVING AGENCY and transmitted in writing to PERFORMING AGENCY before they become effective.

PERFORMING AGENCY shall comply with Chapter 777 of the Health and Safety Code and the rules jointly adopted by the RECEIVING AGENCY and the Commission on State Emergency Communications (CSEC), 25 TAC §§ 5.51-5.59.

A23

PERFORMING AGENCY shall have and maintain daily poison reporting data consistent with the AAPCC data collection standards and legislative reporting requirements. To the extent practical, PERFORMING AGENCY shall utilize similar management information network standards of compatibility. Poisoning data shall be submitted in the format, manner and frequency prescribed by RECEIVING AGENCY.

PERFORMING AGENCY shall adhere to the provisions of the Health and Safety Code, Chapter 84, and 25 TAC § 99.1, relating to the immediate reporting of confirmed or suspected acute occupational pesticide poisonings, including those requiring hospitalization. Non-occupational pesticide poisonings shall be reported in like manner.

PERFORMING AGENCY shall be the designated site for mandatory reporting of controlled substance overdoses as prescribed by Health and Safety Code §§ 161.041-.044. Data collected shall be reported in the format, manner and frequency prescribed by RECEIVING AGENCY.

PERFORMING AGENCY shall provide on-going support for poison center-related telecommunications in its facility as negotiated with the CSEC.

PERFORMANCE MEASURES

The following performance measures will be used to assess, in part, the PERFORMING AGENCY'S effectiveness in providing the services described in this contract Attachment, without waiving the enforceability of any of the other terms of the contract.

8 human exposure calls to Poison Control Center per 1000 population;

180 public and professional education presentations conducted; and,

175,000 educational materials distributed.

PERFORMING AGENCY shall provide a monthly report entitled "Report of Human Exposures" to RECEIVING AGENCY Program. The report shall document the number of calls per 1000 population. The report may be submitted on paper or electronically on the "Toxicall" system when it is implemented. PERFORMING AGENCY shall submit a completed "Measurable Outcome Criteria Quarterly Report Form" to RECEIVING AGENCY Program within thirty (30) days after the end of each quarter.

PERFORMING AGENCY shall provide services to clients who live or receive services in the following count(ies)/area: Archer, Armstrong, Bailey, Baylor, Briscoe, Brown, Callahan, Carson, Castro, Childress, Clay, Cochran, Coleman, Collingsworth, Comanche, Cottle, Crosby, Dallam, Deaf Smith, Dickens, Donley, Eastland, Fisher, Floyd, Foard, Garza, Gray, Hale, Hall, Hansford, Hardeman, Hartley, Haskell, Hemphill, Hockley, Hutchinson, Jack, Jones, Kent, King, Knox, Lamb, Lipscomb, Lubbock, Lynn, Mitchell, Montague, Moore, Motley, Nolan, Ochiltree, Oldham, Parmer, Potter, Randall, Roberts, Runnels, Scurry,

Shackelford, Sherman, Stephens, Stonewall, Swisher, Taylor, Terry, Throckmorton, Wheeler, Wichita, Wilbarger, Yoakum, Young, and surrounding counties.

SECTION II. SPECIAL PROVISIONS:

General Provisions, **Overtime Compensation** Article, is not applicable and PERFORMING AGENCY shall comply with the following paragraphs:

PERFORMING AGENCY is authorized to pay employees who are not exempt under the Fair Labor Standards Act (FLSA), 29 USC, Chapter 8, § 201 et seq., for overtime or compensatory time at the rate of time and one-half per FLSA.

PERFORMING AGENCY is authorized to pay employees who are exempt under FLSA on a straight time basis for work performed on a holiday or for regular compensatory time hours when the taking of regular compensatory time off would be disruptive to normal business operations.

Authorization for payment under this provision is limited to work directly related to poison control activities and the amount shall not exceed 5% of the annual personnel costs for those eligible positions to be allowable.

PERFORMING AGENCY shall document proper authorization for approval for any work performed by exempt or non-exempt employees in excess of forty (40) hours in a workweek.

SECTION III. BUDGET:

PERSONNEL	$462,040.00
FRINGE BENEFITS	36,097.00
TRAVEL	12,000.00
EQUIPMENT	0.00
SUPPLIES	4,500.00
CONTRACTUAL	80,000.00
OTHER	4,013.00
TOTAL DIRECT CHARGES	$598,650.00
INDIRECT CHARGES	$92,509.00
TOTAL	$691,159.00

Total reimbursements will not exceed $691,159.00 .

Financial status reports are due the 30th of December, 30th of March, 30th of June, and the 30th of November.

The negotiated indirect cost amount shown above is less than PERFORMING AGENCY'S current approved indirect cost rate on file at RECEIVING AGENCY. Indirect cost will be charged in accordance with the negotiated rate, but may not exceed the amount shown above. Indirect charges to this contract may not exceed the amount shown above, except by prior written approval of RECEIVING AGENCY.

DOCUMENT NO. -
ATTACHMENT NO.
PURCHASE ORDER NO.

PERFORMING AGENCY:

RECEIVING AGENCY PROGRAM:

TERM: THRU.

SECTION I. SCOPE OF WORK:

PERFORMING AGENCY shall assist RECEIVING AGENCY Program in: 1) promoting the reduction of injuries occurring from exposure to poisons and toxic substances through public and professional education, and 2) reduce medical costs incurred by State of Texas residents by providing treatment recommendations.

PERFORMING AGENCY shall:

1. Promote public safety and injury prevention through well-coordinated poison control activities within the State of Texas;
2. Provide and maintain a twenty-four (24) hour toll free telephone referral and information service for the public and health care professionals according to the requirements of the American Association of Poison Control Centers (AAPCC). Referral and information services shall be provided directly or through coordination with the other centers in the Poison Center Network as identified in RECEIVING AGENCY'S Program's RFP number E14 0001.3;
3. Provide information and conduct poison prevention or other poison related educational programs for communities and health care professionals within PERFORMING AGENCY'S identified service areas of ;
4. Provide technical assistance to other State of Texas agencies requesting toxicology assistance;
5. Provide consultation services to health care professionals and the public concerning medical toxicology;
6. Maintain daily poison reporting data consistent with the AAPCC data collections standards, Texas Poison Center Network (TPCN) standardized operating policies and procedures, and legislative reporting requirements;
7. Utilize management information network standards as prescribed in the design of RECEIVING AGENCY'S Program's centralized database and documented in the Centralization of Data and Technology Among Texas Poison Centers Project Charter dated October 22, 2003. Data shall be submitted to the centralized database and shared with

RECEIVING AGENCY'S Program daily or more often during times of emergency, outbreak, or terrorist event;

8. Immediately report confirmed or suspected acute occupational pesticide poisonings, including those requiring hospitalization to RECEIVING AGENCY'S Program, in the format provided by RECEIVING AGENCY'S Program;
9. Immediately report non-occupational pesticide poisonings to RECEIVING AGENCY'S Program, in the format provided by RECEIVING AGENCY'S Program;
10. PERFORMING AGENCY shall be the designated site for mandatory reporting of controlled substance overdoses. Data collected shall be reported to RECEIVING AGENCY'S Program, in the format, manner and frequency prescribed by RECEIVING AGENCY'S Program;
11. PERFORMING AGENCY shall document proper authorization for approval of any work performed by exempt or non-exempt employees in excess of forty (40) hours in a work week;
12. Provide on-going support for poison center related telecommunications at its facility;
13. Any revisions to the organizational structure shall be submitted to RECEIVING AGENCY'S Program, in writing, prior to implementation, and shall be in compliance with AAPCC certification guidelines; and
14. PERFORMING AGENCY shall provide copies of all financial and/or administrative audits conducted on poison center operations, including independent audits and internal audits to RECEIVING AGENCY'S Program within contract Attachment term.

PERFORMING AGENCY shall comply with the following applicable federal and state laws, rules, regulations, standards, and guidelines:

1. Chapter 777 Health and Safety Code. Publication can be located at web site http://www.capitol.state.tx.us/statutes/hs.toc.htm;
2. 25 Texas Administrative Code (TAC), §§5.51-5.59. Publication can be located at web site http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=3&ti=25&pt=1;
3. Chapter 84 Health and Safety Code. Publication can be located at web site http://www.capitol.state.tx.us/statutes/hs.toc.htm;
4. 25 TAC §99.1. Publication can be located at web site http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=25&pt=1&ch=99&rl=Y;
5. Health and Safety Code §§161.042-.044. Publication can be located at web site http://www.capitol.state.tx.us/statutes/hs.toc.htm;
6. American Association of Poison Control Center. Publication can be located at web site http://www.aapcc.org/;
7. Centralization of Data & Technology Among Texas Poison Centers Project Charter dated 10/22/2003; and
8. RECEIVING AGENCY'S Program's Texas Poison Center Network Standardized Operating Policies and Procedures.

The following documents are incorporated by reference and made part of this contract Attachment:

1. RECEIVING AGENCY'S Program's fiscal year (FY) 2004 Texas Poison Center Network Request for Proposal (RFP) E14 0001.1 issued March 28, 2003;

2. PERFORMING AGENCY'S Texas Poison Center Network RFP Application dated May 15, 2003, and any revisions agreed upon, in writing, by PERFORMING AGENCY and RECEIVING AGENCY'S Program;
3. RECEIVING AGENCY'S Program's FY 2005 Texas Poison Center Network Renewal Application E14 0001.2 issued April 23, 2004;
4. PERFORMING AGENCY'S Texas Poison Center Network Renewal Application dated May 14, 2004, and any revisions agreed upon, in writing, by PERFORMING AGENCY and RECEIVING AGENCY'S Program;
5. RECEIVING AGENCY'S Program's FY 2006 Texas Poison Center Network Renewal Application E14 0001.3 issued May 20, 2005;
6. PERFORMING AGENCY'S Texas Poison Center Network Renewal Application dated June 8, 2005, and any revisions agreed upon, in writing, by PERFORMING AGENCY and RECEIVING AGENCY'S Program;

Within thirty (30) days of receipt of an amended standard(s) or guideline(s), PERFORMING AGENCY shall inform RECEIVING AGENCY'S Program, in writing, if it will not continue performance under this contract Attachment with the amended standard(s) or guideline(s). RECEIVING AGENCY may terminate the contract Attachment immediately or within a reasonable period-of-time as determined by RECEIVING AGENCY.

RECEIVING AGENCY reserves the right, where allowed by legal authority, to redirect funds in the event of financial shortfalls. RECEIVING AGENCY'S Program will monitor PERFORMING AGENCY'S expenditures on a monthly basis. If expenditures are below that projected in PERFORMING AGENCY'S total contract amount as shown in SECTION III. BUDGET, PERFORMING AGENCY'S budget may be subject to a decrease for the remainder of the Attachment term. Vacant positions existing after ninety (90) days may result in a decrease in funds.

Through this contract Attachment, RECEIVING AGENCY and PERFORMING AGENCY are furnishing a service related to homeland security and under the authority of Texas Government Code §421.062, neither agency is responsible for any civil liability that may arise from furnishing any service under this contract Attachment.

PERFORMANCE MEASURES

The following performance measures will be used to assess, in part, PERFORMING AGENCY'S effectiveness in providing the services described in this contract Attachment, without waiving the enforceability of any of the other terms of the contract.

Measure A:
Calls handled by the Poison Center should be derived from the Toxic Exposure Surveillance System (TESS) maintained by RECEIVING AGENCY'S Program database and NOT the Automated Call Distribution (ACD) database maintained at each poison center.

1. Number of human patient exposure calls is ;
2. Number of follow-up calls for human patient exposures is ;

SECTION II. SPECIAL PROVISIONS:

General Provisions, **Overtime Compensation** Article, is revised to include the following:

PERFORMING AGENCY is authorized to pay employees who are not exempt under the Fair Labor Standards Act (FLSA), 29 USC, Chapter 8, §291 et seq., for overtime or compensatory time at the rate of time and one-half per FTE.

General Provisions, **Equipment and Supplies** Article, is revised to include the following:

PERFORMING AGENCY shall retain title to all equipment purchased with contract funds under authority of §12.053 of the Health and Safety Code.

PERFORMING AGENCY shall also submit one (1) copy of the annual cumulative equipment inventory report (TDH Form GC-11) to RECEIVING AGENCY'S Program no later than October 15th of each year.

A. MAY
ING EXECUTIVE DIRECTOR

TEXAS
WORKERS' COMPENSATION COMMISSION
SOUTHFIELD BUILDING, MS-4D, 4000 SOUTH IH-35, AUSTIN, TEXAS 78704-7491
(512)448-7900

MEMORANDUM

DATE: August 13, 1998

TO: Scott Richardson
Worker's Health and Safety Division

FROM: Pam Oglesby
Assistant General Counsel

RE: MOU with Texas Department of Health

I have reviewed the MOU with TDH as well as the current laws on illegal access or exceeding authorized access to electronically stored information. Although it does not appear that the MOU is effected by the changes, I believe it would be prudent to have new Confidentiality statements signed by all relevant TDH employees, which cite the new statutes. Therefore, I'm sending you a revised statement with attachments to be forwarded to TDH.

If you need any additional information or have any questions, let me know.

Pam Oglesby
ext. 3969

Appendix B

Questionnaires

Occupational
Non-Occupational

Report Date: _____

Received by: _____

To be completed at data entry:

Case ID #: _____

Event ID#: _____

Exposure ID#: _____

Event Descriptor:

Case #: _____ **Report Source contact phone #:** _____

Observation of residue and/or contamination by a trained professional/ SAMPLES taken? *(see last page)* _____

Last Name: _____ First Name: _____ Middle Int: _____

Home Address: _____ City: _____ Zip Code: _____

County: _____ FIPS: _____ Telephone No.: _____ D.O.B: _____

Gender: ☐Male ☐Female Hispanic: ☐ Yes ☐ No Speaks English: ☐Yes ☐No Age: _____

☐(01) American Indian/Alaskan ☐(03) Black ☐ (06) Mixed

☐(02) Asian/Pacific Islander ☐(05) White ☐ (08) Other ☐ (09) Unknown

Event Date: _____ **What were you doing when you were exposed to the pesticide?**

Description (note form): _____

_____

_____

_____ First Exposed ___:___ How long___:___ Symptom onset ___:___

HEALTH EFFECTS reported by case: _____

_____

Event_SUPERVISION: Was the application performed by a **licensed applicator**?: ☐ Yes ☐ No

Where did the **event take place**? **Event site** (Farm, Home Nursery) _____

Address: _____ City: _____ County: _____

Where were you when you were exposed? **Case site** (ex. Farm, Home, Nursery) _____

Name of other exposed individuals: _____ Phone: _____

☐ Drift ☐ Surface ☐ Targeted ☐ Leak/Spill ☐ Indoor Air ☐ Unknown ☐ Other **EXP TYPE**

☐ Dermal ☐ Injection ☐ Inhalation ☐ Eye ☐ Ingestion ☐ Unknown ☐ Other **EXP ROUTE**

Chemical Info:

	1st Product	2nd Product	3rd Product
Name			
Active Ingredient			
Other			

What was the **TARGET?** _____ (see also pg. 3)

Application Equipment: _____ (see also pg. 3)

FIRST CARE **Date** medical attention sought: _____

(1) Physician office
(2) Emergency Department
(3) Hospital Admission _____to_____
(7) Employee Health Center/Company Physician
(4) Advice from Poison Control (TPCN)
(5) No medical care sought
(6) Other
(9) Unknown

Name of Facility: _____ Phone: _____
Location: _____ Fax: _____
Requested: _____ **Received:** _____
Hospitalized: Admit Date: ____/____/____ Discharge Date: ____/____/____ Length of Stay: ____Days
Diagnosis: _____ Diag. date : ICD-9 Code : _____
Physician: _____
PRE-EXISTING CONDITIONS:
Pregnant: _____ Allergies: _____ Asthma: _____ ACI: _____
(1 = Dr. Reported 2 = Exposed Reported 3 = Both Reported 4= Not Present 9 = Unknown)

Did you have to miss more than 1 day from work as a result of the exposure?
Lost Time: (1) Yes, ___days (2) No time lost (3) Unemployed, lost normal activity (9) Unknown

EMPLOYMENT INFORMATION

Was exposure work related? Yes No

Place of Employment: _____ Address: _____
City/Zip: _____ Business phone: _____
May we contact your employer if necessary? Yes No Supervisor's Name: _____
Supervisor's phone: _____
What is your **job title**? _____ **COC (Occupational) Code**: _____
General Job Duties: _____
Industry at time of Exposure: _____ **SIC (Industry) Code**: _____
What were you doing when exposed? _____

Incidents involving **APPLICATION, MANUFACTURE, OR HANDLING/WORKING** with pesticides:
Were you wearing any type of **personal protective equipment**? Yes No

Supplied air respirator Respirator Dust mask Boots Clothing
Gloves (cotton & leather) Gloves (synthetic) Goggles Engineering

AGRICULTURE: **Have you had WPS training *(the blue card)*?** Yes No When? _____
1: Were you told of **Re-entry time restrictions**? Yes No
2: Have you been informed this season about **hazards of pesticides**? Yes No
3: Have you been told this season about resources for **emergency care**? Yes No
4: Have you been informed about **pesticide safety and PPE use**? Yes No

SOURCE OF INCIDENT INFORMATION

(01) Physician Report	(07) Obituary/news	(13) Worker representative	(065) Tx Workforce Comm
(02) Poison Control Center	(08) TWCC	(14) Medical record review	(067) Other TDH program
(03) Other Healthcare Prov	(09) Self-report	(15) Employer report	(97) State Health Dept
(04) Laboratory report	(10) Co-worker report	(21) Agricultural Nurse Program	(98) Other
(05) Death cert/med. Exam Rpt	(11) Friend or Relative report	(061) Tx Dept Agriculture	(99) Unknown
(06) Report/refer from gov agcy	(12) Identified during site visit	(062) SPCB	

Referred to another agency? _____

SITE INFORMATION ○= Case Site ✓= Event Site

(01) Farm	(13) Labor Housing		(53) Golf Course
(02) Nursery	(20) Residential Institution	(39) Other manufacturer	(54) Private Vehicle
(03) Forest	(21) School	(40) Office/Business	(55) Public Transportation
(04) Livestock Production facility	(22) Daycare facility	(41) Retail Establishment	(59) Other
(05) Greenhouse	(23) Prison	(42) Service Establishment	(60) Emergency Response Veh
(10) Single Family Home	(24) Hospital	(50) Road/Rail	(70) More than one site
(11) Mobile Home	(29) Other institution	(51) Rd/Rail/Utility/Right of Way	(98) Not Applicable
(12) Multi-Unit Housing	(30) Pesticide Manufacture	(52) Park	(99) Unknown

EQUIPMENT

(01) Aerial application equip	(06) High Pressure Fumigator	(11) Ground sprayer NEC	(98) Not Applicable
(02) Chemigation	(07) Handheld granular/dust appl	(12) Manual Placement	(99) Unknown
(03) Pressurized can/bomb	(08) Spray line/handheld	(13) Dip tank or tray	
(04) Aerosol generator/fogger	(09) Sprayer, backpack	(14) More than one type	
(05) Soil Injector	(10) Trigger pump/compressed air	(15) Other	

TARGET

(010) Landscape/ornamentals	(110) Tree fruits	(450) Seed/pod vegetables	(700) Humans
(020) Forest trees/land	(111) Citrus fruits	(460) Misc. vegetables	(701) Human - skin/hair
(031) Veterinary-livestock	(112) Tree nuts	(500) Grain/grass/fiber crp	(702) Human – clothing
(032) Veterinary-domestic animals	(113) Pome fruits	(501) Fiber crops	(703) Human-skin/hair/clothing
(041) Building Structure	(114) Stone fruits	(510) Forage/fodder/silage/grass	(800) Bait for rodent, bird, predator
(042) Building Surface	(120) Subtropical/misc. fruits	(520) Forage/fodder/silage/leg	(801) Wide-scale pub. Com.-wide
(043) Building space treatment	(200) Beverage crops	(530) Cereal grain crops	(061) Pools (swimming, jacuzzi)
(050) Undesired plant	(300) Flavor/spice crops	(540) Sugar crops	(998) Not Applicable
(060) Aquatic-pond, stream, lake	(400) Vegetable crops	(550) Misc. field crops	(999) Unknown
(070) Soil	(410) Curcurbit vegetables	(600) Oil crops	(850) Other
(080) Wood product	(420) Fruiting vegetables	(601) Application to seeds	
(100) Fruit crops	(430) Leafy vegetables	(650) Crops-cross category	
(101) Small fruits	(440) Root/tuber vegetables		

ACTIVITY

(01) Applying Pesticides	(04) Repair/maintenance on appl equip	(07) Emergency response	(10) Outdoors-routine liv
(02) Mixing or Loading	(05) Any Combination of 01-04	(08) Routine work-not application	(98) Not Applicable

General	*Neurological*	*Cardiovascular*	*Gastrointestinal*
•Acidosis __	•☐Altered Taste __	•Bradycardia __	☐Anorexia __
•Alkalosis __	•☐Anx/Irr/Hyper __	•Cardiac Arrest __	•☐Constipation __
•Anion Gap __	•☐Ataxia __	☐Chest Pain __	•☐Diarrhea __
☐Fatigue __	•☐Blur Visn __	•Cond Dist __	•☐GI Bleeding __
•☐Fever __	•☐Coma __	•Hypertension __	☐Nausea __
	•☐Confusion __	•Hypotension __	☐Pain __
Renal	•☐Diaphor __	☐Palpitations	•☐Vomiting __
•☐Hematuria __	☐Dizziness __	•Tachycardia __	
•☐Oliguria __	•☐Fainting __		*Eye*
•☐Polyuria __	•☐Fascic __		•☐Abrasion __
•Proteinuria __	☐Headache __	*Respiratory*	•☐Burns __
	•☐Memory Loss __	•☐Asthma Dx __	•☐Conj Dx __
Dermal	☐Musc Pain __	•☐Cough __	•Miosis __
•☐Bullae __	•☐Paralysis __	•☐Cyanosis __	•Mydriasis __
•☐Burns __	•☐Paresthesia __	•☐Depression __	•☐Pain/Irr/Inflam __
•☐Edema __	•Per Neur __	•☐Dyspnea __	•☐Tears __
•☐Hives __	•☐Rigidity __	•☐Edema __	
☐Pain __	•☐Salivation __	•☐LR Irritation __	
☐Pruritis __	•☐Seizure __	☐Pl Pain __	
•☐Rash __	•☐Slur Spch __	•☐Tachypnea	
•☐Redness __	•☐Weakness __	•☐UR Irritation	
•☐Pattern __		•☐Wheezing __	

- **Signs:**

☐ **Symptoms:**

Biological Tests:

Key
1. • Dr. Reported
2. Exposed Person Reported
3. • Both Dr. and Person Reported

OUTCOME & INTENT

Fatal 1) Fatal, pesticide related 2) Fatal, non-pesticide related 3) Fatal, relation unknown
8) Not applicable (not fatal) 9) Unknown

Intention 1) Yes, suspected intentional 2) No, unintentional

FIFRA Violation: _____
Label Violation: _____
EVENT NARRATIVE (for SPIDER/NIOSH):_____

_____

_____

_____

_____

Agent Comments:

Violation Comments:

BRIEF EXPOSURE DESCRIPTION (for SPIDER/NIOSH): -

_____

_____

_____

Narrative and Management Notes (not exported to NIOSH):

Health Comments:

Date Comments:

Follow-up Notes (cont. from pg. 6):

Follow-up:

❑	***Pending medical records for follow-up (insert dates)***			
Status	**Action**	**Date 1**	**Date 2**	**Date 3**
❑	Case interviewed			
❑	Proxy interviewed			
❑	Left message			
❑	Called – No answer/No Machine			
❑	Phone disconnected/ Unable to locate person			
❑	Evening call			
❑	Mailed letter			

Other contact info (more space provided other side):

Severity ☐ 1 = Fatal 2 = High 3 = Moderate 4 = Low 8 =Evaluated, Not applicable

A. Documentation of exposure ☐☐

Only if information regarding the **pesticide product, active ingredient or generic chemical class** is available, choose 1 or 2 plus the corresponding source (select the strongest (1) source available):

1 - Confirmed by: a-envir/bio testing b-professional observation c-biological evidence
d-eye/derm signs e. min 1 sign, 1 sym consistent w/appendix 2

2 - Reported by: a-case b-witness c-application records
d-nonprofessional observation e-other

If a **pesticide** is not involved:

3 - Strong evidence of no exposure

If pesticide identification (ie product or EPA reg #, active ingredient or generic chemical class) information is unavailable:

4 - Insufficient data

B. Documentation of health effect ☐ 1 - 2+ Findings by medical staff 2 - 2+abnormal symptoms
3 - No post exposure findings 4 - Insufficient Data

C. Evaluation of causal relationship ☐☐

(Put a number in first box and letter in second box if first box is 1.)

1 - Fits known toxicology
a-characteristic (Appendix 2 of case classification) and temporal relationship is plausible
b-consistent with literature and known toxicology

2 - Inconsistent with known toxicology

3 - Definitely ruled out (evidence of non-pesticide causal agent)

4 - Insufficient toxicological information available

NIOSH classification _____ Alternate classification _____

Classification categories 1=Definite 5=Unlikely
2=Probable 6=Insufficient information
3=Possible 7=Exposed/asymptomatic
4=Suspicious 8=Unrelated

FIFRA-LABEL VIOLATION INFO STATUS: check if pending:

Appendix C

Educational Materials

Presentations, Educational Outreach, Meetings

September 05 PEST Staff facilitated and presented at the third Pesticide Ad-hoc Advisory Committee meeting. The meeting was hosted by Texas Tech University in El Paso, TX.

July 2005 Maria Saucillo and Maribel Garcia attended and presented at the Progressive Farmer Farm Safety day camp for migrant children (ages 8-13) in the Lubbock area.

April 2005 Maribel Garcia and Brienne Brown attended and presented at the Migrant Farm Worker Conference in Levelland.

April 2005 PEST staff participated and display an exhibit in the *2005 A Healthy you... Mind, Body and Soul Health Fair* for HHSC employees. Austin.

April 2005 Maria Saucillo attended and presented at the International Conference on Environmental and Human Health in El Paso.

April 2005 PEST staff coordinated, facilitated the second Pesticide Ad-hoc Advisory Committee meeting, El Paso.

October 2004 Maria Saucillo and Jennifer Sievert presented and lead a discussion with farmworkers at the Sin Fronteras Border Farmworker's Center.

October 2004 PEST staff met with individuals from the El Paso/ New Mexico area for the first Pesticide Ad-hoc Advisory Committee meeting, El Paso.

October 2004 Maribel Garcia and Brienne Brown presented recognition and reporting seminars to approximately 90 emergency department healthcare providers in 5 Hidalgo County Hospitals.

September 04 Promoting a Clean Environment for Health Kids conference (The Farmworker Justice Fund). Maria Saucillo presented reporting and occupational health information. Maribel Garcia also attended the conference. El Paso.

September 04 Jennifer Sievert co-presented "Spraying Overkill" with Frank Crull, Texas Structural Pesticide Control Board, in the EPA Pesticide Regulatory Education Program (PREP) course "Pesticides and Public Health" in Davis, CA.

September 04 PEST Program staff updated their program brochure for healthcare providers.

August 2004 Maribel Garcia presented recognition and reporting seminars to approximately 90 emergency department healthcare providers in 5 Bexar County hospitals.

July 2004 PEST staff traveled to the Eastern region of the state and presented pesticide exposure recognition and reporting to area physicians.

July 2004 PEST staff supervised an exhibit booth highlighting residential and occupational pesticide exposure risks at a local health fair for Spanish-speaking immigrants.

June 2004 CSTE annual conference, Boise, ID: Jennifer Sievert presented background material for NIOSH's data analysis of pesticide exposures in retail establishments and "A Survey of Worker Protection Training in Texas Farmworkers".

June 2004 PEST staff traveled to El Paso to meet with local health and agriculture officials to discuss the creation of a regional pesticide exposure steering committee.

April 2004 Maria Saucillo and Jennifer Sievert received cultural competency training for farmworker outreach, at the National Center for Farmworker Health in Buda, TX.

April 2004 Maria Saucillo met with healthcare providers and the regional promotora coordinator to discuss reporting and build support for the upcoming steering committee meeting. She also maintained an exhibit booth in the El Paso Lower Valley Health Fair.

April 2004 Annual TDA Pesticide inspectors meeting, Junction, TX: Jennifer Sievert presented PEST agricultural-related statistics and reporting information.

April 2004 MAFO conference, San Antonio, TX: Jennifer Sievert presented "Pesticides in the Fields, Health Effects, Regulation and the role of the Farmworker Advocate". Jeff Shire presented "Survey of Worker Protection Training in Texas Farmworkers".

February 2004 SENSOR-Pesticides Winter meeting, Seattle, WA: Maria Saucillo presented "Pesticide Exposures in Retail Establishments".

November 03 Maria Saucillo attended the Migrant Farmworker Stream Forum in Houston.

November 03 Jennifer Sievert participated in the MAFO (farmworker advocate association affiliated with US Department of Labor) conference planning committee, San Antonio.

August 2003 Maria Propeck and Jennifer Sievert received WPS trainer certification from TDA, along with 25 promotoras. Weslaco.

July 2003 Texas Workforce Commission staff invited the PEST program to participate on the planning committee for the 2004 annual MAFO conference. Austin.

August 2003 Maria Propeck and Jennifer Sievert received WPS trainer certification from TDA in Weslaco, along with 25 promotoras.

July 2003 Texas Workforce Commission staff invited the PEST program to participate on the planning committee for the 2004 annual MAFO conference, addressing farmworker labor, health and social issues.

June 2003 Jennifer Sievert attended the annual CSTE-SENSOR meeting in Hartford, CT, and moderated two lunch roundtable discussions regarding occupational health issues for Southern states.

June 2003 Jennifer Sievert and Maria Propeck traveled to Harlingen and met with directors of the Farmworker Union and the Texas A&M University Community Health Program seeking participants to receive WPS trainer training.

February 2003: Maria Propeck and Venkat Chaturvedi attended a PEST exhibit table in the TDH Nursing Leadership Conference "Partners and Public Health in Concert." Approximately 120 public health nurses and other health care professional were in attendance.

January 2003: Maria Propeck attended the Texas School Health Association annual conference in El Paso.

January 2003: PEST staff hosted the SENSOR Pesticides winter workshop at the Texas Department of Health (TDH). Jennifer Sievert presented on 2 farmworker investigations.

December 2002: PEST staff conducted outreach to more than 500 elementary school faculty and students in Texas and in Mexico in December 2002, in accordance with a grant funded by EPA. Elementary schools located within 1/4 mile of farmland were selected to receive bilingual pesticide awareness education.

October 2002: PEST staff met with TDA and school officials in El Paso County to discuss solutions to the continuous reports of aerial pesticide applications to crops surrounding several schools during school hours. PEST staff provided names of landowners of the surrounding fields to facilitate communication for application notification.

Stockers

A Customer was reaching for Sevin dust insecticide on the shelf Reaching high above head, Sevin dust spilled from a torn package on his face. He went to the hospital after experiencing shortness of breath, nausea and dizziness.

- Wear gloves when handling pesticides to avoid skin contact
- Use caution when opening boxes with box cutters—check for torn bags before stocking on shelves
- Always handle pesticide products with caution to prevent spills, leaks, or setting off aerosols.

In case of a spill or leak

Control the Spill
Immediate steps should be taken to control the spill. Don't expose yourself to the chemical. Use Protective equipment. Pesticides can enter the body through the skin, the eyes, the mouth, and the lungs.

Contain the spill
Isolate the area and keep it from spreading. Liquids can be contained by using absorbent materials such as sand, clay or pet litter.

Cleaning the spill
Consult your Risk Manager, company protocol, and/or chemical MSDS sheet for proper cleaning and disposal or hazardous substances.

Cashiers

A Store cashier scanned a bag of Amdro granular insecticide that had some tears. A nearby fan blew the granules onto the cashier. Cashier went to the hospital for an itchy, painful, red rash on his hand. He missed a day of work.

- When scanning products, always be aware of product leaks or tears
- In case of a torn or leaking harmful product, contain the leak and remove yourself and customers from the area. Refer to your company's spill/clean-up protocol.

Custodial

- Never mix or combine pesticides or cleaning products
- Protect hands and eyes from splashes; always ventilate properly
- Many disinfectants have the signal word DANGER on label

If you are injured or feel ill

Notify your supervisor or store manager as soon as possible
In case of an emergency, call the Poison Control Hotline at
1-800-222-1222

Identify the name of the pesticide and its chemical contents. If you have symptoms seek medical attention. Always read the label; it lists the ingredients, directions for use and first aid instructions in case of accidental poisoning.

Pesticide Exposure Surveillance in Texas Program (PEST)
Environmental and Injury
Epidemiology and Toxicology Branch
Texas Department of State Health Services
www.dshs.state.tx.us/epitox/pesticides.htm
1-800-588-1248
512-458-7269

C5

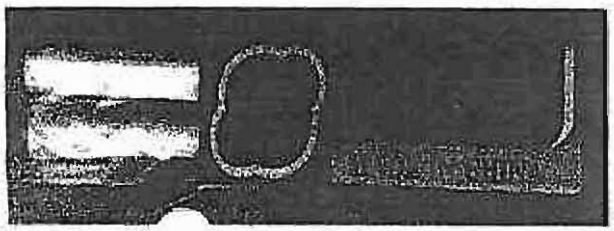
Why is it Dangerous?

- Mistaken for common blackboard chalk

- No list of ingredients printed
- Overexposure to the chemicals found in insecticide chalk can cause serious health effects, such as vomiting, stomach pains, convulsions, tremors, and loss of consciousness. Serious allergic reactions are also possible.

- The packaging may contain high levels of lead and other hazardous metals, presenting another health risk if handled or placed in the mouth.

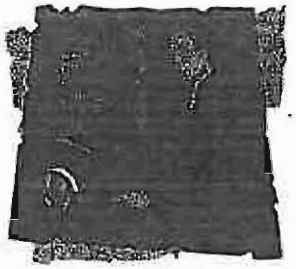
SOURCE: U.S. EPA (ENVIRONMENTAL PROTECTION AGENCY)



Where is it sold?

The chalk is sold illegally under several names, including: "Miraculous Insecticide Chalk," Pretty Baby Chalk" and "Chinese Chalk."

It has been advertised on the Internet and is sold at swap meets, flea markets, and grocery stores selling products imported from Asia.

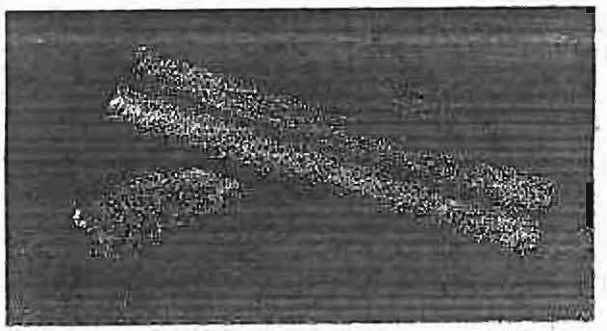


What is it used for?

The chalk is imported illegally from China and other countries, and is described as being effective against roaches, ants, and other household pests. A line is drawn along floors, baseboards, kitchen drawers and closets.

DO NOT DISPOSE OF PESTICIDES OR OTHER POISONS IN THE TRASH OR IN ANY DRAINAGE. CONTACT LOCAL AUTHORITIES FOR PROPER DISPOSAL INFORMATION

Insecticide Chalk: Illegal and Hazardous to Children



C7

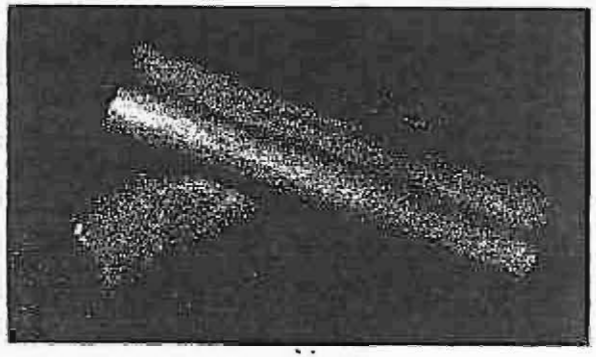
TDH

TEXAS DEPARTMENT OF HEALTH
1-800-588-1248
FAX: 512-458-7169

In case of an EMERGENCY, call the POISON CONTROL CENTER at 1-800-222-1222

TDH PUBLICATION NO 09-11603

Tiza Insecticida: Ilegal y Peligrosa para los Niños



TDH

Departamento de Salud de Tejas
1-800-588-1248
Fax: 512-458-7169

En caso de EMERGENCIA, llame al CENTRO para el CONTROL de ENVENENAMIENTOS
1-800-222-1222

Número de Publicación TDH 09-11603

¿Dónde se vende?

La tiza se vende bajo varios nombres, incluyendo ", "Pretty Baby Chalk" y "Chinese Chalk." Se es anunciado en el Internet y es vendido en intercambio reúne, los mercados de la pulga y las abarroterías que venden productos importados de Asia.

¿Para qué se usa?

La tiza se vende ilegalmente para el control de insectos. Está importado ilegalmente de la China y otros países, y anuncia ser efectiva contra las cucarachas, las hormigas, y contra otros pestes de la casa. Una línea de tiza se dibuja por el piso, los gabinetes de la cocina o por los zócalos.

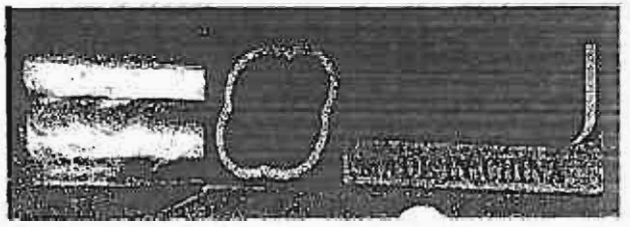
NO TIRE PESTICIDAS Y OTROS VENENOS EN EL BOTE DE LA BASURA NI EN EL DRENAJE. LLAME A LOS OFICIALES LOCALES PARA LUGARES DE DEPOSITO

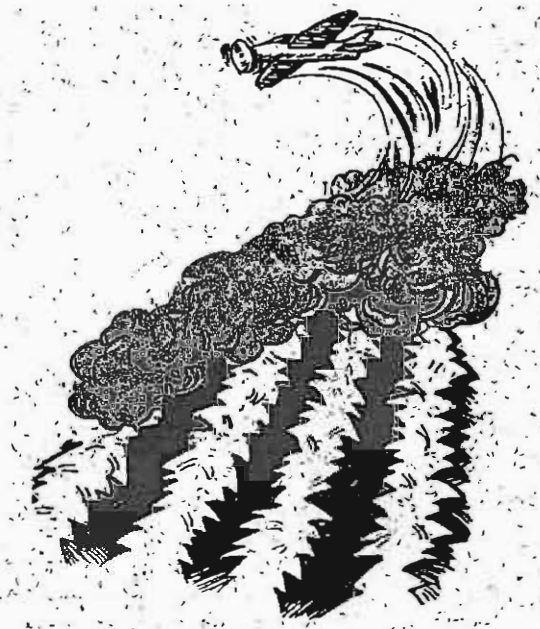
¿Por qué es peligrosa?

- La tiza insecticida se confunde con la tiza común de la pizarra, aumententando el riesgo de contacto con los niños.
- El envase NO contiene una lista de advertencias o de ingredientes.

•La exposición excesiv puede producir efectos graves a la salud, comc vómitos, dolor de estómago, convulsione temblores, y coma. Reacciones alérgicas también son posibles.

- El envase de este producto puede contener altos niveles de plomo y otros metales peligrosos; al tener contacto con la piel o la boca representa aún otro riesgo. Fuente de Información: U.S. EPA (La Agencia de Protección del Medio Ambiente)





Reporting Acute Pesticide Exposure

- All health care providers, hospitals, clinics and lab directors are required by law to report work-related pesticide exposures to the Department of State Health Services (Texas Occupational Condition Reporting Act, Health and Safety Code, Chapter 81)
- Texas Poison Control Network (TCPN), state agencies, regional health departments, and individuals also report pesticide exposures to DSHS

The pesticide exposure report form can be downloaded from our web page.

www.dshs.state.tx.us/epitox/pesticides.htm

Pesticide Exposure Surveillance in Texas Program (PEST)

Environmental and Injury Epidemiology and Toxicology Branch
Texas Department of State Health Services
www.dshs.state.tx.us/epitox/pesticides.htm

(800) 588-1248
(512) 458-7269

POISON Help
1-800-222-1222

TEXAS Department of State Health Services

Funded in part by Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH) grant #U60/CCU608464-01. This does not necessarily represent the views of NIOSH.

Artwork from the US Environmental Protection Agency.

Stock No. 6-223 Revised 10/04

Pesticide Exposure Surveillance in Texas

Why Do Ph, cians Fail to Report Pesticide Exposure?

- Unaware of reporting law and how to report
- Non-specific illnesses make it difficult to make an accurate diagnosis
- Not thinking of pesticides or chemicals

Why Do Workers Fail to Report Pesticide Exposure?

- May not think they are sick enough to seek care
- Cannot afford health care
- Afraid of being fired if their employer finds out
- Not thinking of pesticides and chemicals

What Information Does DSHS Need?

- Exposed individual's name, address, phone number, birth date, race or ethnicity and diagnosis
- Lab results (e.g. cholinesterase tests)
- Occupation and employer information if exposure is work-related

How Are the Data and Information Used?

- Reported information is confidential
- Continual surveillance allows us to identify poisoning incidents, provide assistance, and make recommendations to prevent and control future exposures
- Data help us understand and describe the extent of pesticide poisoning in Texas
- Information is used to develop targeted education and prevention materials and to provide appropriate pesticide exposure prevention training

Occupations At-Risk for Pesticide and Chemical Exposure

- Ground pesticide applicators
- Nursery workers
- Farmers, poultry farmers and ranchers
- Harvesters or field workers
- Aerial applicators
- Exterminators
- Warehouse workers who handle pesticide
- Workers who work with arsenic- and creosote-treated wood
- Police and firefighters

Taking Occupational History

- What kind of work do you do?
  ¿Qué clase de trabajo hace usted?
- Are pesticides or chemicals being used at home or work?
  ¿Se usan pesticidas o productos químicos en su casa o en su trabajo?
- Do you get sick or dizzy after or while you are working?
  ¿Se siente usted enfermo o mareado mientras trabaja o después de terminar su trabajo?
- Do you feel more or less sick when you are at work?
  ¿Se siente usted más o menos enfermo cuando está trabajando?
- Have you been exposed to pesticides, chemicals or solvents before?
  ¿Ha sido usted expuesto en el pasado a pesticidas, productos químicos o solventes?

Symptoms Associated with a Pesticide Exposure

- Gastrointestinal
  Problemas gastrointestinales
- Pinpoint pupils
  Pupilas resaltadas
- Watery eyes
  Ojos llorosos
- Runny nose
  Gotea la nariz, moquear
- Excessive salivation
  Secreción excesiva de saliva
- Excessive sweating
  Sudor excesivo, Traspiración excesiva
- Tingling/Numbness
  Cosquilleo/Sensación adormecedora
- Dizziness
  Mareo, vértigo
- Dermatological irritation
  Irritación dermatológica
- Respiratory
  Problemas respiratorios

Protect Yourself From Exposure to Disinfectants

Pesticide Exposure Surveillance in Texas (PEST) Program

To report an incident or request information about disinfectant exposure call:

(512) 458-7269 (800) 588-1248 FAX (512) 458-7169

Visit our website: http://www.dshs.state.tx.us/epitox

How can disinfectant exposure be avoided?

1. Follow instructions on the label.
2. Wear gloves and other protective gear as necessary.
3. Avoid contact with skin and eyes.
4. Always ventilate the area well during and after mixing or applying.
5. NEVER mix cleaning products, especially bleach.
6. In an emergency, seek medical attention immediately and call the poison hotline: 1-800-222-1222.

Mistakes or disregard for label instructions can HARM:

- YOU and YOUR FAMILY
- YOUR CLIENTS
- WATER, AIR, SOIL and ITS INHABITANTS

TEXAS Department of State Health Services
DSHS
1100 West 49th Street
Mail Code: T-701
Austin, TX 78756

FIRST CLASS MAIL
U.S. POSTAGE
PAID
AUSTIN, TX
PERMIT NO. 28

C10

Protéjase Usted y Proteja a su Familia de los Pesticidas

Programa de vigilancia de exposición a pesticidas en Texas (Programa PEST) incluye exposición a lo siguiente:

- disinfectantes
- raticidas
- fumigantes
- herbicidas
- insecticidas
- repelentes

Si usted trabaja con los pesticidas, siga estos pasos para protegerse a sí mismo y para proteger a su familia:

- Siempre lávese las manos con agua y jabón después de trabajar con los pesticidas o de tocar las plantas tratadas.
- Vístase de ropa que le cubre los brazos y las piernas al trabajar con los pesticidas.
- Manténgase lejos de los campos que han sido fumigados; ¡esto es especialmente importante para los niños y las mujeres embarazadas!
- Quítese las botas y el sombrero (si es posible, cámbiese de ropa en su lugar de trabajo) antes de entrar en su hogar.
- Lave la ropa que utiliza para trabajar (utilice agua caliente y mucho jabón) después de ponérsela una vez. No lave la ropa que usted utiliza para trabajar y que podría estar contaminada con la ropa de su familia.
- Lea y siga las instrucciones en la etiqueta de los venenos para el hogar y los que utiliza en su trabajo. Siempre mantenga los venenos lejos de los niños.
- Si usted ha estado alrededor de los pesticidas y se siente enfermo, obtenga atención médica de inmediato y comuníquese con la línea directa para los envenenamientos: 1-800-222-1222.

Programa de vigilancia de exposición a pesticidas en Texas (Programa PEST) -- Si usted tiene preguntas sobre la exposición a los pesticidas, llame al: (512) 458-7269 (800) 588-1248 FAX (512) 458-7169

Sitio del Internet: http://www.tdh.state.tx.us/epitox

TEXAS Department of State Health Services
DSHS
1100 West 49th Street
Mail Code: T-701
Austin, TX 78756

C11

Protect Yourself and Your Family from Pesticides

Pesticide Exposure Surveillance in Texas (PEST) includes exposure to the following:

- **disinfectants**
- **rodenticides**
- **fumigants**
- **herbicides**
- **insecticides**
- **repellents**

If you work with pesticides, follow these steps to protect yourself and your family:

- Always wash hands with soap and water after working with pesticides or handling treated plants.
- Wear clothes that cover your arms and legs when working with pesticides.
- Stay away from fields that have been sprayed; this is especially important for children and pregnant women!
- Take off boots and hat (if possible change clothes at the workplace) before entering your house.
- Wash work clothes (use hot water and lots of soap) after wearing them one time. Do not wash potentially contaminated work clothes with your family's other clothes.
- Read and follow the instructions on the labels of household pesticides and pesticides used for your work. Always keep poison away from children.
- If you have been around pesticides and feel sick, seek medical attention immediately and contact the poison hotline: 1-800-222-1222.

TEXAS Department of State Health Services
DSHS
1100 West 49th Street
Mail Code: T-701
Austin, TX 78756

Pesticide Exposure Surveillance in Texas (PEST) Program
If you have questions about pesticide exposure call:
(512) 458-7269 (800) 588-1248 FAX (512) 458-7169
Website: http://www.dshs.state.tx.us/epitox

C12

Reporting Occupational Pesticide Exposure in Texas is the LAW

Reporting helps prevent and control pesticide poisoning

Pesticide Exposure Surveillance in Texas (PEST) includes exposure to the following:

- disinfectants
- rodenticides
- fumigants
- herbicides
- insecticides
- repellents

Report* Acute Occupational Pesticide Exposure

Interview Tips for Pesticide Exposures:

- **Occupational Exposure:** Identify occupation, length of time at job, hazards at workplace (e.g., pesticides, disinfectants), and use of personal protective equipment.
- **Environment:** Are pesticides (e.g., bug or weed killers, flea and tick sprays, pet collars, powders, disinfectants, bleach) used in the home, garden or on a pet?
- **Pediatric Patient:** Determine occupation of household members, whether anyone in the family works with hazardous materials, if these materials may have been brought home. Assess storage practices and use of household and garden pesticide products.

*Texas law requires healthcare providers to report suspected work-related pesticide exposure.

TO REPORT: Call the DSHS PEST Program at 1-800-588-1248 or you may fax a report form to 512-458-7169
To download a report form:
www.dshs.state.tx.us/epitox/pestrptfrm.pdf

PESTICIDE RESOURCES FOR HEATH CARE PROVIDERS
Texas Poison Control Network 1-800-222-1222
Recognition and Management of Pesticide Poisoning, 5th Ed. 1999
www.epa.gov/oppfead1/safety/healthcare/handbook/handbook.htm

TEXAS Department of State Health Services
1100 West 49th Street
Mail Code: T-701
Austin, TX 78756

C13

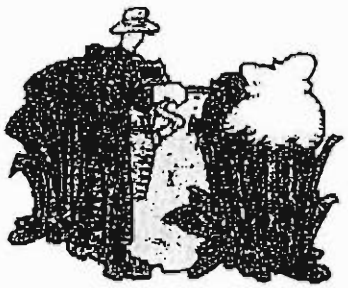
TEXAS
Department of State Health Services

Pesticide Exposure Surveillance in Texas (PEST) Program

About PEST Program

Frequently Asked Questions

Reporting Information



Educational Materials

Helpful Phone Numbers

Email Epitox

Para ver esta red en español

About PEST

The *Pesticide Exposure Surveillance in Texas* program maintains a database of information on pesticide poisonings occurring in the state of Texas. Physicians and laboratories are required to report occupation related pesticide poisonings. Additional surveillance data are collected from other state agencies and the Poison Control Network. The surveillance program is responsible for conducting investigations of poisoning incidents when appropriate and providing educational information.

The clinical symptoms of acute occupational pesticide poisoning vary depending on the type of pesticide, the route of exposure, and/or duration of exposure. It is important to determine exposure history and/or occupational information. Please report all known and/or suspected cases of acute occupational pesticide poisoning to DSHS.

Occupations at risk of acute pesticide poisoning include:

- Ground Applicators
- Nursery Workers
- Farmers and Ranchers
- Harvesters or Field Workers
- Warehouse Workers who handle/transport pesticides
- Pesticide Formulator or Manufacturers
- Fumigators
- Aerial Applicators
- Police and Fire Fighters
- Structural Pest Control Operators

For information on farm workers see the National Health Service

Corps Migrant Health website, or the Migrant Clinician's Network website.

Frequently Asked Questions

I was working in the field when a crop duster flew overhead spraying the neighboring fields. I felt the mist and could taste the chemical sprayed. What should I do?

- If you feel ill, seek medical attention immediately. You may also contact the **Texas Poison Center Network** toll free, 24 hours a day at **1 (800) 222-1222**for chemical/health related information.
- Remove all clothing (hats and other accessories), separate it, and shower.
- Call the Texas Department of Agriculture (TDA) at **1 (800) TELL- TDA** to report the incident. Pesticide applicators have strict guidelines to follow regarding all aspects of pesticide use and TDA regulates agricultural-related pesticide use.

We recently moved into a duplex and I've noticed a strong pesticide odor that won't go away. I've been experiencing headaches and nausea. Could the pesticides be responsible for this?

- If you are experiencing health-related problems you should seek medical attention. The odor in your home may or may not be pesticide-related. The Structural Pest Control Board (SPCB) of Texas regulates non-agricultural pesticide applicators. Depending on the situation, SPCB may conduct an investigation to determine if there are any pesticide-related problems in your home. You may contact the SPCB at **(512) 305-8270**. For information on the chemical content of certain household insecticides see the Over-the-Counter Insecticides page created by the Pesticide Education Office at the University of Nebraska-Lincoln.

We have a pest problem in our home, however I have small children and I really don't want to fill our home with pesticides. Are there effective alternatives?

- There are many non-toxic or at least minimally toxic

alternatives to traditional pesticides. Check your local phonebook and/or see the EPA fact sheet: Safe Substitutes at Home: Non-toxic Household Products for possible alternatives.

I live along the US/Mexican border. I've noticed that shops and street vendors in both countries sell pesticide products with homemade labels, or sometimes no labels at all. I've heard from others that these products are very effective at pest control and are inexpensive. Do you have any idea what these pesticides contain, and if they might be especially harmful to humans?

Use of several non-registered pesticide products have been reported. Two of these pesticides are as follows:

- **Polvo de avión**
  "Airplane powder" is a white powder often sold in small plastic bags. The substance is actually methyl-parathion, categorized as a severely hazardous pesticide formulation restricted by the EPA and restricted to only certain outdoor commercial use. The DSHS Region 9/10 Office of Border Health led a tri-state, bi-national awareness campaign funded by EPA. Local, state and federal agencies participated in this campaign to assess the magnitude of the problem, educate the public and healthcare providers, and prevent future exposures. For more information, you may contact Blanca Serrano, MPH, RS at **1-800-693-6699**. Residents of the Western Texas Rio Grande Border or Permian Basin Area may also contact the West Texas Poison Control Center at **1-800-222-1222**.

- **Miraculous Chalk**
  Like its name, this product looks like chalk and is applied as such. Persons often apply the pesticide chalk as a border to eating utensils or on the floor at the entrance of their home. Samples of these insecticidal chalks have indicated synthetic pyrethroids as the active ingredient. Small children are often exposed to the chalk because of its bright, attractive appearance. In addition to the harmful effects the chalk can have on human health, packaging has been found to contain lead.

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Reporting Information:

Who is responsible for reporting occupational conditions?

- Physicians
- Health Professionals
- Any persons in charge of a clinical or hospital laboratory, blood bank, mobile unit or other facility in which a laboratory examination reveals evidence of the reportable disease.

How do you obtain forms to report occupational conditions?

- Call our toll-free number **1 (800) 588-1248** to request reporting forms.
- The Human Pesticide Exposure Report Form (PDF file: 17 KB) was created by the PEST section to report pesticide exposures and can be obtained on-line.
- Formulario de informe Exposición a los pesticidas por los humanos
- The Texas Department of State Health Services Weekly Notifiable Conditions Report Form (EPI-1) can be obtained on-line by choosing Reporting Forms then EPI 1. (PDF file: 202 KB, 2000 revision)

*Forms must be viewed/printed with Adobe® Acrobat® Reader, visit our file viewing information page for download information. For additional assistance please call 512-458-7263.

How do you report occupational conditions?

- Cases can be reported directly to the Environmental and Injury Epidemiology and Toxicology Branch, DSHS, by calling our toll-free number **1 (800) 588-1248.**
- Case reports can be faxed to **(512) 458-7169.**
- Case reports can be mailed to the Environmental and Injury Epidemiology and Toxicology Branch.
- Case reports can also be made to the local or regional staff of the health department who will transmit the information directly to the DSHS central office.

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Educational Materials

Pesticide Exposure brochure "pdf" *(100KB)*

Possible Pesticide Exposure of Employees at a Government Agency, Disease Prevention News Article "pdf" *(77KB)*

Treatment and management phone numbers:

National Pesticide Information Center (NPIC)
1 (800) 858-7378

Structural Pest Control Board
512-305-8270

Texas Poison Center Network
1 (800) 222-1222

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** External links to other sites are intended to be informational and do not have the endorsements of the Texas Department of State Health Services. These sites may also not be accessible to people with disabilities.**

Last Updated April 18, 2005

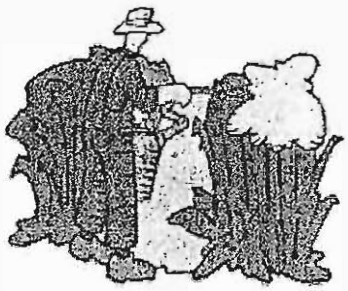
TEXAS
Department of State Health Services

Programa de vigilancia de exposición a pesticidas en Texas (Programa PEST)

Sobre PEST

Preguntas comunes

Reportando información



Materiales educacionales

Números telefónicos útiles

Mándenos correo electrónico

Sobre PEST

El programa de vigilancia de exposición a pesticidas en Texas (PEST, por sus siglas en inglés) mantiene una base de datos de información sobre envenenamientos por pesticidas que ocurren en el estado de Texas. Los médicos y laboratorios están obligados a reportar los envenenamientos por pesticidas que suceden en el ámbito ocupacional. También, datos adicionales de vigilancia acumulados por otras agencias estatales y de la Poison Control Network (Red del control de envenenamientos) son coleccionados. El programa de vigilancia tiene las responsabilidades de proporcionar información educativa y, cuando sean apropiadas, de llevar a cabo investigaciones sobre los incidentes de envenenamiento.

Los síntomas clínicos del envenenamiento agudo ocupacional por pesticidas varian, dependiendo del tipo de pesticida, la ruta de exposición, y / o la duración de exposición. Es importante determinar la historia de exposición y / o la información ocupacional. Favor de reportar al DSHS (Departamento Estatal de Servicios de Salud) todos los casos conocidos y / o sospechados de envenenamiento agudo ocupacional por pesticidas.

Algunas ocupaciones con un riesgo de envenenamiento por pesticidas son las siguientes:

- Aplicadores de pesticidas en el suelo
- Trabajadores en los viveros
- Agricultores y rancheros
- Cosechadores o campesinos
- Trabajadores en almacenes que manipulan / transportan las pesticidas
- Fabricantes o formulistas de pesticidas
- Fumigadores
- Aplicadores aéreos de las pesticidas
- Policías y bomberos
- Operadores de sistemas de control de los insectos en las estructuras

Para información sobre los trabajadores agrícolas, véase el sitio de la Red del National Health Service Corps Migrant Health, (Cuerpos nacionales de servicio de salud para los trabajadores agrícolas), o el sitio de la Migrant Clinician's Network

(Red de clínicas para trabajadores agrícolas.)For information on farm workers see the National Health Service Corps Migrant Health website, or the Migrant Clinician's Network website.

Preguntas comunes

Estaba trabajando en el campo cuando pasó un avión fumigador por los terrenos vecinos. Sentí la neblina y el sabor del químico vaporizado. ¿Qué debo hacer?

- Si usted se siente enfermo, busque atención médica inmediatamente. También, usted puede comunicarse con el **Texas Poison Center Network** (Centro de la Red de Venenos de Texas) las 24 horas del día al número telefónico gratuito, 1 **(800) 222-1222** para información relacionada con los químicos y la salud.
- Quítese toda la ropa (los sombreros y otros artículos), póngala por separado, y dése una ducha.
- Llame al **Departamento de Agricultura de Texas** (TDA por sus siglas en inglés) al **1 (800) TELL-TDA** y oprima el número 2 para reportar el incidente en español. Los aplicadores de pesticidas tienen directivas estrictas que tienen que seguir con respecto a todos los aspectos de la utilización de pesticidas. El TDA regula la utilización de pesticidas en el campo agrícola.

Recientemente nos mudamos a un dúplex y he notado que persiste un olor fuerte de pesticida. He estado experimentando dolores de cabeza y náuseas. ¿Podría ser que las pesticidas me estén causando esta condición?

- Si usted está experimentando problemas con su salud, deberá buscar atención médica. El olor en su hogar puede ser o no puede que esté relacionado con las pesticidas. La Junta de Control de Plagas Estructurales **(Structural Pest Control Board , SPCB por sus siglas en inglés)** regula a los aplicadores de pesticidas no-agrícolas. Dependiendo de la situación, SPCB puede llevar a cabo una investigación para determinar si hay problemas relacionados con la pesticida en su hogar. Usted puede comunicarse con el SPCB al **(512) 305-8270**. Para información sobre el contenido químico de ciertos insecticidas para uso doméstico, véase la página Over-the-Counter Insecticides (Insecticidas para el uso común) creada por la Pesticide Education Office (Oficina de educación sobre las pesticidas) de la University of Nebraska-Lincoln.

Tenemos un problema de plagas en nuestro hogar, sin embargo tengo hijos pequeños y verdaderamente no quiero llenar nuestro hogar con pesticidas. ¿Existen algunas alternativas eficaces?

- Hay muchas alternativas a las pesticidas tradicionales, las cuales son poco tóxicas o no-tóxicas. Consulte su guía telefónica local y / o vea el sitio de la Red de la Agencia de Protección Ambiental (EPA por sus siglas en inglés.) También puede consultar la hoja informativa ofrecida por la EPA para alternativas potenciales,"EPA fact sheet: Safe Substitutes at Home: Non-toxic Household Products" ("Sustitutos sanos en casa: los productos no-tóxicos para uso doméstico.")

Vivo a lo largo de la frontera entre México y los Estados Unidos. He notado

que tiendas y ambulantes en ambos países venden pesticidas con etiquetas hechas a mano, o aún sin ninguna etiqueta a veces. He oído decir a otras personas que estos productos son baratos y muy eficaces para controlar los insectos. ¿Tiene alguna idea qué contienen estas pesticidas, y si es posible que sean especialmente dañinas para los humanos?

Se ha reportado el uso de varios productos pesticidas no registrados. Dos de estas pesticidas son las siguientes:

- **Polvo de avión**
  Polvo de avión es un polvo blanco que se vende frecuentemente en pequeñas bolsas de plástico. En realidad, la sustancia es metilparatión, la cual se clasifica como una fórmula de pesticida extremamente peligrosa, restringida por la EPA para ciertos usos comerciales al aire libre. La Región 9/10 de la Oficina de salud fronteriza del DSHS encabezó una campaña binacional tri-estatal para crear conciencia en el público sobre las pesticidas. La EPA proporcionó los fondos para la campaña. Agencias locales, estatales y federales participaron en esta campaña para evaluar la magnitud del problema, educar al público y a los proveedores del cuidado de salud, y prevenir exposiciones a la sustancia en el futuro. Para más información, puede comunicarse con Blanca Serrano, MPH, RS al **1-800-693-6699**. Los residentes de Western Texas Rio Grande Border (la frontera occidental del Río Bravo del Norte) o del área del Permian Basin también pueden comunicarse con el West Texas Poison Control Center (Centro del Control de Venenos de Texas Occidental) al **1-800-222-1222**.

- **Tiza milagrosa ("Miraculous Chalk")**
  Así como indica su nombre, este producto parece tiza y se aplica de la misma manera. Las personas frecuentemente aplican esta pesticida como una barrera al lugar donde se guardan los cubiertos, o en el suelo a la entrada de su hogar. Muestras de estas tizas insecticidas han indicado que el ingrediente activo de las mismas es uno de los piretroides sintéticos. Los niños pequeños están expuestos a la tiza frecuentemente por su aspecto luminoso y atractivo. Además de los efectos dañinos que la tiza en sí puede tener a la salud humana, se ha descubierto que el embolso de la tiza contiene plomo.

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Reportando Información: :

¿Quiénes tienen la responsabilidad de reportar condiciones ocupacionales?

- Médicos
- Profesionales de salud
- Cualesquiera personas encargadas de un laboratorio en un hospital o clínica, un banco de sangre, una unidad móvil u otra instalación en el cual un examen del laboratorio revele evidencia de una enfermedad sujeta a notificación.

¿Cómo se consiguen los formularios para reportar condiciones ocupacionales?

- Llame a nuestro número telefónico gratuito **1 (800) 588-1248** para pedir los formularios de notificación.
- The Human Pesticide Exposure Report Form (PDF file: 17 KB)(Formulario para reportar la exposición humana a una pesticida) fue creado por la sección

PEST para reportar las exposiciones a las pesticidas, y lo puede conseguir a través del Internet.

- Formulario de informe Exposición a los pesticidas por los humanos
- Puede conseguir a través del Internet también el formulario de DSHS para reportar las condiciones sujetas a notificación. Vaya al Texas Department of State Health Services Weekly Notifiable Conditions Report Form (EPI-1), seleccione "Reporting" y luego "EPI 1 Form." (PDF file: 202 KB, 2000 revision)

*Forms must be viewed/printed with Adobe® Acrobat® Reader, visit our file viewing information page for download information. For additional assistance please call 512-458-7263.

¿Cómo se reportan condiciones ocupacionales?

- Puede reportar los casos directamente al Environmental and Injury Epidemiology and Toxicology Branch, (Rama de Epidemiología del Medioambiente y las Lesiones, y la Toxicología) del DSHS, llamando a nuestro número telefónico gratuito **1 (800) 588-1248**.
- Puede mandar por fax los reportajes de casos al **(512) 458-7169**.
- Puede enviar los reportajes de casos por correo a la Environmental and Injury Epidemiology and Toxicology Branch.
- Puede reportar los casos también al personal local o regional del departamento de salud quienes transmitirán la información directamente a la oficina central del DSHS.

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Materiales educacionales

Pesticide Exposure brochure,(Folleto sobre la exposición a las pesticidas) "pdf" *(100KB)*

Números telefónicos para manejo y tratamiento:

National Pesticide Information Center (NPIC) (Centro Nacional de Información sobre las pesticidas)
1 (800) 858-7378

Structural Pest Control Board, (Junta de Control de Plagas Estructurales)
512-305-8270

Texas Poison Center Network, (Centro de la Red de Venenos de Texas)
1 (800) 222-1222

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Los "links" externos a otros sitios de la Red tienen como propósito el proporcionar información y no tienen la aprobación del Departamento Estatal de Servicios de Salud de Texas. Además, es posible que estos sitios no sean accesibles para las personas con incapacidades.

Last Updated April 18, 2005

C22

Pesticide Poisoning?

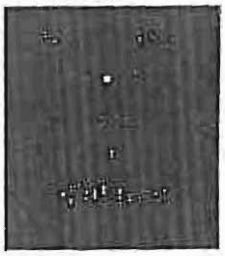
For assistance and information about all types of poisonings, call 1-800-222-1222
Poison Control Center Hotline

If you have been exposed to pesticides, notify the **Texas Department of Health:**
1-800-588-1248
All Information is Confidential

Information or Complaints regarding Pesticides for Agricultural Use
Texas Department of Agriculture (TDA)
1-800-835-5832

Acute Occupational Pesticide Poisoning is a Reportable Condition in Texas
Call 1-800-588-1248 to Report

Pesticide label
DANGER
Follow Label Instructions
VENTILATE



The Most Common Symptoms of Pesticide Poisoning Include:

- Headache
- Loss of Coordination, Dizziness
- Muscle Cramps
- Nausea and Vomiting
- General Weakness
- Cough, Respiratory Irritation
- Chest Pain
- Skin/Eye Irritation

When you seek medical attention, identify the name of the pesticide and its chemical contents

Texas Poison Control Network
CALL 1-800-222-1222

C23

¿Envenenamiento por Pesticidas?

Para ayuda y información inmediato sobre toda clase de envenenamientos, **llame al**

1-800-222-1222

Centro de Información de Envenenamientos

Si Ud. ha estado expuesto a pesticidas notifica al **Departamento de Salud de Tejas:**

1-800-588-1248

Toda información es confidencial

Información o Quejas sobre Pesticidas de Uso Agrícola

El Departamento de Agricultura (TDA)

1-800-835-5832

En Tejas, hay que notificar al TDH el Envenenamiento por Pesticidas en el Trabajo

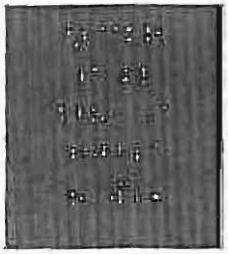
LLÁME AL 1-800-588-1248

Etiqueta del pesticida

PELIGRO

SIGA LAS Instrucciones

¡VENTILE!



Los Síntomas Más Comunes de Envenenamiento por Pesticidas Incluyen:

- Dolor de Cabeza
- Pérdida de Coordinación y Mareo
- Calambres musculares
- Naúsea y Vómito
- Debilidad general
- Tós, Irritación de las vías respiratorias
- Dolor en el Pecho
- Irritación de la piel/ de los ojos

Cuando busca ayuda médica, identifique el nombre del pesticida y su composición química, si es posible (mire en la etiqueta del producto)

Centro de Información de Envenenamientos

llame al 1-800-222-1222

C24

pesticide sa ety

agriculture

agriculture are very strong and ... cause adverse health symptoms to humans

- Pesticides can be carried away from crops and into your home through water, land, on your skin, and on clothing.
- **If you work, go to school, or live near an agricultural area that uses pesticides, take extra precautions to prevent exposure.**

If you are exposed to

If you would like to ... more about the pesticides ... agricultural repro...

...you work in agricultural fields, ...sticides can be carried home on your ...thes, shoes, or skin.

...move shoes before entering home to avoid ...king pesticides indoors

...move all work clothing ...wer or wash your hands, face ... re touching your family, kids

...its and vegetables can have pesticide ...ue on them. **Wash all fruits and ...tables before you eat them.**

...er use a pesticide container once it is ...y. Even if you wash them, empty ...iners can still have pesticides in them.

to prevent

pesticide poisoning...

C25

...ways keep pesticides out of ...ldren's reach

...not put pesticides in other containers.

...chemical names and other ...rtant information are on the label

...se of pesticide poisoning

...ou must use pesticides, protect your ..., EYES, NOSE and MOUTH from ...ides; follow the label instructions; ...nsider less-toxic pesticides

...e: Boric Acid

children

- **Protect children from pesticide exposure by keeping pesticides out of reach. Small children put objects in their mouths and play on the ground and near cabinets where pesticides may be kept or applied.**
- **For head lice treatment, consider that many shampoos contain dangerous pesticides. There are chemical-free alternatives that eliminate the risk of pesticide poisoning to your child.**

TDH

TEXAS DEPARTMENT OF HEALTH

1-800-588-1248

FAX: 512-458-7169

In case of an EMERGENCY, call the POISON CONTROL CENTER

FROM USA: 1-800-222-1222

TDH PUBLICATION NO. 09-11446

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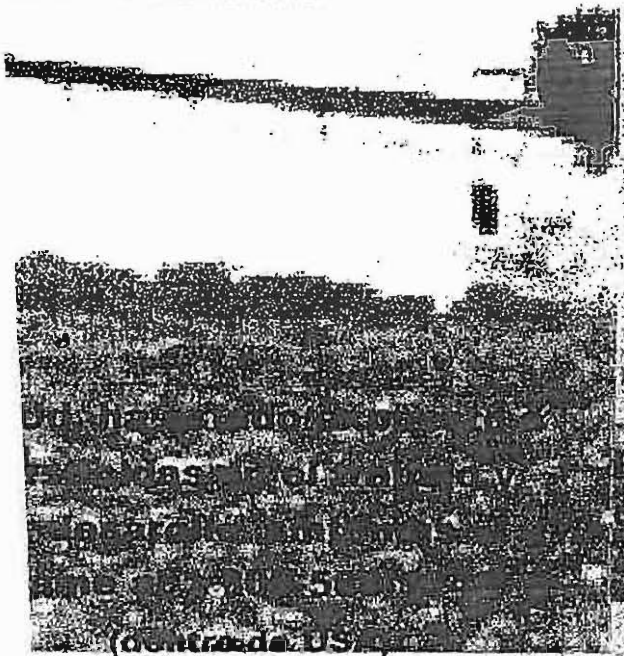

(contrada US

información es confidencial

C 22

TDH

)epartamento de Salud de Tejas
1-800-588-1248
Fax: 512-458-7169

e EMERGENCIA, llame al CENTRO
ONTROL de ENVENENAMIENTOS
lo de USA: 1-800-222-1222

la agricultura

agricultura son muy entes y pueden causar síntomas adversos a la salud humana

• **Los pesticidas se pueden llevar desde** la cosecha [redacted] **a través del aire, el agua, la tierra, la piel o su ropa**

• **Si Ud. trabaja, estudia o vive en una área agrícola donde usan pesticidas, tenga cuidado para prevenir**

los niños

• Proteja a los niños de la exposición a pesticidas por mantener los pesticidas fuera del alcance de los niños. **Los niños pequeños llevan objetos a la boca, juegan en el suelo y cerca de los gabinetes donde se guardan o aplican pesticidas.**

• Para el tratamiento de **piojos**, hay que acordarse que **muchos shampoos contienen pesticidas peligrosos**. Hay tratamientos alternativos sin químicos que eliminan el riesgo de envenenamiento por pesticidas a su hijo.

los residuo

• Si Ud. trabaja en la agricultura, los pesticidas pueden llegar a su casa por la ropa, los zapatos o la piel

-Debe quitarse los zapatos al entrar en casa para no llevar pesticidas [illegible] separe la ropa de trabajo, y duchese [illegible] cabellos, brazos y cara [illegible] con su familia o sus hijos

Las frutas y verduras [illegible] residuos de pesticidas. [illegible] lave las frutas y verduras antes de consumirlas

-Nunca use el envase de pesticidas vacío. Antes de lavar puede haber [illegible] pesticidas

para prevenir

envenenamiento por pesticidas...

• Siempre mantenga los pesticidas **fuera del alcance de los niños**

• Siempre guarde los pesticidas en su **envase original. La etiqueta tiene los nombres de los químicos y otra información necesaria en el caso de envenenamiento.**

• Si va a usar pesticidas, **proteja la piel, los ojos, naríz y la boca** de pesticidas; **siga las instrucciones**, y **considere pesticidas menos tóxicos** como el ácido borico

Appendix D

Investigation Criteria
Written Protocols

Criteria for Field Investigation

1. Events that result in a hospitalization or;
2. Events that involve 4 or more ill individuals, or;
3. Events that occur despite use according to the pesticide label, or;
4. Events that indicate the presence of a recurrent problem at a particular workplace and/or employer.

Texas Department of State Health Services

Environmental & Injury Epidemiology and Toxicology Branch

Final Report

Manufacturing Employees Exposed to Warehouse Application of Aluminum Phosphide

BACKGROUND

On June 4, 2004, the Pesticide Exposure Surveillance in Texas (PEST) Program at the Texas Department of State Health Services (DSHS) received reports of seven occupational pesticide exposures from a hospital healthcare provider. The reports, which included individual contact information, symptoms, diagnoses, and the name of the pesticide, indicated that the exposures occurred on June 1, 2004 at a pet-food manufacturing company warehouse. Three days prior to the exposures a licensed pesticide applicator had applied Weevil-cide, active ingredient aluminum phosphide, in the warehouse. Two employees had been sent home ill and all seven were transported by management to the local hospital emergency department.

Under a Cooperative Agreement with the National Institute for Occupational Safety and Health (NIOSH), the DSHS PEST Program tracks acute occupational pesticide exposure in Texas. Program priorities considered for conducting rapid follow-up investigations include occupational pesticide exposures and illnesses associated with 1) hospitalization or death, 2) exposure of more than four workers associated with a single exposure event, and 3) a temporal clustering of three or more reports associated with a particular pesticide product. Because of the occupational nature of this incident, the exposure of more than four workers, and the pesticide's high toxicity, staff from the PEST Program initiated a field investigation to discuss pesticide practices, help develop written protocols, conduct face-to-face interviews with employees, document the building designs and exposure locations, and meet with regulators to discuss potential violations. The purpose of these investigations is to prevent future exposures.

SITE VISIT

PEST staff contacted the Structural Pest Control Board (SPCB), the agency responsible for regulating this application of pesticides to buildings, to coordinate a site visit to the facility. At 8:00 a.m. June 15, 2004, the PEST program coordinator, a DSHS Environmental Epidemiologist, a PEST public health technician, and an SPCB inspector visited the facility where the exposures occurred. At that time they met with the company's risk manager and the assistant supervisor of the crew that was working on June 1, 2004. PEST staff explained the objectives of the investigation and why the company needed to develop a written fumigation protocol to prevent future exposures. The risk manager provided staff with a memo dated June 1, 2004 summarizing the events leading up to and following the exposures. According to the risk manager, fumigation generally occurs on a quarterly basis. He indicated that management values their worker's health and had already implemented training and education to prevent such an event from reoccurring. PEST staff and the SPCB inspector toured the warehouse facility. The

administrative offices, located at the front of the facility and separated from the warehouses by a door, do not share indoor air with the warehouses. There were three warehouses connected by garage door sized openings; heavy plastic strips covered the openings.

Employee Interviews

PEST Program staff interviewed the seven employees that were in the facility where the alleged exposures occurred. All interviews were conducted in confidential manner in a closed office. All seven employees were white Hispanic males who ranged in age from 21 to 43 years of age. Two of the employees only spoke Spanish; these interviews were conducted in Spanish. In addition to asking standard pesticide exposure interview questions PEST staff also asked questions specific to this exposure. All seven employees reported that they had been informed about the pesticide application. Four workers did not know the name of the pesticide and only four indicated some knowledge of the health effects associated with exposure to the pesticide. Two of the 7 employees worked at the company less than 6 months; five worked for the company for two or more years. They described their job titles as order puller, shipper, forklift driver, general help, and assistant supervisor.

FINDINGS

At 6:00 a.m. the assistant supervisor/safety officer, assuming that the pesticide applicator had forgotten to remove the warning sign, entered the door of the fumigated warehouse. He removed the signs and proceeded to the other warehouses. To access the adjacent warehouse, the assistant supervisor removed a plastic barrier separating the treated warehouse from the untreated warehouses. He unlocked the door to the first warehouse, which had no warning signs. The other six employees entered through this door to clock in. Employees had noted that the warehouse was cloudy and smelled bad. The assistant supervisor then instructed two of the men to work in the treated warehouse to clean up the ashes left by the pesticide application. One employee indicated that he told the assistant supervisor that he didn't feel well and was told to continue working. According to the memo provided by the risk manager, another employee arrived at 6:45 a.m., noticed the odor and contacted the pesticide applicator, who arrived around 7:00 a.m. The applicator, who had overslept, took actions to ventilate the warehouse and recover the improperly disposed ashes. He reported that phosphine levels in the air were below the 0.3ppm limit. According to a company memo, shortly after the applicator arrived one of the men who had tended to the ashes in the treated warehouse and another employee who was working in the production warehouse reported being nauseous and dizzy and were sent home. The memo also indicated that the risk manager was notified by on-site management at approximately 8:00 a.m. and met with two supervisors to review the MSDS and the symptoms reported by the workers. They picked up the two employees that had been sent home and transported all seven to the hospital emergency department.

All seven employees were examined in the emergency department approximately three hours after entering the warehouse. All employees could have been exposed via inhalation and two could have been exposed via dermal contact; they reported residue on their clothing. According to medical records their clothing was removed and placed in hazardous materials bags. The two employees that were sent home would have been in the facility for at least 1.5 hours. The five remaining employees worked in the warehouse approximately 2.5 hours before being transported to the hospital. Medical records indicated that each employee was given oxygen and observed for approximately five hours. No laboratory tests were performed. After a final evaluation from the emergency room physician the employees were released. PEST staff transcribed health information from the medical records and interviews (Table 1). Six of the seven employees reported dizziness. The constellation of health effects reported by all seven employees is consistent with the known toxicology of phosphine exposure (fatigue, nausea, headache, dizziness, thirst, cough, shortness of breath, rapid heartbeat, and chest tightness). The PEST program assigns pesticide exposures a severity index rating based on whether or not medical care was sought, health effects, and whether or not time was lost from work or usual activities. Based on this standardized criteria, there were six exposures of low severity, and one moderately severe exposure. All seven employees reported to work the following day.

Table 1. Summary of Reported Health Effects

System	Health Effect	Number Reported
Neurological	Headache	5
	Dizziness	6
	Blurred Vision	1
	Muscle Pain	2
	Weakness	2
General	Fatigue	2
	Fever	2**
Repiratory	Sore throat	4
	Shortness of breath	3
	Cough	4
	Swollen tonsils	1**
Gastrointestinal	Nausea	4
	Vomiting	2*
	Diarrhea	1
Dermatologic	Rash	1

* Physical findings documented by physician for *one* of the two total reported

**Physical findings documented by physician

Structural Pesticide Control Board (SPCB) Investigation

PEST staff contacted SPCB enforcement staff June 7, 2004 and met with the regional SPCB inspector on June 15, 2004. That same day, the inspector met with the pesticide applicator and reviewed the application records. Label violations resulted from the absence of warning placards posted at every entrance. The SPCB investigation also revealed that the routine fumigations and rodent control applications for this company were only communicated verbally. SPCB issued the pesticide applicator a one-time warning for the following violations:

- Engaging in pest control practices in a manner that could be injurious to the public health, safety, or to the environment;
- Application inconsistent with pesticide label; and
- Failure to provide signs, disclosure and information sheets to customers prior to or at the time of treatment.

CHEMICAL INFORMATION:

Weevil-cide (Aluminum Phosphide)

Weevil-cide is an insecticidal fumigant. Aluminum Phosphide carries a signal word "Danger" and is classified as EPA toxicity class I (Attachment A). Symptoms of acute exposure to phosphine gas, which is released when aluminum phosphide is exposed to humidity include headache, dizziness, nausea, difficulty breathing, vomiting, and diarrhea. Aluminum Phosphide is available in pellets, tablets, sachets, ropes, and strips. It is applied on animal feed, bulk grain, cottonseed, peanuts, processed food, leaf tobacco stores, railcars, and warehouses.

Manufacturer instructions for treatment if inhaled are to remove the exposed individual from the contaminated area into fresh air, keep them warm, and check for breathing. Overexposure to phosphine is described on the pesticide label as headache, dizziness, nausea, difficult breathing, vomiting and diarrhea. The label states: in *all cases of overexposure, get immediate medical attention.*

CONCLUSIONS/ RECOMMENDATIONS

It is clear that the alleged June 1, 2004 pesticide exposure could have been prevented. The pesticide applicator had overslept and did not complete the fumigation procedure three hours prior to 6:00 a.m. (as he had apparently done in the past). The assistant supervisor ignored the warning signs posted on the warehouse and did not contact the applicator to verify his assumption that the application was complete. The door used by the other employees did *not* have a warning sign. Neither the assistant supervisor nor the six workers reportedly identified the odors, ash, and taped plastic as warning signs that there was still a hazard. The workers reported headaches and dizziness and did not seek fresh air; the pesticide applicator arrived at the warehouse, but the company memo does not state that the

employees sought fresh air at that time. Medical care was sought 2 ½ hours after initially entering the warehouse, after two higher-level managers assessed the situation and consulted the MSDS.

Employee education at a company that regularly applies a restricted-use toxicity class I fumigant is essential to worker's safety. If the employees had been aware of the health effects associated with exposure to the pesticide and knew what to do in case of exposure they may have removed themselves from the situation. The memo prepared by the risk manager indicated that a chemical safety and signage training session was scheduled two days after the incident. When asked, only three of the seven employees were able to identify the pesticide involved in the incident. The fumigation protocol (Attachment B) was prepared and implemented by the risk manager, with input from the PEST program on July 2, 2004; widespread communication, both written and oral are central to the protocol. Documents and discussion from the June 15th field investigation support the company's willingness to take actions to ensure worker's safety. We strongly recommend that the risk manager and upper management continue to educate their employees on the pesticides used in their facility, keep chemical MSDS in a central location known to all, and follow the procedures outlined in the fumigation protocol. All education materials and communication should be in English and Spanish.

Report prepared by:

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Maribel Garcia, Public Health Technician, PEST Program

Austin, Texas October 20, 2004

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Tejas

FUMIGATION MEMO

DATE: 7/2/04

TO: Rodney Caison
Juan Cota
MPF Petfoods, LTD

FROM: Charles Brownlow
Tejas Safety & Health

REFERENCE: **Fumigation Management Plan**

Plant manager shall designate a coordinator and an assistant coordinator (who can fulfill the coordinator's role in the event of illness or other absence) for the fumigation procedure. (plant manager can be coordinator) Both coordinators will share information in the processes below.

The coordinator will see that the following is accomplished:
General:

1. Establish and maintain an Accident Prevention Program that includes training workers on general safe work practices and include special instructions about the hazards that may be found at a particular job.

2. Train workers to understand MSDS and warning labels on products used in the workplace. Train workers to understand the hazards of workplace chemicals, safe handling methods, personal protective gear and emergency procedures.

For specific pest-control applications:

1. The Pest Control Provider is contacted and a defined fumigation schedule is set, in writing. This schedule will be posted in a specific place in plant manager's work area.
2. Obtain a current MSDS and label for the product to be used in the fumigation
3. Study the MSDS, label and Pest Control Provider's Emergency Response Plan to become familiar with the procedure(s) and safety concerns
4. Assure that the quarantined location(s) of the facility will be unoccupied during the scheduled time
5. The Pest Control Provider will notify the coordinator, in writing and by live telephone conversation. If coordinator is unavailable, provider will contact the assistant coordinator within 2-4 days prior to the fumigation date and provide proper notices to be posted. (*see # 8 below)*
6. Shall notify all pertinent management personnel of the fumigation and the scope of the process, to include the quarantined locations and timetable during the week of the scheduled fumigation. Inform employees about the health effects of chemicals and how to prevent exposure.
7. Shall coordinate with the employees and management, assuring that the facility will not be needed during the fumigation time table
8. Shall post the appropriate notice/warning in a conspicuous location (*i.e.* at the time clock) to notify employees of the fumigation plans, warning them to NOT ENTER if posting/placard are present Complete contact information for both coordinator and assistant coordinator will be included on the placard. This shall be posted 48 hours prior to fumigation date and removed at close of business day of re-entry to workplace.
9. The Pest Control Provider will have sole custody of the 'quarantined location(s) during the timetable and proper posting/placard and safety procedures will be followed. No *Tejas* or *MPF* employee shall cross the posted placard barrier(s)
10. At the conclusion of the fumigation procedure and time table, the Pest Control Provider will remove the posting/placard(s) and monitor the air quality. Once air quality has been determined safe and pesticide residue is properly removed, along with all other applicator procedures for this pesticide, the Pest Control Provider will 'return' custody of the facility to the 'defined' coordinator and business can resume as usual. All placard(s) shall be removed at **close of business** day of re-entry.

If you have any questions, please feel free to call me.
Respectfully,

Charles, Office 364-2488

Appendix E

Worker Protection Survey

Introduction

The agricultural industry is one of the most hazardous industries in the United States [National Safety Council 2002, McCurdy et al. 2003, Rein 1992]. The inherent mechanical, environmental, and chemical hazards associated with the industry are exacerbated by a workforce that changes with the growing season and is largely comprised of seasonal and migrant workers. Seasonal and migrant workers are often poverty-stricken with approximately less than $ 10,000 family annual income per year [Shipp 2005]. In addition, migrant workers lack the required documentation to work legally in the United States and are medically underserved, thereby increasing their risk for occupational injuries and diseases [Rust 1990, Arcury et al. 1999]. Pesticide exposure to workers or pesticide handlers is one of the hazards associated with this industry that poses a serious health risk to farmworkers. A worker performs tasks such as harvesting, weeding or watering. A pesticide handler performs tasks such as mixing, loading, cleaning, transferring, applying, etc [EPA, 2005]. Acute exposure can result in nausea, vomiting, dizziness, headaches, abdominal pain, and skin and eye problems. Long-term exposure may lead to chronic health problems such as dermatitis, respiratory problems, fatigue, sleep and memory disorders, anxiety, miscarriages, birth defects, neurological deficits, and cancer [Lee 2002, Clary et al. 2003, Fleming 2003, Susitaival et al. 2004]. A California study comparing the cancer rates of Hispanic farmers and farmworkers to the general Hispanic population of California found that both farmer and farmworker occupations had higher rates for leukemia, brain cancer, CNS cancer, skin melanoma, stomach cancer, prostate cancer, non-Hodgkin's lymphoma, uterine cervix and corpus cancer compared to the general California Hispanic Population [Mills 2001]. The EPA estimates that 10,000-20,000 physician-diagnosed pesticide poisonings occur each year among the approximately 3,380,000 U.S. agricultural workers [Blondell 1997]. Seasonal and migrant farmworkers, often who live and work in areas where pesticides are used are at highest risk [McCauley 2001, Curwin et al. 2002, NEETF 2005]. According to the Migrant and Seasonal Farmworker Enumeration Profiles Study [Larson 2000], approximately 197,000 migrant and seasonal farmworkers labor in Texas.

Data suggest that migrant and seasonal farmworkers and their families are among the most economically disadvantaged, medically indigent, and have the poorest health of any group in the U.S. [McCauley 2001]. Although farmworkers have been described as suffering the highest rate of work-

related injury, morbidity, and mortality in the nation [Schenker 1996, Lee et al. 2002], little has been done to investigate the training that farmworkers receive to mitigate their risk of harm. When this survey commenced, few studies had looked at adherence to the Environmental Protection Agency's (EPA) Worker Protection Standards (WPS) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which requires farmworkers to receive training in pesticide safety. Now, the literature shows that several surveys were conducted between the years 1998-2001, and the common components in each strengthen the overall results [Shipp et al., 2005; Jackson, 2002; McCauley et al., 2002; Arcury et al., 2001; Villarejo et al., 2000; Quandt et al. 1999]. The revised federal WPS, which took effect in 1995, sets requirements for employers of pesticide handlers and agricultural workers. These requirements include application notification, reentry restrictions, personal protective equipment training, and providing information about and transport to medical services. Farmworkers who participate in voluntary training conducted through the EPA with EPA-developed and approved training materials receive a plastic "blue card".

From 1999-2001 the Texas Department of Health (now the Texas Department of State Health Services, DSHS) Pesticide Exposure Surveillance in Texas (PEST) program conducted the Texas Farmworker Protection Survey to assess whether farmworkers in Texas received WPS training. In addition, the program also accessed whether those who received the training understood the pesticide safety learning objectives of the training. The PEST Program conducts surveillance of acute occupational pesticide poisoning through a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH) and EPA.

Methods

To determine whether Texas farmworkers received WPS pesticide safety training, we interviewed farmworkers at 4 locations around the state where farmworkers congregate or reside during the peak growing seasons; participation was voluntary. We conducted the in-person interviews at: 1) the *Centro de Trabajadores Agrícolas Fronterizos* (The Border Farmworker Center) in El Paso (the westernmost Texas-Mexico Border area), 2) the Brownsville Community Health Center, a federally funded migrant health clinic in the Lower Rio Grande Valley (southernmost Texas-Mexico border area), 3) the Midwest Association of Farmworker Organizations (MAFO) National Farmworker Conference, held in San Antonio

(Central Texas), and 4) the United Farmworkers of America (UFW) monthly union meeting at its area headquarters in San Juan, Texas, approximately 60 miles west of Brownsville. Twelve people (10 female and 2 male) conducted the in-person interviews; five were full-time pesticide surveillance staff with prior training and experience in conducting interviews. Eleven of the interviewers were bilingual (English/Spanish). Each interviewer received training and instructions on how to conduct the interview and additional question specific instructions were included on the questionnaire. Interviewers varied by location.

The survey instrument that we used was based on an unpiloted survey developed by Michigan State University: *Worker Protection Standard Survey of Farm Employees*; unpiloted questions from the Texas Department of Health; and questions developed and employed in the *Evaluation of the EPA's Pesticide Safety Trainings* questionnaire given to farmworkers in Arizona. The survey instrument, which consisted of 80 potential questions grouped into 25 main questions, collected information on farmworkers' demographic characteristics, health status, pesticide safety training experiences, pesticide use in the workplace, experience with WPS compliance in the workplace, and health and safety practices.

We recruited participants by asking if they were a farmworker and inviting them to answer questions regarding safety issues in their work. Participants were given items such as canvas bags and caps at each survey location. Institutional Review Board (IRB) approval was not required because we did not record names nor collect human specimens. Interviewers also assured each participant of the confidentiality of their responses to the questions asked. The revised questionnaire, employed among 92 farmworkers in the final surveys in El Paso and San Juan restricted participation to those who had worked in agriculture from the last 2 years to present. Those who did not meet this requirement were thanked for their interest and we completed the interview. Prior to the inclusion of these questions, we ascertained farmworker status orally before proceeding with the interview. Both versions of the instrument were available to interviewers in English and Spanish. All of the farmworkers interviewed spoke English, Spanish or both; however, the vast majority of the interviews were conducted in Spanish.

To analyze the data, we identified variable names for each of the survey questions and created a corresponding database in Microsoft Access. We entered the information from the questionnaires into the database manually and performed a number of quality assurance checks on the database to ensure

that the responses were entered accurately. Finally, we performed simple, descriptive statistics and cross-tabulations on the responses for each location and for all locations combined using a statistical software package (SAS Institute Inc.).

Results

Demographics

We interviewed a total of 210 farmworkers: 124 in El Paso, 27 in San Antonio, 35 in Brownsville and 24 in San Juan with the study population primarily being of Hispanic origin. The age distribution of the farmworkers, by area surveyed is presented in Figure 1. The median age for the farmworkers was 47 years, overall 32 percent were between 40 and 49 years old, and 44% were 50 years-old or older (Table 1). Three-fourths of the San Juan population was 39 years old or less, making it the youngest of the 4 populations surveyed. Approximately 6% of all the participants had no formal education; 34% completed 1-5 years of education, 29% completed 6-8 years of education, 21% completed 9-12 years of education and less than 10% of the total sample reported completing more than 12 years of education (Table 1). Of the 210 workers surveyed, 78% reported having more than 1-5 years experience in farmwork with 28% reporting more than 25 years experience. Eighty-six percent of the participants who were asked about their current work status reported that they were currently employed as farmworkers (Table 1).

Safety Training

Twenty-nine percent of the 210 workers interviewed reported that they had ever received safety training in pesticide use with 23% indicating that they had received WPS training (Table 2). Less than 20% reported having the WPS "blue card" in their possession at the time of the interview. Of the 75% of total interviewed workers that had ever worked in a field treated with pesticides, 34% also indicated receiving pesticide training. Among the four survey locations, none of the farmworkers interviewed in San Juan, Texas reported receiving WPS training (Figure 2), but two of the 24 farmworkers interviewed in the San Juan survey indicated receiving pesticide training.

Additional information pertaining to the training can be found in Table 2. Of the workers who received WPS training 91% indicated that they understood all of the training; 79% indicated that the training was useful; and 94% indicated that they plan to use WPS training in the future (Table 2). Training

was provided via video (19%), manual (31%), and flipchart (19%) with 68% of the respondents indicating that the training was provided in Spanish. Comparing the 4 geographic sites, more farmworkers from the San Antonio National Farmworker Conference population received pesticide training (41%) compared to the other populations.

Work environment

Twenty-six percent of the farmworkers indicated that they had at some time mixed or applied pesticides to fields or crops; 75% indicated that they had worked in fields treated with pesticides (Table 3). Thirty-seven percent of the predominantly female survey population in Brownsville and 37% of the San Antonio farmworker populations mixed or applied pesticides; compared to 22% and 17% of the El Paso and San Juan populations, respectively (Table 3). With respect to WPS compliance in the workplace, 67% indicated that there was no central posting area for notification of recent pesticide applications; 53% indicated that they received pesticide application information from their boss (Table 3). Fifty-eight percent reported that emergency numbers, required to be posted, were not posted; 54% indicated that pesticide safety posters were not displayed. Twenty-nine percent of the respondents indicated that they or their co-workers had been in a situation in which their safety was at risk due to pesticides. One-third of the respondents who reported that they used tobacco indicated that they did not wash their hands while in the fields (Table 3).

Health-status

Sixty-one percent of the participants had experienced two or more of the health symptoms listed on the questionnaire during the previous 12 months. Fatigue (51%), watery eyes (40%) and headaches lasting for hours (32%) were the most frequently reported symptoms experienced during the previous year (Table 4). Seventy two percent of the farmworkers who reported a health effect during the past year indicated that they talked with their family about the problem; 27% indicated that they talked to their crew chief, supervisor, or owner of the farm about the health problem(s); and 38% indicated that they talked to a doctor or nurse about their health problems (Table 5). Forty three percent had missed work due to the health problem(s); however, 59% denied seeking medical care for the health problems (Table 5). Thirty-two percent of the farmworkers interviewed indicated that a farmer or a supervisor would transport them

to a healthcare facility if they experienced a pesticide-related illness (Table 5).

Discussion

Farmworker labor regulations vary from state to state; however, in general, the regulations for farmworkers differ from those of other occupations. According to the U.S. Department of Labor, farm operations that employ 10 or fewer workers on any one day are exempt from OSHA regulation [Runyan 2001]. In 1997, approximately 50% of the farmworkers in the United States were not covered by OSHA regulations. Since January 1, 1995, agricultural employers have been required to ensure that workers receive basic pesticide safety information before they enter an area that has been treated with pesticides. This information must be provided if workers will not receive the complete WPS-required pesticide safety training within the first 5 days of entering a treated area. Under the WPS regulation, the agricultural employer must ensure that the pesticide safety information is communicated to agricultural workers in a manner they can understand.

The results of this survey suggest that the majority of Texas farmworkers are not receiving the required EPA WPS training. The percentage of farmworkers in this survey who reported ever receiving training in pesticide use and safety (28.6%) was lower than the percentage of farmworkers in North Carolina (35.2%) who indicated receiving such training [Arcury et al. 1999]. Additionally, only 23% of the farmworkers interviewed in this survey indicated that they had received the WPS training and 17% of the farmworkers interviewed in this survey reported that they had been trained in pesticide use or safety in the last five years. The findings from this survey support previous WPS assessments that conclude that many farmworkers are not receiving the required pesticide safety training [Arcury et al., 1999]. In a survey conducted in 2000/2001 among an all-female farmworker population in Texas, 56% of the farmworkers reported having pesticide safety training [Shipp, 2005]. Additionally, the survey results suggest that agricultural employers may not be following the guidelines of WPS such as providing pesticide application and emergency notification.

These data indicate that communication patterns between farmworkers and supervisors could be improved. Fewer than 27% of the farmworkers indicated that they would tell a supervisor about health problems experienced on the job and 59% denied ever seeking medical care for the health problems that they experienced. Communication barriers can render the WPS requirements such as transportation to a

healthcare facility ineffective. In 2003, there were 74 health clinics (including satellite clinics) in Texas serving migrant farmworkers [Villarejo 2003]. Despite the availability of these clinics and other resources such as Medicaid, these services are under-utilized [Pransky 2002, Villarejo 2003]. Communication barriers between farmworkers and supervisors, farm owners, and/or crew chiefs can lead to complications or affect treatment, particularly if the farmworker doesn't seek necessary medical attention and/or does not know the name and active ingredient of the pesticide to which he or she may have been exposed. There is some evidence in the literature that WPS education may not be sufficient to reduce the risk of pesticide injuries [McCauley et al. 2004]. There also is evidence that providing WPS training may not necessarily result in good work practices [WA Dept. of L&I 2005]. To effectively communicate the risks associated with using pesticide, WPS programs need to be tailored to the farmworkers being trained [Quandt et al. 2004, Vela Acosta 2005]. It has previously been shown that, in spite of WPS training, a lack of knowledge about pesticides safety correlated with participants who speak a language other than English [McCauley et al. 2002]. The most widely used medium for training is video [Larson 2000, Arcury et al. 1999]; however, for some populations the use of videos for training may be problematic as they often are narrated in English. In Texas, only 19% of the respondents indicated that a video was used and 68% indicated that the training was provided in Spanish.

The results presented in this paper are based on a self-report questionnaire and are valid only to the extent that farmworkers reported their training experiences accurately. We attempted to reduce the misunderstanding of the survey questions by using bilingual interviewers trained in consistent and culturally sensitive interview techniques. Migrant workers also may have an inherent suspicion of government and may not have been forthcoming in reporting anomalies in their employers' training and work practices; particularly if they felt that the information would get back to their employer, potentially affecting future employment [McCurdy et al. 2000, Vela-Acosta et al. 2002]. Interviewer gender also could have affected the results. With the exception of the primarily female Brownsville farmworker population (n=35), the majority of the participants were male migrant farmworkers. These workers were interviewed by females; a situation that, due to cultural differences, may or may not have affected the farmworkers' responses. With respect to public health, data suggest that migrant farmworkers and their families are among the most economically disadvantaged, medically indigent, and have the poorest health of any

group in the U.S. [McCauley 2001].

Abstract

The U.S. Environmental Protection Agency's (EPA) Worker Protection Standard (WPS) regulation requires that farmworkers receive basic pesticide safety training. The Texas Department of State Health Services (DSHS) surveyed farmworkers at four separate locations in Texas to assess whether workers had received the required pesticide safety training. The survey asked questions about training attributes, employer WPS compliance, and health issues associated with pesticide exposure. Bilingual interviewers documented responses from 210 farmworkers. Seventy-three percent of the farmworkers surveyed were 40 years old or older. Thirty-one percent of those surveyed had 9 or more years of formal education, and 62% had worked 10 years or more as a farmworker. Less than 30% of the farmworkers reported receiving some type of worker training in pesticide safety; 23% reported receiving WPS training. Twenty-six percent of the farmworkers reported that they had personally mixed or applied pesticides, and 75% indicated that they had worked in a field treated with pesticides. Thirty-one percent reported that they had missed work the previous year because of health problems consistent with pesticide exposure symptomology, and 28% reported that they had consulted with a health care professional about their illness. Responses varied by geographic location and sub-population of farmworkers surveyed. The results of this survey suggest that the majority of Texas farmworkers are not receiving the required EPA WPS training and that communication patterns between farmworkers and supervisors, with respect to pesticide exposure and use, could be improved.

Acknowledgments

We would like to thank the farmworkers who participated in this survey.

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Figure 1. Age of Farmworkers (by location)

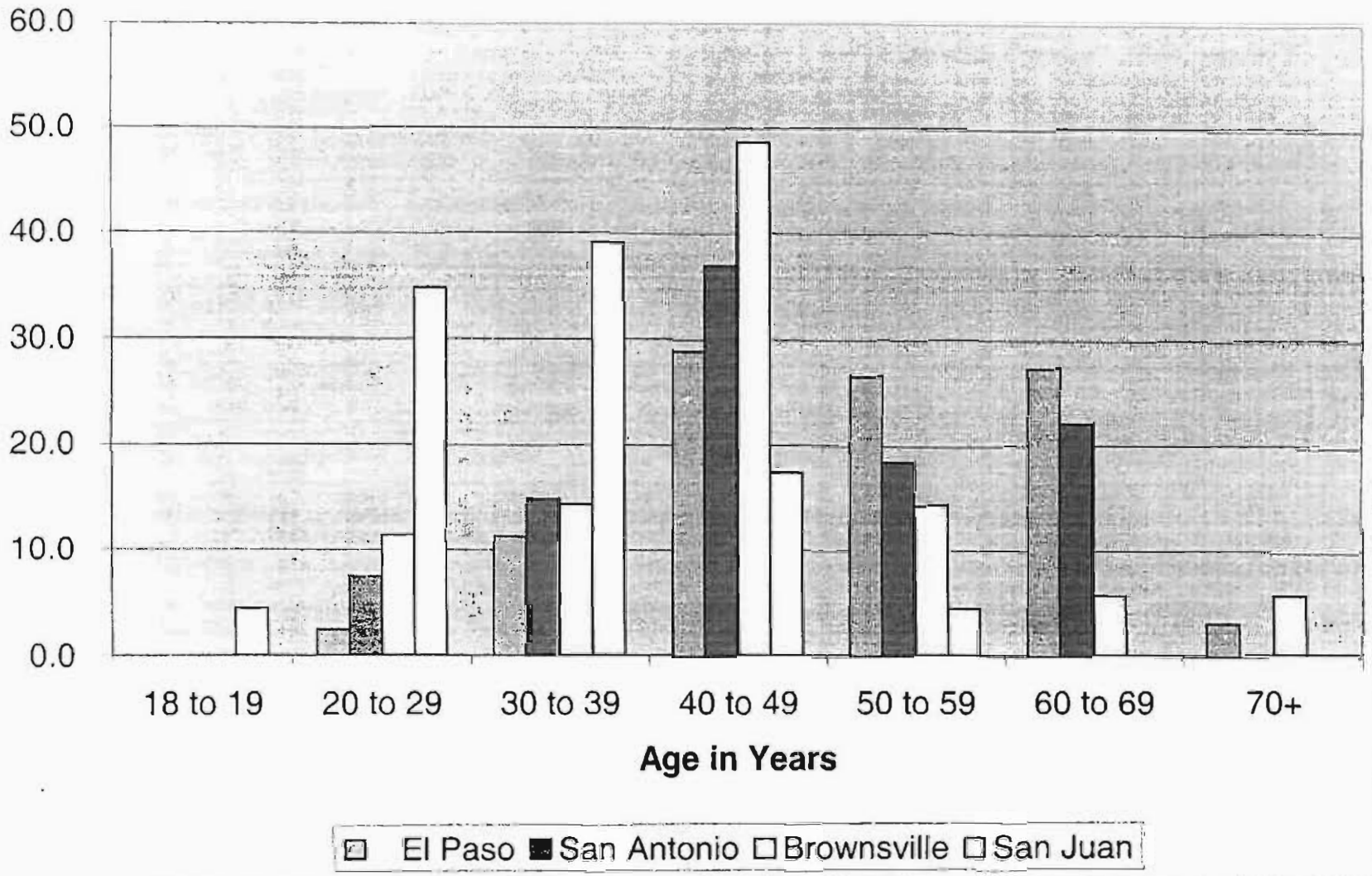

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Table 1. Respondent characteristics

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Age of farmworker (years)										
18 to 19	1	0.5	0	0.0	0	0.0	0	0.0	1	4.3
20 to 29	17	8.1	3	2.4	2	7.4	4	11.4	8	34.8
30 to 39	32	15.3	14	11.3	4	14.8	5	14.3	9	39 1
40 to 49	67	32.1	36	29.0	10	37.0	17	48.6	4	17.4
50 to 59	44	21.1	33	26.6	5	18.5	5	14.3	1	4.4
60 to 69	42	20 1	34	27.4	6	22.2	2	5.7	0	0.0
70+	6	2.9	4	3.2	0	0.0	2	5.7	0	0.0
(missing)	1		0		0		0		1	
Education										
No formal education	12	5.8	10	8.2	0	3.4	2	5.7	0	0.0
1 to 5 years school completed	71	34.3	59	48.4	3	15.5	4	11.4	5	21.7
6 to 8 years school completed	60	29.0	39	32.0	1	34.5	12	34.3	8	34.8
9 to 12 years school completed	44	21.3	11	9.0	12	36.2	15	42.9	6	26.1
More than 12 years of schooling	20	9.7	3	2.5	11	10.3	2	5.7	4	17.4
(missing)	3		2		0		0		1	
Years worked as farmworker										
1 to 5 years	46	22.0	16	12.9	4	14.8	13	37.1	13	56.5
6 to 10 years	34	16.3	20	16.1	6	22.2	7	20.0	1	4.3
11 to 15 years	37	17.7	21	16.9	4	14.8	5	14.3	7	30.4
16 to 20 years	24	11.5	15	12.1	4	14.8	4	11.4	1	4.4
21 to 25 years	9	4.3	6	4.8	3	11.1	0	0.0	0	0.0
More than 25 years	59	28.2	46	37.1	6	22.2	6	17.1	1	4.3
(missing)	1		0		0		0		1	
Currently working as a farmworker (Began asking in El Paso 2000)										
Yes	78	85.7	66	98.5					12	50.0
No	13	14.3	1	1.5					12	50.0
	1		1							

** missing not used in percentage calculations*

Table 2. Questions on training.

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
Question	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Ever trained in pesticide use/safety										
Yes	60	28.6	38	30.7	11	40.7	9	25.7	2	8.3
No	150	71.4	86	69.3	16	59.3	26	74.3	22	91.7
Trained in pesticide use/safety past 5 years (Began asking in El Paso 2000)										
Yes	16	17.4	15	22.1					1	4.2
No	76	82.6	53	77.9					23	95.8
WPS training ever received										
Yes	48	22.9	35	28.2	9	33.3	4	11.4	0	0.0
No	162	77.1	89	71.8	18	66.7	31	88.6	24	100.0
WPS card in possession										
Yes	41	19.5	33	26.6	6	22.2	2	5.7	na	na
No	169	80.5	91	73.4	21	77.8	33	94.3	na	na
Was WPS training useful/used										
Yes	38	79.2	29	82.9	5	55.6	4	100	na	na
No	10	20.8	6	17.1	4	44.4	0	0	na	na
Plan to use WPS training in future										
Yes	45	93.7	34	97.1	7	77.8	4	100	na	na
No	3	6.3	1	2.9	2	22.2	0	0	na	na
Who did the training										
Foreman	1	1.7	0	0	0	0	1	12.5	0	0
Farmer	3	5.3	0	0	2	18.2	1	12.5	0	0
Supervisor	8	14	4	11.1	1	9.1	2	25	1	50
Other	45	79	32	88.9	8	72.7	4	50	1	50
(missing)	3		2		0		1		0	
Trained via video										
Yes	11	19	5	13.9	5	45.5	0	0	1	50
No	47	81	31	86.1	6	54.5	9	100	1	50
(missing)	2		2		0		0		0	

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Trained via manual										
Yes	18	31	15	41.7	3	27.3	0	0	0	0
No	40	69	21	58.3	8	72.7	9	100	2	100
(missing)	2		2		0		0		0	
Trained via flipchart										
Yes	11	19	7	19.4	4	36.4	0	0	0	0
No	47	81	29	80.6	7	63.6	9	100	2	100
(missing)	2		2		0		0		0	
Language used in training										
English	8	14	0	0	7	63.6	1	12.5	0	0
Spanish	39	68.4	34	94.4	0	0	3	37.5	2	100
Both	10	17.5	2	5.6	4	36.4	4	50	0	
(missing)	3		2		0		1			
Understood the training										
Yes	51	91.1	32	94.1	9	81.8	8	88.9	2	100
No	5	8.9	2	5.9	2	18.2	1	11.1	0	0
(missing)	4		4		0		0		0	
How many people trained with you										
1-5	6	11.3	1	2.8	3	42.9	1	12.5	1	50
6-15	10	18.9	8	22.2	1	14.3	1	12.5	0	0
16-20	8	15.1	5	13.9	3	42.9	0	0	0	0
21+	29	54.7	22	61.1	0	0	6	75	1	50
(missing)	7		2		4		1		0	
Answers rinse eyes if exposed?										
Yes	119	56.7	64	51.6	21	77.8	17	48.6	17	70.8
No	91	43.3	60	48.4	6	22.2	18	51.4	7	29.2
Answers induce vomiting if ingested?										
Yes	32	15.2	16	12.9	5	18.5	6	17.1	5	20.8
No	178	84.8	108	87.1	22	81.5	29	82.9	19	79.2

* *missing not used in percentage calculations*

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Table 3. Questions on work environment.

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
Question	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Ever work in fields treated w/pesticides										
Yes	157	74.8	93	75.0	26	96.3	21	60.0	17	70.8
No	53	25.2	31	25.0	1	3.7	14	40.0	7	29.2
Ever mix or apply pesticides										
Yes	54	25.7	27	21.8	10	37.0	13	37.1	4	16.7
No	156	74.3	97	78.2	17	63.0	22	62.9	20	83.3
Insecticides used at current work site										
Yes	95	45.2	51	41.1	18	66.7	11	31.4	15	62.5
No	87	41.4	57	46	5	18.5	18	51.4	7	29.2
Don't Know	28	13.3	16	12.9	4	14.8	6	17.1	2	8.3
Herbicides used at current work site										
Yes	87	41.4	52	41.9	20	74.1	8	22.9	7	29.2
No	94	44.8	56	45.2	4	14.8	20	57.1	14	58.3
Don't Know	29	13.8	16	12.9	3	11.1	7	20	3	12.5
Fungicides used at current work site										
Yes	69	32.9	47	37.9	11	40.7	6	17.1	5	20.8
No	101	48.1	58	46.8	11	40.7	22	62.9	10	41.7
Don't Know	40	19	19	15.3	5	18.5	7	20	9	37.5
Central area posts recent spraying of pesticides										
Yes	56	27.1	30	24.4	6	22.2	15	42.9	5	22.7
No	139	67.1	87	70.7	20	74.1	15	42.9	17	77.3
Don't Know	12	5.8	6	4.9	1	3.7	5	14.3	0	0
(missing)	3		1		0		0		2	
Field posting signs alert when ok to enter field										
Yes	89	42.8	61	49.2	6	22.2	16	45.7	6	27.3
No	114	54.8	62	50	20	74.1	16	45.7	16	72.7
Don't Know	5	2.4	1	0.8	1	3.7	3	8.6	0	0
(missing)	2		0		0		0		2	
Boss notifies when ok to enter field										
Yes	128	61.2	74	59.7	10	37	28	80	16	69.6
No	73	34.9	47	37.9	16	59.3	3	8.6	7	30.4
Don't Know	8	3.8	3	2.4	1	3.7	4	11.4	0	0
(missing)	1		0		0		0		1	

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Boss notifies of recent sprayings										
Yes	110	52.9	64	52	8	29.6	27	77.1	11	47.8
No	93	44.7	57	46.3	19	70.4	6	17.1	11	47.8
Don't Know	5	2.4	2	1.6	0	0	2	5.7	1	4.4
missing	2		1		0		0		1	
One location notifying of recent sprayings										
Yes	77	36.8	47	37.9	5	18.5	19	54.3	6	26.1
No	120	57.4	70	56.4	22	81.5	11	31.4	17	73.9
Don't Know	12	5.7	7	5.6	0	0	5	14.3	0	0
(missing)	1		0		0		0		1	
Emergency numbers posted where people can find										
Yes	75	35.9	38	30.6	9	33.3	22	62.9	6	26.1
No	121	57.9	78	62.9	17	63	10	28.6	16	69.6
Don't Know	13	6.2	8	6.5	1	3.7	3	8.6	1	4.3
(missing)	1		0		0		0		1	
Pesticide safety poster up to see										
Yes	90	43.1	52	41.9	6	22.2	23	65.7	9	39.1
No	112	53.6	69	55.7	20	74.1	10	28.6	13	56.5
Don't Know	7	3.3	3	2.4	1	3.7	2	5.7	1	4.4
(missing)	1		0		0		0		1	
You/coworker in situation of risk from pesticides										
Yes	63	29.4	32	25.8	14	51.8	7	20	9	39.1
No	151	70.6	92	74.2	13	48.2	28	80	14	60.9
(missing)	1		0		0		0		1	
Do you ever use tobacco										
Yes	49	23.4	37	29.8	6	22.2	3	8.6	3	13
No	156	74.6	84	67.7	21	77.8	31	88.6	20	87
Don't Know	4	1.9	3	2.4	0	0	1	2.9	0	0
(missing)	1		0		0		0		1	
How often wash hands in fields (tobacco users)										
Always	9	18.7	5	13.9	0	0	3	100	1	33.3
Often	8	16.7	7	19.4	0	0	0	0	1	33.3
Seldom	12	25	10	27.8	2	33.3	0	0	0	0
Never	16	33.3	13	36.1	2	33.3	0	0	1	33.3
Don't Know	3	6.3	1	2.8	2	33.3	0	0	0	0
(missing)	1		1		0		0		0	

** missing not used in percentage calculations*

Table 4. Health-related questions.

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
Question	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
How would you get to the doctor										
Walk	8	3.9	7	5.8	0	0	0	0	1	4.3
Own Car	33	16.2	2	1.7	11	42.3	15	42.9	5	21.7
Friend's Car	55	27.0	27	22.5	10	38.5	8	22.9	10	43.4
Farmer / Supervisor	66	32.3	51	42.5	4	15.4	6	17.1	5	21.7
Other	42	20.6	33	27.5	1	3.8	6	17.1	2	8.7
(missing)	6		4		1		0		1	
Any health symptom experienced in previous year										
Yes	151	71.9	85	68.6	24	88.9	23	65.7	19	90.5
No	59	28.1	39	31.4	3	11.1	12	34.3	2	4.5
(missing)	3		0		0		0		3	
Ever seek medical care for health problems										
Yes	62	41.1	31	36.5	17	70.8	10	43.5	4	21.1
No	89	58.9	54	63.5	7	29.2	13	56.5	15	78.9
Given tranportation to medical facility										
Yes	27	45.0	11	36.7	8	47.1	5	55.6	3	75
No	33	55.0	19	63.3	9	52.9	4	44.4	1	25
(missing)	91		55		7		14		15	
Ever miss work because of health problems										
Yes	65	43.3	38	45.2	12	50.0	9	39.1	6	31.6
No	85	56.7	46	54.8	12	50.0	14	60.9	13	68.4
(missing)	1		1							

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Days of worked missed										
Less than One day missed	4	6.2	2	5.3	1	8.3	1	11.1	0	0
1 to 2 days missed	19	29.2	10	26.3	4	33.3	3	33.3	2	33.3
3-5 days missed	19	29.2	10	26.3	2	16.7	3	33.3	4	66.7
6-10 days missed	5	7.7	4	10.5	1	8.3	0	0	0	0
11-15 days missed	5	7.7	1	2.6	3	25	1	11.1	0	0
16-30 days missed	6	9.2	5	13.2	1	8.3	0	0	0	0
31+ days missed	7	10.8	6	15.8	0	0	1	11.1	0	0
(missing)	86		47		12		14		13	
Talk to other farmworkers about health problems										
Yes, always	22	21.6	6	12.2	9	37.5	5	21.7	2	33.3
Sometimes	24	23.5	17	34.7	3	12.5	0	0	4	66.7
No, never	56	54.9	26	53.1	12	50	18	78.3	0	0
(missing)	49		36						13	
Talk to Doctor/Nurse about health problems										
Yes, always	32	31.7	8	16.3	13	54.2	8	34.8	3	60
Sometimes	26	25.7	15	30.6	5	20.8	4	17.4	2	40
No, never	43	42.6	26	53.1	6	25	11	47.8	0	0
(missing)	50		36						14	
Talk to crew chief about health problems										
Yes, always	20	22.5	3	8.1	7	29.2	8	34.8	2	40
Sometimes	12	13.5	7	18.9	1	4.2	1	4.3	3	60
No, never	55	61.8	27	73	14	58.3	14	60.9	0	0
Don't Know	2	2.2	0	0	2	8.3	0	0	0	0
(missing)	62		48						14	
Talk to supervisor about health problems										
Yes, always	19	21.3	3	7.9	6	25	7	30.4	3	75
Sometimes	13	14.6	10	26.3	1	4.2	1	4.3	1	25
No, never	55	61.8	25	65.8	15	62.5	15	65.3	0	0
Don't Know	2	2.3	0	0	2	8.3	0	0	0	0
(missing)	62		47						15	
Talk to farm owner about health problems										
Yes, always	14	16.3	2	5.4	7	29.2	5	21.7	0	0
Sometimes	11	12.8	7	18.9	1	4.2	1	4.4	2	100
No, never	59	68.6	28	75.7	14	58.3	17	73.9	0	0
Don't Know	2	2.3	0	0	2	8.3	0	0	0	0
(missing)	65		48						17	

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Talk to family about health problems										
Yes, always	67	53.6	24	35.8	19	79.2	17	73.9	7	63.6
Sometimes	30	24.0	24	35.8	2	8.3	0	0	4	36.4
No, never	28	22.4	19	28.4	3	12.5	6	26.1	0	0
(missing)	26		18						8	
problems (combined/collapsed variable)										
Yes	109	72.2	56	65.9	22	91.7	17	73.9	14	73.7
No	42	27.8	29	34.1	2	8.3	6	26.1	5	26.3
Talk to a Doctor or Nurse about health problems (collapsed variable)										
Yes	58	38.4	23	27.1	18	75	12	52.2	5	26.3
No	93	61.6	62	72.9	6	25	11	47.8	14	73.7
Talk to Crew chief or Supervisor or Owner about health problems (combined/collapsed variable)										
Yes	40	26.5	14	16.5	10	41.7	10	43.5	6	31.6
No	111	73.5	71	83.5	14	58.3	13	56.5	13	68.4

** missing not used in percentage calculations*

Table 5. Questions on health symptoms.

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Any health symptom experienced in previous year										
Yes	151	71.9	85	68.6	24	88.9	23	65.7	19	90.5
No	59	28.1	39	31.4	3	11.1	12	34.3	2	4.5
(missing)	3		0		0		0		3	
Headaches lasting for hours in past year										
Yes	66	31.9	35	28.2	11	40.7	13	37.1	7	33.3
No	141	68.1	89	71.8	16	59.3	22	62.9	14	66.7
Dizziness in past year										
Yes	50	24.1	23	18.5	14	51.8	6	17.1	7	33.3
No	157	75.9	101	81.5	13	48.2	29	82.9	14	66.7
Fainting in past year										
Yes	14	6.8	8	6.4	4	14.8	1	2.9	1	4.8
No	193	93.2	116	93.6	23	85.2	34	97.1	20	95.2
Stomach pain in past year										
Yes	57	27.5	32	25.8	12	44.4	3	8.6	10	47.6
No	150	72.5	92	74.2	15	55.6	32	91.4	11	52.4
Double/blurry vision in past year										
Yes	51	24.6	27	21.8	13	48.1	4	11.4	7	33.3
No	156	75.4	97	78.2	14	51.9	31	88.6	14	66.7
Watery eyes in past year										
Yes	82	39.6	45	36.3	15	55.6	13	37.1	9	42.9
No	125	60.4	79	63.7	12	44.4	22	62.9	12	57.1
Tiredness in past year										
Yes	106	51.2	63	50.8	18	66.7	11	31.4	14	66.7
No	101	48.8	61	49.2	9	33.3	24	68.6	7	33.3
Nausea in past year										
Yes	35	16.9	18	14.5	10	37.0	4	11.4	3	14.3
No	172	83.1	106	85.5	17	63.0	31	88.6	18	85.7
Vomiting in past year										
Yes	25	12.1	13	10.5	7	25.9	4	11.4	1	4.8
No	182	87.9	111	89.5	20	74.1	31	88.6	20	95.2

Question	Total (n=210)		El Paso (n=124)		San Antonio (n=27)		Brownsville (n=35)		San Juan (n=24)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Excessive sweating in past year										
Yes	50	24.3	32	26	9	33.3	5	14.3	4	19.1
No	156	75.7	91	74	18	66.7	30	85.7	17	80.9
Rashes in past year										
Yes	49	23.7	27	21.8	8	29.6	6	17.1	8	38.1
No	158	76.3	97	78.2	19	70.4	29	82.9	13	61.9
Difficulty breating in past year										
Yes	36	17.4	17	13.7	13	48.1	4	11.4	2	9.5
No	171	82.6	107	86.3	14	51.9	31	88.6	19	90.5
Drooling in past year										
Yes	8	3.9	7	5.6	1	3.7	0	0	0	0
No	199	96.1	117	94.4	26	96.3	35	100	21	100
Muscle spasms in past year										
Yes	56	27.1	35	28.2	10	37	3	8.6	8	38.1
No	151	72.9	89	71.8	17	63	32	91.4	13	61.9
Chest pain in past year										
Yes	34	16.4	17	13.7	9	33.3	5	14.3	3	14.3
No	173	83.6	107	86.3	18	66.7	30	85.7	18	85.7
Runny nose in past year										
Yes	58	28.0	31	25	11	40.7	10	28.6	6	28.6
No	149	72.0	93	75	16	59.3	25	71.4	15	71.4
Diarrhea in past year										
Yes	30	14.5	16	12.9	8	29.6	1	2.9	5	23.8
No	177	85.5	108	87.1	19	70.4	34	97.1	16	76.2

** missing not used in percentage calculations*

Appendix F

Publications

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 49:383–393 (2006)

Acute Pesticide-Related Illness Among Emergency Responders, 1993–2002

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Background *Emergency responders are among the first to arrive at a pesticide-related release event. Magnitude, severity, and risk factor information on acute pesticide poisoning among those workers is needed.*

Methods *Survey data collected from the SENSOR-Pesticides, CDPR and HSEES programs between 1993 and 2002 from 21 states were reviewed. Acute occupational pesticide-related illness incidence rates for each category of emergency responder were calculated, as were incidence rate ratios (IRR) among emergency responders compared to all other workers employed in non-agricultural industries.*

Results *A total of 291 cases were identified. Firefighters accounted for 111 cases (38%), law enforcement officers for 104 cases (36%), emergency medical technicians for 34 cases (12%), and 42 cases (14%) were unspecified emergency responders. Among the 200 cases with information on activity responsible for exposure, most were exposed while performing activities related to a pesticide release event (84%) and not involving patient care, while the remainder involved exposure to pesticide-contaminated patients. A majority of cases were exposed to insecticides (51%). Most had low severity illnesses (90%). The incidence rate was highest for firefighters (39.1/million) and law enforcement officers (26.6/million). The IRRs were also elevated for these professions (firefighters, IRR = 2.67; law enforcement officers, IRR = 1.69).*

Conclusions *The findings suggest the need for greater efforts to prevent acute occupational pesticide-related illness among emergency responders.* Am. J. Ind. Med. 49:383–393, 2006. *Published 2006 Wiley-Liss, Inc.*[†]

KEY WORDS: pesticides; poisoning; police; fire; emergency medical technicians

INTRODUCTION

Pesticides are ubiquitous in our society. Given their pervasiveness, events involving an uncontrolled release of pesticides will arise through fires involving warehouses where pesticides are stored, highway spills during transport, unintentional drift of pesticides from farm fields, and intentional contamination of an individual during a suicide

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Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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Accepted 24 January 2006
DOI 10.1002/ajim.20286. Published online in Wiley InterScience (www.interscience.wiley.com)

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attempt. Emergency responders, such as firefighters, police officers, and emergency medical technicians, are among the first to arrive to the scene of a pesticide-related emergency event. Anecdotal information indicates that these exposures have sometimes led to illness among emergency responders [Merritt and Anderson, 1989], suggesting a risk of acute illness when responding to hazardous events.

Recently, large amounts of public health resources have been used to prevent and to be prepared to respond to chemical and biological terrorism events. Pesticides are among the chemical agents that might be used by terrorists [CDC, 2005a].

An assessment of the magnitude and incidence of acute pesticide poisoning among emergency responders can provide information on the preparedness of these important public servants, and can highlight areas in need of preventive action. To our knowledge this study is the first to provide information on the magnitude and incidence of acute pesticide poisoning among those responding to pesticide-related emergency events.

METHODS

Data were obtained on individuals age 15 through 64 years who developed an acute pesticide-related illness or injury from pesticide exposures incurred while engaged in emergency response and/or from exposure to a pesticide-contaminated patient between 1993 and 2002. The occupational categories of interest were firefighters (1990 Bureau of the Census [BOC] occupation codes = 416, 417) [US BOC, 1992], law enforcement officers (BOC occupation codes 418, 423), and emergency medical technicians (BOC occupation codes 089, 208, or 446 and BOC industry codes = 401, 831, or 910). Both volunteer and career firefighters were included. Throughout this report, these eligible workers will be collectively referred to as "emergency responders." This report excludes cases involving non-working bystanders. Exposures occurring in non-emergency situations were also excluded (e.g., firefighters exposed to pesticides used for routine pest control at their workplace, or law enforcement officers who are exposed to off-target drift of an aerially applied pesticide).

Source of Cases

Cases were identified from the Sentinel Event Notification System for Occupational Risks-Pesticides (SENSOR-Pesticides) program, the California Department of Pesticide Regulation (CDPR) pesticide poisoning surveillance program, and the Hazardous Substances Emergency Events Surveillance (HSEES) System. The SENSOR-Pesticides program is funded by the National Institute for Occupational Safety and Health (NIOSH) and the US Environmental Protection Agency (EPA), and provides financial and/or technical support to state agencies engaged in surveillance of acute occupational pesticide-related illness and injury [Calvert et al., 2004]. The SENSOR-Pesticides states that provided cases included the California Department of Health Services (CDHS), the Texas Department of State Health Services, the Washington State Department of Health, the Oregon Department of Human Services, the New York State Department of Health, and the Florida Department of Health. The Arizona Department of Health Services, the Louisiana Department of Health and Hospitals, and the Michigan Department of Community Health were queried but reported no relevant cases for the years under study. Each of these state agencies maintains its own surveillance system for acute pesticide-related illness and injury. The CDPR surveillance program is similar to SENSOR-Pesticides but uses a slightly different case definition and comparable but different standardized variables. Cases were also provided by HSEES under a data sharing agreement. HSEES is maintained by the Agency for Toxic Substances and Disease Registry/National Center for Environmental Health (ATSDR/NCEH). It collects reports from state health departments on events associated with sudden, uncontrolled, or illegal releases of hazardous substances [Horton et al., 2004]. A total of 17 states (AL, CO, IA, LA, MN, MO, MS, NC, NH, NJ, NY, OR, RI, TX, UT, WA, WI) participated in HSEES for at least 6 years during the study period. The data used in these analyses were surveillance data provided to the lead author without identifiers, and as such are exempt from consideration by the human subjects review board (45 CFR 46.101[b][4]).

The time periods for which acute pesticide-related illness data were available varied by agency. The SENSOR-Pesticides programs in California, New York, Oregon, Texas, and Washington State, as well as CDPR, provided data for the entire study period. As for the other SENSOR-Pesticides states, data were available for the following time periods: Arizona, 1993–2001; Florida, 1998–2002; Louisiana, 1999–2002, and Michigan, 2000–2002. With respect to HSEES, 10 states participated for the entire study period: Alabama, Colorado, Iowa, New York, North Carolina, Oregon, Rhode Island, Texas, Washington, and Wisconsin. The remaining HSEES states participated for the following time periods: Louisiana, 2001–2002; Minnesota and Mississippi, 1995–2002; Missouri, 1994–2002; New Hampshire, 1993–1996; and New Jersey and Utah, 2000–2002.

To avoid double counting the same case, cases provided by SENSOR/CDPR were compared to cases in HSEES. Cases that matched on year and month of exposure, state, age, gender, and pesticide active ingredient were assumed to be the same individual. These individuals were included in the SENSOR/CDPR totals only. Similarly, cases provided by CDPR and CDHS were compared and cases that matched were counted only once in the SENSOR/CDPR totals.

Information Available on Each Case

The information collected by the state agencies and HSEES includes date of illness, information on the case (gender, age, occupation, industry, health effects, illness severity), whether the illness occurred as a result of workplace exposures, activity being performed by the individual at the time they were exposed, whether personal protective equipment (PPE) was used, and the pesticide(s) that produced the illness. Length of hospitalization and information on time lost from work was collected by the state agencies but not by HSEES. For this analysis, PPE included eye protection (e.g., goggles or faceshield), hand protection (i.e., gloves), or respiratory protection (i.e., respirator).

The EPA acute toxicity category was sought for all pesticide products responsible for illness. The EPA classifies all pesticide products into one of four toxicity categories based on established criteria (40 CFR Part 156). Pesticides with the greatest toxicity are placed in Category I, and those with the least are in Category IV. In this analysis, the toxicity category for the pesticide product responsible for illness was often provided by state agencies participating in SENSOR/CDPR, but was not available for cases reported by HSEES. In events involving exposure to more than one product, the event was assigned a toxicity category corresponding to the product with the greatest toxicity category. When the toxicity category was not provided, it was retrieved from a US EPA dataset [US EPA, 2005] that provides information on pesticide products, including the assigned toxicity category. When the specific product was not identified, and only the active ingredient was available, we selected the toxicity category most commonly assigned to products that contain the active ingredient.

Severity Index

A standardized severity index [CDC, 2001a] was used to assign severity to all cases provided by SENSOR/CDPR. A *low severity illness or injury* consists of minimally bothersome health effects that generally resolve rapidly (e.g., dermatitis, headache, dizziness, nausea, vomiting, abdominal pain, cough, upper respiratory irritation, dyspnea, fatigue, and ocular inflammation). A *moderate severity illness or injury* consists of non-life threatening health effects that are more pronounced, prolonged, or of a systemic nature compared to low severity effects. A *high severity illness or injury* consists of life-threatening health effects or those that result in significant residual disability or disfigurement. HSEES collects limited information to assign severity. HSEES cases who were hospitalized were assumed to have *moderate severity illness or injury*. All other HSEES cases were assumed to have *low severity illness or injury*. HSEES collects insufficient information to identify high severity illnesses and injuries.

Case Definition

SENSOR-Pesticides and CDPR have similar case definitions. Cases identified by state agencies were included only if health effects developed subsequent to pesticide contact and the health effects were determined by state surveillance professionals to be consistent with the known toxicology of the pesticide product. Cases were classified as definite, probable, possible, or suspicious based upon the strength of evidence supporting the occurrence of a pesticide exposure, and whether the ill individual reported symptoms versus had signs observed by a health care professional. A full description of these standardized case definitions is beyond the scope of this study but is available elsewhere [Calvert et al., 2001; CDC, 2005b].

HSEES does not have a standardized case definition for occupational pesticide-related illness and injury; however, cases are defined as persons sustaining at least one injury or symptom as a result of the event. Events identified by HSEES can involve the release of several chemicals, including pesticides and non-pesticide chemicals. Generally, HSEES cases were associated with events involving the release of pesticides only. In events where pesticides and non-pesticides were released, one author (GMC) assessed whether the health effects were consistent with the pesticide exposure. HSEES cases were excluded if the released pesticide was not specifically identified, or if headache, heat stress, or trauma were the only health effects identified. Headache alone is considered too non-specific and insufficient for a diagnosis of pesticide poisoning, trauma was thought unlikely to be related to pesticide exposure, and heat stress was considered unrelated to pesticide poisoning.

Data Analysis

SAS software was used for data management and chi-square statistical analyses of categorical data. Incidence rates for each occupational category of interest were calculated for 1993 through 2002. The numerator was the total number of illness cases in the relevant occupational category. The denominator was obtained from the full time equivalent (FTE) estimates derived from the Current Population Survey (CPS) conducted between 1993 and 2002 [Bureau of Labor Statistics, 2004]. FTE data corresponds to the states and time periods included in the study. Incidence rates for all emergency responders combined were also calculated. Included in this calculation were emergency responders of unknown specific type. Poisson regression was used to test the trend of incidence rates across the years of exposure.

The rate calculations for firefighters had to be handled differently due to the limitations of the CPS data. CPS compiles industry and occupation FTE estimates only on workers engaged in paid employment. As such, unpaid volunteer firefighters do not appear in the FTE estimates.

Therefore, the incidence rate calculation for firefighters included the salaried career firefighters only. In addition, for those firefighters whose career versus volunteer status was unknown, we made the assumption that the proportion that were career was equal to the proportion that were career among those with known career versus volunteer status. These firefighters with unknown status but who were assumed to be career were included in the incidence rate calculations for firefighters and for all emergency responders combined.

The risk of acute pesticide-related illness among each occupational category was calculated by comparing their rate to that of all other non-agricultural workers aged 15–64 years [Rothman, 1986]. Non-agricultural workers were chosen as the comparison group because a priori it was thought that workers and emergency responders had a similar risk for pesticide exposure. Agricultural workers were thought to have a much higher rate of pesticide exposure because between 1998 and 2002, a rate of 163 cases/million agricultural worker FTEs was identified. The data on non-agricultural workers were obtained from the same state agencies (SENSOR/CDPR) that provided the data on emergency responders, but excluded were illnesses associated with non-occupational exposures, pesticide exposures that produced no health effect, emergency responders, and illnesses associated with intentional (e.g., suicidal, malicious intent) exposures. Because data on pesticide poisoning incidence is not available for states with a HSEES program only, this risk calculation was restricted to states with a SENSOR program. The incidence rate ratio (IRR) was calculated by dividing the acute pesticide-related illness incidence rate among emergency responders by the incidence rate among all other non-agricultural workers. A ratio that exceeds 1 suggests that emergency responders have a higher risk of acute pesticide-related illness compared to all other non-agricultural workers. Confidence intervals were calculated according to methods described by Rothman [1986].

RESULTS

From 1993 through 2002, 291 individuals were identified who developed an acute occupational pesticide-related illness or injury from pesticide exposures incurred while engaged in emergency response or from care of a pesticide-contaminated patient. Of these, 183 (63%) were identified by SENSOR/CDPR, and 108 (37%) by HSEES (9 cases were identified by both SENSOR and HSEES, and were included in the SENSOR/CDPR totals only) (Table I). Most of those identified were firefighters (111 [38%]) or law enforcement officers (104 [36%]) (Tables I and II). The median age among the ill emergency responders was 34 years (range: 17–64 years) and 89% were male. Among the 183 SENSOR/CDPR cases, 40 (22%) were classified as definite, 89 (49%) as probable, 23 (13%) as possible, and 31 (17%) as suspicious. There were 119 separate pesticide exposure events identified, and the median number of ill emergency responders per event was 2 (range 1–22). Most events (n = 55, 46%) involved only 1 ill emergency responder, and among the 64 multi-victim events, the median number of ill emergency responders per event was 3. The largest event occurred in Texas in 1994 and involved aldicarb exposure leading to low severity illness among 22 unspecified emergency responders who wore no PPE.

Incidence Rates

Between 1993 and 2002, the average annual incidence rate among emergency responders was 33.6/million emergency responder FTEs (Table II). The incidence rates demonstrated a statistically significant decreasing trend ($P < 0.01$) between 1993 and 2002, although the decrease was not monotonic (Table III, Fig. 1). A similar decrease in rates over time was observed for all other non-agricultural workers (Fig. 1). The incidence rates were highest among firefighters. Among US geographic regions, the incidence rate was highest among emergency responders in the West region states (Table IV).

Incidence Rate Ratios

Overall, the rate of acute occupational pesticide-related illness was significantly higher among those engaged in emergency response activities, compared to the rate among all non-agricultural workers (IRR = 2.13, 95% CI = 1.86, 2.44) (Tables II and III). The IRRs were elevated for all categories of emergency responders (i.e., firefighters, law enforcement officers, and emergency medical technicians) (Table II). The IRR was found to be highest in the Northeast (Table IV).

Pesticides Responsible for Illness

Information on the pesticides responsible for acute occupational pesticide-related illness in emergency responders is provided in Table I. Insecticides alone were responsible for 51% of the illnesses, and insecticides combined with another pesticide were responsible for an additional 4% of cases. Among the insecticides, organophosphates (n = 76), pyrethroids (n = 31), and carbamates (n = 22) were most commonly responsible. Specific organophosphate insecticides included malathion (n = 42), phorate (n = 14), and diazinon (n = 10). Among the specific pyrethroids associated with illness were, esfenvalerate (n = 14), cyfluthrin (n = 7), and allethrin (n = 7). Aldicarb (n = 22) was the specific carbamate most commonly associated with illness in emergency responders (all aldicarb-related illnesses occurred in a single event). Fumigants were also responsible for a high proportion of

TABLE I. Severity of Acute Pesticide-Related Illness and Associated Factors, 1993–2002

	Moderate severity illness (n = 30)	Low severity illness (n = 261)	Total (N = 291)
Age, mean (range)	31.8 (18–53)	34.7 (17–64)	34.3 (17–64)
Male (%)	27 (90)	228 (89)	255 (89)
Occupation (%)			
Firefighter[a]	11 (37)	100 (38)	111 (38)
Law enforcement	14 (47)	90 (34)	104 (36)
Emergency medical technicians	5 (17)	29 (11)	34 (12)
Unspecified responder[b]	0	42 (16)	42 (14)
Organ system involved (%)			
Respiratory	27 (90)	172 (66)	199 (68)
Neurological	19 (63)	127 (49)	146 (50)
Gastrointestinal	12 (40)	102 (39)	114 (39)
Eyes	11 (37)	69 (26)	80 (27)
Skin	5 (17)	40 (15)	45 (15)
Cardiac	9 (30)	11 (4)	20 (7)
Pesticide functional class (%)			
Insecticide	21 (70)	128 (49)	149 (51)
Fumigant	3 (10)	45 (17)	48 (17)
Disinfectant	1 (3)	32 (12)	33 (11)
Herbicide	1 (3)	37 (14)	38 (13)
Fungicide	1 (3)	5 (2)	6 (2)
Multiple functional classes	3 (10)	14 (5)	17 (6)
Pesticide acute toxicity category (%)			
I	12 (40)	131 (50)	143 (49)
II	1 (3)	36 (14)	37 (13)
III	15 (50)	79 (30)	94 (32)
Unknown	2 (7)	15 (6)	17 (6)
Source of report (%)			
SENSOR-Pesticides/CDPR	26 (87)	157 (60)	183 (63)
HSEES	4 (13)	104 (40)	108 (37)
Total	30 (10)	261 (90)	291

[a]The number includes both paid (career, n = 47), and unpaid (volunteer, n = 42) firefighters. Also included are firefighters for whom career versus volunteer status is unknown (n = 22).
[b]This category consists of cases identified by HSEES as "responder (unknown type)."

cases (17%), most commonly chloropicrin (n = 28). Finally, herbicides (13%) and disinfectants (11%) were responsible for substantial numbers of cases. Common herbicides included glyphosate (n = 9) and atrazine (n = 7), while common disinfectants included chlorine (n = 8), sodium hypochlorite (n = 7), and calcium hypochlorite (n = 7).

Information on the EPA acute toxicity category was available for 274 (94%) of the cases. Of these, 143 (52%) were exposed to acute toxicity category I pesticides, 37 (14%) to category II pesticides, and 94 (34%) to category III pesticides. However, it should be noted that several emergency responders were exposed to fumes from burning pesticides. It is not known if the combustion fumes have the same toxicity as the parent compound.

Illness Severity

Most of the acute occupational pesticide-related illnesses among emergency responders were of low severity (261/291 [90%]) (Table I). Severity was moderate in 10% of the cases. No deaths and no cases of high severity were identified. Law enforcement officers accounted for the largest proportion of moderate severity illnesses (47%). Information on whether the illness resulted in lost time from work was available for 145 emergency responders. Among these 145, 36 (25%) had lost time (median lost time = 1 day, range 1–32 days). Those exposed to insecticides were more likely to have moderate severity illness (insecticide exposed = 14%, all others = 6%, $P = 0.01$) and lost time

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TABLE II. Total Numbers of Cases of Acute Occupational Pesticide-Related Illness, Full Time Equivalent Estimates, Incidence Rates, and Incidence Rate Ratios, by Occupation, 1993–2002

Occupation (1990 BOC occupation codes)	Number (%) with acute occupational pesticide-related illness	FTE estimates[a]	Incidence rate[b]	Incidence rate ratio (95% CI)[c]
All	291 (100)	7.12	33.57	2.13 (1.86, 2.44)
Firefighters[d] (416, 417)	111 (38)	1.51	39.07	2.67 (2.05, 3.47)
Law enforcement (418, 423)	104 (36)	3.91	26.60	1.69 (1.38, 2.07)
Emergency medical technicians (089, 208, 446 where 1990 BOC industry codes = 401, 831, or 910)	34 (12)	1.70	20.00	1.22 (0.84, 1.77)
Unspecified responder or other[e]	42 (14)	—	—	—

BOC = US Bureau of the Census; FTE = full time equivalent

[a]In millions.

[b]Per million FTEs

[c]Compares the risk of an acute occupational pesticide-related illness among category of interest with all other non-agricultural workers. Only includes cases identified in states participating in SENSOR. The incidence rate among all other non-agricultural workers in the SENSOR states was 19.27/million FTEs

[d]The number includes both paid (career, n = 47), and unpaid (volunteer, n = 42) firefighters. Also included are firefighters for whom career vs volunteer status is unknown (n = 22). However, because denominator data are unavailable for volunteer firefighters, the incidence rate includes the career firefighters and 12 of the unspecified firefighters only (12 of the unspecified firefighters were assumed to be career, as this represents the proportion [53%] who were career among those with known career vs. volunteer status).

[e]This category consists of cases identified by HSEES as "responder (unknown type)". Although an incidence rate was not separately calculated for this category, these responders were included in the overall incidence rate.

from work (insecticide exposed = 26%, all others = 15%, $P = 0.09$) compared to those exposed to all other pesticides. Neither severity ($P = 0.09$) nor lost time from work ($P = 0.40$) was associated with the EPA acute toxicity category assigned to the pesticide. Most cases (268, 92%) were evaluated and treated in a health care facility, and 8 (3%) of these were hospitalized. For all pesticides combined, the most commonly observed effects involved the respiratory system (68% of emergency responders reported health effects involving this system), followed by neurological (50%) and gastrointestinal effects (39%). Effects on the eyes (27%) and skin (15%) were less commonly reported.

TABLE III. Numbers of Cases of Acute Occupational Pesticide-Related Illness, Full Time Equivalent Estimates, Incidence Rates, and Incidence Rate Ratios, by Year, 1993–2002

	Emergency response workers			All other non-agricultural workers			
Year	Number with acute occupational pesticide-related illness	FTE estimates[a]	Incidence rate[b,c]	Number with acute occupational pesticide-related illness	FTE estimates[a]	Incidence rate[b,c]	Incidence rate ratio (95% CI)[d]
1993	29	0.51	54.90	1,017	33.13	30.70	2.33 (1.60, 3.39)
1994	41	0.54	68.52	973	33.08	29.41	2.93 (2.08, 4.12)
1995	43	0.62	66.13	990	33.54	29.52	2.66 (1.89, 3.74)
1996	45	0.60	43.33	1,012	34.22	29.57	1.61 (1.02, 2.53)
1997	26	0.63	34.92	754	35.52	21.23	2.17 (1.39, 3.38)
1998	17	0.77	12.99	790	42.37	18.65	0.92 (0.49, 1.72)
1999	19	0.78	24.36	666	45.47	14.65	2.17 (1.38, 3.42)
2000	31	0.84	28.57	613	51.15	11.98	3.43 (2.30, 5.12)
2001	21	0.96	19.79	501	50.46	9.93	2.20 (1.34, 3.62)
2002	19	0.86	15.12	526	48.04	10.95	1.17 (0.58, 2.34)
Total	291	7.12	33.57	7,842	406.98	19.27	2.13 (1.86, 2.44)

FTE full time equivalent

[a]In millions

[b]Per million FTEs

[c]Volunteer firefighters were excluded from the rate calculations. A statistically significant decreasing trend between 1993 and 2002 was found for the incidence rates ($P < 0.01$)

[d]Compares the risk of an acute occupational pesticide-related illness among category of interest with all other non-agricultural workers. Only includes cases identified in states participating in SENSOR

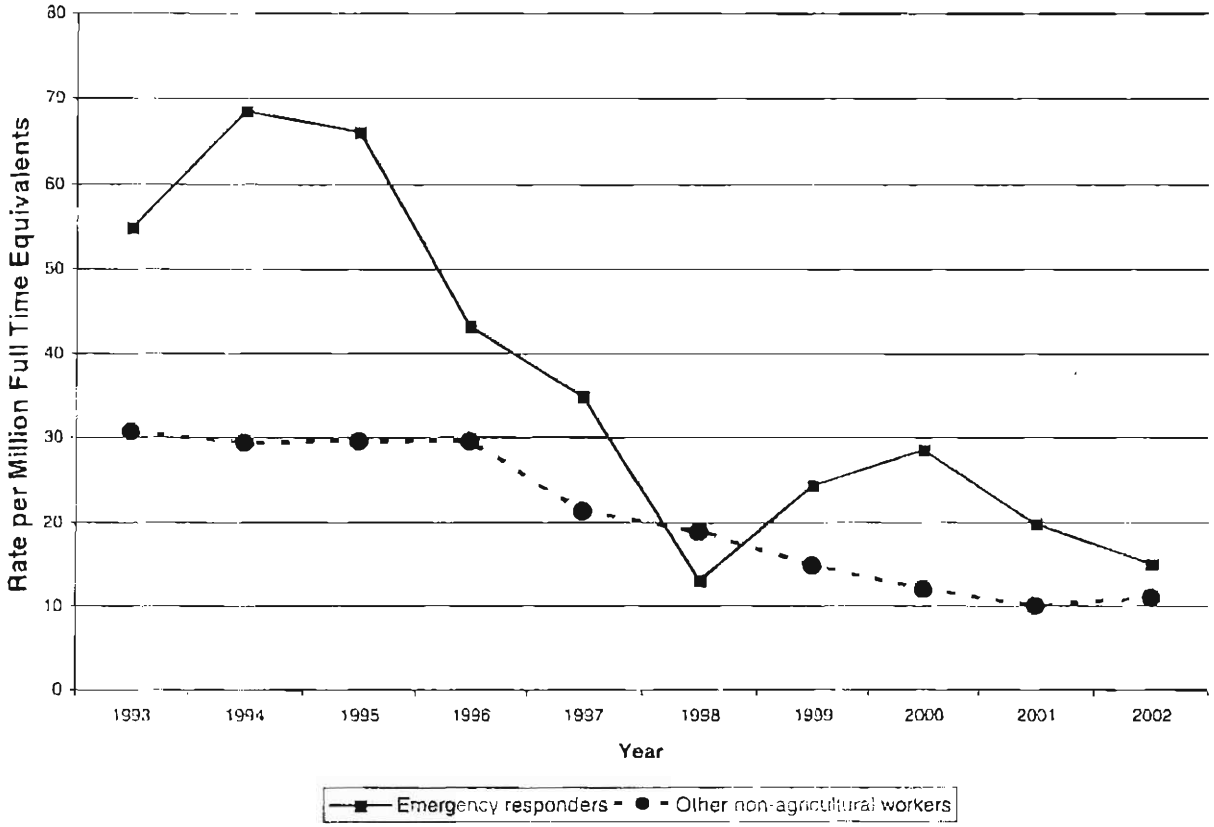

FIGURE 1. Rate of pesticide poisoning among emergency responders and other non-agricultural workers, 1993–2002.

TABLE IV. Numbers of Cases of Acute Occupational Pesticide-Related Illness, Full Time Equivalent Estimates, Incidence Rates, and Incidence Rate Ratios, by US Region, 1993–2002

	Emergency response workers			All other non-agricultural workers			
Region	Number with acute occupational pesticide-related illness	FTE estimates[a]	Incidence rate[f,g]	Number with acute occupational pesticide-related illness	FTE estimates[a]	Incidence rate[f]	Incidence rate ratio (95% CI)[h]
Midwest[b]	32	0.77	14.29	58	13.14	4.41	—
Northeast[c]	20	1.38	10.87	220	73.91	2.98	4.31 (2.55, 7.27)
South[e]	68	2.37	21.52	768	127.82	6.01	4.11 (2.99, 5.65)
West[d]	171	2.60	62.31	6,796	192.11	35.38	1.98 (1.69, 2.31)
Total	291	7.12	33.57	7,842	406.98	19.27	2.13 (1.86, 2.44)

FTE, full time equivalent

[b]Iowa, Michigan, Minnesota, Missouri, Wisconsin

[c]New Hampshire, New Jersey, New York, Rhode Island

[e]Alabama, Florida, Louisiana, Mississippi, North Carolina, Texas

[d]Arizona, California, Colorado, Oregon, Utah, Washington State

[f]In millions

[g]Per million FTEs

[a]Volunteer firefighters were excluded from the rate calculations

[h]Compares the risk of an acute occupational pesticide-related illness among category of interest with all other non-agricultural workers. Only includes cases identified in states participating in SENSOR. No cases were identified in Midwest states participating in SENSOR.

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Activities Associated With Illness

Job activities associated with illness were also identified. Of the 200 individuals with available information on job activity (this information was not available for 84% of cases identified by HSEES) most (n = 168, 84%) were exposed while investigating or responding to a fire or another type of pesticide release. Most of these were law enforcement officers (n = 95) or firefighters (n = 62). The remainder (n = 32, 16%) had evidence suggesting that their pesticide exposure occurred while caring for a pesticide-contaminated patient, including contact with contaminated clothing or body fluids. Most of these individuals were emergency medical technicians (n = 19). The remainder were firefighters (n = 9) and law enforcement officers (n = 4).

Information on use of PPE was available for 193 (66%) individuals (Table V). PPE was used by 42% (n = 81) of these emergency responders. The proportions who wore PPE varied significantly across the emergency response occupations ($P < 0.01$). Firefighters (77%) were most likely to wear PPE. The type of PPE worn is provided in Table V.

Representative Events

Two representative events that were detected through these surveillance efforts are briefly described below:

Event 1

In 2000 in California, several emergency responders went to a home where an individual committed suicide by ingesting and dousing himself with malathion. When the emergency responders arrived, they were not aware of the identity of the chemical. An unlabeled container sat next to the suicide victim. The chemical was not identified to be malathion until after the patient was taken to the coroner. A total of nine emergency responders (four firefighters, three police officers, and two paramedics) developed low severity illness classified as probable. It is unknown whether cholinesterase testing was performed. Four were exposed while attempting to resuscitate the suicide victim or during transport, and five were exposed to the strong odor coming from the home. All of the responders wore hand protection (rubber or latex gloves) but none wore a respirator.

Event 2

In Florida in 2000, nine emergency responders developed acute pesticide-related illness when responding to a chemical fire on a farm where a tractor exploded. The tractor was carrying organophosphate insecticides, including phorate. The nine ill responders included six firefighters, two paramedics, and one police officer. Three had moderate severity illness classified as definite, and six had low severity illness classified as probable. All had involvement of the respiratory system, including upper airway irritation (n = 7), dyspnea (n = 2), chest pain (n = 2), and cough (n = 2). All received medical attention, and none were hospitalized. Five had cholinesterase concentrations measured, but all were within the laboratory normal range. Information on usage of PPE was not available.

DISCUSSION

Our findings of acute pesticide-related illness among emergency responders demonstrate that there are risks of placing oneself in harm's way while protecting others. Fortunately, the overall incidence rates were very low suggesting that pesticide emergency events may be rarely encountered. The rates may be low because the incidence of pesticide release events are low and/or because those who are present at release events are not exposed to pesticides. Zeitz

TABLE V. Type of Personal Protective Equipment Worn by Emergency Responder Occupation (n = 193*)

Type of PPE	Firefighters (n = 77)	Law enforcement officers (n = 60)	Emergency medical technicians (n = 14)	Unspecified responder (n = 42)	All (n = 193)
Respirator					
Supplied air	8	0	0	0	8
Air purifying	3	0	0	0	3
Dust mask/disposable	0	0	0	0	0
Eye protection					
Goggles/faceshield	45	0	1	12	58
Hand protection					
Synthetic	44	3	5	12	64
Cloth/leather	14	1	0	1	16
Total (used any PPE)	59 (77%)	4 (7%)	5 (36%)	13 (31%)	81 (42%)

*Information on PPE use was available for only 193 (66%) of the emergency responders identified with acute occupational pesticide poisoning.

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et al. [2000] found that pesticides were involved in just 8% of hazardous substances emergency events identified by HSEES. Nonetheless, because the risk exists, mechanisms are needed to rapidly and efficiently provide emergency responders with information both on the hazards they face, whether they be pesticides or other hazardous materials, and the PPE that is needed to prevent exposures to these hazards. Emergency responders also need to be trained on the nature and characteristics of these hazards and on the appropriate use and limitations of PPE. It is also recognized that the initial phases of an emergency response are often chaotic, and that ensuring and enforcing appropriate PPE use may be difficult as it is not unusual for these responders to have a mindset of "risk a life to save a life" [Jackson et al., 2002].

The incidence rate for all emergency responders combined decreased across time (Table III). It is not clear what was responsible for this decline. Among the possibilities are an overall decrease in emergency pesticide events, especially events involving highly toxic pesticides, and/or emergency responders making greater efforts to avoid exposure, especially after the lessons learned from the Tokyo subway sarin attack in 1995 [Nozaki et al., 1995].

The incidence of acute pesticide-related illness was highest among emergency responders in the West region states, which included California and Washington State. California and Washington State have the longest running surveillance programs and have greater staffing levels compared to surveillance programs in the other states. These characteristics have previously been cited to explain the higher overall pesticide poisoning incidence rates observed in these states [Calvert et al., 2004], and this likely is the explanation for our findings.

Firefighters

Firefighters had the highest incidence of acute pesticide-related illness, almost three times that of other non-agricultural workers. There are several potential explanations for these higher risks. For example, firefighters are often first to arrive at an emergency event and may be exposed before the pesticide hazards are identified. In addition, firefighters may feel a false sense of security by wearing turnout gear (helmet with facepiece, coat, pants, boots, and gloves), when in reality this gear may not protect against inhalation and dermal absorption of pesticides. Although most firefighters wore turnout gear, this PPE was insufficient to prevent acute pesticide-related illness. Few firefighters wore respiratory protection. This has been documented by other investigators who studied firefighters exposed to other inhalational hazards [Austin et al., 2001; Feldman et al., 2004]. In addition to the need for improved PPE and training on its use, firefighters need monitoring equipment that can quickly and accurately assess the chemical hazards that are present at emergency events.

Law Enforcement Officers

Law enforcement officers were also found to have a statistically significantly elevated risk of acute pesticide poisoning compared to other non-agricultural workers. Compared to other emergency responders, law enforcement officers were the least likely to wear PPE. In all probability, this is because law enforcement officers generally are not provided with PPE unless they are members of a specialized response team [Jackson et al., 2002]. Our findings reinforce the need for law enforcement officers to be given appropriate PPE and training on its proper use.

Emergency Medical Technicians

Emergency medical technicians were found to have the lowest pesticide poisoning rates among emergency responders, but their rates were elevated compared to all other workers employed in non-agricultural industries. One reason for this may be because emergency medical technicians are called to emergency events to care for the ill or injured, and not to directly control, contain, or confine the emergency event (e.g., put out a fire, clean up a spill, or police an area). An emergency medical technician's exposure is more likely to be remote from where the pesticide release occurred, and their exposure is often limited to the quantity of pesticide on the patient, their clothing or personal effects. Although some poisoned emergency medical technicians wore PPE, this usually consisted only of synthetic gloves. Such PPE was inadequate to prevent pesticide poisoning.

Emergency medical technicians usually will care for patients before they have been decontaminated. Ideally, patients should be promptly decontaminated and emergency medical services need to develop and adhere to decontamination protocols [Pons and Dart, 1999; Macintyre et al., 2000]. Recommendations are available for preventing acute pesticide-related illness among health care professionals who are involved with medical stabilization of contaminated patients or involved with decontamination [Agency for Toxic Substances and Disease Registry, 2001; CDC, 2001b; OSHA, 2004; 29 CFR 1910.120]. At a minimum, these include use of level C protection (i.e., full face mask and powered/non-powered canister/cartridge filtration respirator, and non-encapsulated chemical-resistant suit, gloves, and boots). With level C protection, the type of canister/cartridge should be appropriate to the pesticide; if the pesticide cannot be identified, a high efficiency particulate air (HEPA)/organic vapor/acid gas cartridge is recommended [OSHA, 2004]. In many pesticide-related emergencies, the specific pesticide may be unknown, resource materials (e.g., pesticide label, material data safety sheet) may not be readily handy, and efforts to obtain this information may delay administering medical care to the

patient [Levitin and Siegelson, 1996]. Given these constraints and the rarity with which emergency medical technicians will encounter a pesticide-contaminated patient, one all-inclusive PPE policy should be adopted by emergency medical services when caring for these patients. This PPE policy should minimize confusion, allow timely donning of PPE, and permit quick provision of medical care to patients by emergency medical technicians who are adequately protected. Emergency medical technicians should stay upwind and upgrade from any hazardous releases. Note that level C protection does not maximally guard the skin and lungs. Entry into areas with known or suspected hazardous materials contamination requires a determination that the PPE worn affords adequate protection. In addition to adhering to these guidelines, emergency medical services need to train staff in the proper use of PPE [Pons and Dart, 1999; Macintyre et al., 2000]. Emergency responders who may need to wear respiratory protection must be deemed medically fit to do so according to the OSHA Respiratory Protection Standard (29 CFR 1910.134).

Limitations

Our data and analysis have several potential limitations. The illness rates that we observed are likely to be underestimates since many emergency responders may not have been ascertained. Many are never identified because they neither seek medical care, nor contact appropriate authorities (e.g., poison control). Furthermore, because the signs and symptoms of acute pesticide-related illness are not pathognomonic, many emergency responders/health care professionals who seek medical care may not be correctly diagnosed and therefore are not ascertained. Even among those who are correctly diagnosed, many are not reported, despite the fact that 30 states have mandatory reporting of occupational pesticide-related illness [Calvert et al., 2001]. However, some of the cases identified in this report may be false positive cases because non-specific symptoms may have been coincidental and not caused by the exposure. In addition, because only CDPR and HSEES capture cases associated with disinfectant exposure, the magnitude of disinfectant cases described in this report may be underestimated.

For 14% of our cases, the specific occupational title of the responder was not available. The incidence rates for firefighters, law enforcement personnel, and emergency medical technicians would likely increase if the specific occupation of these cases was known. In addition, little information was available to assign severity to the cases identified by HSEES. Only 4% of HSEES cases were identified as having moderate severity, which is significantly lower than the 14% of SENSOR/CDPR cases with moderate severity ($P < 0.01$). It is possible that the number of moderate severity HSEES cases was underestimated.

TABLE VI. Recommendations to Prevent Acute Pesticide-Related Illness Among Emergency Responders

Findings and Recommendations
• Pesticide emergency events are relatively rare, and emergency responders may be unfamiliar with pesticide hazards
• Firefighter turnout gear may not protect against pesticide exposure
• Mechanisms are needed to rapidly provide emergency responders with information on the pesticide hazards at a scene
• Emergency responders need to wear appropriate PPE when responding to pesticide events
• Respiratory protection is especially important (65% of responders reported respiratory symptoms)
• Emergency responders need to be trained on the appropriate use and limitations of PPE
• Emergency responders need to know how to locate information on chemical hazards

It would have been useful to determine the incidence of pesticide illness among emergency responders who specifically attended a pesticide-related emergency. Knowing this illness incidence would have provided a truer estimate of risks associated with such events; however, this denominator information was not available.

CONCLUSION

Emergency personnel responding to pesticide release events have an increased risk of pesticide poisoning compared to all other workers employed in non-agricultural industries. Fortunately, the overall pesticide poisoning incidence rates were very low among emergency responders. Among emergency responders, the incidence rates were highest for firefighters. A vast majority of the illnesses were of low severity. The mitigation efforts we recommend are relevant regardless of the size of the pesticide emergency, whether it is a small scale emergency or a catastrophic terrorist attack (Table VI). Emergency responders are placed in harm's way whenever they respond to an emergency chemical event, including those involving pesticides. It is essential to reduce these risks and protect the health of responders.

ACKNOWLEDGMENTS

The authors thank the Agency for Toxic Substances and Disease Registry, Hazardous Substances Emergency Events Surveillance System, and Maureen Orr for kindly providing access to their data, and Jia Li for securing the CPS data and adapting it for our purposes. The authors also thank Thomas Hales, Jefferey Burgess, and David Ippolito for kindly reviewing an earlier version of this manuscript.

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Acute Illnesses Associated With Pesticide Exposure at Schools

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Context Pesticides continue to be used on school property, and some schools are at risk of pesticide drift exposure from neighboring farms, which leads to pesticide exposure among students and school employees. However, information on the magnitude of illnesses and risk factors associated with these pesticide exposures is not available.

Objective To estimate the magnitude of and associated risk factors for pesticide-related illnesses at schools.

Design, Setting, and Participants Analysis of surveillance data from 1998 to 2002 of 2593 persons with acute pesticide-related illnesses associated with exposure at schools. Nationwide information on pesticide-related illnesses is routinely collected by 3 national pesticide surveillance systems: the National Institute for Occupational Safety and Health's Sentinel Event Notification System for Occupational Risks pesticides program, the California Department of Pesticide Regulation, and the Toxic Exposure Surveillance System.

Main Outcome Measures Incidence rates and severity of acute pesticide-related illnesses.

Results Incidence rates for 1998-2002 were 7.4 cases per million children and 27.3 cases per million school employee full-time equivalents. The incidence rates among children increased significantly from 1998 to 2002. Illness of high severity was found in 3 cases (0.1%), moderate severity in 275 cases (11%), and low severity in 2315 cases (89%). Most illnesses were associated with insecticides (n=895, 35%), disinfectants (n=830, 32%), repellents (n=335, 13%), or herbicides (n=279, 11%). Among 406 cases with detailed information on the source of pesticide exposure, 281 (69%) were associated with pesticides used at schools and 125 (31%) were associated with pesticide drift exposure from farmland.

Conclusions Pesticide exposure at schools produces acute illnesses among school employees and students. To prevent pesticide-related illnesses at schools, implementation of integrated pest management programs in schools, practices to reduce pesticide drift, and adoption of pesticide spray buffer zones around schools are recommended.

JAMA 2005;294:455-465 www.jama.com

EXPOSURE TO PESTICIDES IN THE school environment is a health risk facing children and school employees. Despite efforts of several organizations and laws in several states to reduce pesticide use at and around schools,[1] pesticides continue to be used in schools.[2] Another source of pesticide exposure at schools is from pesticides used on farmland contiguous to school facilities. However, as a result of the work of the US Environmental Protection Agency (EPA), advocacy groups, universities, state regulators, the pest control industry, and others, and laws or strong voluntary programs in several states, pesticide use has been reduced in some school districts.[3]

Currently, there are no specific federal requirements on limiting pesticide exposures at schools. Under the Federal Insecticide, Fungicide, and Rodenticide Act, pesticides must be regis-

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tered with the EPA before they are sold or distributed.[4] The Food Quality Protection Act[5] of 1996 amended the Federal Insecticide, Fungicide, and Rodenticide Act, bolstering the protection of children through requiring that pesticides used on foods produce no harm. However, there are no specific provisions in these laws about the use of pesticides at schools.[1,6]

The Federal Insecticide, Fungicide, and Rodenticide Act is often supplemented by more stringent state pesticide laws to protect children from pesticides at schools. For example, 18 states recommend (n=6) or require (n=12) schools to use integrated pest management strategies and 7 states restrict pesticide applications in areas neighboring a school.[7] However, there are still large gaps throughout the country where children may not be afforded adequate protection.[1,8]

Pesticide poisoning is a commonly underdiagnosed illness in the United States today. The clinical findings of acute pesticide poisoning are rarely pathognomonic but instead can resemble acute upper respiratory tract illness, conjunctivitis, or gastrointestinal illness, among other conditions. Detailed description of the diverse syndromes associated with different types of pesticides is available.[9]

Although some information about acute illnesses associated with pesticide exposures at schools is available,[10,11] there has not been an effort to provide a nationwide summary of this health problem. To estimate the magnitude of and the risk factors for pesticide-related illnesses associated with exposures at schools, we examined information from state-based pesticide poisoning surveillance systems (the National Institute for Occupational Safety and Health's Sentinel Event Notification System for Occupational Risks [SENSOR] pesticides program and the California Department of Pesticide Regulation [CDPR]), and the Toxic Exposure Surveillance System (TESS), which is a national database of all calls made to poison control centers and is maintained by the American Association of Poison Control Centers.[12,13]

METHODS

Study Design and Participants

School employees, parents, and students who developed acute pesticide-related illnesses from pesticide exposure at child care centers and elementary and secondary schools from 1998 to 2002 were identified (TABLE 1). Data were obtained from states participating in the SENSOR pesticides program (California, Washington, Texas, Florida, Louisiana, New York, Oregon, and Michigan), CDPR (California), and TESS (all US states and District of Columbia, with the exception of Hawaii). The data used in these analyses were surveillance data and as such are exempt from consideration by the human subjects review board and need for informed consent. Integrating data from these 3 surveillance systems provides the best available understanding of the problem of pesticide poisoning at schools. The states participating in the SENSOR and CDPR programs obtain information from multiple sources (government agencies, poison control centers, and reports from health care organizations) and conduct active case follow-up.[12] In addition, all cases identified by the CDPR are referred to the relevant county agricultural commissioner who investigates the exposure circumstances.[10,12] The TESS data are provided by approximately 67 US poison control centers.[13] Approximately 13% of their calls come from physicians treating patients who are exposed and 87% come from patients or their relatives.[12,13]

Table 1. Type of Information Provided by Surveillance Systems, 1998-2002

Available Information	Pesticide Surveillance System		
	SENSOR*	CDPR	TESS†
Occupation of cases provided	Yes	Yes	No
Source of exposure provided (pesticides applied on school grounds vs pesticide drift)	Yes	Yes	No
Nonoccupational cases provided	Yes: Florida, Louisiana, New York, Oregon, Texas, Washington No: California, Michigan	Yes	Yes
Information on disinfectants provided	Yes: Florida, Louisiana, Michigan No: California, New York, Oregon, Texas, Washington	Yes	Yes
Years data were available	1998-2002: California, Florida, Louisiana, New York, Oregon, Texas 2000-2002: Michigan, Washington	1998-2002	1998-2002
Types of schools included	Public and private elementary and secondary schools, child care centers	Public and private elementary and secondary schools, child care centers	Elementary and secondary schools, colleges, universities, child care centers

Abbreviations: CDPR, California Department of Pesticide Regulation; SENSOR, Sentinel Event Notification System for Occupational Risks; TESS, Toxic Exposure Surveillance System.
*Includes Texas, Washington, Florida, Louisiana, California, New York, Oregon, and Michigan.
†Cases included information from all US states and District of Columbia, with the exception of Hawaii.

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Cases were included if health effects developed subsequent to pesticide exposure and if these effects were consistent with the known toxicology of the pesticide product, as determined by state surveillance professionals (SENSOR and CDPR cases) or a poison control center specialist (TESS cases). The states participating in the SENSOR pesticides program adopted a standardized case definition in 1998, and CDPR uses a similar case definition. Briefly, the case definition required information on pesticide exposure, health effects, and evidence supporting an association between the pesticide exposure and the health effects. A full description of the standardized case definition has been previously published.[12] Identification of TESS cases relied on the experience and judgment of the poison control center specialist managing the specific case. Multiple cases exposed in a single exposure incident were identified as 1 exposure event. Exclusion criteria included exposure to substances other than pesticides, suicides, intentional abuse, and malicious use.

SENSOR and CDPR primarily capture work-related pesticide poisoning cases, whereas TESS primarily captures non–work-related cases (Table 1). Detailed information on work-related cases was provided by SENSOR and CDPR only. The SENSOR and CDPR cases were further classified into exposure to *pesticides applied on school grounds* when indoor and outdoor pesticide applications on school grounds resulted in illness, and to *pesticide drift* when pesticide drift from applications to neighboring farmland resulted in illness among students and school employees.

For the present analyses, the toxicity category of the pesticide product was retrieved from a data set made available by the EPA. The EPA assigns acute toxicity category I to the most toxic pesticide products and category IV to the least toxic pesticide.[14]

Illness severity was categorized for SENSOR and CDPR cases using standardized criteria.[15] State agencies classified severity for the cases they identified in 2001 and 2002. Two authors (W.A.A. and G.M.C.) assigned severity to 1998-2000 SENSOR cases, all CDPR cases, and all TESS cases.[16] High severity includes cases in which the illness or injury is severe enough to be considered life-threatening and commonly involves hospitalization to prevent death. Signs and symptoms include seizures and pulmonary edema. Moderate severity illness or injury includes cases of less severe illness or injury often involving systemic manifestations requiring treatment. The individual is able to return to normal functioning without any residual disability. Low severity illness or injury typically resolves without treatment and is often manifested by skin, eye, or upper respiratory tract irritation.[15]

Table 2. Characteristics of Acute Pesticide-Related Illnesses by Surveillance Systems, 1998-2002

	No. (%)		
	SENSOR and CDPR (n = 406)	TESS (n = 2187)	Total (N = 2593)
Age group			
Children	149 (36.7)	1831 (83.7)	1980 (76.4)
Adults	254 (62.6)	274 (12.5)	528 (20.4)
Unknown	3 (0.7)	82 (3.7)	85 (3.3)
Sex			
Female	245 (60.3)	920 (42.1)	1165 (44.9)
Male	143 (35.2)	1166 (53.3)	1309 (50.5)
Unknown	18 (4.4)	101 (4.6)	119 (4.6)
Pesticide toxicity category*			
I	154 (37.9)	183 (8.4)	337 (13.0)
II	49 (12.1)	225 (10.3)	274 (10.6)
III	200 (49.3)	875 (40.0)	1075 (41.5)
Undetermined	3 (0.7)	904 (41.3)	907 (35.0)
Pesticide functional class			
Insecticides only	186 (45.8)	625 (28.6)	811 (31.3)
Insecticides combined†	84 (20.7)	0	84 (3.2)
Disinfectants	99 (24.4)	731 (33.4)	830 (32.0)
Repellents	3 (0.7)	332 (15.2)	335 (12.9)
Herbicides	21 (5.2)	258 (11.8)	279 (10.8)
Fungicides	0	102 (4.7)	102 (3.9)
Rodenticides	0	93 (4.3)	93 (3.6)
Fumigants	9 (2.2)	1 (0.1)	10 (0.4)
Other pesticide class	4 (1.0)	45 (2.0)	49 (1.9)
Severity‡			
High	1 (0.3)	2 (0.1)	3 (0.1)
Moderate	59 (14.5)	216 (9.9)	275 (10.6)
Low	346 (85.2)	1969 (90.0)	2315 (89.3)
Year of exposure			
1998	74 (18.2)	373 (17.1)	447 (17.2)
1999	114 (28.1)	408 (18.7)	522 (20.1)
2000	105 (25.9)	422 (19.3)	527 (20.3)
2001	43 (10.6)	494 (22.6)	537 (20.7)
2002	70 (17.2)	490 (22.4)	560 (21.6)
Total	406 (15.7)	2187 (84.3)	2593 (100.0)

Abbreviations: CDPR, California Department of Pesticide Regulation; SENSOR, Sentinel Event Notification System for Occupational Risks; TESS, Toxic Exposure Surveillance System.

*The US Environmental Protection Agency assigns category I to the most acutely toxic pesticide products and category IV to the least acutely toxic pesticide product.

†Includes cases exposed to insecticides in combination with other pesticides.

‡High severity includes cases in which the illness or injury is severe enough to be considered life-threatening and commonly involves hospitalization to prevent death. Moderate severity illness or injury includes cases of less severe illness or injury often involving systemic manifestations requiring treatment (the individual is able to return to normal functioning without any residual disability) and low severity illness or injury is often manifested by skin, eye, or upper respiratory tract irritation (it may also include fever, headache, fatigue, or dizziness) and typically the illness or injury resolves without treatment.

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Table 3. Severity of Acute Pesticide-Related Illness and Associated Factors, 1998-2002

	No. (%)		
	Moderate Severity Illness (n = 275)	Low Severity Illness (n = 2315)	Total (N = 2593)*
Age group			
Children	150 (7.6)	1829 (92.4)	1980 (76.4)
Adults	92 (17.4)	434 (82.2)	528 (20.4)
Unknown	33 (38.8)	52 (61.2)	85 (3.3)
Sex			
Female	132 (11.3)	1030 (88.4)	1165 (44.9)
Male	104 (7.9)	1205 (92.1)	1309 (50.5)
Unknown	39 (32.8)	80 (67.2)	119 (4.6)
Pesticide toxicity category†			
I	59 (17.5)	278 (82.5)	337 (13.0)
II	19 (6.9)	255 (93.1)	274 (10.6)
III	129 (12.0)	944 (87.8)	1075 (41.5)
Undetermined	68 (7.5)	838 (92.4)	907 (35.0)
US region‡			
Midwest	86 (13.2)	564 (86.8)	650 (25.1)
Northeast	54 (12.9)	362 (86.6)	418 (16.1)
Southeast	64 (8.4)	701 (91.5)	766 (29.5)
West	69 (9.2)	682 (90.8)	751 (29.0)
Unspecified	2 (25.0)	6 (75.0)	8 (0.3)
Pesticide functional class			
Insecticides only	80 (9.9)	728 (89.8)	811 (31.3)
Insecticides combined§	3 (3.6)	81 (96.4)	84 (3.2)
Disinfectants	101 (12.2)	729 (87.8)	830 (32.0)
Repellents	21 (6.3)	314 (93.7)	335 (12.9)
Herbicides	41 (14.7)	238 (85.3)	279 (10.8)
Fungicides	3 (2.9)	99 (97.1)	102 (3.9)
Rodenticides	2 (2.2)	91 (97.8)	93 (3.6)
Fumigants	4 (40.0)	6 (60.0)	10 (0.4)
Other pesticide class	20 (40.8)	29 (59.2)	49 (1.9)
Pesticide chemical class			
Organophosphorous compound	30 (10.8)	248 (89.2)	278 (10.7)
Organophosphorous combined‖	11 (14.9)	63 (85.1)	74 (2.9)
Inorganic compounds	35 (15.4)	192 (84.6)	227 (8.8)
Inorganic compounds combined‖	3 (30.0)	7 (70.0)	10 (0.4)
Pyrethrins	5 (6.8)	69 (93.2)	74 (2.9)
Pyrethrins combined‖	6 (13.3)	39 (86.7)	45 (1.7)
Indandiones	7 (8.5)	75 (91.5)	82 (3.2)
Indandiones combined‖	3 (11.1)	24 (88.9)	27 (1.0)
Pyrethroids	8 (11.3)	62 (87.3)	71 (2.7)
Pyrethroids combined‖	3 (11.5)	23 (88.5)	26 (1.0)
Chlorophenoxy compounds	2 (2.9)	67 (97.1)	69 (2.7)
Chlorophenoxy compounds combined‖	1 (7.7)	12 (92.3)	13 (0.5)
Carbamates	5 (9.6)	46 (88.5)	52 (2.0)
Other chemical class	140 (9.9)	1275 (90.1)	1415 (54.6)
Unspecified	16 (12.3)	113 (86.9)	130 (5.0)
Total	275 (10.6)	2315 (89.3)	2593 (100.0)

*Three high severity cases are included in the totals.
†See Table 2 for explanation of categories.
‡Midwest region includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; northeast region includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; southeast region includes Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; and west region includes Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
§Includes cases exposed to insecticides combined with other pesticides.
‖Includes cases exposed to multiple chemicals/classes including organophosphates, inorganic compounds, pyrethrins, indandiones, or chlorophenoxy compounds.

Data quality control procedures included the elimination of duplicates between SENSOR (California) and CDPR, and between SENSOR and CDPR combined and TESS. To detect duplicates between SENSOR and CDPR combined and TESS, a case-by-case comparison was performed when a reporting source for SENSOR and CDPR cases was a poison control center. Cases that matched each other on state, date of exposure, age, sex, and pesticide name were assumed to involve the same individual. Such individuals were included only once in the state agency totals. Six CDPR and 8 TESS duplicates were deleted.

Data Analysis

SAS release 8.02 (SAS Institute Inc, Cary, NC) and Epi Info version 3.2.2 (Centers for Disease Control and Prevention, Atlanta, Ga) were used for data management and statistical analysis. Age was stratified into children (<18 years) and adults (≥18 years).

Illness incidence rates among children were calculated. Rate numerators were obtained by summing the number of ill children reported by year, and denominators were obtained from the US Census data[17] by summing the number of children in the corresponding state and year. Denominators were adjusted by subtracting estimates of preschoolers not attending organized child care centers[18] and home-schooled children.[19]

Illness incidence rates among school employees were calculated for SENSOR and CDPR cases only. Denominators were obtained from the Current Population Survey[20] by summing the number of full-time equivalents employed in schools in states and years that contributed to the numerator. Non–work-related cases (eg, parents) and cases with unknown work-related status, which included all TESS cases, were not included in these calculations.

We used odds ratios (ORs) to assess whether age, sex, acute toxicity pesticide category, surveillance system, or site of pesticide applications were associated with severity of illness. Odds ratios, 95% confidence intervals (CIs), χ^2 tests, and P values were calculated us-

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ing the Epi Info Statcalc utility. SAS release 8.02 was used to calculate the Poisson regression test for trends in incidence rates across the years of exposure. $P \leq .05$ was considered statistically significant.

RESULTS

From 1998 to 2002, 2593 individuals were identified with acute pesticide-related illnesses associated with pesticide exposures at schools. SENSOR identified 147 cases (6%), CDPR identified 259 cases (10%), and TESS identified 2187 cases (84%) (TABLE 2). Most illnesses reported by SENSOR (n=96, 65%) and CDPR (n=158, 61%) were adults, whereas most cases reported by TESS were children (n=1831, 84%). Among the 2181 persons with known exact age, the mean age for children was 9.5 years (range, 0.5-17.2 years) and the mean age for adults was 36.1 years (range, 18-76 years).

Three cases of high severity illness were identified. There were no fatalities reported. The odds of high and moderate severity illness were higher among cases reported by SENSOR and CDPR (15%) compared with TESS (10%) (OR, 1.6; 95% CI, 1.1-2.2), among adults (18%) compared with children (8%) (OR, 2.6; 95% CI, 2.0-3.5), and among females (12%) compared with males (8%) (OR, 1.5; 95% CI, 1.2-2.0). Moderate severity illness was more common (TABLE 3) among those exposed to fumigants (n=4, 40%), herbicides (n=41, 15%), insecticides (n=83, 9%), and disinfectants (n=101, 12%). TABLE 4 describes symptoms of high and moderate severity cases.

Insecticides were associated with 895 illnesses (Table 2). The most frequent insecticides were pyrethrins (n=119, 13% of all insecticides), chlorpyrifos (n=116, 13%), malathion (n=84, 9%), diazinon (n=78, 9%), and pyrethroids (n=47, 5%). Disinfectants were associated with 830 illnesses. The most frequent disinfectants were sodium hypochlorite (n=175, 21% of all disinfectants), phenol compounds (n=175, 21%), pine oil (n=104, 13%), and quaternary ammonium compounds

Table 4. Clinical Manifestations of Pesticide-Related Illnesses Among Cases of High and Moderate Severity in the United States, 1998-2002*

	No. (%)		
	High Severity Illness (n = 3)	Moderate Severity Illness (n = 275)	High and Moderate Severity Illness (n = 278)
Respiratory	2 (66.7)	133 (48.4)	135 (48.6)
Cough	1 (33.3)	58 (21.1)	59 (21.2)
Dyspnea	1 (33.3)	50 (18.2)	51 (18.3)
Wheezing	1 (33.3)	43 (15.6)	44 (15.8)
Upper respiratory tract pain	2 (66.7)	27 (9.8)	29 (10.4)
Pleuritic pain	0	3 (1.1)	3 (1.1)
Pulmonary edema	1 (33.3)	0	1 (0.4)
Other	1 (33.3)	3 (1.1)	4 (1.4)
Gastrointestinal	1 (33.3)	89 (32.4)	90 (32.4)
Vomiting	1 (33.3)	69 (25.1)	70 (25.2)
Nausea	0	50 (18.2)	50 (18.0)
Abdominal pain	0	10 (3.6)	10 (3.6)
Diarrhea	0	3 (1.1)	3 (1.1)
Other	0	4 (1.5)	4 (1.4)
Nervous system	1 (33.3)	87 (31.6)	88 (31.7)
Headache	0	55 (20.0)	55 (19.8)
Blurred vision	0	26 (9.5)	26 (9.4)
Dizziness	0	10 (3.6)	10 (3.6)
Confusion	0	3 (1.1)	3 (1.1)
Hyperactivity/anxiety/irritability	0	2 (0.7)	2 (0.7)
Muscle weakness	0	2 (0.7)	2 (0.7)
Ataxia	0	1 (0.4)	1 (0.4)
Seizures	1 (33.3)	0	1 (0.4)
Fasciculations	0	1 (0.4)	1 (0.4)
Muscle pain	0	1 (0.4)	1 (0.4)
Other	0	5 (1.8)	5 (1.8)
Eye	0	79 (28.7)	79 (28.4)
Irritation/pain/conjunctivitis	0	74 (26.9)	74 (26.6)
Corneal abrasion	0	11 (4.0)	11 (4.0)
Lacrimation	0	9 (3.3)	9 (3.2)
Burns	0	2 (0.7)	2 (0.7)
Other	0	3 (1.1)	3 (1.1)
Skin	1 (33.3)	30 (10.9)	31 (11.2)
Erythema	1 (33.3)	15 (5.5)	16 (5.8)
Irritation/pain	0	8 (2.9)	8 (2.9)
Pruritus	0	8 (2.9)	8 (2.9)
Edema/swelling	1 (33.3)	6 (2.2)	7 (2.5)
Second- and third-degree burns	0	5 (1.8)	5 (1.8)
Bullae	0	4 (1.5)	4 (1.4)
Rash	0	3 (1.1)	3 (1.1)
Other	0	4 (1.5)	4 (1.4)
Cardiovascular	1 (33.3)	7 (2.5)	8 (2.9)
Tachycardia	1 (33.3)	2 (0.7)	3 (1.1)
Chest pain	0	3 (1.1)	3 (1.1)
Other	0	2 (0.7)	2 (0.7)
Miscellaneous symptoms	2 (66.7)	66 (24.0)	68 (24.5)

*Because more than one clinical effect may have been reported for any person, the sum of the specific effects may not equal the total number reported for the organ system.

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(n=81, 10%). Repellents were associated with 335 illnesses, including naphthalene (n=136, 41%) and diethyl toluamide (DEET, n=127, 38%). Herbicides were associated with 279 illnesses, including glyphosate (n=100, 36%), 2,4-dichlorophenoxyacetic acid (n=53, 19%), and pendimethalin (n=40, 14%).

Information on the toxicity category of pesticides associated with illnesses was available for 1686 cases (Table 3). Children were less likely to be exposed to toxicity category I pesticides compared with adults (14% of children and 42% of adults, $P<.001$). The odds of high and moderate severity illness were higher among cases exposed to toxicity category I (18%) than cases exposed to toxicity category III pesticides (12%) (OR, 1.5; 95% CI, 1.1-2.2). The pesticide active ingredients associated with high and moderate severity illness are shown in TABLE 5.

Incidence Rates

The overall incidence rate among children for 1998-2002 was 7.4 cases per million children (TABLE 6). The yearly incidence rates increased from 1998 through 2002 for preschool children ($P<.001$), school-aged children ($P=.002$), and all combined ($P<.001$). The overall incidence rate among adults was 27.3 cases per million full-time equivalents (TABLE 7), and the yearly incidence rates decreased from 1998 through 2002 ($P<.001$).

Table 5. Active Ingredients by Pesticide Functional Class Associated With High and Moderate Illness Severity, 1998-2002*

Pesticide Functional Class	No. (%) High and Moderate Severity Illness (n = 278)	Low Severity Illness (n = 2315)	Total (N = 2593)†
Insecticides	68 (10.3)	593 (89.7)	661 (100.0)
Pyrethrins	11 (9.2)	108 (90.8)	119 (18.0)
Chlorpyrifos	12 (10.3)	104 (89.7)	116 (17.5)
Malathion	23 (27.4)	61 (72.6)	84 (12.7)
Diazinon	4 (5.1)	74 (94.9)	78 (11.8)
Pyrethroids	11 (23.4)	36 (76.6)	47 (7.1)
Propoxur	2 (33.3)	4 (66.7)	6 (0.9)
Other active ingredient	5 (2.4)	206 (97.6)	211 (31.9)
Disinfectants	82 (14.2)	495 (85.8)	577 (100.0)
Phenol compounds	14 (8.0)	161 (92.0)	175 (30.3)
Sodium hypochlorite	33 (18.9)	142 (81.1)	175 (30.3)
Pine oil	10 (9.6)	94 (90.4)	104 (18.0)
Quaternary ammonium compound	18 (22.2)	63 (77.8)	81 (14.0)
Formaldehyde/hydrogen chloride	5 (29.4)	12 (70.6)	17 (2.9)
Other active ingredient	2 (8.0)	23 (92.0)	25 (4.3)
Repellents	19 (6.4)	276 (93.6)	295 (100.0)
Naphthalene	11 (8.1)	125 (91.9)	136 (46.1)
Diethyl toluamide (DEET)	7 (5.5)	120 (94.5)	127 (43.1)
Other active ingredient	1 (3.1)	31 (96.9)	32 (10.8)
Herbicides	36 (15.0)	204 (85.0)	240 (100.0)
Glyphosate	21 (21.0)	79 (79.0)	100 (41.7)
Pendimethalin	8 (20.0)	32 (80.0)	40 (16.7)
Trifluralin	2 (50.0)	2 (50.0)	4 (1.7)
Other active ingredient	5 (5.2)	91 (94.8)	96 (40.0)
Other pesticide functional class	24 (14.0)	147 (86.0)	171 (100.0)
Total	229 (11.8)	1715 (88.2)	1944 (100.0)

*An active ingredient is one that prevents, destroys, repels, or mitigates a pest, or is a plant regulator, defoliant, desiccant, or nitrogen stabilizer.
†Total number of cases with available information on active ingredients. Note that active ingredient information was not available for all cases.

Illnesses Reported by SENSOR and CDPR

The SENSOR and CDPR results are combined (Table 2) because the case definition and level of detail are similar. A total of 406 persons were exposed to pesticides in 173 events for a mean of 2.3 cases per exposure event (range, 1-61 cases). Eleven exposure events accounted for 208 cases (51%). The 244 work-related cases were exposed in 155 events.

Occupational Illnesses. Among the 244 work-related cases, 144 (59%) were not applying pesticides, 93 (38%) were applying or handling pesticides, and 7 (3%) had no information available. Among the 144 employees not applying pesticides, 96 (67%) were exposed to pesticides applied on school grounds and 48 (33%) were exposed to pesticide drift from neighboring farmland. Sixty-three nonapplicator illnesses (44%) were among teachers. Among the 93 school employees who were applying or handling pesticides, there were 41 custodians and gardeners, 26 food preparation workers, 7 teachers, 7 maintenance workers, and 12 unspecified school employees.

Illnesses Associated With Exposure to Pesticides Applied on School Grounds and Pesticide Drift From Farmland. A total of 281 cases (69%) that were reported to SENSOR and CDPR were exposed to pesticide applications on school grounds (TABLE 8). Insecticides (n=156, 56%) and disinfectants (n=99, 35%) accounted for most of the cases. The most common active ingredients were diazinon (n=64, 23%), sodium hypochlorite (n=47, 17%), chlorpyrifos (n=40, 14%), quaternary ammonium compound (n=38, 14%), and malathion (n=14, 5%).

A total of 125 cases (31%) were exposed to pesticide drift. Insecticides accounted for 114 cases (91%) and fumigants for 9 cases (7%). The most common active ingredients were chlorpyrifos (n=28, 22%), methamidophos combined with chlorothalonil and propargite (n=25, 20%), mancozeb combined with glyphosate (n=20, 16%), cyfluthrin combined with

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dicofol (n=16, 13%), and malathion (n=13, 10%).

Exposure via pesticide drift compared with pesticides applied on school grounds did not increase the odds of high and moderate severity illness (OR, 0.6; 95% CI, 0.3-1.2; P=.09). A higher proportion of children compared with adults were exposed via drift from neighboring farmland (40% vs 25%, P=.001).

COMMENT

These findings indicate that pesticide exposures at schools continue to produce acute illnesses among school employees and students in the United States, al-

Table 6. Annual Number and Incidence Rates per Million of Acute Pesticide-Related Illnesses Among Children, 1998-2002*

Region†	Year of Exposure					
	1998	1999	2000	2001	2002	1998-2002
Midwest						
Cases, No.	68	85	97	127	137	514
Population, No.	12 971 329	12 645 800	12 415 063	12 659 255	12 792 569	63 481 822
Incidence rate, per million	5.2	6.7	7.8	10.0	10.7	8.1
Northeast						
Cases, No.	53	65	105	62	68	353
Population, No.	9 291 895	9 935 145	10 060 770	10 126 121	10 257 622	49 671 552
Incidence rate, per million	5.7	6.5	10.4	6.1	6.6	7.1
Southeast						
Cases, No.	111	141	104	138	126	620
Population, No.	16 576 618	18 298 366	18 211 754	19 014 539	20 583 054	92 684 331
Incidence rate, per million	6.7	7.7	5.7	7.3	6.1	6.7
West						
Cases, No.	52	109	84	134	106	485
Population, No.	11 782 566	11 338 067	11 694 488	12 459 307	12 624 149	59 898 577
Incidence rate, per million	4.4	9.6	7.2	10.8	8.4	8.1
United States						
Cases, No.	284	400	390	461	437	1972‡
Population, No.	50 622 407	52 217 378	52 382 074	54 259 223	56 257 393	265 738 476
Incidence rate, per million	5.6	7.7	7.4	8.5	7.8	7.4

*Includes number of children with pesticide-related illnesses and population in the states that reported cases from 1998 through 2002. Children were younger than 18 years and reported by Sentinel Event Notification System for Occupational Risks, California Department of Pesticide Regulation, and Toxic Exposure Surveillance System.
†Midwest region included Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; northeast region included Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; southeast region included Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; and west region included Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
‡Eight cases are not included in these rates because information on state where the exposure occurred was not available.

Table 7. Annual Number of Acute Pesticide-Related Illnesses and Incidence Rates Among School Employees, Preschool, and School-Aged Children, 1998-2002*

	Year of Exposure					
	1998	1999	2000	2001	2002	Overall
Workers (≥18 years)						
Cases, No.	68	42	54	20	60	244
Full-time equivalents, No.	1 532 876	1 329 312	2 023 135	1 727 500	2 325 209	8 938 032
Incidence rate†	44.4	31.6	26.7	11.6	25.8	27.3
Preschool (0-5 years)						
Cases, No.	59	76	68	84	104	391
Population, No.‡	5 220 556	5 659 786	3 587 875	5 053 894	4 626 154	24 148 266
Incidence rate, per million	11.3	13.4	19.0	16.6	22.5	16.2
School-aged (6-17 years)						
Cases, No.	225	324	322	377	333	1581
Population, No.§	45 401 851	46 557 592	48 794 199	49 205 329	51 631 239	241 590 210
Incidence rate, per million	5.0	7.0	6.6	7.7	6.4	6.5

*School employees were reported by Sentinel Event Notification System for Occupational Risks and California Department of Pesticide Regulation, and includes the states of California, Florida, Louisiana, Michigan, New York, Oregon, Texas, and Washington. Preschool and school-aged children were reported by Sentinel Event Notification System for Occupational Risks and California Department of Pesticide Regulation, and Toxic Exposure Surveillance System, which includes all US states and District of Columbia with the exception of Hawaii.
†Per million full-time equivalents.
‡Estimated number of preschool children attending day care centers, nursery, preschool, Headstart, family day care, or school.
§Number of children attending school, excluding home-schooled children.

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beit mainly of low severity and with relatively low incidence rates. Illnesses were associated with pesticides applied on school grounds and with pesticide drift from neighboring farmland. The pesticide exposures at schools might be associated in part with several factors: a lack of federal and state regulations regarding pesticide usage in schools[1]; regulatory noncompliance by school management, school employees, and pesticide applicators in states in which regulations and recommendations have been passed; and insufficient involvement of stakeholders (eg, parents, teachers, students, school administrators, pest managers).[6]

Table 8. Exposure to Pesticides Applied on School Grounds vs Pesticide Drift From Farmland in the United States, 1998-2002*

	No. (%)		
	Pesticides Applied on School Grounds (n = 281)	Pesticide Drift From Farmland (n = 125)	Total (N = 406)
Surveillance system			
SENSOR	75 (26.7)	72 (57.6)	147 (36.2)
CDPR	206 (73.3)	53 (42.4)	259 (63.8)
Severity			
High	1 (0.4)	0	1 (0.3)
Moderate	46 (16.4)	13 (10.4)	59 (14.5)
Low	234 (83.3)	112 (89.6)	346 (85.2)
Age group			
Children	90 (32.0)	59 (47.2)	149 (36.7)
Adults	191 (68.0)	63 (50.4)	254 (62.6)
Unknown	0	3 (2.4)	3 (0.7)
Work-relatedness			
Work-related	190 (67.6)	54 (43.2)	244 (60.1)
Non–work-related	91 (32.4)	68 (54.4)	159 (39.2)
Unknown	0	3 (2.4)	3 (0.7)
Occupation			
Student	84 (29.9)	62 (49.6)	146 (36.0)
Teacher	41 (14.6)	35 (28.0)	76 (18.7)
Custodian and gardener†	43 (15.3)	1 (0.8)	44 (10.8)
Food preparation occupations	32 (11.4)	1 (0.8)	33 (8.1)
Maintenance worker	12 (4.3)	0	12 (3.0)
Parent	1 (0.4)	5 (4.0)	6 (1.5)
Other occupations	60 (21.4)	17 (13.6)	77 (19.0)
Not applicable‡	5 (1.8)	0	5 (1.2)
Unknown	3 (1.1)	4 (3.2)	7 (1.7)
Pesticide toxicity category§			
I	96 (34.2)	58 (46.4)	154 (37.9)
II	46 (16.4)	3 (2.4)	49 (12.1)
III	136 (48.4)	64 (51.2)	200 (49.3)
Undetermined	3 (1.1)	0	3 (0.7)
Pesticide functional class			
Insecticides only	140 (49.8)	46 (36.8)	186 (45.8)
Insecticides combined‖	16 (5.7)	68 (54.4)	84 (20.7)
Disinfectants	99 (35.2)	0	99 (24.4)
Herbicides	20 (7.1)	1 (0.8)	21 (5.2)
Fumigants	0	9 (7.2)	9 (2.2)
Repellents	3 (1.1)	0	3 (0.7)
Other	3 (1.1)	1 (0.8)	4 (1.0)
Total	281 (69.2)	125 (30.8)	406 (100.0)

Abbreviations: CDPR, California Department of Pesticide Regulation; SENSOR, Sentinel Event Notification System for Occupational Risks.
*Pesticide exposure due to pesticide applications on school grounds and pesticide drift from neighboring farm fields.
†Includes 6 gardeners.
‡Children younger than 5 years.
§See Table 2 for explanation of categories.
‖Includes cases exposed to insecticides combined with other pesticides.

We found that the pesticide poisoning incidence rates among children increased during the period of our report. Given that 40% (n=59) of SENSOR and CDPR cases involving children were exposed to pesticide drift and, given increasing suburban sprawl, this trend among children might be related to an increased number of schools situated next to farmland.[6] Additional studies are needed to confirm this hypothesis. Hypotheses for the decreasing trend in illness rates among school employees include changes in pesticide use practices and increased awareness of the toxic effects of pesticides.

Incidence rates among school employees were found to be higher than incidence rates among children. Possible explanations include school employees are called to protect children when incidents occur, whereas students are often quickly evacuated; school employees are at schools for more hours compared with students; and some school employees handle or apply pesticides.

Based on SENSOR and CDPR data, most cases of acute pesticide-related illnesses were associated with pesticides applied on school grounds (n=281, 69%). Repeated pesticide applications on school grounds raise concerns about persistent low level exposures to pesticides at schools. It is known that some pesticides degrade slowly when they are not exposed to sun, rain, and bacterial action in the soil.[21-24] In addition, pesticide residues on the school grounds might be tracked into school buildings by students and school employees. The chronic long-term impacts of pesticide exposures have not been comprehensively evaluated; therefore, the potential for chronic health effects from pesticide exposures at schools should not be dismissed.[25] Unfortunately, the surveillance methods used in our report are inadequate for assessing chronic effects.

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Although insecticides were most frequently associated with pesticide-related illnesses (n=895, 35%), we found that exposure to disinfectants at schools might also be a cause for concern. First, disinfectants accounted for 830 (32%) of 2593 total cases and for 101 (37%) of 275 moderate severity cases. Second, 259 (56%) of 461 cases of disinfectant exposure with toxicity category available were of toxicity category I. Finally, most of the disinfectants associated with moderate illnesses were products commonly used at schools (sodium hypochlorite and quaternary ammonium compounds).

We also found acute illnesses associated with exposure to pesticide drift from neighboring farmland. These exposures might have resulted from pesticide applicators not complying with pesticide labels, regulations, and/or guidance to avoid pesticide spray drift, or lack of federal and state regulations regarding pesticide application around schools. Additionally, pesticide drift from neighboring farm fields might increase pesticide exposure inside schools. Some studies[26-29] suggest that dwellings adjacent to fields can be contaminated by pesticide drift during applications and subsequent wind recirculation of dust from the fields.

To prevent illnesses associated with pesticide applications on or near school grounds, there is a need to reduce pesticide use. This can be accomplished by implementing integrated pest management at schools and using methods that reduce pesticide drift from farmland. Integrated pest management programs can reduce pesticide use at schools.[3,30] Integrated pest management is endorsed by the EPA,[3] National Parent Teacher Association,[31] National Education Association, and other organizations. The elements of integrated pest management are detailed in the Box. Useful guidance and references on integrated pest management in schools are widely available.[3,32] Some disadvantages of integrated pest management implementation include the requirements of more involvement of school employees, parents, and students, and the need to be educated on pest biology and integrated pest management. Finally, some economic investment is usually required at the outset of an integrated pest management program. However, over the long term, the costs of integrated pest management have been found to be lower than traditional pest control.[3,32]

We tried to identify illness rate differences among children across states with different integrated pest management laws (mandatory, voluntary, without laws). However, this comparison was not meaningful because these laws have tremendous variation across states in terms of coverage, enforcement, and

Box. Recommendations to Reduce Pesticide Exposures at Schools

Pesticides Applied on School Property

Implement school integrated pest management programs:

- Monitor for pest problems.
- Identify the sources of any pest problems.
- Eliminate the sources of any pest problems, using pesticides only as a last resort. Use nontoxic methods, such as ensuring sanitary conditions and structural integrity.
- If nontoxic pest control methods are impractical or unsuccessful, then use pesticides having the lowest possible toxicity. Pesticides in US Environmental Protection Agency toxicity categories I and II should be avoided if possible. If pesticides are used:
  - Provide prior written notification of the application.
  - Post notices in designated areas at the school.
  - Students and staff should not be present during pesticide applications.
  - Restrict entry into a previously treated area for a specified duration following an application.
- Call a poison control center or seek medical attention if pesticide-related illnesses arise.
- Trained and qualified workers should handle and apply pesticides. They must be provided with appropriate safety equipment.
- Put the school's policy on pest control in writing and distribute it to school stakeholders periodically (eg, at the beginning of the school year).
- Involve and train stakeholders (school management, parents, teachers, students, and pesticide applicators).

Pesticide Drift From Neighboring Farmland

Reduce or eliminate application methods that result in drift.

Timing of pesticide applications. Applications should be performed when students and school employees are not present.

Farmers and pesticide applicators should comply with labels, regulations, and guidance to avoid pesticide spray drift.

Pesticides should be applied by trained applicators.

Establish and enforce nonspray buffer zones around schools. Size of buffer zone depends on toxicity of pesticide, type of application (ground or aerial), and weather conditions. For example, 7 states require buffer zones ranging from 300 feet to 2.5 miles around schools.

Underreporting

Improvement in pesticide poisoning surveillance is needed. Every state should implement an acute pesticide-related illness surveillance system.

Acute pesticide-related illnesses should be a reportable condition in all states.

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implementation. Additionally, 40% of cases among children in SENSOR and CDPR were exposed to pesticide drift. A similar proportion of children in the entire data set might have been exposed to pesticide drift but these cases could not be identified in TESS. Integrated pest management practices in schools are not designed to prevent exposures to pesticide drift. There were too few SENSOR and CDPR cases involving onsite applications in schools (n = 281) to assess integrated pest management laws.

Our findings are subject to at least 3 limitations. First, these results should be considered low estimates of the magnitude of the problem because many cases of pesticide poisoning are likely not reported to surveillance systems or poison control centers. Individuals who do not seek medical care or report their illness to a surveillance system or a poison control center will not be identified. Even when individuals seek medical care, their illness may not be recognized as pesticide-related, because of the nonpathognomonic nature of the signs and symptoms and because clinicians receive little training on these illnesses.[33,34] Second, although all of these cases met the definition criteria, the possibility of some false-positives cannot be excluded. Given both the nonspecificity of the clinical findings of pesticide poisoning and the lack of a criterion standard diagnostic test, some illnesses temporally related to pesticide exposures may be coincidental and not caused by these exposures. Third, although the case definition was similar, some characteristics of the populations reported by these 3 systems were different. TESS was efficient in capturing data for children, but it did not collect information on occupation, work-relatedness, and the activity the person was performing when exposed to pesticides. The SENSOR and CDPR data apply to 8 states and principally identify work-related cases. Not all states participating in SENSOR collect information on nonoccupational cases; therefore, many cases among children were likely missed by SENSOR and CDPR. None of these data sources are comprehensive. The literature suggests that less than one third of poisoning cases treated in health care facilities are reported to poison control centers and in states where SENSOR and TESS systems are in place, TESS identified only 10% of the cases identified by SENSOR.[35]

In conclusion, despite the limitations of these 3 surveillance systems, our report is useful in providing national estimates of the magnitude of pesticide-related illnesses among school employees and students, and in identifying the risk factors that should be targeted for prevention. Strategies recommended to reduce pesticide exposures at schools include adopting integrated pest management programs and using methods to reduce pesticide drift from farmland.

Author Contributions: Dr Alarcon had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Alarcon, Calvert.
Acquisition of data: Calvert, Blondell, Mehler, Sievert, Propeck, Tibbetts, Becker, Lackovic, Soileau, Das, Beckman, Male, Thomsen, Stanbury.
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Drafting of the manuscript: Alarcon, Calvert.
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Statistical analysis: Alarcon.
Administrative, technical, or material support. Alarcon, Calvert, Blondell, Mehler, Sievert, Propeck, Tibbetts, Becker, Lackovic, Soileau, Beckman, Male, Thomsen, Stanbury.
Study supervision: Calvert.
Financial Disclosures: None reported.
Funding/Support: This study was supported by the US government through the US Environmental Protection Agency and the Centers for Disease Control and Prevention, which employs Drs Alarcon, Calvert, and Blondell.
Role of the Sponsor: The National Institute for Occupational Safety and Health/Centers for Disease Control and Prevention (CDC) designed and conducted the study, collected, managed, analyzed, and interpreted the data and prepared, reviewed, obtained external peer review, and approved the manuscript.
Disclaimer: The reviews expressed and the results/conclusions reached within this article do not necessarily reflect the opinions of the CDC, US Environmental Protection Agency, or each author's state agency.
Acknowledgment: We thank Ximena Vergara (Public Health Institute, Oakland, Calif) who provided support in data management in the California Department of Health Services, Marty Petersen (National Institute for Occupational Safety and Health/CDC, Division of Surveillance, Hazard Evaluation and Field Studies) who provided support in statistical analysis; Donald Baumgartner (US Environmental Protection Agency, Region V), Sherry E. Jones (National Center for Chronic Disease Prevention and Health Promotion/CDC, Division of Adolescent and School Health), and John Palassis (National Institute for Occupational Safety and Health/CDC, Education and Information Division) who provided a comprehensive review of this article, and Jia Li (National Institute for Occupational Safety and Health/CDC, Division of Surveillance, Hazard Evaluation and Field Studies) who provided information on full-time equivalents from the US Current Population Survey.

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MMWR™
Weekly
June 3, 2005 / 54(21);533-535

Unintentional Topical Lindane Ingestions --- United States, 1998--2003

Lindane* is an organochlorine pesticide found in certain prescription-only shampoos and topical lotions used to treat pediculosis (i.e., lice infestation) and scabies; lindane has been associated with human neurologic toxicity (*1,2*). In 2004, CDC was alerted to cases of illness caused by unintentional ingestion of lindane by persons mistaking the product for a liquid oral medication (e.g., cough syrup). To assess the extent of illness from ingestion of lindane, CDC, with assistance from the U.S. Environmental Protection Agency, Food and Drug Administration (FDA), and state health departments, collected case reports and analyzed data from the Sentinel Event Notification System for Occupational Risks-Pesticides (SENSOR-Pesticides) program and the Toxic Exposure Surveillance System (TESS). This report summarizes the results of that analysis, which identified 870 cases of unintentional lindane ingestion during 1998--2003, and describes two examples of lindane ingestions. To reduce the risk of lindane ingestion, public health authorities should alert clinicians to the hazards of lindane and the importance of following FDA usage guidelines, which include dispensing lindane in manufacturer-produced, 1- or 2-ounce single-use containers.

Case Reports

Case 1. In November 2004, the Washington State Department of Health reported that a boy aged 3 years ingested approximately 1 teaspoon of 1% lindane shampoo from a previously used 2-ounce bottle. Subsequently, the mother induced vomiting in the boy twice; 1 hour later the boy collapsed and experienced a tonic-clonic seizure lasting 4--5 minutes. After 3 hours, the child was discharged from the emergency department in stable condition.

Case 2. In December 2003, a man aged 47 years in Texas mistakenly ingested 1 ounce of lindane (percentage concentration unknown) from a bottle he believed to be cough syrup. The man vomited; he contacted the poison control center the following morning. He did not seek clinical evaluation.

Surveillance Data

Data were analyzed from pesticide poisoning surveillance systems participating in the SENSOR-Pesticides program† to identify symptomatic cases involving unintentional topical lindane ingestions during 1998--2003. Cases were classified as definite, probable, possible, or suspicious based on the clinical interpretation of signs or symptoms reported by a physician or patient, and evidence of lindane ingestion (*3,4*). Cases were also obtained from TESS§, which is

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maintained by the American Association of Poison Control Centers; poison information specialists determined which cases had signs and symptoms consistent with lindane exposure. Illness severity was categorized for all cases. Excluded were cases involving ingestion of veterinary and agricultural pesticide products that contained lindane.

During 1998--2003, TESS reported 857 symptomatic cases of unintentional lindane ingestion (Figure); none of the cases were reported as resulting in death. Severity was low in 778 cases (91%), moderate in 71 cases (8%), and high in eight cases (1%) (*4*). Among 823 patients with known ages, median age was 13 years (range: <1--86 years); 53% were female. Signs and symptoms included vomiting (59%), nausea (18%), oral irritation (19%), abdominal cramping (4%), cough (4%), and seizure (3%).

During 1998--2003, SENSOR-Pesticides identified a total of 13 symptomatic cases of unintentional lindane ingestion. Four cases (31%) were classified as definite, two (15%) as probable, six (46%) as possible, and one (8%) as suspicious. Severity was low in eight cases (62%), moderate in three cases (23%), and high in two cases (15%) (*3*). Median age was 7 years (range: <1--58 years), and 69% were male. Signs and symptoms included vomiting (69%), nausea (46%), headache (23%), seizure (23%), abdominal cramping (8%), and confusion (8%). Six (46%) cases in children and four (31%) cases in adults were the result of mistaking lindane for cough syrup; two (15%) cases were in unsupervised children who drank lindane, and one (8%) case was the result of pharmacy error (i.e., lindane was recovered from a bottle labeled albuterol).

In addition to lindane, FDA-approved treatments for pediculosis include two over-the-counter medications (pyrethrin/piperonyl butoxide and permethrin) and malathion, a prescription-only therapy. During 1998--2003, TESS identified 523 symptomatic cases of unintentional ingestion of these alternative medications (Figure). Median age was 9 years (range: <1--67 years). Among TESS reports, unintentional lindane ingestions were more likely to produce illness (857 illnesses of 1,463 ingestions [58%]) than unintentional ingestions of each of three other medications, and more likely to produce illness than all three of those medications combined (523 illnesses of 1,691 ingestions [31%]; odds ratio = 3.16, 95% confidence interval = 2.72--3.67).

Reported by: *J Sievert, Texas Dept of State Health Svcs. M Lackovic, MPH, Louisiana Dept of Health and Hospitals. A Becker, PhD, Florida Dept of Health. DH Lew, Oregon Dept of Human Svcs. B Morrissey, Washington State Dept of Health. J Blondell, PhD, Office of Pesticide Programs, US Environmental Protection Agency. LY Kim-Jung, PharmD, MR Pitts, PharmD, CA Holquist RPh, Food and Drug Admin. AM Petersen, MPH, JS Alonso-Katzowitz, GM Calvert, MD, Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, CDC.*

Editorial Note:

Pediculosis and scabies are common human parasitic infestations. This report indicates that when lindane, a treatment for pediculosis and scabies, is unintentionally ingested, illness can occur, including vomiting and seizures. In 1995, lindane was changed to a second-line therapy for pediculosis because safer alternatives existed (*5*). Lindane also had the slowest pediculicidal and least effective ovicidal activity compared with three other approved pediculicides (i.e., 1% permethrin, 0.3% pyrethrin, and 0.5% malathion) (*6*). In 2003, in light of continued postmarketing surveillance reports of toxicity, FDA revised product labeling guidelines to limit the amount of lindane dispensed to 1- or 2-ounce single-use containers and to require providing

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patients with a Medication Guide warning of risks from inappropriate use. In addition, FDA issued a Public Health Advisory with these changes (*7*). The new advisory, along with a substantial increase in retail price for lindane, appear to have resulted in a declining number of cases of lindane ingestion (Figure). This decline is similar to the 67% decrease in lindane prescriptions from 1998 to 2003 (*8*).

Before the advisory, bottles of bulk lindane were sometimes repackaged by pharmacies into smaller bottles resembling those used for liquid oral medications (e.g., cough syrup). This resemblance likely contributed to many unintentional ingestions. Subsequent to the advisory, bottles of bulk lindane still in use were not recalled from pharmacies. Therefore, some repackaging might still occur. In addition, consumers might have repackaged lindane in their homes.

In September 2004, the North American Task Force on Lindane drafted an action plan for future use. On January 1, 2005, Canada withdrew registration of lindane for agricultural pest control; Mexico is working on a plan to phase out all uses of lindane. However, with the exception of California, which banned lindane for medicinal use on January 1, 2002, U.S. representatives to the North American Commission for Environmental Cooperation announced that the United States will continue to allow use of lindane as both a pesticide and pharmaceutical (*9*).

The findings in this report are subject to at least three limitations. First, because of the passive surveillance methodology of TESS and SENSOR, the number of reported cases is likely fewer than the number of actual cases. Second, certain eligible cases might have been inadvertently excluded because of erroneous information that suggested exposure to lindane in a veterinary or agricultural product. Finally, although all cases were symptomatic, the possibility of false positives cannot be excluded. Because clinical findings of lindane poisoning are nonspecific and no standard diagnostic test exists, certain illnesses related temporally to lindane exposure might not have been caused by the exposure.

Lindane use in shampoos and lotions for treatment of pediculosis and scabies is declining. However, because of the toxicity of lindane and the potential for illness from unintentional ingestion, health-care providers should be educated regarding appropriate use and packaging. Lindane is a second-line therapy for both scabies and lice and should not be tried unless other treatments have failed or are intolerable; use of lindane also should be avoided for persons weighing less than 110 pounds (50 kg). Because of the risk for toxicity, treatment should not be repeated, even if itching persists; itching can occur, even after successful treatment (especially for scabies) and can be treated symptomatically. In addition, pharmacists should not transfer lindane to other containers and should only dispense lindane in manufacturer-provided 1- or 2-ounce containers. Finally, periodic educational outreach programs can help increase awareness among health-care providers of the new lindane use guidelines.

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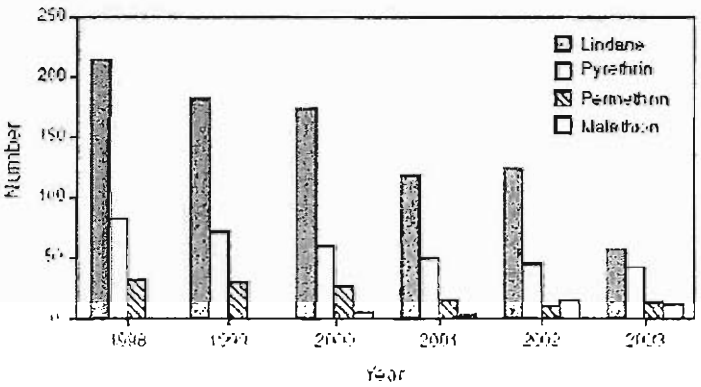
* Lindane is also referred to as gamma-hexachlorocyclohexane.

† SENSOR-Pesticides is a surveillance program coordinated by the National Institute for Occupational Safety and Health (NIOSH) at CDC and conducted by health departments in nine states. Most participating states collect information on both nonoccupational and occupational pesticide poisonings from various sources (e.g., poison control centers, workers' compensation agencies, or state departments of agriculture). However, priority is given to occupational cases; therefore, the number of nonoccupational poisoning cases is limited.

§ TESS receives reports from nearly all poison control centers nationwide.

Figure

FIGURE. Number of symptomatic cases from unintentional ingestion of medication for pediculosis and scabies, by medication and year of exposure — Toxic Exposure Surveillance System and the Sentinel Event Notification System for Occupational Risks-Pesticides program, 1998–2003.



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Date last reviewed: 6/2/2005

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AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 45:14–23 (2004)

Acute Occupational Pesticide-Related Illness in the US, 1998–1999: Surveillance Findings From the SENSOR-Pesticides Program

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Background *Concern about the adverse public health and environmental effects of pesticide use is persistent. Recognizing the importance of surveillance for acute occupational pesticide-related illness, we report on surveillance for this condition across multiple states.*

Methods *Survey data collected between 1998 and 1999 were obtained from the seven states that conduct acute occupational pesticide-related illness surveillance as part of the Sentinel Event Notification System for Occupational Risks (SENSOR) program. Data were collected by these state programs in a standardized manner and analyzed. Acute occupational pesticide-related illness incidence rates for those employed in agriculture and those employed in non-agricultural industries were also calculated.*

Results *Between 1998 and 1999, a total of 1,009 individuals with acute occupational pesticide-related illness were identified by states participating in the SENSOR-pesticides program. The mean age was 36 years, and incidence rates peaked among 20–24 year-old workers. The overall incidence rate was 1.17 per 100,000 full time equivalents (FTEs). The incidence rate among those employed in agriculture was higher (18.2/100,000 FTEs) compared to those employed in non-agricultural industries (0.53/100,000 FTEs). Most of the illnesses were of low severity (69.7%). Severity was moderate in 29.6% of the cases, and high in four cases (0.4%). Three fatalities were identified. Insecticides were responsible for 49% of all illnesses.*

Conclusions *Surveillance is an important tool to assess acute pesticide-related illness, and to identify associated risk factors. Our findings suggest that these illnesses continue to be an important occupational health problem, especially in agriculture. As such, greater efforts are needed to prevent acute occupational pesticide-related illness.* Am. J. Ind. Med. 45:14–23, 2004. *Published 2003 Wiley-Liss, Inc.*[†]

KEY WORDS: pesticides; poisoning; agricultural workers' diseases; insecticides; herbicides; incidence; risk

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Accepted 14 August 2003
DOI 10.1002/ajim.10309. Published online in Wiley InterScience (www.interscience.wiley.com)

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INTRODUCTION

Pesticides are substances used to destroy, mitigate, or repel pests, and their usage is widespread in the US. In a typical year, about 1.24 billion pounds of conventional pesticides are used [Donaldson et al., 2002], which represents 22% of the entire worldwide use of these pesticides. Over 16,000 pesticide products are registered for use in the US, and these contain one or more of the 674 registered active ingredients.

Although pesticides serve many useful purposes, the public continues to express concerns about the adverse public health and the environmental effects of pesticides. Ensuring safe use of pesticides, especially in the agricultural sector, can be difficult. There are many reasons for this. Although pesticide products go through an extensive battery of testing prior to being registered by the US Environmental Protection Agency (EPA), the testing protocol cannot address the entire spectrum of environmental conditions, mixtures of chemicals, chronic exposure patterns, and human susceptibilities. Given these testing limitations, it is possible that adverse health effects could result even when pesticide products registered by the EPA are used in accordance with label instructions. In addition, the EPA often delegates pesticide use enforcement to state departments of agriculture. These state agencies face barriers (e.g., insufficient personnel) to inspect pesticide-using worksites and farms frequently enough to ensure safe pesticide usage. Finally, because agricultural workers rarely belong to unions, are often non-US citizens, and often have poor English language skills, they may be very reluctant to raise health and safety concerns.

Surveillance for acute pesticide-related illness can serve many purposes. It can promptly identify pesticide problems by both serving as an early warning system of any unexpected health effects not observed during manufacturer testing, and detecting pesticide problems caused by non-compliance with pesticide regulations. In addition, surveillance data are useful for assessing both the magnitude of acute pesticide-related illness and poisoning trends over time. Furthermore, risk factors identified through surveillance or follow-up investigations can be targets for effective interventions.

The National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention (NIOSH/CDC), through the Sentinel Event Notification System for Occupational Risks (SENSOR) program has provided technical and financial support for state-based surveillance of acute occupational pesticide-related illness and injury since 1987. The SENSOR-pesticides program is also partially funded by the EPA. This report summarizes the SENSOR-pesticides surveillance data for 1998 and 1999. It includes data from all but one of the eight states with a pesticide poisoning surveillance program (Washington State was not included because their program used a different case definition and variables during the years summarized in this article). Although previous reports have described findings for a single state [Maddy et al., 1990; Mehler et al., 1992; Schnitzer and Shannon, 1999; Das et al., 2001a], this is the first report on acute occupational pesticide-related illness incidence across multiple states.

MATERIALS AND METHODS

Data from 1998 and 1999 were collected from the seven states participating in the SENSOR-pesticides program during those years. Cases were provided by the California Department of Health Services, the Texas Department of Health, the Oregon Department of Human Services, the New York State Department of Health, the Florida Department of Health, the Louisiana Department of Health and Hospitals (only 1999 data were available), and the Arizona Department of Health Services. These states began using a common standardized case definition and classification scheme to evaluate reports in 1998.

Each of the participating states obtains case reports from many different sources. All of these states require physician reporting of pesticide-related illness cases [Calvert et al., 2001]. Other sources of case reports vary by state and include poison control centers, emergency medical services, medical laboratories, other health care providers, clinics, worker representatives (e.g., Migrant Legal Aid, selected community contacts, co-workers, friends, relatives), employers and state agencies with jurisdiction over pesticide use (e.g., departments of agriculture and structural pest control boards). States also routinely review other data sources to identify additional potential cases (e.g., workers' compensation claims, hospital discharge data, news reports, and death certificates). In addition, some states accept self-reports.

Once a report is received, the states determine whether the subject was symptomatic and whether the involved chemical is a pesticide. If so, attempts are made to interview the poisoned subject or their proxy to obtain details on the poisoning event, and medical records are requested. Besides identifying, classifying, and tabulating pesticide poisoning cases, the states periodically perform in-depth investigations of pesticide-related events and develop interventions aimed at particular industries or pesticide hazards.

The information collected by the state agencies in a standardized manner includes date of illness, information on the ill individual (gender, race, age, signs, symptoms, industry, and occupation) whether the illness occurred as a result of workplace exposures, identification of the pesticide(s) that produced the illness, activity of the individual when exposed, type of exposure (e.g., drift, direct spray, indoor air exposure, or exposure to a spill or leaking container), biological monitoring information (i.e., cholinesterase testing and results, and whether other biological testing was performed), and whether personal protective equipment

(PPE) was used. For this analysis, PPE included goggles, faceshield, gloves (cloth, leather, rubber, or synthetic), rubber/chemically resistant boots, chemically resistant clothing, or a respirator.

Only cases involving occupational exposures are included in this article. A case is classified as occupational if the pesticide exposure occurred while at work. All other cases are classified as non-occupational. Suicides and attempted suicides are classified as non-occupational.

The EPA toxicity category was sought for all pesticide products associated with the illness event. The EPA classifies all pesticide products into one of four toxicity categories based on established criteria (40 CFR Part 156). Pesticides with the greatest toxicity are placed in category I, and those with the least are in category IV. In those instances when only the pesticide active ingredient associated with the illness event was available, and not the pesticide product, toxicity category information was not available. Pesticide products are classified into toxicity categories, but not active ingredients.

Case Definition

The case definition for acute pesticide-related illness and injury was finalized in 1998 [Calvert et al., 2001]. A full description of the case definition is beyond the scope of this article but is available elsewhere [CDC, 2000a]. Briefly, information in three areas is required: pesticide exposure, health effects, and toxicological evidence supporting an association between exposure and effect. A case of pesticide-related illness or injury is classified into one of the following categories: definite, probable, possible, or suspicious. The specific classification category applied to a given case depends on the certainty of exposure, whether health effects consisted of signs observed by a health care professional versus symptoms reported by the poisoned subject, and the extent to which the health effects were consistent with the known toxicology of the pesticide product. The health department reporting the case classified it.

Illness severity was determined for each case. A detailed description of the severity index used to assign severity is also beyond the scope of this article but is available [CDC, 2001]. Briefly, a case of pesticide-related illness or injury is classified into one of the following categories: low, moderate, high, or death. Information considered when assigning severity includes signs and symptoms, whether health care was sought, length of hospital stay, and work days lost due to the illness. A *low severity illness or injury* consists of minimally bothersome health effects that generally resolve rapidly. A *moderate severity illness or injury* consists of non-life threatening health effects that are more pronounced, prolonged, or of a systemic nature compared to a low severity illness. A *high severity illness or injury* consists of life threatening health effects or those that result in significant residual disability or disfigurement. *Death* is the severity category assigned to fatalities resulting from pesticide exposure. Because the severity index was not finalized until 2001, one of the authors (G.M.C.) assigned severity to all of the cases.

Data Analysis

SAS software was used for data management and chi-square statistical analyses of categorical data. Incidence rates were calculated. The numerator was the total number of illness cases. The denominator was obtained from the full time equivalent (FTE) estimates derived from the Current Population Survey conducted between 1998 and 1999 [Bureau of Labor Statistics, 2001]. Average annual incidence rates were calculated for those employed in agriculture (Bureau of the Census industry codes [BOC] = 010–030), and for those employed in non-agricultural industries (all other BOC industry codes). Incidence rates were also calculated for various age groups, for males and females, and for each of the participating states. Because only one occupational case was identified by Louisiana, it was not included in the rate analyses. Incidence rate ratios (IRR) were derived by taking the ratio of relevant rates, and confidence intervals were calculated [Rothman, 1986].

RESULTS

Between 1998 and 1999, a total of 1,009 cases of acute occupational pesticide-related illness were identified by the SENSOR-pesticides program. There were 523 cases in 1998 and 486 cases in 1999. These cases fell into the following classification categories: definite = 98 (10%), probable = 258 (26%), possible = 546 (54%), and suspicious = 107 (11%). The incidence rate was 1.17 per 100,000 FTEs (Table I).

The mean age was 36 years (range 13–73 years). Incidence rates peaked among 20–24-year-old workers and decreased gradually with increasing age (Fig. 1). Information on race/ethnicity was available for 366 cases (36%). Of these, 198 (54%) were Caucasian, 125 (34%) were Hispanic, 34 (9%) were black, and 9 (2%) were classified as "other" race. Males accounted for 63% of the cases. The incidence rate among males was slightly higher compared to females (male = 1.25/100,000 FTEs, female = 1.04/100,000 FTEs, IRR = 1.20, 95% confidence interval (CI) = 1.06, 1.36). Median latency between exposure date and date of report to the state health department was 13 days (range 0–783 days). A total of 50% of the cases were exposed in the summer months (June through September).

The industry where the case was employed was available for 911 cases. A total of 469 cases (51%) were employed in agriculture and 58% were exposed in the summer months. The incidence rate among those employed in agriculture

TABLE I. Distribution of Cases of Acute Occupational Pesticide-Related Illness, Full Time Equivalent (FTE) Estimates and Incidence Rates by Industrial Sector and State, 1998–1999; SENSOR-Pesticides Program

	Industrial sector (BOC codes)								
	All			Agricultural (010–030)			Non-agricultural (all other codes)		
State[a]	N	FTE estimates[b]	Incidence rate[c]	N	FTE estimates[b]	Incidence rate[c]	N	FTE estimates[b]	Incidence rate[c]
Arizona	23	4,336	0.53	19	135	14.1	2	4,201	0.05
California	588	29,846	1.97	343	1,109	30.9	229	28,737	0.80
Florida	88	13,769	0.64	48	335	14.3	38	13,434	0.28
New York	32	15,796	0.20	8	192	4.2	24	15,604	0.15
Oregon	47	3,140	1.50	8	123	6.5	39	3,017	1.29
Texas	229	19,420	1.18	42	678	6.2	109	18,742	0.58
Total	1,007	86,307	1.17	468	2,572	18.2	441	83,735	0.53

BOC, Bureau of the Census Industry codes.
[a]Excluded from this table were two cases: the one Louisiana case, and a case involving an adolescent under 15 years of age (denominator data is not available for those under 15 years of age). In addition, industrial sector information was not available for 98 cases. These 98 cases are included only in the columns that describe all cases.
[b]In thousands of FTEs.
[c]Per 100,000 FTEs.

was 18.2/100,000 FTE (Table I). Interestingly, although 70% of the agricultural cases were male, the incidence rate among males (15.6/100,000 FTEs) was significantly lower than that among females (29.7/100,000 FTEs) (IRR = 0.53, 95% CI = 0.43, 0.65). As was found for all industries combined, the incidence rate among agricultural cases was highest among 20–24-year-old workers (Fig. 1). The occupation of most cases employed in agriculture was farm worker (70%).

A total of 442 cases were employed in non-agricultural industries. These cases were almost evenly split between males (234 cases, 53%) and females (205 cases, 46%) (3 cases had unknown gender). The incidence rate among those employed in non-agricultural industries was 0.53/100,000

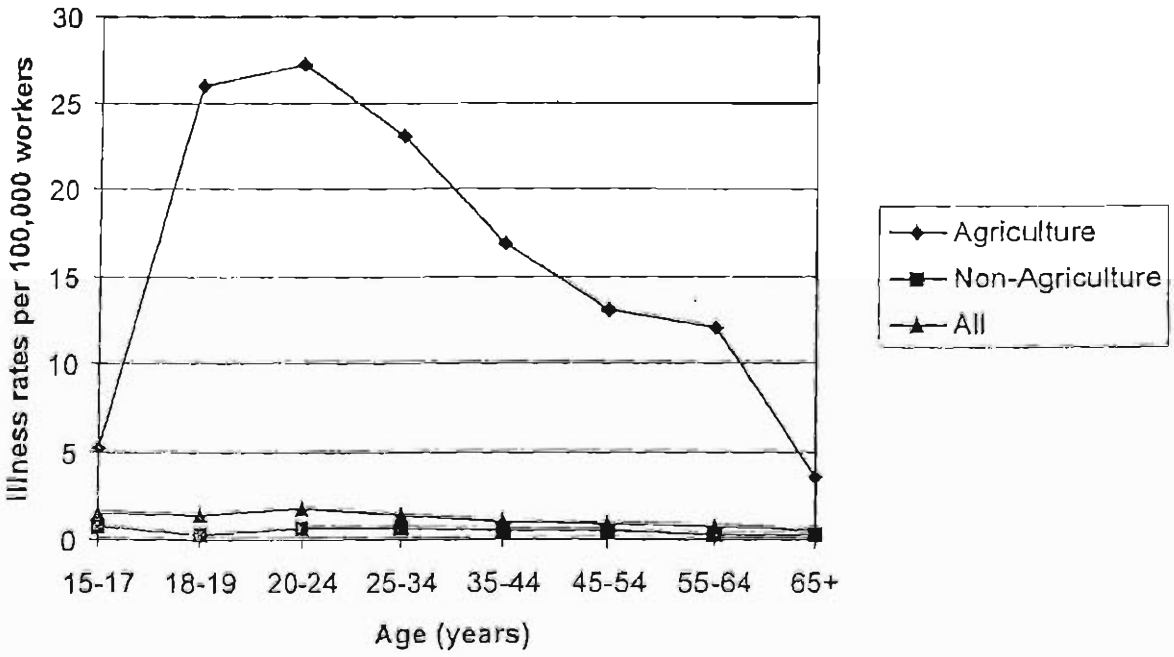

FIGURE 1. Acute occupational pesticide-related illness rates by age and industry, 1998–1999, SENSOR pesticides program.

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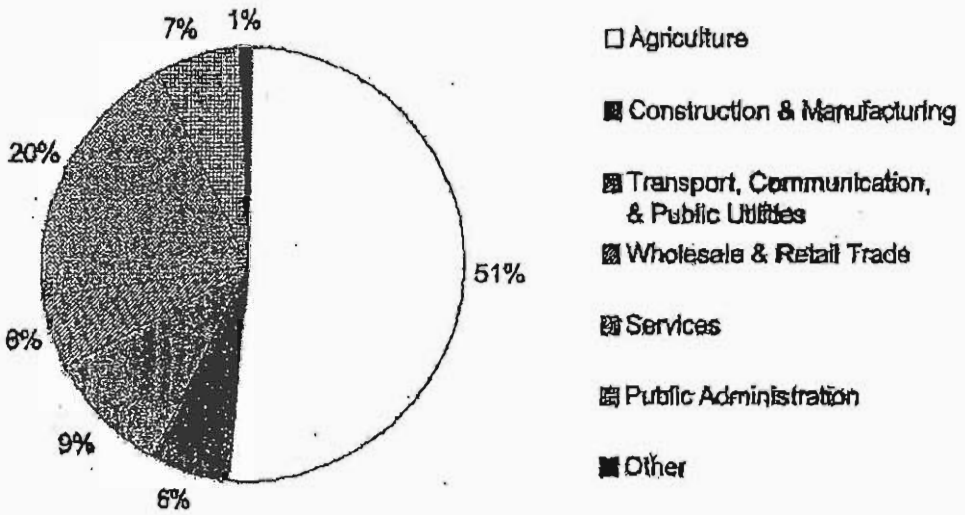

FIGURE 2. Acute occupational pesticide-related illnesses by industry category, 1998–1999; SENSOR-pesticides program. Agriculture (51%); Construction and Manufacturing (6%); Transport, Communication and Public Utilities (9%); Wholesale and Retail Trade (6%); Services (20%); Public Administration (7%); Other (1%).

FTEs, and was significantly lower among males (0.48/100,000 FTEs) compared to females (0.58/100,000 FTEs) (IRR = 0.83, 95% CI = 0.68, 0.99). The incidence rate was highest among 15–17 year olds (0.76/100,000 FTEs) and decreased with increasing age (Fig. 1). A total of 40% of the non-agricultural cases (177 cases) were employed in the services sector (Fig. 2), and 21 of these were employed in pest control.

Information on the number of cases identified by each state is provided in Table I. California identified the most cases and had the highest overall incidence rate and the highest agricultural incidence rate.

Information on the pesticides responsible for acute occupational pesticide-related illness is provided in Table II. Insecticides were responsible for 49% of the illnesses. Among the insecticides, organophosphates (n = 233), carbamates (n = 76), pyrethroids (n = 55), and pyrethrins (n = 46) were most commonly responsible. A total of 160 separate active ingredients were identified as potentially responsible for one or more illness cases. Among these active ingredients, Table III provides the 16 most commonly reported. These 16 active ingredients are thought to be responsible for 563 (57%) of the 996 cases having active ingredient information available.

The active ingredient responsible for the largest number of cases was sulfur. Sulfur is used as an acaricide and fungicide on a variety of crops, and is irritating to the skin, eyes, and respiratory tract. All but one of the sulfur-associated cases were exposed in California. Of the 78 cases, 67 were employed in agriculture and most were farm workers (n = 58) performing routine work activities that did not involve pesticide application. Sulfur was often used on

TABLE II. Acute Occupational Pesticide-Related Illness by Pesticide Functional Class and Severity, 1998–1999; SENSOR-Pesticides Program

	Severity category				
Pesticide functional class	**Low**	**Moderate**	**High**	**Death**	**Total**
Insecticides	359 (72%)	132 (27%)	3 (1%)	0	494 (49%)
Herbicides	55 (65%)	29 (35%)	0	0	84 (8%)
Fungicides	37 (70%)	16 (30%)	0	0	53 (6%)
Fumigants	66 (57%)	49 (43%)	0	0	115 (11%)
Disinfectants	29 (69%)	13 (31%)	0	0	42 (4%)
Insecticides + fungicides	60 (81%)	13 (18%)	1 (1%)	0	74 (7%)
Other[a]	23 (77%)	4 (13%)	0	3 (10%)	30 (3%)
Multiple[b]	74 (63%)	43 (37%)	0	0	117 (12%)
Total	703 (69.7%)	299 (29.6%)	4 (0.4%)	3 (0.3%)	1,009

[a]This category includes plant growth regulators, insect growth regulators, wood treatment products, preservatives, and insect repellants.
[b]Pesticide product was classified into more than one functional class

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TABLE III. List of the 16 Pesticide Active Ingredients Thought to be Responsible for the Largest Number of Acute Occupational Pesticide-Related Illnesses, and the Type of Exposure, 1998–1999; SENSOR-Pesticides Program

Active ingredient (US EPA chemical code)	N	Type of exposure[a]					
		Drift (%)	Surface (%)	Indoor air (%)	Spray (%)	Contact (%)	Unknown (%)
Sulfur (77501)	78	9	13	5	14	22	37
Malathion (57701)	56	34	9	14	25	14	4
Chlorpyrifos (59101)	51	29	0	18	8	10	35
Methyl bromide (53201)	49	0	2	2	4	82	10
Pyrethrins (69001)	49	0	0	69	4	8	19
Carbofuran (90601)	47	0	74	0	4	17	5
Diazinon (57801)	41	34	0	20	10	20	16
Propetamphos (113601)	39	0	0	95	0	0	5
Metam-sodium (39003)	38	71	0	0	5	13	11
Glyphosate (103601)	24	8	4	0	29	25	34
Propargite (97601)	20	30	0	0	10	5	55
Copper (metallic) (22501)	16	63	0	0	31	0	6
Copper sulfate (24401)	15	0	7	0	13	40	40
Dimethoate (35001)	14	50	0	0	21	7	22
Methoprene (105401)	13	15	0	85	0	0	0
Permethrin (109701)	13	23	0	23	8	23	23

[a]Type of exposure indicates how the pesticide exposure occurred. This information was not available for 31% of the cases (312/1,009). Drift, exposure by off target deposition during pesticide application; surface, exposure by contact with treated surface; indoor air, exposure via indoor air contamination; spray, exposure by direct spray of the pesticide; contact, exposure by spill, leaking container, or other direct contact.

beverage crops (e.g., wine grape vineyards) (n = 27) and on other small fruit crops (e.g., table grapes) (n = 11). As expected, health effects most often involved the skin (n = 45, 58%), eyes (n = 32, 41%), and respiratory tract (n = 22, 28%). Severity for these sulfur-associated cases was low for most (n = 64, 82%), moderate for 13 (17%) cases, and high for one (1%).

Overall, most of the acute occupational pesticide-related illnesses were of low severity (69.7%) (Table II). The three fatalities involved Vietnamese shrimpers whose bodies were found in their fishing vessel off the Florida coast. They had used sodium metabisulfite to preserve their catch. Sulfur dioxide gas, acutely toxic to the respiratory tract, is liberated when sodium metabisulfite is mixed with water. The medical examiner concluded that these three deaths were due to sulfur dioxide exposure.

Among the four cases with high severity was a 34-year-old female hospital housekeeper who was exposed to an organophosphate (propetamphos) and a pyrethroid (cyfluthrin) after entering a recently treated surgical unit, and was hospitalized for 4 days with dyspnea, fasiculations, dizziness, and vomiting. Another was a 27-year-old pesticide applicator working in agriculture who was sprayed with malathion and dimethoate and developed pulmonary edema. An additional high severity case involved a 26-year-old female bus driver who was exposed to sulfur when it drifted from a nearby field which was being sprayed. She experienced dyspnea, and hypoxemia that resulted in a 4-day hospitalization. Finally, a 47-year-old manager of a hardware and feed store where pesticides were sold, and who was also exposed to pyrethrins/pyrethroids at his home, developed hypersensitivity pneumonitis that required a 13 day hospitalization.

A total of 850 (84%) cases were evaluated and treated by a health care professional, and of these, 58 were hospitalized for a median of 1 day (range 1–13 days). An additional 70 cases (7%) received advice only from a poison control center, and the remaining cases either received no medical care (49, 5%), unknown care (31, 3%), or other, unspecified care (9, 1%). For all pesticides combined, the most commonly observed effects involved the nervous system (58%), the gastrointestinal system (49%), the respiratory system (48%), the eye (39%), and the skin (30%).

Laboratory testing data were obtained on a low proportion of cases. Among the 332 subjects poisoned by cholinesterase-inhibiting insecticides, cholinesterase tests were performed on 95 (29%), not performed on 70 (21%), and this information was unknown for 167 (50%). Among the 95 who were tested, 15 (16%) had an abnormal result (14 had an abnormal result compared to the laboratory reference range and 1 had an abnormal result compared to his baseline cholinesterase activity), 53 were normal, and 27 had an unknown result. Information on whether other biological testing was performed was available on 646 subjects. Of these,

only 77 (12%) had such testing performed. Most of this testing was among those poisoned with carbamates (37/77, 48%), fumigants (24/77, 31%), and organophosphates (10/77, 13%). Standardized information is not collected on the type of other biological testing performed, nor on the test results. However, 31 of the tested carbamate cases were exposed in the same outbreak and had urinary carbofuran metabolites measured [CDC, 1999a].

For most cases, the pesticide exposure occurred while the individual was performing routine work activities that did not involve pesticide application (673/1,009; 67%). For 25% (255/1,009) of the cases, the exposure occurred while the individual was involved with the pesticide application process (i.e., applying, mixing/loading, transport/disposal, or equipment repair/maintenance). The proportion of cases exposed during the pesticide application process was greater among those employed in agriculture (153/469; 33%) versus those employed in non-agriculture (83/442; 19%) ($P < 0.001$). The activity of the individual at the time of exposure was unknown for the remaining cases (81/1,009; 8%). As would be expected, among those exposed during the pesticide application process, exposure often occurred by direct spray (59/255; 23%) or by contact from a spill or leaking equipment (79/255; 31%). In contrast, among those who were not applying pesticides at the time of exposure, the exposure was often by drift (153/673; 23%) or by exposure to indoor air contaminated with pesticides (188/673; 28%). For 26% of the cases (258/1,009), information on how the exposure occurred was not available.

Information on the target of the pesticide was available for 714 cases (71%). A large proportion were not related to an intended pesticide application, but instead occurred after a spill, from exposure to a leaking pesticide container, or during emergency response (134/714; 19%). Of these, 14 cases were health care workers who were poisoned after exposure to pesticide-contaminated patients. For exposures related to an intended pesticide application, the target of the pesticide depended on whether or not the worker was employed in agriculture. Most of the non-agricultural cases arose from treatment of building structures (178/297; 60%) and from landscaping treatments (33/297; 12%). Among the cases that occurred among agricultural workers, the intended target of the pesticides were often fiber crops (e.g., cotton) (57/291; 20%), beverage crops (e.g., wine grapes) (40/291; 14%), landscaped areas (33/291; 11%), soil (i.e., to disinfect for fungi, nematodes, and insects) (21/291; 7%), other small fruit crops (e.g., berries, table grapes) (18/291; 6%), and undesired plants (i.e., the undesired plant was the *only* target) (14/291; 5%).

EPA toxicity category information was available for 20 (42%) of the affected individuals. A total of 209 (50%) were exposed to toxicity category I pesticides, 98 (23%) to category II pesticides, and 113 (27%) to category III pesticides. Those employed in agriculture were more likely to be exposed to toxicity category I or II pesticide products (171/204; 84%) compared to those employed in non-agricultural industries (126/187; 67%, $P < 0.01$).

For only 456 cases was information on PPE use available. Of these, PPE was used by 140 (31%). Those involved with the pesticide application process were more likely to wear PPE (56/85; 66%) compared to those performing routine work activities that did not involve pesticide application (83/368; 23%) ($P < 0.001$). The PPE most often worn by those involved with pesticide application included rubber/synthetic gloves ($n = 21$), chemical goggles/faceshield ($n = 24$), and chemically resistant clothing ($n = 22$). The PPE most often worn by those performing routine work activities included dust masks/disposable respirators ($n = 81$) and cloth or leather gloves ($n = 32$). The proportion of applicators who used PPE was greater among those employed in agriculture (agriculture = 79%; non-agriculture = 51%, $P < 0.01$). Illness severity was found not to be associated with use of PPE ($P = 0.07$), but those who wore PPE were more likely to be exposed to toxicity category I or II pesticides (PPE worn = 83%; PPE not worn = 69%, $P = 0.02$). The fact that the subjects were poisoned despite using PPE suggests that the PPE was either inappropriate or incorrectly used.

As for involvement of enforcement agencies, this information was available only for 157 cases. Of these, violations of pesticide rules and regulations were identified in 71 cases. Most violations pertained to Federal Insecticide, Fungicide, and Rodenticide Act violations ($n = 65$), including non-compliance with the pesticide product label ($n = 44$), and worker protection standard violations ($n = 20$). A total of 24 cases were associated with Occupational Safety and Health Administration standard violations. Enforcement agencies investigated an additional 63 cases but no violations were cited. Several cases were not investigated by enforcement agencies, either because the case subject refused ($n = 10$), or because enforcement agency involvement was not applicable ($n = 11$). Enforcement agency findings were pending in two cases. Neither agricultural employment ($P = 0.36$) nor illness severity ($P = 0.36$) were associated with a violation.

Case reports were received from many different sources. The three leading report sources were other government agencies (e.g., the state department of agriculture and county health departments) (35%), workers' compensation (32%), and poison control centers (20%). The remaining cases were reported by a variety of sources, including health care professionals (5%) and employers (3%). The principal report source varied across states. In Arizona, New York, and Oregon other government agencies provided most reports, California's principal report source was workers' compensation, Texas' data were largely from poison control centers, and in Florida it was through employer reports. Among the three leading report sources, median latency between

exposure date and date of report to the state health department were lowest for other government agencies at 9 days. Median latency for workers' compensation was 14 days and for poison control centers was 126 days.

DISCUSSION

When used properly, pesticides offer a variety of benefits to society. They increase crop yields, preserve foodstuffs, and combat pathogenic and nuisance insect infestations. However, pesticides are also among the few chemicals that are specifically designed to kill and cause harm. Because society allows these chemicals to be disseminated into the environment, society incurs a responsibility to ensure their safe use and to survey for associated health effects. One method to assess the public health impact of pesticide use is through acute pesticide poisoning surveillance. Acute pesticide poisoning surveillance has been endorsed by many organizations and federal government authorities [CSTE, 1999; GAO, 2000; NIOSH, 2001; Pew Environmental Health Commission, 2001].

The data generated by the SENSOR-pesticides program can be useful for identifying potentially relevant risk factors. For example, those employed in agriculture were found to have a far greater incidence rate for acute occupational pesticide-related illness compared to those employed in nonagricultural industries. This higher rate may be partially explained by the high usage of pesticides in agriculture. During 1998–1999, the agricultural industry used 79% of the total US volume of pesticide active ingredient [Donaldson et al., 2002]. In contrast, agricultural employment accounted for only 3% of FTEs in the US (Table I). Furthermore, within agriculture, insecticides (36%), fumigants (16%), and products containing both insecticides and fungicides (13%) were responsible for a large proportion of illnesses. These pesticides could be a focus of intervention efforts, especially on farms producing fiber crops (e.g., cotton) and beverage crops (e.g., wine grapes). In addition, interventions targeting farm workers should be considered as these workers accounted for most agricultural illnesses. As affected farm workers were often performing routine work activities that did not involve pesticide application (215/329; 65%), frequently through exposure to pesticide drift (71/215; 33%) or contact with a treated plant or other surface (45/215; 21%), these activities are other important intervention targets. This report and other evidence [Arcury et al., 2001] suggest poor compliance with the Worker Protection Standard, suggesting the need to enhance enforcement, and employer and worker awareness of this standard.

Although identification of poisoning risk factors is useful for targeting intervention efforts, the limited resources of state surveillance systems precluded obtaining all relevant risk factor information. For each illness case, attempts are made to collect data on a large number of variables (i.e., 148 variables). Securing this information is labor- and resource-intensive. Although improvements are needed to ensure that this information is collected on a higher proportion of cases, this cannot occur without providing additional resources to state surveillance programs.

In addition to assessing magnitude and identifying risk factors, the SENSOR-pesticides program has identified many emerging pesticide problems [CDC, 1999a,b,c, 2000b, 2003; Das et al., 2001b; Calvert et al., 2003]. Detection of these problems has resulted in efforts to prevent their recurrence. For example, after illnesses were found to be associated with the pesticides used to eradicate Medfly infestations, additional resources were employed to successfully prevent subsequent Medfly infestations at least through mid-2003. The findings from this study also supported the need for public notification requirements in Medfly eradication and mosquito abatement programs [CDC, 1999c, 2003]. Another emerging pesticide problem that was detected involved illnesses associated with automatic insecticide dispensers [CDC, 2000b]. Following dissemination of the findings of this report, EPA requested that the registrants of these products respond to the CDC recommendations for use modification and warning labels.

Our surveillance findings have led to efforts to raise awareness of pesticide toxicity among workers and health care professionals. Intervention efforts aimed at workers include creation of pesticide safety information materials (e.g., a novella and health promotion messages) for Spanish-language radio transmission and distribution of brochures that summarize pesticide safety messages and trinkets (e.g., key chains) that deliver poison control and health department contact information. To improve the ability of health care professionals to recognize, manage, and prevent pesticide-related illnesses, SENSOR-pesticides representatives assisted in the development of a strategic plan to expand and enhance relevant educational opportunities and resources [NEETF, 2002]. In addition, surveillance programs conduct outreach to clinicians to raise awareness of pesticide issues. Finally, surveillance findings have also been a spring board for research projects including one to enhance laboratory reporting of cholinesterase measurements and another examining the neurobehavioral effects associated with acute pesticide-related illness.

Several limitations with this surveillance data should be noted. Although the active ingredients provided in Table III were likely responsible for the reported pesticide-related illness, this may not have always been the case. This is because on average, each poisoned subject was exposed to 1.5 active ingredients. In those instances where the case was exposed to multiple active ingredients, it is possible that only one of the active ingredients produced the illness. Furthermore, pesticide products also may contain solvents and other inert ingredients, some of which may produce illness. However, since identification of inert ingredients present in

pesticide products often is not available, attribution of illness to these ingredients rarely can be made.

Other limitations involve the incidence rates. These rates are likely to be underestimates due to one or more factors [Azaroff et al., 2002]. Many individuals with pesticide-related illness are never ascertained because they neither seek medical care nor call appropriate authorities. Furthermore, because the signs and symptoms of acute pesticide-related illness are not pathognomonic, and because most health care professionals receive little instruction on this illness, many who seek medical care may not be correctly diagnosed. Even among those who are correctly diagnosed, many are not reported to state surveillance systems, despite the fact that each of the participating states has mandatory reporting of occupational pesticide-related illness [Calvert et al., 2001]. Finally, illness rates among those exposed to pesticides are not available because the number of workers exposed to pesticides is unknown. Instead, our denominators include all workers employed in a given industry. Because of under-ascertainment of cases and because not all of those included in the denominator are at risk for pesticide poisoning, the rates we provide must be considered minimum estimates of the true magnitude of the problem.

Rapid identification of a toxic agent can be critical to the diagnosis of pesticide poisoning. However, with the exception of tests for cholinesterase-inhibiting insecticides, biological markers of exposure have either not been developed or are not widely available. Enhancing laboratories to measure toxic chemicals in the body, either unchanged or metabolically altered, will both strengthen our ability to diagnose acute pesticide-related illness and aid in the timely recognition of toxin-related outbreaks.

Although the incidence rates for acute occupational pesticide-related illness were highest in California, this finding should be interpreted with caution. This finding does not necessarily mean that pesticide exposures are more hazardous or more prevalent in California; more likely it has to do with better case reporting. Whereas 53% of the California cases were identified through workers' compensation reports, only two other states, Oregon and Texas, received workers' compensation reports and in these states these reports accounted for only 2% and 1%, respectively. Clearly, workers' compensation is an important source of case reports, especially when the workers' compensation system is designed and utilized as in California. Other states with relatively high incidence rates were able to exploit other report sources. For example, in Texas 76% of cases were reported by poison control centers, whereas poison control centers accounted for only 4% of cases in the remaining states. An earlier finding that state surveillance systems capture only 14% of cases identified by poison control centers [Calvert et al., 2003] suggests the need for better poison control center reporting in all states. The relatively high incidence rate in Oregon may be attributed to the success of its interagency board, the Pesticide Analytical Response Center (PARC). PARC consists of representatives from various state agencies with jurisdiction over pesticides, health, and the environment. PARC representatives periodically meet to review pesticide incidents, coordinate investigations, and develop prevention strategies.

Data from the two oldest pesticide poisoning surveillance systems in the US were not included in these analysis. They were initiated in the early 1970s and are currently maintained by the California Department of Pesticide Regulation (CDPR) and the Washington State Department of Health. Both of these programs were using case definitions and variables that differed from SENSOR-pesticides in 1998–1999, and this precluded inclusion of their data. However, these older programs appear to have more success with case ascertainment. For example, during 1998–1999, the CDPR alone identified 909 cases of acute occupational pesticide related illness (Louise Mehler, CDPR, unpublished communication, August 23, 2002).

Clearly, improvements in case ascertainment can be made in all states. To maximize case ascertainment, surveillance programs can optimize use of workers compensation data, poison control center data, and data from other state agencies with enforcement jurisdiction over pesticides. To improve poison control center reporting, SENSOR-pesticides is funding modifications to a software program used by most poison control centers that will allow prompt electronic reporting of eligible reports. The SENSOR-pesticides program also encourages state surveillance systems to obtain access to submitted workers' compensation claims data and to foster effective collaborations with other state agencies having jurisdiction over pesticides.

The case definition used for acute pesticide poisoning surveillance is relatively complex. There are several reasons for this complexity, including the need for sufficient flexibility to handle the large number of registered active ingredients and pesticide products, and their associated toxic effects. For various reasons, relatively few cases met the strict criteria required for a "definite" classification. However, given the degree of evidence required to classify a case into one of the other three classification categories, we think the number of false-positive cases is minimal. Unfortunately, because there is no gold standard for the diagnosis of acute pesticide-related illness, it is impossible to determine the case definition's sensitivity, specificity, and predictive value positive. Despite the limitations of the case definition, it provides an objective, standardized approach for assessing the pesticide exposure–health effect relationship.

A final limitation is that this article provides information on acute illnesses associated with pesticide exposure only. Although pesticides are also associated with chronic illnesses (e.g., non-Hodgkin's lymphoma is associated with 2,4-dichlorophenoxyacetic acid (2,4-D) exposure [Dich et al., 1997] and chronic neurological effects are associated with

acute organophosphate poisoning [Eyer, 1995]), the difficulty with attributing these to pesticide exposures precludes conducting surveillance of chronic pesticide-related illnesses. Estimating the extent of chronic pesticide-related illnesses would require applying attributable risk proportions to data from national surveys.

In conclusion, surveillance is an important tool. It can identify emerging pesticide problems, estimate the magnitude of acute occupational pesticide-related illness and injury, and identify associated risk factors. Although improvements can be made to the SENSOR-pesticides program, we are aware of no better national surveillance system for acute occupational pesticide-related illness and injury. Additional support for this surveillance system will improve the prompt identification of pesticide problems and will help to ensure that prevention efforts are effectively targeted.

ACKNOWLEDGMENTS

The authors thank Margot Barnett for sharing her expertise which made this surveillance system and this paper possible. We also thank Thomas Arcury, PhD, Jerome Blondell, PhD, and Richard Ehrenberg, MD for kindly reviewing an earlier draft of this manuscript.

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Journal of Toxicology
CLINICAL TOXICOLOGY
Vol. 42, No. 1, pp. 55–60, 2004

ARTICLE

Epidemiology of Lindane Exposures for Pediculosis Reported to Poison Centers in Texas, 1998–2002

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ABSTRACT

Background: Lindane (gamma-benzene hexachloride), commonly used as a treatment for pediculosis, has been associated with adverse reactions and has recently undergone increased regulation. *Objective:* We sought to describe the patterns of a large number of lindane exposures reported to poison centers in Texas during 1998–2002. *Methods:* Data on all lindane exposures for pediculosis reported to the Texas Poison Center Network were analyzed. *Results:* There were 528 reported human exposures to lindane for pediculosis. The incidence of lindane exposures has decreased by 52% from 1998 to 2002. Misuse or abuse of lindane was reported in at least 87% of the cases. Of those cases with a known patient age, 45% were less than age 6 yrs, 23% age 6–19 yrs, and 32% over age 19 yrs. Female patients accounted for 55% of reported cases. Of those cases with a known medical outcome, 61% reported no effects. The most frequently reported symptoms were vomiting, nausea, and ocular irritation or ocular pain. *Conclusion:* The number of reported lindane exposures in Texas is decreasing. The majority of reported exposures involve misuse or abuse of the product. The pattern of symptoms reported in Texas was consistent with the literature.

Key Words: Lindane; Pediculosis; Texas Poison Center Network.

INTRODUCTION

Lindane (gamma-benzene hexachloride) is a chlorinated hydrocarbon commonly used as an agricultural pesticide and for the treatment of scabies and pedic[illegible] when applied topically. In the latter instance, lind[illegible] approved by the FDA and is available by prescr[illegible] only. The primary target of action of lindane i[illegible]

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DOI: 10.1081/CLT-120028745

0731-3810 (Print); 1097-9875 (O[illegible]
www.dekker[illegible]

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Journal of Toxicology
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INTRODUCTION

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Table I. Lindane lotion and shampoo exposures reported to the Texas Poison Center Network during 1998-2002 by year.

Year	Total Texas population	Lindane exposures	Penetrance*	Percentage change in penetrance from previous year
1998	19,759,614	132	0.007	
1999	20,044,141	131	0.007	−2.2%
2000	20,851,820	96	0.005	−29.6%
2001	21,195,281	94	0.004	−3.7%
2002	21,500,997	75	0.003	−21.3%

*exposures per 1,000 population

central nervous system. Animal studies indicate that lindane is readily absorbed through the gastrointestinal tract, skin, and lungs (1).

Although adverse reactions after normal use of lindane have been described (2), adverse reactions mainly result from misuse of the product such as prolonged dermal exposure, repeated dermal applications, application to diseased skin, or ingestion (3,4). Misuse may result from problems understanding the application directions on the label where the product is administered orally rather than dermally (5).

Dermal exposure to lindane results in symptoms including seizures, dizziness, headache, nausea, diarrhea, abdominal pain, urinary and fecal incontinence, muscle weakness, myoclonic jerks, fatigue, weight loss, hair loss, sleep disturbance, cognitive dysfunction, and anemia, with some of the symptoms reportedly lasting for long periods of time (2,3,6–8). Common symptoms of lindane ingestion include nausea, vomiting, seizures, drowsiness, and lethargy. Other symptoms observed with oral exposure to lindane include headaches, dizziness, irritability, tremors, coma, renal failure, and muscle necrosis (5,9–13). Both dermal and oral lindane exposure have been associated with death (5,12,13). Treatment of lindane exposure is symptomatic, and there is no specific antidote. Lavage and charcoal have been used for treatment of oral lindane exposure (11).

Over the past eight years, lindane has become more tightly regulated. In 1995, lindane was classified as a second-line therapy because safer, more effective treatments had been found. Effective January 1, 2002, the State of California banned the use and sale of any lindane-containing product used for the treatment of pediculosis or scabies (14). In March 2003, the United States Food and Drug Administration (FDA) issued a Public Health Advisory announcing the addition of extensive warnings to the labels of topical formulations ndane lotion and shampoo for the treatment of lice scabies (15).

Much of the literature on the adverse effects of lindane consists of case reports. The intent of this investigation was to describe the patterns of lindane exposures reported to poison centers in Texas during a recent five-year period.

MATERIALS AND METHODS

A five-year retrospective study used data from the Texas Poison Center Network (TPCN), a network of the six poison centers that together service the entire state. All of the TPCN centers use the American Association of Poison Control Centers (AAPCC) Toxicall program and Toxic Exposure Surveillance System (TESS) database in order to collect information on received calls.

Cases reviewed included all human exposures involving lindane reported to the TPCN during 1998–2002. Exposures to lindane used as an agricultural pesticide or veterinary treatment were excluded from the analysis. The exposure incidence was calculated for each year of the study period. The distribution of lindane exposure factors such as patient age and gender, reason and route of exposure, outcome, exposure and management sites, symptoms, and treatment was determined using AAPCC categories.

The proportion of cases known to be due to misuse or abuse of lindane was determined. Information on symptoms and treatment were not available for 1998 and 1999; analyses of those variables were restricted to 2000–2002. Seasonal patterns were analyzed by calculating the distribution of lindane exposures by month. All variables were not necessarily available for all of the cases, so the sum of the subcategories will not always equal the total number of cases.

RESULTS

There were 571 human exposures to lindane reported to the TPCN during 1998–2002. Forty-three of the exposures were excluded as they involved

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Table 2. Distribution of lindane lotion and shampoo exposures reported to the Texas Poison Center Network during 1998-2002 by selected variables for various patient age groups.

	Total No. (%)	<6 years No. (%)	6-19 years No. (%)	>19 years No. (%)
Gender				
Male	232 (45.3)	113 (49.3)	41 (34.7)	78 (47.3)
Female	280 (54.7)	116 (50.7)	77 (65.3)	87 (52.7)
Reason for exposure				
Unintentional	474 (90.3)	228 (99.1)	102 (87.2)	132 (80.0)
Intentional	31 (5.9)	0 (0.0)	10 (8.5)	21 (12.7)
Adverse reaction	18 (3.4)	2 (0.9)	5 (4.3)	11 (6.7)
Other	2 (0.4)	0 (0.0)	0 (0.0)	1 (0.6)
Exposure route				
Ingestion	415 (78.9)	188 (81.4)	97 (82.9)	120 (72.7)
Dermal	71 (13.5)	23 (10.0)	13 (11.1)	33 (20.0)
Ocular	21 (4.0)	11 (4.8)	6 (5.1)	4 (2.4)
Inhalation	4 (0.8)	0 (0.0)	0 (0.0)	4 (2.4)
Ingestion & Dermal	11 (2.1)	7 (3.0)	0 (0.0)	3 (1.8)
Ocular & Dermal	3 (0.6)	1 (0.4)	1 (0.9)	1 (0.6)
Other	1 (0.2)	1 (0.4)	0 (0.0)	0 (0.0)
Outcome				
None	199 (60.7)	106 (70.7)	47 (59.5)	43 (46.2)
Minor	104 (31.7)	35 (23.3)	28 (35.4)	40 (43.0)
Moderate	22 (6.7)	9 (6.0)	3 (3.8)	9 (9.7)
Major	3 (0.9)	0 (0.0)	1 (1.3)	1 (1.1)
Death	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Exposure site				
Own residence	471 (92.2)	219 (95.2)	106 (89.8)	146 (89.6)
Other residence	19 (3.7)	9 (3.9)	7 (5.9)	3 (1.8)
Workplace	2 (0.4)	0 (0.0)	0 (0.0)	2 (1.2)
Other	19 (3.7)	2 (0.9)	5 (4.2)	12 (7.4)
Management site				
Non-health care facility	238 (46.3)	95 (41.1)	54 (45.8)	89 (53.9)
At/En route to health care facility	130 (25.3)	62 (26.8)	30 (25.4)	38 (23.0)
Referred to health care facility	143 (27.8)	73 (31.6)	33 (28.0)	37 (22.4)
Other	3 (0.6)	1 (0.4)	1 (0.8)	1 (0.6)
Month of exposure				
January	38 (7.4)	14 (6.1)	11 (9.3)	13 (7.9)
February	48 (9.3)	22 (9.5)	10 (8.5)	16 (9.7)
March	52 (10.1)	29 (12.6)	10 (8.5)	13 (7.9)
April	46 (8.9)	13 (5.6)	18 (15.3)	15 (9.1)
May	44 (8.6)	18 (7.8)	9 (7.6)	17 (10.3)
June	46 (8.9)	17 (7.4)	7 (5.9)	22 (13.3)
July	39 (7.6)	13 (5.6)	8 (6.8)	18 (10.9)
August	37 (7.2)	18 (7.8)	9 (7.6)	10 (6.1)
September	44 (8.6)	26 (11.3)	9 (7.6)	9 (5.5)
October	37 (7.2)	20 (8.7)	8 (6.8)	9 (5.5)
November	40 (7.8)	18 (7.8)	9 (7.6)	13 (7.9)
December	43 (8.4)	23 (10.0)	10 (8.5)	10 (6.1)

lindane formulated for agricultural or veterinary purposes, including one instance where a veterinary product was used to treat human pediculosis. Thus, 528 cases were analyzed. Table 1 contains the distribution of reported lindane exposures by year. Although the Texas population increased during the five-year period, the number of reported lindane exposures decreased. As a result, the number of lindane exposures declined

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during 1998–2002, with the number of cases in 2002 being 52% that reported in 1998.

Of the 514 cases with a known patient age, 231 (44.9%) were less than age 6 yrs, 118 (23.0%) age 6–19 yrs, and 165 (32.1%) over age 19 yrs. The distribution of reported lindane exposures by other selected variables is shown in Table 2. A higher proportion of reported lindane exposures involved female patients. This pattern was found among all age groups, although the gender difference was greatest for cases 6–19 yrs of age.

The distribution of total lindane exposure cases by month demonstrated no clear seasonal pattern. The highest percentage of lindane exposures for patients age less than 6 yrs were reported to have occurred in March and September but otherwise showed no obvious seasonal trends. Reports of lindane exposures were relatively constant throughout the year for patients age 6–19 yrs with the exception of a high proportion of exposures reported in April. Reported lindane exposures among patients age greater than 19 yrs tended to be higher in February–July, with the highest proportion of reported exposures occurring in June.

Therapeutic error was reported in 152 (28.8%) of the cases. In 116 (22%) of the cases, lindane was reported to have been ingested when it was mistaken for another medication or beverage. In 7 (1.3%) cases, the lindane was in an incorrectly labeled container. Lindane was ingested instead of applied topically in 11 (2.1%) cases, including 1 case where poison center notes indicated a language barrier existed. In 31 (5.9%) cases, lindane was used on the skin more frequently or for a longer period of time than recommended.

The majority of reported lindane exposures were unintentional, a pattern observed among all of the age groups. However, the proportion of reported intentional exposures and adverse reactions increased with age. Most of the reported lindane exposures occurred through ingestion. The next most common exposure route was dermal, followed by ocular. A small portion of exposures occurred via multiple routes. The 19 yrs and older age group was more likely than the other age groups to report dermal exposure.

Among all lindane exposures reported during 2000–2002, the most frequently reported symptoms were vomiting (n=32), nausea (n=16), and ocular irritation or pain (n=13). Other symptoms reported in four or more patients included erythema, dermal irritation or pain, abdominal pain, throat irritation, agitation or irritability, dizziness, drowsiness or lethargy, seizures, and conjunctivitis. The most frequent symptoms reported among ingestion cases were vomiting (n=31), nausea (n=10), and throat irritation (n=6). Among dermal exposure cases, the most common reported symptoms were erythema (n=5), dermal irritation or pain (n=4), and nausea (n=4).

The most frequently reported treatments for cases of ingested lindane during 2000–2002 were dilution or irrigation (n=89), charcoal (n=79), and use of a cathartic or other emetic (n=49). Other treatments reported in four or more cases of lindane ingestion were lavage, food, anticonvulsant, and IV fluids. For dermal lindane exposures during the same time period, the most frequent treatment was dilution or irrigation (n=21).

Outcome information was unavailable for more than half (62%) of the reported exposures. No health effects were reported for 199 (38%) of the lindane exposures, and few cases reported major health effects. Medical outcome was classified as minor or moderate for 24% (N=126) of the lindane exposures. There were no deaths related to reported lindane exposures.

When the outcome distribution was examined by patient age, the proportion of cases with minor or moderate effects tended to increase with age. A preponderance of reported lindane exposures among all age groups occurred at the patient's own residence. In the majority of all reported lindane exposures, the patient was either at or en route to a health care facility or referred to a health care facility by the poison center. Similar patterns were noted for patients aged less than 6 yrs and aged 6–19 yrs, whereas more patients aged greater than 19 yrs were managed in non-health-care facility settings.

DISCUSSION

This investigation described the epidemiology of lindane exposures reported to poison centers in Texas during a recent five-year period. In spite of the potential seriousness of lindane exposures, most of the literature on the subject consists of reports of a small number of cases. This investigation provides information on over 500 reported cases of lindane exposure.

While the 2000 Census reported that 69% of the Texas population was 20 yrs of age or greater, only 32% of reported lindane exposures were found among adults. This disproportionate number of cases among children and adolescents is either due to a higher likelihood of adverse lindane exposures among non-adults or a greater tendency to report lindane exposures to poison centers if they involve children and adolescents.

Seasonal variation in reported lindane exposures was only observed for adults. It might be expected that

school-age children would be more likely to be exposed to scabies and head lice at school, and thus more likely to have lindane exposures during the school year. However, the data do not support such a hypothesis. It is unclear why the proportion of reported lindane exposures among patients aged 6–19 yrs was much higher in April than in any other month.

Most of the reported lindane exposures were unintentional. However, the proportion of cases that was intentional or involved adverse reactions increased with age. The most frequent exposure route was ingestion, followed by dermal and ocular routes. A dermal exposure among adults was twice as likely as in the other age groups, suggesting that adults were either less likely to ingest lindane or more likely to report dermal exposures.

Therapeutic error was reported in almost 30% of the cases. Approximately 80% of the therapeutic errors involved lindane ingestion. In at least one-in-five of the cases, the exposure involved lindane ingestion when it was mistaken for another medication or beverage. This indicates that a portion of the population is misusing lindane. Although some of this misuse may reflect carelessness, misuse also may occur if people were not directed to use the product correctly or they misunderstood instructions and thought the product was to be given orally.

Many of the symptoms reported in association to lindane exposures in this study—vomiting, nausea, ocular irritation or pain, erythema, dermal irritation or pain, abdominal pain, throat irritation, agitation or irritability, dizziness, drowsiness or lethargy, seizures, and conjunctivitis—have been previously reported in the literature. Anemia was not reported in any of our cases although this symptom has been reported in several previous studies (7,16). The more common treatments used for the lindane exposures were dilution or irrigation, charcoal, and use of a cathartic or other emetic and less frequently treatments for specific symptoms. These treatments also have been utilized in previous studies.

The majority of reported lindane exposures among children and adolescents had no reported effect. In contrast, a higher proportion of reported lindane exposures among adults had a reported minor-moderate effect. In spite of this, reported lindane exposures among the younger age groups were more often managed at health-care facilities while those among adults were more frequently managed outside of health-care facilities. These patterns may reflect a greater tendency to report exposures and to seek treatment at health-care facilities among young patients, even if there is little or no apparent health effect from the lindane exposure. This suggests that a portion of these visits to health-care facilities might be unnecessary.

Regardless of the lack of health effects reported for 199 of the lindane exposures in this study, the large number of exposures and persons who sought medical treatment at health-care facilities underscores the need for education to both consumers and health-care providers. Both physicians and pharmacists should clearly explain the correct directions for use of these lindane products. The fact that this formulation of lindane is available by prescription only may inadvertently bias consumers to perceive lindane as safe. Physicians should consider the potential adverse effects of lindane and appropriately counsel patients when it is prescribed; alternatively, physicians could consider prescribing non-lindane pediculicides.

The number of reported lindane exposures declined substantially during the five-year period of the study, with the number of cases reported in 2002 being slightly more than half the number of cases reported in 1998. There are several possible explanations for this decline. There could be decreased use of lindane products in favor of other products considered to be safer and more effective as pediculicides (10). There could also be a decline in the occurrence of adverse human exposures to lindane. Lastly, there could be decreased reporting of lindane exposures to the poison centers in Texas.

The main limitation to this investigation is the scope of the data. The TPCN is a passive system in that exposures are reported to poison centers and reporting is voluntary. Moreover, it cannot be assumed that all subgroups were equally likely to report lindane exposures; thus the data may be biased. Another limitation is that some of the reported exposures may have been identified as lindane lotion or shampoo when they were actually higher concentrations of lindane intended for agricultural or veterinary purposes. In addition, a proportion of cases may have been assigned the wrong codes, particularly in relation to exposure reason, by the persons handling the poison calls. Review of the case notes might be useful for identifying such coding errors. However, case notes are not collected in a consistent fashion, and no attempt at correcting case notes was made.

In conclusion, the pattern of symptoms and treatments reported for over 500 cases of lindane exposure in Texas was consistent with the literature. Exposures to lindane were most commonly reported among children and adolescents and among females. Reported exposures were predominantly unintentional and involved ingestion of the product. Errors in use of

lindane products were common. No obvious seasonal patterns in reports of lindane exposures were observed, even among school-age children. Reported lindane exposure patterns tended to differ between the age groups. The reports of lindane exposures decreased over a five-year period as regulations on lindane increased. This information can be used by poison centers to target education for the prevention of adverse lindane exposures.

ACKNOWLEDGMENTS

Funding for this research was provided by a contract with the Commission on State Emergency Communications in Texas. We would like to thank the staff of the six poison centers (Central Texas Poison Center, North Texas Poison Center, Texas Panhandle Poison Center, South Texas Poison Center, Southeast Texas Poison Center, West Texas Regional Poison Center) of the TPCN who collected the data.

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Submitted August 6, 2003
Accepted October 1, 2003

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Acute Pesticide-Related Illnesses Among Working Youths, 1988–1999

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Objectives. The goal of this study was to describe acute occupational pesticide-related illnesses among youths and to provide prevention recommendations.

Methods. Survey data from 8 states and from poison control center data were analyzed. Illness incidence rates and incidence rate ratios were calculated.

Results. A total of 531 youths were identified with acute occupational pesticide-related illnesses. Insecticides were responsible for most of these illnesses (68%), most of which were of minor severity (79%). The average annual incidence rate among youths aged 15 to 17 years was 20.4 per billion hours worked, and the incidence rate ratio among youths vs adults was 1.71 (95% confidence interval=1.53, 1.91).

Conclusions. The present findings suggest the need for greater efforts to prevent acute occupational pesticide-related illnesses among adolescents. (*Am J Public Health.* 2003;93:605–610)

Work is a common aspect of youths' lives. In fact, the vast majority of young people are, at some time, employed while they are in school. Many of the hazards faced by working youths are receiving increasing attention.[1–3] Although concerns have been raised about pesticide exposures among working youths,[2,4,5] few data are available to support these concerns.

To address the need for more information about the effects of occupational pesticide exposures among young people, we examined the magnitude, incidence, and nature of acute pesticide-related illnesses among working youths. We also compared the rate of such ill-es among youths with the corresponding for adults. In this article, in addition to describing the results of our analyses, we provide recommendations for prevention of these illnesses. To our knowledge, ours is the first study to provide population-based estimates of the occurrence of acute occupational pesticide-related illness among young people.

METHODS

Data were obtained on individuals 17 years or younger who developed acute pesticide-related illnesses while working. We excluded cases involving nonoccupational exposures, attempted suicides, intentional malicious use (e.g., attempted homicide), or exposure for a psychotropic effect. In addition, cases caused by disinfectants were excluded, because such cases are not tracked in many states.

Information on cases was provided by the Toxic Exposure Surveillance System (TESS), the California Department of Pesticide Regulation, the California Department of Health Services, the Texas Department of Health, the W gton State Department of Health, the Oregon Department of Human Services, the New York State Department of Health, the Florida Department of Health, the Louisiana Department of Health and Hospitals, and the Arizona Department of Health Services. TESS, maintained by the American Association of Poison Control Centers, collects poisoning reports submitted by approximately 85% of US poison control centers.[6]

Each of the state agencies that contributed data on cases maintains its own surveillance system for acute pesticide-related illness and injury. It should be noted that 4 states neither have poison control centers that participate in TESS nor have in place a state-based surveillance system (Maine, Mississippi, South Carolina, and Vermont).

The periods for which acute pesticide-related illness and injury surveillance data were available varied by agency. TESS data were available for 1993 through 1998. Surveillance data from Texas are considered complete as of 1987; Oregon, as of 1988; New York and Washington State, as of 1991; Arizona and Louisiana, as of 1992; Florida, as of 1998; and California, as of 1989. Data from state agencies were collected through 1999.

The information collected by TESS and the state agencies includes date of illness, information on the ill individual (sex, age, signs, and symptoms), whether the illness occurred as a result of workplace exposures, and the pesticide or pesticides that produced the illness. Additional information collected by the state agencies but not by TESS includes race/ethnicity, occupation, industry, activity of the individual during the exposure, type of exposure (e.g., drift, direct spray, or exposure to a spill or leaking container), and whether personal protective equipment was used. For the present analysis, we defined use of personal protective equipment as use of goggles, face shields, gloves, or respirators.

The Environmental Protection Agency (EPA) acute toxicity category was sought for all pesticides responsible for illness. EPA classifies pesticide products into 1 of 4 acute toxicity categories based on established criteria. Pesticides having the highest toxicity are placed in category I, and those having the lowest are included in category IV. In the case of the present analyses, the acute toxicity category of the pesticide product responsible for causing an illness was often provided by the contributing state agency. When not provided, information on acute toxicity category was retrieved from a data set made available by EPA.

Information on illness severity was sought for all eligible cases. Except for Washington State and Louisiana, state agencies did not determine severity levels for the cases they identified. TESS criteria were used to assign

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severity levels to the cases provided by TESS and the other state agencies.[6] *Minor effects* consisted of minimally bothersome health effects that generally resolved rapidly. *Moderate effects* consisted of non–life-threatening health effects that were more pronounced or prolonged than minor effects or of a systemic nature. *Major effects* consisted of life-threatening health effects or those resulting in "significant residual disability or disfigurement."

To avoid repeated inclusion of the same case, we compared cases provided by each state agency with cases included in TESS. Cases that matched each other in terms of year and state of exposure, age, sex, and pesticide active ingredient were assumed to involve the same individual. Such individuals were included in the state agency totals only.

Case Definition

Cases were included only if health effects developed subsequent to pesticide contact and these effects were evaluated by poison control or state surveillance professionals as sistent with the known toxicology of the cide product. TESS relies on the experience and judgment of poison control center specialists managing specific cases to determine whether the affected individuals have symptoms and signs consistent with the pesticide exposure. No standardized criteria are used to make this determination. A full description of the standardized case definition used by each state agency is beyond the scope of the present article, but this information is available elsewhere.[7]

Data Analysis

SAS software (SAS Institute Inc, Cary, NC) was used for data management and in conducting χ^2 analyses to examine categorical data. Incidence rates among subjects aged 15 to 17 years were calculated for the period 1993 through 1998. The numerator was the total number of illness cases; the denominator was obtained from estimates of hours worked derived from the 1993 through 1998 administrations of the Current Population Survey.[8,9] The Current Population Survey does not provide data on workers younger than 15 years. In lating incidence rates for young workers, it is preferable to use hours worked rather than employment counts.[9] The reason is that youths work fewer hours per week, and fewer weeks per year, than adults. Using employment counts would underestimate the risk of acute pesticide-related illnesses among young people.

Average annual incidence rates were calculated for young people employed in agricultural (Bureau of the Census industry codes 010–030) and nonagricultural (all other Census Bureau industry codes) industries. Because information on industry was not available from TESS, the assumption was made that the proportion of TESS cases involving individuals employed in agriculture was equal to the proportion found among the cases reported by state agencies. Male and female incidence rates and rates for each of 4 US regional areas were also calculated.

We calculated risks of acute pesticide-related illness among individuals aged 15 to 17 years by comparing rates among these youths with those among adults aged 25 to 44 years.[10] The data on adults were obtained from the same agencies that provided the data on youths, with the same exclusions applied. The age range of the adult comparison group was chosen a priori and was based on methodology used previously in examinations of occupational fatalities.[11] We calculated the incidence rate ratio as the youth–adult ratio of number of acute pesticide-related illnesses per hour worked. A ratio greater than 1 would suggest that youths have a higher risk of acute pesticide-related illnesses than adults. Confidence intervals (CIs) were calculated according to methods described by Rothman.[10]

RESULTS

During 1988 to 1999, 531 youths were identified with acute occupational pesticide-related illnesses. Of these individuals, 428 were identified by TESS and 103 by state agencies (9 cases were identified by both TESS and a state agency). The median age among these young people was 16 years (range: 6–17 years), and 122 (23%) were 13 years or younger; 68% were male. Information on race and ethnicity was available for 42 of the patients identified by state agencies (TESS does not collect this information). All 42 were White, and 21 of these individuals (51%) also reported Hispanic ethnicity. Of the 524 cases for which month of illness was known, 368 (70%) occurred between May and August.

Between 1993 and 1998, the average annual incidence rate among youths aged 15 to 17 years was 20.4 per billion hours worked (Table 1). Incidence rates have decreased in recent years (Table 2). The incidence rate was much higher among those employed in agriculture (196.9/billion hours worked) than among those not so employed (7.0/billion hours worked), and the rate was higher among male (27.9/billion hours worked) than among female (11.5/billion hours worked) youths. The rate was highest among those working in Western-region states (Table 3).

The risk of acute occupational pesticide-related illness was higher in youths than in adults (Tables 1 and 2). Overall, the incidence rate ratio among working youths compared with adults was 1.71; the ratio was lower among young people employed in agriculture (0.74). Results showed that incidence rate ratios were highest in the Midwest and lowest in the West (Table 3).

Information on the pesticides responsible for illnesses is provided in Table 4. Insecticides were responsible for 68% of the illnesses. Among the insecticides, organophosphates (142 cases) and pyrethroids (57 cases) were most commonly responsible. Specific organophosphate insecticides included chlorpyrifos (40 cases), diazinon (23 cases), and malathion (12 cases). Among the specific pyrethroids associated with illnesses were cypermethrin (14 cases) and cyhalothrin (12 cases). Glyphosate (33 cases) and 2,4-dichlorophenoxyacetic acid (16 cases) were the specific herbicides most commonly associated with youth illnesses.

Information on EPA acute toxicity category was available for 432 (81%) of the affected individuals. Of these youths, 51 (12%) were exposed to acute toxicity category I pesticides, 90 (21%) were exposed to category II pesticides, and 291 (67%) were exposed to category III pesticides. The percentage of individuals exposed to category I and category II pesticides was higher among those employed in agricultural industries (67%; 44 of 66 cases) than among those employed in nonagricultural industries (41%; 12 of 29 cases; $P=.02$).

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TABLE 1—Total Numbers of Cases of Acute Occupational Pesticide-Related Illness, Estimates of Hours Worked, Incidence Rates, and Incidence Rate Ratios, by Industrial Sector, 1993–1998

	Working Youths Aged 15–17 Years			Working Adults Aged 25–44 Years			
Industrial Sector (Bureau of the Census Codes)	No. (%) With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked[a]	Incidence Rate[b]	No. (%) With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked[a]	Incidence Rate[b]	Incidence Rate Ratio (95% Confidence Interval)[c]
All	333 (100)	16 328	20.4	9599 (100)	804 785	11.9	1.71 (1.53, 1.91)
Agriculture (010–030)	213 (64)[d]	1 082	196.9	5367 (56)	20 261	264.9	0.74 (0.65, 0.85)
Nonagriculture (all other codes)	107 (32)[d]	15 246	7.0	4232 (44)	784 524	5.4	1.30 (1.07, 1.58)

[a]In millions of hours.
[b]Per billion hours worked.
[c]Compares the risk of an acute occupational pesticide-related illness among working youths with that among adults in the same industrial sector.
[d]A total of 4% of working youths had no information on industry, and these individuals were not included in analyses stratified by industrial sector.

TABLE 2—Numbers of Cases of Acute Occupational Pesticide-Related Illness, Estimates of Hours Worked, Incidence Rates, and Incidence Rate Ratios, by Year, 1993–1998

	Working Youths Aged 15–17 Years			Working Adults Aged 25–44 Years			
Year	No. With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked[a]	Incidence Rate[b]	No. With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked[a]	Incidence Rate[b]	Incidence Rate Ratio (95% Confidence Interval)[c]
1993	46	2366	19.4	1504	133 066	11.3	1.72 (1.28, 2.31)
1994	51	2636	19.3	1571	131 774	11.9	1.62 (1.23, 2.14)
1995	74	2752	26.9	1809	132 993	13.6	1.98 (1.57, 2.50)
1996	60	2794	21.5	1697	134 419	12.6	1.71 (1.32, 2.21)
1997	49	2800	17.5	1535	136 483	11.2	1.56 (1.17, 2.07)
1998	53	2980	17.8	1483	136 050	10.9	1.63 (1.24, 2.14)
Total	333	16 328	20.4	9599	804 785	11.9	1.71 (1.53, 1.91)

[a]In millions of hours.
[b]Per billion hours worked.
[c]Compares the risk of an acute occupational pesticide-related illness among working youths with that among working adults.

Most of the cases of acute occupational pesticide-related illness among youths were of minor severity (418 of 531; 79%). Severity was moderate in 20% of the cases and major in 1% (Table 4). No fatalities were identified. Proportions of cases within a given severity category were similar across the pesticide functional classes ($P=.48$) and EPA acute toxicity categories ($P=.38$). A total of 236 (44%) patients were evaluated and treated in a health care facility; 13 (3%) were hospitaliz of whom were treated in an intensive care unit. When all pesticides were combined, the most commonly observed effects involved the gastrointestinal system (28% of youths reported health effects involving this system), followed by dermal effects (23%).

We also identified job tasks associated with illness. Seventy-one percent of subjects (70 of 99) were employed in agriculture (industry and occupation were available for only 99 of the cases identified by state agencies and for none of the TESS cases). Of the 70 agricultural workers affected, 15 (21%) were exposed while directly handling pesticides (i.e., applying [n=13], disposing of [n=1], or mixing and loading [n=1] pesticides), and 55 (79%) were exposed while doing routine work that did not involve direct handling of pesticides.

Only 3 youths appeared to be working in violation of the Fair Labor Standards Act (FLSA). These 3 youths were younger than 16 years, were employed on farms not owned or operated by their parents, and were applying or handling EPA acute toxicity category I or II pesticides. Among the 55 agricultural workers not handling pesticides, 33 (60%) were exposed while handling plant products previously sprayed with pesticides, 9 (16%) were exposed to drift from pesticides applied to the fields where they

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TABLE 3—Numbers of Cases of Acute Occupational Pesticide-Related Illness, Estimates of Hours Worked, Incidence Rates, and Incidence Rate Ratios, by US Region, 1993–1998

	Working Youths Aged 15–17 Years			Working Adults Aged 25–44 Years			
US Region	No. With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked[a]	Incidence Rate[b]	No. With Acute Occupational Pesticide-Related Illnesses	Estimated Total No. of Hours Worked[a]	Incidence Rate[b]	Incidence Rate Ratio (95% Confidence Interval)[c]
Midwest[d]	89	5220	17.0	1167	194 783	6.0	2.83 (2.28, 3.51)
Northeast[e]	28	2589	10.8	938	150 048	6.3	1.71 (0.93, 3.16)
South[f]	125	5379	23.2	2743	284 187	9.7	2.39 (2.00, 2.86)
West[g]	88	3140	28.0	4688	175 767	26.7	1.05 (0.66, 1.66)
Total[h]	333	16 328	20.4	9599	804 785	11.9	1.71 (1.53, 1.91)

[d]Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin.
[e]Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont.
[f]Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.
[g]Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.
[a]In millions of hours.
[b]Per billion hours worked.
[c]Compares the risk of an acute occupational pesticide-related illness among working youths with that among working adults.
[h]The sum of the number with acute pesticide-related illnesses is less than the total because 3 youths and 63 adults had no information on state of residence.

TABLE 4—Numbers of Youths With Acute Occupational Pesticide-Related Illnesses, by Functional Class of Pesticides and Severity, 1988–1999

Pesticide Functional Class	Minor Severity, No. (%)	Moderate Severity, No. (%)	Major Severity, No. (%)	Total, No. (%)
Insecticides	286 (80)	68 (19)	5 (1)	359 (68)
Herbicides	89 (78)	23 (20)	2 (2)	114 (21)
Fungicides	16 (73)	6 (27)	0 (0)	22 (4)
Insect and moth repellents	15 (79)	4 (21)	0 (0)	19 (4)
Fumigants	7 (70)	3 (30)	0 (0)	10 (2)
Rodenticides	5 (71)	2 (29)	0 (0)	7 (1)
Total	418 (79)	106 (20)	7 (1)	531 (100)

worked, and 8 (15%) were exposed to off-target drift from pesticides applied to neighboring fields.

The remaining 29 youths were not employed in agriculture. Five (17%) of these youths were applying pesticides at the time they were exposed, and they were employed as general laborers or in maintenance, suggesting that pesticide application was not their primary job activity. An additional 12 (41%) youths were employed as clerks or stock workers in the retail sector. Three of these young people were exposed while cleaning up pesticides that had spilled on a store shelf, and one was exposed while changing a canister in an automatic insecticide dispenser. The remaining 13 (45%) youths were employed in a variety of sectors.

Information on use of personal protective equipment was available for only 70 (68%) of the 103 cases reported by state agencies. Such equipment was used by 16% of the youths involved in these episodes. Proportions of young people using protective equipment did not differ significantly according to EPA acute toxicity category ($P=.59$). Nineteen percent (9 of 48) of youths employed in agriculture used protective equipment, as compared with 10% (2 of 21) of youths employed elsewhere ($P=.34$). Only 25% of those who directly handled pesticides used personal protective equipment.

DISCUSSION

The higher risks of acute occupational pesticide-related illnesses among youths than adults observed in this study suggests that current regulations may offer insufficient protection for working youths. There are several potential explanations for these higher risks. Young people are generally less experienced and assertive than adults, and thus they may not question assignments that place them at risk for pesticide exposure.[2] Youths also are often involved in part-time and seasonal work and, as a result, may receive less training. In addition, they may be more sensitive to pesticide toxicity and may manifest acute illnesses at lower exposure thresholds.[12] Because these acute illnesses affect young people at a time before they have reached full developmental maturation, there is also concern about unique and persistent chronic effects.

Youths employed in agriculture appear to have far greater incidence rates of acute occupational pesticide-related illnesses than youths employed elsewhere. These higher rates may be partly explained by the high usage of pesticides in the agriculture industry. In 1996–1997, the agriculture industry used 77% of the total US volume of active pesticide ingredients.[13] In contrast, agricultural employment was responsible for only 7% of total hours

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worked by individuals aged 15 to 17 years (Table 1).

The risk of pesticide poisoning in the agricultural sector was lower among youths than among adults. However, this risk comparison and the others provided should be interpreted with caution, because they represent crude estimates. For example, in terms of our denominator, we do not know how many of the hours worked involved pesticide exposure. We assumed that adults and young people have the same probability of pesticide exposure per hour worked. Unfortunately, we have no data to support or refute this assumption, because the number of pesticide-exposed workers and the duration of their exposure are unknown. This lack of information also precludes our identifying the specific industries and occupations involving the greatest risks.

Among the 99 youths for whom information was available on industry, occupation, and activity at the time of pesticide exposure, only 3 appeared to be working in violation of FLSA. On the basis of this finding that 97% of the young people affected were engaged in legal activities under the FLSA, we recommend that the act be strengthened to prevent such acute illnesses. According to the FLSA, 16 years is the minimum age at which individuals can be employed in an agricultural job that involves handling or applying acutely toxic agricultural chemicals. Exempted from these prohibitions are youths younger than 16 years who are employed by and working on farms owned or operated by a parent or guardian. In addition, youths are not explicitly prohibited from nonagricultural employment that involves handling or applying pesticides.

To protect young farmworkers, the Worker Protection Standard may also need to be strengthened and better enforced. Among the provisions of this standard are restrictions on individuals' entering a pesticide-treated field before expiration of the restricted entry interval (the period required to elapse before one can reenter a field without personal protective equipment) and requirements for training of workers on the hazards associated with pesticides. We found that among the ill youths employed in the agricultural industry, 33 were exposed through contact with treated surfaces, most commonly by entering farm fields recently sprayed with pesticides (n=30). Three of these cases resulted from violations of restricted entry interval requirements, whereas 18 cases occurred despite compliance with these requirements; this latter finding suggests that longer intervals may be required to protect youths. The unique susceptibility of children was not considered in the establishment of restricted entry intervals. In comparison with adults, young people's greater relative body surface area to body mass ratio can lead to more absorption of pesticides.[14]

Our data and analysis involve several potential limitations. The illness rates we observed are probably underestimates, because a large number of cases among youths are not ascertained. Many cases are never identified because the youths affected neither seek medical care nor contact appropriate authorities (e.g., poison control centers). Furthermore, because the signs and symptoms of acute pesticide-related illnesses are not pathognomonic, many youths who seek medical care may not be correctly diagnosed and thus are not classified as having such illnesses.

Although 30 states require reporting of occupational pesticide-related illnesses, many cases, even those occurring among young people who are correctly diagnosed, are not reported.[7] One reason is that only 8 states have surveillance programs for these illnesses, and the fact that 7 of these 8 states are located in the West or South region helps to explain their higher incidence rates. However, even in these 8 states cases are underreported. For example, when we compared state agency and TESS data from these states, only 14% of the TESS cases were also included in the state agency data (i.e., for the years 1993–1998, among those younger than 18 years or aged 25 to 44 years). In the remaining 42 states, only TESS data are available to obtain counts of occupational pesticide-related illnesses.

Reliance on poison control center data can also lead to underascertainment. Because reporting is voluntary, many poisoning cases do not result in calls to the poison control center. The literature suggests that fewer than one third of poisoning cases treated in health care facilities are reported to poison control centers.[15,16] In addition, we found that in states with availability of both TESS data and data from a state agency, TESS identified only 10% of the cases identified by the state agencies (this comparison was made according to the parameters just described).

Finally, we suspect that some working youths may provide misleading information about their age. For example, one individual who became ill after entering a carbofuran-treated field before the expiration of the restricted entry interval initially reported his age as 19 years. Only later did he concede that his true age was 13 years. Therefore, the data we provide should be considered as representing minimum estimates of the true magnitude of the problem.

A related limitation is that incidence rate ratios may be affected by reporting bias if there is differential reporting of cases among youths relative to adults. We found that the elevated risk observed among youths in comparison with adults was confined to cases identified by TESS (incidence relative risk [IRR]=2.18; 95% CI=1.94, 2.45). Among cases reported by state agencies, the rate among youths was similar to that among adults (IRR=0.94; 95% CI=0.71, 1.24). This difference in risk may be due to biased reporting, either to poison control centers (i.e., these centers may be receiving fewer adult reports than child reports) or to state agencies (i.e., the risks observed in the TESS data may be closer to the true values, and state agencies may see greater underreporting of pediatric cases). That there is less underreporting to poison control centers of pediatric poisoning deaths than adult poisoning deaths suggests that TESS may be susceptible to reporting bias.[6] Conversely, the fact that 27% of the pediatric TESS cases occurred among youths younger than 14 years, as compared with only 6% of state agency cases, suggests that state agencies may be hampered in their ability to identify cases among working children.

A final limitation is that information on industry and occupation was not available for TESS cases. Use of different assumptions about the proportion of TESS cases in which the affected individuals are employed in agriculture can lead to different incidence rates by industry. For example, our analysis of youths aged 15 to 17 years who were in-

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cluded in both the TESS and the state agency data (n=9) revealed that 4 (44%) of these young people were employed in agriculture, 3 (33%) were employed in nonagricultural industries, and 2 (22%) had missing employment information. When these percentages were assigned to the TESS cases, the incidence rates for working youths in agricultural and nonagricultural industries were 146.0 and 7.2 per billion hours worked, respectively. These findings suggest that, relative to the incidence rates presented in Table 1, rates may be lower among those employed in agriculture and higher among those employed in nonagricultural industries.

In conclusion, recognizing that many occupational pesticide-related illnesses can be prevented, we offer the following recommendations:

- Improvements in surveillance are needed to overcome the limitations of underreporting. It would be useful if each state conducted surveillance of acute pesticide-related illnesses and injuries.
- The Bureau of Labor Statistics should improve collection of youth employment data, which would provide more accurate denominator data for calculating injury and illness rates.
- Because the signs and symptoms of acute pesticide-related illnesses may be difficult to link to pesticide exposure, health care professionals should be reminded to consider environmental and occupational exposures.
- Information on child labor laws and adolescent occupational hazards should be more effectively disseminated to students, parents, school officials, and employers.
- The FLSA and the Worker Protection Standard should be reviewed and appropriately revised to ensure that workers younger than 18 years are protected against toxic pesticide exposures. ■

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This article was accepted March 30, 2002.

Contributors

G.M. Calvert was the primary author and took the lead on data analysis and writing the article. The remaining authors assisted in data acquisition and interpretation and provided critical revisions of the article.

Acknowledgments

We wish to thank Anne Mardis, MD, for providing the Current Population Survey data, Charles Mueller for his statistical advice and Jerry Blondell, PhD, for providing access to the TESS data.

Human Participant Protection

No protocol approval was needed for this study.

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July 11, 2003 / 52(27);629-634

Surveillance for Acute Insecticide-Related Illness Associated with Mosquito-Control Efforts --- Nir States, 1999--2002

Ground and aerial applications of insecticides are used to control populations of adult mosquitoes, whic spread such diseases as West Nile virus--related illness, eastern equine encephalitis, and dengue fever (This report summarizes investigations of illnesses associated with exposures to insecticides used during 1999--2002 to control mosquito populations in nine states (Arizona, California, Florida, Louisiana, Michigan, New York, Oregon, Texas, and Washington) (estimated 2000 population: 118 million). The findings indicate that application of certain insecticides posed a low risk for acute, temporary health eff among persons in areas that were sprayed and among workers handling and applying insecticides. To reduce the risk for negative health effects, public health authorities should 1) provide public notice of application times and locations and appropriate advice about preventing exposures, 2) ensure that insecticide handlers and applicators meet state-mandated training and experience requirements to preve insecticide exposure to themselves and the public, and 3) implement integrated pest management contr strategies that emphasize mosquito larval control, reduction of mosquito breeding sites, and judicious u of insecticides to control adult mosquito populations.

Staff in state-based pesticide poisoning surveillance programs identified patients who had been exposed insecticides used in mosquito-control efforts in nine states during April 1999--September 2002. Information was gathered on persons who had illnesses consistent with the national case definition for pesticide poisoning, which requires the collection of data on pesticide exposure, health effects, and toxicologic evidence supporting an association between exposure and effect (*2,3*). Cases of insecticide-related illness or injury were classified as either definite, probable, or possible, depending on the certair of exposure and whether health effects were signs observed by a health-care provider or symptoms reported by a patient (*2,3*).

Of the 133 cases of acute insecticide-related illness associated with mosquito control that were identifie two (1.5%) were classified as definite, 25 (18.8%) as probable, and 106 (79.7%) as possible. Of the 132 cases for which work-relatedness could be assessed, 36 (27.3%) were work-related and 96 (72.7%) wer not work-related; 31 (86.1%) of the 36 work-related cases occurred among males, and 66 (68.8%) of th 96 cases that were not work-related occurred among females.

Of the 49 cases identified in 2001, a total of 29 (59.2%) were related to a single event at a softball gam which workers operating a mosquito-control truck inadvertently sprayed 29 persons (16 spectators, 12 players, and one coach) with Fyfanon ULV®, which contains malathion. All 29 persons were treated in emergency departments (EDs).

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Of the 133 persons with acute insecticide-related illness associated with mosquito control, 35 (26.3%) were identified from monitoring media reports (including 34 reported subsequently by health-care providers), 32 (24.1%) were reported by poison-control centers, 27 (20.3%) were self-reported, and sev (5.3%) were reported by state health departments. Physicians and EDs were responsible for initial reporting of five and three cases, respectively. The remaining cases were reported initially by friends or relatives (n = seven), government agencies (n = five), employers (n = four), laboratories (n = two), and other sources (n = six).

Of the 85 persons with reported illness who were known to have sought medical care, 45 (52.9%) were treated in EDs, 35 (41.2%) were treated in physicians' offices, four (4.7%) were treated in employee he: centers, and one (1.2%) was hospitalized. An additional 16 persons received advice from a poison-cont center, and 15 did not seek medical care; information about medical treatment was not available for 17 persons.

Of the 133 reported cases of pesticide-related illness, 95 (71.4%) cases were associated with organophosphates, primarily malathion. Malathion alone was associated with 64 (67.4%) of the 95 case 37 (27.8%) cases were associated with pyrethoids, primarily sumithrin (24 cases) and resmethrin (10 cases) (Table 1).

Illness severity was categorized for all cases (4). One exposure was associated with illness of high seve (Table 2). When her neighborhood was sprayed, a woman aged 54 years was exposed to sumithrin, whi passed through operating window fans and a window air conditioner. She had exacerbation of her asthn and chronic obstructive pulmonary disease. The majority of the remaining cases were of low (65.4%) o moderate (33.8%) severity.

The majority of cases were associated either with respiratory (66.2%) or neurologic (60.9%) dysfunctio Other systems affected were gastrointestinal (45.1%), ocular (36.1%), dermal (27.1%), cardiovascular (12.0%), renal-genitourinary (3.0%), and miscellaneous (28.6%).

Of 36 persons who were exposed at their workplaces (Table 1), 14 (38.9%) were insecticide applicators and 22 (61.1%) were performing tasks that did not involve pesticide application. Seven (50.0%) of 14 applicators were exposed to sumithrin; of the other 22 workers, 11 (50%) were exposed to malathion, a five (22.7%) were exposed to resmethrin. Illness of moderate severity was more frequent among applicators (42.9%) than nonapplicators (27.3%).

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Editorial Note:

The findings in this report indicate that serious adverse outcomes potentially related to public health insecticide application were uncommon. When administered properly in a mosquito-control program, insecticides pose a low risk for acute, temporary health effects among persons in areas that are being sprayed and among workers handling and applying insecticides. In this analysis, adverse health effects were identified in a small percentage of the population in the nine states. Data about the actual number

persons potentially or actually exposed were not available because insecticide applications were conduc only in certain areas of participating states, and the boundaries of these areas were not available.

Malathion, naled, sumithrin, and resmethrin were associated with the majority of reported cases of acut insecticide-related illness. Malathion is an organophosphate insecticide that is classified as an acute toxicity category III compound*. Although it is less acutely toxic than many other organophosphates, adverse health effects have been reported by exposed persons (*5*). Naled is an acute toxicity level I organophosphate. When combined with piperonyl butoxide, resmethrin and sumithrin are highly effecti insecticides that are of low-order toxicity to mammals, including humans; these pyrethroid products are classified as acute toxicity category III compounds and have been associated with adverse health effect humans (*6,7*).

These insecticide formulations are registered by the U.S. Environmental Protection Agency for use in urban areas for mosquito control and benefit the public by controlling populations of mosquitoes that transmit diseases that affect humans. Reported symptoms associated with these insecticides were temporary and included dermal, ocular, and upper and lower respiratory tract irritation and exacerbatior conditions such as asthma. These health effects might represent irritant or allergic responses, to either t insecticide or its carrier (*5,7,8*). Anxiety about insecticide use for mosquito control also might have bee responsible for symptoms in some persons.

The findings in this report are subject to at least three limitations. First, the number of reported cases is probably an underestimate of the true magnitude of illnesses associated with mosquito-control efforts. Affected persons who did not seek medical care or whose symptoms were not reported to a surveillance system could not be identified; even if these persons had sought medical care, their illness might not ha been recognized as insecticide-related, and even if they had received a proper diagnosis, their cases mig not have been reported. Second, only nine states have pesticide poisoning surveillance systems, and the data in this report might not be representative of the 41 states without such surveillance systems. Finall although all cases were consistent with case definition criteria, the possibility of false positives cannot b excluded. Because clinical findings of pesticide poisoning are nonspecific, especially when of mild severity, and no standard diagnostic test exists, some illnesses related temporally to insecticide exposur might be coincidental and not caused by the exposures.

To reduce potential risks from insecticide exposure, CDC recommends the use of integrated pest management strategies for mosquito-control programs that emphasize mosquito larval control, reductio breeding sites (e.g., human-made collections of stagnant water such as unchlorinated swimming pools, discarded tires or other containers, and bird baths), and judicious use of insecticides to control adult mosquito populations when quantitative measures suggest an elevated risk for human infection or in community settings when extensive immature mosquito larval habitats cannot be controlled (*9,10*). Wh insecticides are used, public health agencies should inform the public when and where spraying will oc and communicate how to reduce the likelihood of exposure. To avoid direct exposure from passing spra trucks, public health agencies should ensure that visible and audible warnings are made before spraying Persons with exposure-related health concerns should consult their health-care providers. To prevent exposures from improper application methods, insecticide handlers and applicators should be trained in proper insecticide handling and application methods and in the use of appropriate personal protective equipment.

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* The U.S. Environmental Protection Agency classifies pesticide products into one of four acute toxicity categories on the b of certain criteria, with category I comprising pesticides with the greatest toxicity and category IV those with the least toxici

Table 1

TABLE 1. Number and percentage of persons with mosquito-control insecticide–related illnesses, by type of insecticide exposu state, sex, site of exposure, severity of illness, and year — nine states*, 1999–2002

Characteristic	1999		2000		2001		2002		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Insecticide										
Malathion	22	(84.6)	1	(3.3)	31	(88.3)	10	(35.7)	64	(48.1)
Malathion + pyrethrin	0		0		0		2	(7.1)	2	(1.5)
Malathion + pyrethroid	0		0		0		2	(7.1)	2	(1.5)
Naled	0		4	(13.3)	15	(30.6)	4	(14.3)	23	(17.3)
Sumithrin	2	(7.7)	21	(70.0)	0		1	(3.6)	24	(18.1)
Resmethrin	0		2	(6.7)	1	(2.0)	7	(25.0)	10	(7.5)
Fenthion	1	(3.8)	0		0		1	(3.6)	2	(1.5)
Other†	1	(3.8)	2	(6.7)	2	(4.1)	1	(3.6)	6	(4.5)
State										
New York	10	(38.5)	22	(73.3)	29	(59.2)	1	(3.6)	62	(46.6)
Texas	9	(34.6)	5	(16.7)	2	(4.1)	15	(53.6)	31	(23.3)
Florida	7	(26.9)	1	(3.3)	15	(30.6)	5	(17.9)	28	(21.1)
Arizona	0		0		1	(2.0)	2	(7.1)	3	(2.3)
California	0		2	(6.7)	0		0		2	(1.5)
Oregon	0		0		0		2	(7.1)	2	(1.5)
Washington	0		0		0		2	(7.1)	2	(1.5)
Michigan	0		0		1	(2.0)	1	(3.6)	2	(1.5)
Louisiana	0		0		1	(2.0)	0		1	(0.8)
Sex										
Male	15	(57.7)	18	(60.0)	18	(36.8)	13	(46.4)	61	(46.9)
Female	11	(42.3)	12	(40.0)	34	(69.4)	15	(53.6)	72	(54.1)
Site of exposure										
Public area	8	(30.7)	6	(20.0)	35	(71.4)	11	(39.3)	60	(45.1)
Home	6	(23.1)	11	(36.7)	9	(18.4)	8	(28.6)	34	(25.6)
Workplace	12	(46.2)	12	(40.0)	3	(6.1)	9	(32.1)	36	(27.1)
Other	0		1	(3.3)	2	(4.1)	0		3	(2.2)
Severity§										
High	0		1	(3.3)	0		0		1	(0.8)
Moderate	11	(42.3)	16	(53.3)	11	(22.4)	5	(17.9)	45	(33.8)
Low	15	(57.7)	11	(36.7)	38	(77.6)	23	(82.1)	87	(65.4)
Total	26	(19.5)	30	(22.6)	49	(36.8)	28	(21.0)	133	(100.0)

*Arizona, California, Florida, Louisiana, Michigan, New York, Oregon, Texas, and Washington.
†Chlorpyrifos (n = one), permethrin (n = one), petroleum hydrocarbons (n = two), pyrethrins (n = one), and temephos (n = one).
§Defined by using the Severity Index for Use in State-Based Surveillance of Acute Pesticide-Related Illness and Injury (4).

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Table 2

TABLE 2. Number and percentage of persons with mosquito-control insecticide–related illnesses, by type of insecticide exposu age group, and severity* of illness — nine states†, 1999–2002

Characteristic	High		Moderate		Low		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Insecticide								
Malathion	0		18	(40.0)	46	(52.9)	64	(48.1)
Malathion + pyrethrin	0		0		2	(2.3)	2	(1.5)
Malathion + pyrethroid	0		1	(2.2)	1	(1.2)	2	(1.5)
Naled	0		4	(8.9)	19	(21.8)	23	(17.3)
Sumithrin	1	(100.0)	18	(40.0)	5	(5.8)	24	(18.1)
Resmethrin	0		4	(8.9)	6	(6.9)	10	(7.5)
Fenthion	0		0		2	(2.3)	2	(1.5)
Other§	0		0		6	(6.9)	6	(4.5)
Age group (yrs)								
0–5	0		1	(2.2)	0		1	(0.8)
6–19	0		7	(15.6)	22	(25.3)	29	(21.8)
20–39	0		13	(28.9)	21	(24.1)	34	(25.6)
40–59	1	(100.0)	22	(48.9)	33	(37.9)	56	(42.1)
≥60	0		2	(4.4)	6	(6.9)	8	(6.0)
Unknown	0		0		5	(5.8)	5	(3.8)
Total	1	(0.8)	45	(33.8)	87	(65.4)	133	(100.0)

*Defined by using the Severity Index for Use in State-Based Surveillance of Acute Pesticide-Related Illness and Injury (4).
†Arizona, California, Florida, Louisiana, Michigan, New York, Oregon, Texas, and Washington.
§Chlorpyrifos (n = one), permethrin (n = one), petroleum hydrocarbons (n = two), pyrethrins (n = one), and temephos (n = one).

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This page last reviewed 7/10/2003

Centers for Disease Control and Prevention
Morbidity and Mortality Weekly Report

Surveillance Systems for Pesticide Intoxications

ANA MARIA OSORIO, MD, MPH

The intent of this article is to provide an overview of surveillance systems dealing with pesticide intoxications. Surveillance, medical monitoring, and the components of a surveillance system are discussed. Information is presented on how to make a diagnosis of environmental or occupational pesticide intoxication, examples of different case definitions, and the steps in investigating a pesticide disease outbreak. Examples from various countries are used to illustrate acute pesticide intoxication surveillance, pesticide exposure surveillance, and medical monitoring of pesticide-exposed workers. Finally, a list of informational sources for pesticide toxicology, medical diagnosis and treatment, and surveillance data is provided. It is anticipated that this information will assist those individuals or organizations seeking to develop such a system, evaluate an existing system, or gain a better understanding of data derived from such systems. *Key words*: pesticides; surveillance systems; toxicology.

INT J OCCUP ENVIRON HEALTH 2002;8:1–13

Depending on the overall goal of the system, surveillance can be interpreted in various ways. Definitions for both general and occupational surveillance are illustrated in citations from the National Institute for Occupational Safety and Health (NIOSH) and the International Labor Organization (ILO), respectively:

> Public health surveillance is the ongoing systematic collection, analysis and interpretation of health data essential to the planning, implementation and evaluation of public health practices, closely integrated with the timely dissemination of these data to those who need to know. The final link in the surveillance chain is the application of these data to prevention and control. A surveillance system includes a functional capacity for data collection, analysis and dissemination linked to public health programs.[1]

> Occupational health surveillance is the ongoing systematic collection, analysis, interpretation and dissemination of data for the purpose of prevention. Surveillance is essential to the planning, implementation and evaluation of occupational health programs and control of work-related ill health and injuries and the protection and promotion of workers' health. Occupational health surveillance includes workers' health surveillance and working environment surveillance.[2]

These definitions illustrate some of the different attributes associated with surveillance systems: monitoring of health outcomes versus hazardous exposures, collecting information for a general population versus medical monitoring of a workforce, systems that focus on just environmental or occupational health conditions, and case ascertainment that may include active collection of health data and/or passive receipt of case reports.

For the purposes of this review, the term *surveillance* refers to the ongoing standardized system of data collection, analysis, interpretation, dissemination and, where appropriate, follow-up intervention for a given health outcome (in this case, pesticide intoxication). Surveillance systems are used for planning, implementing, and evaluating public health intervention and control programs. On a smaller scale, certain components of a surveillance system may be applied to a specific workplace population (which is referred to as a medical monitoring program). Furthermore, all surveillance systems should be periodically reviewed to ensure their optimal performance and usefulness. Examples of both environmental and occupational pesticide intoxication surveillance from various countries are highlighted. The scope of this review focuses on the general public health surveillance model for pesticide intoxications, with a brief discussion of medical monitoring of pesticide-exposed workers and the monitoring of pesticide exposures.

Received from the U.S. Environmental Protection Agency–Office of Pesticide Programs, Washington, DC.

The conclusions and opinions expressed herein are those of the author and do not necessarily represent the views and policies of the U.S. Environmental Protection Agency.

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COMPONENTS OF A PESTICIDE INTOXICATION SURVEILLANCE SYSTEM

The key components and evaluation aspects of a public health surveillance system have been described by the Centers for Disease Control and Prevention in prior documents.[3,4] Furthermore, surveillance systems tend to detect mostly acute intoxications (with clearly defined exposures and rapid onset, subsequent disease). This is due to the difficulty in detecting the relatively long lag time between exposure onset and overt symptoms involved in chronic and long-term health conditions such as cancer. Adapting the general public health model, one would consider the following aspects of a surveillance system for acute pesticide intoxication (API):

Public Health Importance of API

Description of the extent, severity, and preventability of API for the surveillance target population. Is there a large number of known incident or prevalent cases? Is there a high disability or mortality rate for API among certain segments of the population? What are the lost-work days among occupational cases? Are there effective interventions that can prevent morbidity and mortality in this population? With API, access to health care providers familiar with pesticide-related disease may be a factor.

API Surveillance Description

- What are the objectives of the system? These may include detecting outbreaks, monitoring trends, generating hypotheses about API etiology, soliciting participants for research studies, and evaluating intervention efforts.
- Define the term "pesticide." The U.S. Environmental Protection Agency defines a pesticide as a substance to control pests such as insects, fungi, weeds, rodents, nematodes, algae, viruses, and bacteria. Some systems may want to focus on only a subgroup of all possible pesticide compounds.
- Describe the API case definition. The definition will usually include details about person, time, and place characteristics that will indicate an individual as a surveillance API case. These factors may include: pesticide exposure history, geographic restriction, time period, clinical symptoms, physical findings, laboratory results, and environmental sampling.
- What is the overall organization and flow of information. Figure 1 provides a flow diagram of a typical API surveillance system.
- Describe operation and components of system: target population, geographic catchment area, time period for data collection, type of information collected, data sources, storage and security of data, analytic methods, periodicity of reports, and dissemination plan.

Usefulness of the API surveillance system

What actions have been taken as a result of data from the surveillance system? Have results been used to make public health decisions or influence public health policy? Any other anticipated uses of the API surveillance system?

Evaluation of the API Surveillance System Attributes

Simplicity of structure and ease of operation. Manageable amount of information needed for case definition, reporting sources are few in number and easy to understand, simple data transmission and receipt of case reports, minimal staff training requirements, simple data analysis, reasonable number of case information users, and ease of information dissemination.

Flexibility. Ability to adapt to changing information needs or operating conditions.

Acceptability. Willingness of individuals, organizations

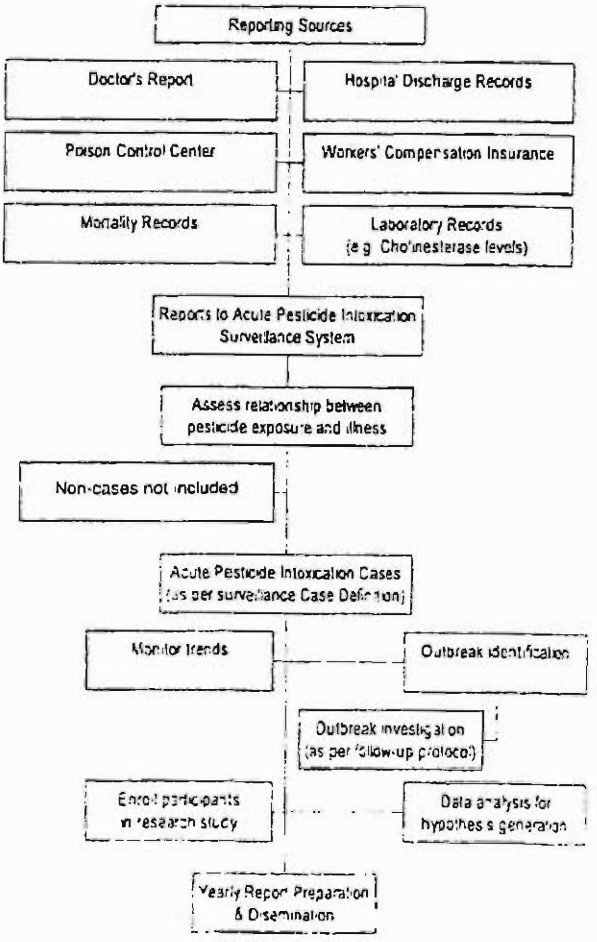

Figure 1—Flow diagram for acute pesticide intoxication surveillance system. Specify target population, geographic area, time period. Overall system to be evaluated every two years

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Chart 1—Analysis of sensitivity and predictive value positive for acute pesticide intoxication (API) surveillance system.

	True API Case	True Non-case	Total
Surveillance API case	A	B	A + B
Surveillance non-case	C	D	C + D
Total	A + C	B + D	A + B + C + D

Sensitivity of case reporting = A / (A + C)

Predictive value positive (PVP) = A / (A + B)

and agencies to participate in system (e.g., physician, laboratory, or hospital reporting rates).

Sensitivity. Case reporting sensitivity is defined as proportion of API cases detected by the surveillance system (Chart 1).

Predictive value positive. Proportion of persons identified as cases that really do have API (Chart 1).

Representativeness. Compare characteristics of reported API events with all such actual events. The total number of APIs in a given population is often not known but general descriptive information about the target population may be helpful: age, socioeconomic status, geographic location, and natural history of API (latency period, exposure route, and fatality or permanent disability outcome). In addition, a comparison of multiple data sources can identify types and degrees of underreporting. For example, comparing doctors' reports with those of poison control centers, laboratory records, hospital discharge records, or workers' compensation information might be helpful.

Timeliness. Can be assessed by determining time needed to complete each step within the API surveillance flow diagrams (Figure 1). Also important is the timeliness of the overall system. This can be evaluated by determining how quickly information is made available for API control and prevention efforts.

Resources Used to Operate System

What are the personnel needs, required equipment, and other operating costs?

Overall System Evaluation

Is the API surveillance system meeting its objectives and operating in an efficient and useful manner? Should any aspects of the system be modified?

ASSESSING THE RELATIONSHIP BETWEEN DISEASE AND AN OCCUPATIONAL OR ENVIRONMENTAL PESTICIDE EXPOSURE

API surveillance systems depend mostly on clinicians' reporting of cases, so it is critical for health care providers to accurately diagnoses pesticide-related health conditions, especially the more readily detected acute intoxications. Because pesticides are often associated with nonspecific medical complaints (especially in the early stages of intoxication), it is very useful to link the traditional medical review of organ systems with an exposure history. Examples of interview questions for pediatric and adult exposure histories can be found in the text, Recognition and Management of Pesticide Poisonings.[5]

In evaluating the association of a given pesticide exposure in the occupational or general environmental setting and a clinical condition, key questions to consider include:

- Are the symptoms and physical signs appropriate for the pesticide being considered?
- Are there co-workers or others in the surrounding environment (e.g., farm, residence, school, neighborhood and non-farm workplace) who are ill?
- Do the timing of the exposure episode and the onset of health problems make sense?
- Is there confirmation of physical exposure to the pesticide (e.g., history of activity with direct pesticide contact, dermal residue sampling, proven pesticide contamination of work clothes or other personal protective equipment)?
- Is there any record of environmental monitoring data (e.g., crop residue, air, soil, or water pesticide tests)?
- Is there any record of biologic monitoring results?
- What is the biologic plausibility of the resulting health effect, given the exposure scenario?
- Can one rule out other non-pesticide exposures or pre-existing health problems?

A concurrent non-pesticide exposure can either have no effect on, exacerbate, or be the sole cause of the health condition under study. It is inappropriate to automatically eliminate occupational or environmental pesticide exposure as a possible contributory factor when underlying or concurrent non-pesticide exposures exist. Consultation with an occupational and environmental health specialist may be needed for those patients with complicated mixed-exposure scenarios or multiple concurrent disease situations.

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INVESTIGATION OF A PESTICIDE INTOXICATION OUTBREAK

One important activity in an API surveillance system is to rapidly identify and investigate outbreaks or disease clusters. These investigations can be quite time-consuming and require a team approach with various health and safety professionals. Thus, a protocol is usually developed with action criteria for when a follow-up investigation should occur. Action criteria are further discussed in the section on API surveillance examples. The following outline covers the major steps involved in investigating an API outbreak:

1. Medical diagnosis

- Formulate a tentative medical diagnosis
- Confirm diagnosis of identified cases
- Review medical records (clinic, hospital, company)
- Review any biologic tests (e.g., cholinesterase activity, parent or metabolite levels)
- Review decontamination procedure for the patient, facility, and transport system
- Consult with treating health care providers
- All of these initial cases represent the group of "index cases"

2. Identify unrecognized cases

- Interview cases and other exposed individuals
- If feasible, interview non-exposed individuals as possible comparison group.
- Interview health care providers at clinics and hospitals in area of outbreak to detect any other cases
- If this is an occupational setting, then conduct interviews with co-workers, company management, and union representative (if unionized workforce). Also, interview company medical care provider and determine whether any medical monitoring exists for the pesticide-exposed workers.

3. API case definition

- Develop working case definition, which will include the following aspects: 1) exposure setting: pesticide type, population group, location and time period, 2) expected physical signs and symptoms, and 3) pertinent biologic or environmental tests.
- The Recognition and Management of Pesticide Poisonings text is a good resource for determining health effects of pesticides.[6]
- Table 1 contains an example of a case definition used for a recent pesticide intoxication outbreak in Central America.

4. Exposure information

- Evaluate the following outbreak information: pesticide formulations involved (concentration and physical form), timing and duration of exposure, delivery system, personal protective equipment used, weather conditions, and general circumstances of the exposure event.
- How many individuals were involved (include pesticide applicators/handlers and bystanders)
- Inspect any machine/apparatus used, original pesticide containers/labels, and personal protective equipment, if available.
- Review past pesticide application log, biologic monitoring records, and environmental sampling results (e.g., leaf or surface residue testing).

5. Characterize cases

- Create a line listing of index cases, additional cases, and exposed individuals. Table 2 illustrates the line listing created for the banana worker outbreak example.

6. Epidemic curve

- Plot out the incidence on a graph comparing number of individuals defined as number of cases versus time representing symptom onset.

TABLE 1 Example of a Case Definition Used in a Recent Pesticide-Intoxication Outbreak

A case is defined as a farm worker who was present during a recent half-day application of a carbamate pesticide (Temik) at a banana plantation AND who has one or more symptoms consistent with cholinesterase inhibition (see table below). For those workers receiving medical attention, reversibility of symptoms after atropine treatment provides confirmation of cholinesterase inhibition.

Possible physical signs and symptoms associated with cholinesterase inhibiting pesticides (organophosphate and carbamate compounds).[5]

Category of Health Effect	Physical Signs and Symptoms
Early onset	Headache, nausea, dizziness, hypersecretion
More severe, later onset	Muscular twitch/fasciculations, weakness, tremor, incoordination, vomiting, abdominal cramps, diarrhea
Ocular	Miosis
Neuropsychiatric	Anxiety, restlessness, depression, memory loss, confusion, toxic psychosis
Respiratory	Bronchorrhea, bronchospasm, pulmonary edema, respiratory depression and arrest
Cardiovascular	Bradycardia and sinus arrest, tachycardia and hypertension, myocardiopathy
Advanced neurologic	Loss of consciousness, incontinence, convulsions

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TABLE 2 Example of a Line Listing of Subjects for an Outbreak Investigation among Banana Workers Involved in Pesticide Applications*

Name	Age (years)	Job Title	Onset of Symptoms	Symptoms (Sx)	Treatment	Activity at Time of Exposure	PPE Use†
Worker 1	27	Backpack applicator	End of application	Dizzy, weak, diarrhea, vomiting	Atropine response, hospital x 1 day	Applying Temik	Yes
Worker 2	21	Backpack applicator	30 minutes after application ended	Severe headache	None	Applying Temik	Yes
Worker 3	31	Backpack applicator	Within 1 hour of end of application	Dizzy, weak, diarrhea, nausea, vomiting	Atropine response, hospital x 1 day	Applying Temik	Unknown
Worker 4	24	Backpack applicator	Within 1 hour of end of application	Dizzy, anorexia, abdominal pain, diarrhea	Atropine response, hospital x 1 day	Applying Temik	Unknown
Worker 5	Unknown	Backpack applicator	Within 1 hour of end of application	Nausea	Observed in ER for approx. 5 hours	Applying Temik	Unknown
Worker 6	Unknown	Backpack applicator	Within 1 hour of end of application	Nausea	Observed in ER for approx. 5 hours	Applying Temik	Unknown
Workers 7–15	Approx. 20–40	Backpack applicator	No sx reported	No sx reported	None reported	Applying Temik	Unknown

*All exposed workers were male and of Hispanic origin. Backpack application of Temik (a carbamate nematocide) occurred for approximately five hours partly during heavy rains.
†PPE = personal protective equipment used by worker, including boots, overalls, cartridge mask, and gloves.

- Figure 2 plots out the epidemic curve for the banana worker outbreak.

7. *Dose–response relationship*
- Determine severity of cases and compare with intensity of exposure. In this way, one can determine whether a dose–response relationship exists (cases with higher levels of exposure also have more severe clinical presentations). For the banana worker example, there was insufficient information about the individual pesticide exposure to allow a more detailed categorization of exposure level.

8. *Incidence rate*
- Derive an incidence rate for the outbreak: (Number of cases/Number of individuals exposed) × 100. In the case of the banana worker episode, the incidence rate is 40% ((6/15) × 100). Even if one accepts only cases that were reported by clinicians, the incidence rate is still quite high at 33.3% ((5/15) × 100).
- Finally, one can compare the outbreak incidence with the general population incidence and conduct a test for statistical significance to assess whether this elevated rate is likely to be real or due to chance.

9. *Report with recommendations for intervention*
- Summarize all the information gathered during the investigation in a report and present to all key stakeholders (e.g., workers, community residents, company representatives, medical community, governmental agencies).
- This report should clearly state the extent of the disease, the etiologic factors, and how to prevent or control the present exposure situation, as well as make recommendations for ways to prevent such episodes in the future.
- While all individuals evaluated should receive their personal test results, one needs to ensure that all public reports and communications with stakeholders maintain the confidentiality of the participants.

ACUTE PESTICIDE INTOXICATION SURVEILLANCE EXAMPLES—UNITED STATES

California Pesticide Illness Surveillance Program

California has required physician reporting of pesticide illnesses since 1971. Pesticide is defined as any substance that controls pests such as insects, fungi, weeds, rodents, nematodes, algae, viruses, bacteria, or adjuvants (substances added to enhance the efficacy of pesticides). Physicians are required to report any suspected case of pesticide-related illness or injury by telephone to the local health officer within 24 hours of examining the patient. Data sources for the Pesticide Illness Surveillance Program include: (1) the Pesticide

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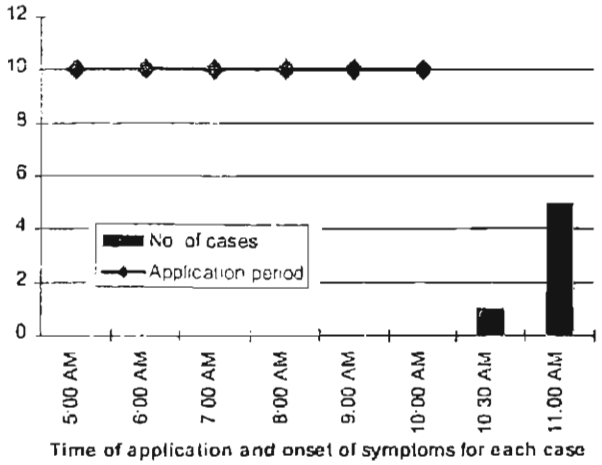

Figure 2—Epidemic curve for banana worker outbreak (6 cases/15 exposed workers).

Illness Report filled out by the health officer receiving the doctor's case report, (2) the Doctors' First Report of Occupational Illness and Injury, which is required for worker's compensation claims, and (3) the California Poison Control System, whereby poison control staff fill out a case report for physicians calling for assistance with a pesticide case.[7]

The county agricultural commissioner is responsible for the investigation of all pesticide-exposure incidents in his or her area. Specialized state-based laboratories provide analytic assistance for the pesticide-exposure investigations.[7] Criteria are used to indicate a high priority incident needing immediate attention: human health effects (death, hospitalized cases, or episode with five or more medically diagnosed illnesses), special incidents (involvement of neighboring states or Mexico), environmental effects (special air, water, animal, and land contamination scenarios), and property loss or damage (depending on extent of financial loss). Yearly summary reports highlight important investigative findings.

Table 3 illustrates results from three years of API surveillance, 1997 through 1999. There were 4,916 cases evaluated as being pesticide-related, with 80 (2.3%) hospitalizations and seven (0.2%) deaths. The majority of the cases presented with systemic symptoms (64%) and involved occupational exposures (82%). Two of the most common activities at the time of exposure were pesticide application (23%) and field work (15%). For agricultural cases, the individuals tend to be predominantly male and younger in age than other cases (Figure 3). For the period 1982–1998, the most common pesticides involved in occupational episodes were sodium hypochlorite, chlorine, and chlorpyrifos (for systemic effects), and sodium hypochlorite, quaternary ammonia, and propargite (for eye and dermal effects) (Table 4). The non-occupational cases had metam-sodium as the most common pesticide exposure, partly due to a large environmental outbreak.

TABLE 3 Selected Data from the California Pesticide Illness Surveillance Program for the Three-year Period 1997–1999[7,9]

	1997	1998	1999	1997–1999 Period
Total reports received	1,806	1,481	1,629	4,916
Pesticide-related cases*	1,319	998	1,201	3,518 (72% of all reports)
Category of cases*				
Definite	261	216	195	672 (19%)
Probable	631	405	635	1,671 (48%)
Possible	427	377	371	1,175 (33%)
Hospitalizations	20	26	34	80 (2.3%)
Fatalities	1	2	4	7 (0.2%)
Health effects of cases				
Systemic	815	574	851	2,240 (64%)
Eye	247	229	191	667 (19%)
Skin	220	177	141	538 (15%)
Eye and skin	37	18	18	73 (2%)
Circumstances of exposure				
Agricultural exposure	545	366	555	1,466 (42%)
Occupational setting	1,158	914	804	2,876 (82%)
Selected activities at time of exposure				
Mixing/loading pesticides	115	84	67	266 (8%)
Pesticide application	328	281	200	809 (23%)
Field work	208	170	134	512 (15%)
Commodity packing/processing	25	33	92	150 (4%)

*Pesticide-related indicates that the relationship between pesticide exposure and resulting symptoms was one of the following:

Definite—High degree of correlation with both medical evidence (e.g., cholinesterase inhibition, positive allergy test, signs observed by clinician) and physical evidence of exposure (e.g., environmental or biological samples and exposure history)
Probable—Relatively high degree of correlation with either medical or physical evidence being inconclusive or unavailable
Possible—Some degree of correlation with both medical and physical evidence inconclusive or unavailable

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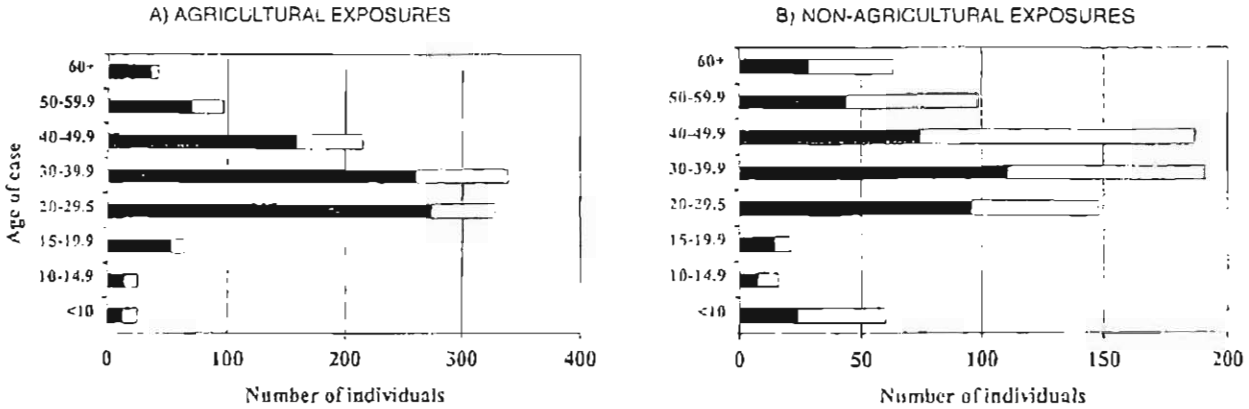

Figure 3—Age and gender (black bars = male, white bars = female) distribution of cases related to pesticide exposures other than antimicrobials, California Pesticide Illness Surveillance Program, 1997–1999. Total of 3,200 cases represented (318 missing age, gender, or agricultural status information).[15]

All of the cases showing the following types of strength of relationship between pesticide exposure and resulting symptoms are included: **definite***—high degree of correlation with both medical evidence (e.g., cholinesterase inhibition, positive allergy test, signs observed by clinician) and physical evidence of exposure (e.g., environmental or biological samples and exposure history);* **probable***—relatively high degree of correlation, with either medical or physical evidence being inconclusive or unavailable; and* **possible***—some degree of correlation with both medical and physical evidence inconclusive or unavailable.*

Due to the extensive nature and long duration of this surveillance system, the API database has been used extensively in health policy development, rule making, research, risk assessment, intervention programs, and evaluation efforts. Several problems exist which may potentially cause underreporting of certain API cases: lack of physician recognition of APIs; subtle and early manifestations of API may not cause an individual to seek medical care; some residents or workers lack medical insurance and do not seek medical care until severe symptoms develop; some residents or workers lack residency documents and do not feel empowered to complain about health problems or seek medical care; some individuals are binational and receive medical attention in their native country (e.g., Mexico); and the migratory nature of some individuals do not allow follow-up or continuity of medical care that would help the medical diagnosis of more subtle or chronic disease. With respect to the surveillance system, some question the strictness of the case definition that may discard some cases that may be true APIs. Language and cultural barriers at the employer, medical community, and surveillance staff levels may pose a problem in light of the diverse population in California (especially among high-risk groups), and some of the non-priority investigations take a long time to be conducted and may compromise the data collection.

SENSOR–Pesticides Program

The Sentinel Event Notification System for Occupational Risk (SENSOR) is a program administered by NIOSH to build and maintain occupational illness and injury surveillance capacity within state health departments. The SENSOR-Pesticides program has a focus on API and includes the state heath departments of the following states: California (this program is different from the California Department of Pesticide Regulation program described in the prior section), New York, Texas, Florida, Oregon, New Mexico, and Washington). The first three state programs are co-funded by NIOSH and EPA, Florida and Oregon are funded solely by NIOSH, and the last two states have self-funded programs but are considered partners in the overall SENSOR–Pesticides program. The goals of SENSOR-Pesticides include: 1) tabulation of API cases, 2) in-depth investigations for case confirmation, 3) development of intervention programs at selected industries or for certain pesticide hazards, 4) timely identification of outbreaks and emerging pesticide problems, and 5) development of a national aggregated API data base.[1]

The reporting sources for SENSOR include physicians' reports, hospital discharge records, poison control center data, laboratory reports (cholinesterase tests), mortality data, and worker's compensation records. The SENSOR–Pesticides program has developed various surveillance-related products for use by participating states: standardized pesticide-related illness case definition, list of standardized reporting variables, and database software (entitled SPIDER) to collect a core set of variables on each case. Table 5 contains the yearly incidence data for the SENSOR state programs. It is interesting to compare the 1998 data from the California SENSOR and California Pesticide Illness Surveillance Programs. The SENSOR program identified 289 occupational pesticide-related cases (definite, probable, and possible classification), while the latter program had 914 cases (also with definite, probable,

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and possible designations but interpreted differently). The California Pesticide Illness Surveillance Program detected over three times as many API cases due partly to a different case definition and classification but this could also be related to this system's more extensive surveillance infrastructure with the ability to conduct investigations on nearly every case report. On the other hand, since all SENSOR states use identical case definitions and classifications, the possibility of combining results across several states is very promising.

ACUTE PESTICIDE INTOXICATION SURVEILLANCE EXAMPLES—INTERNATIONAL

WHO Acute Pesticide Intoxication Data Collection

A simple format for collection of data on acute pesticide intoxication has been developed by the International Program on Chemical Safety, World Health Organization.[12] To develop the survey instrument and a guidance document, workshops on harmonization of data collection on pesticide intoxications were held with key stakeholders. Furthermore, field testing of the survey instrument in selected countries was conducted. Currently, harmonized case data collection using the proposed method is conducted in selected regions of countries in Southeast Asia and the Western Pacific Region. The overall objective of this project is to estimate the extent of human pesticide exposure and poisoning in selected regions/countries with a view to implement preventive and education strategies to reduce morbidity and mortality from pesticide poisoning.

The guidance document for the project participants includes information about objectives, study design, coordination, implementation, and budget considerations. The main sections of the one-page pesticide-

TABLE 4 List of Pesticides Associated with at Least 100 API Cases Identified by the California Pesticide Illness Surveillance Program, 1982–1998.

	Systemic		Eye/Skin		
	Definite/Probable	Possible	Definite/Probable	Possible	Total
In occupational settings					
Sodium hypochlorite	847	243	1711	215	3,016
Sulfur	118	114	326	492	1,050
Quaternary ammonia	46	30	717	64	857
Chlorine	531	99	98	75	803
Chlorpyrifos	341	289	113	44	787
Propargite	19	20	490	150	679
Glyphosate	32	76	354	152	614
Diazinon	188	167	65	29	449
Malathion	187	104	40	18	349
Glutaradehyde	87	22	205	17	331
Propetamphos	156	82	8	4	250
Cyanuric acid	68	13	142	23	246
Methyl bromide	66	55	86	10	217
Metam-sodium	103	20	71	18	212
Methomyl	94	69	20	22	205
Phenolic disinfectants	15	10	153	16	194
Aluminum phosphide	100	47	6	28	181
Calcium hypochlorite	71	19	69	10	169
Parathion	75	69	9	5	158
Mevinphos	4	68	10	5	157
Cyfluthrin	89	23	11	16	144
Dimethoate	78	35	17	10	140
Propoxur	55	46	28	8	137
Creosote	8	2	82	27	119
Paraquat	15	25	59	13	112
In non-occupational setting					
Metam-sodium	341	83	54	2	480
Diazinon	73	39	4	10	126
Chlorpyrifos	57	60	3	1	121
Malathion	87	22	9	1	119
Chlorine	94	12	8	0	114

*These cases were determined to be definitely, probably, or possibly related to pesticide exposure.[10] Strength of relationship between pesticide exposure and resulting symptoms

Definite—High degree of correlation with both medical evidence (e.g., cholinesterase inhibition, positive allergy test, signs observed by clinician) and physical evidence of exposure (e.g., environmental or biological samples and exposure history)
Probable—Relatively high degree of correlation with either medical or physical evidence being inconclusive or unavailable
Possible—Some degree of correlation, with both medical and physical evidence inconclusive or unavailable.

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TABLE 5 Occupational Acute Pesticide Intoxication (API) Cases Reported by Each SENSOR State*

Case Classification†	Arizona‡	California	Florida	New York	Oregon	Texas	Total (% of all cases)
Definite	1	16	67	7	0	12	103 (14%)
Probable	6	138	22	5	2	7	180 (25%)
Possible	15	135	79	3	25	135	392 (53%)
Suspicious	0	53	3	1	13	0	60 (8%)
Total	22	342	171	16	30	154	735

*Figures represent 1999 data except for California with 1998 data.[11]
†Case definition: an acute onset of symptoms dependent on the formulation of the pesticide product and involving one or more systemic symptoms or signs, dermatologic effects, and ocular effects. If available, laboratory data may confirm diagnosis of API. Furthermore, a case is reportable to the national surveillance system when there is documentation of two or more new adverse health effects that are temporally related to a documented pesticide exposure *and* consistent evidence of a causal relationship between the pesticide and the health effects based on the known toxicology of the pesticide. The case classification is complex and depends on the extent of exposure, health effects, and causal relationship.
‡API surveillance in this state was self-funded.

exposure record include information about exposure time and place, source of information, patient details, circumstances of exposure, main activity at time of exposure, location of exposure, route of exposure, product identity, chemical type, medical management, severity rating, clinical outcome and final overall comments. The poisoning severity score is derived from an extensive matrix that looks at type of organ system involvement (gastrointestinal, respiratory, nervous, cardiovascular, hepatic, renal, hematologic, dermal, ocular, and muscular) to then provide a score of 0 (none = no symptoms or signs), 1 (minor = mild, transient, and spontaneously resolving symptoms or signs), 2 (moderate = pronounced or prolonged symptoms or signs), and 3 (severe = severe or life-threatening symptoms or signs). An adaptation of this pesticide exposure record was used for a recent nationwide survey of acute pesticide intoxications in Belize and proved to be quite useful in obtaining key information in a standardized way from medical records and health care providers.

Belize—PLAGSALUD Project

Belize is one of seven countries participating in the Occupational and Environmental Aspects of Exposure to Pesticides in the Central American Isthmus project (PLAGSALUD). This program is funded by the Danish International Development Agency (DANIDA) under the technical execution of the Pan American Health Organization (PAHO)/World Health Organization (WHO). PLAGSALUD programs are carried out in conjunction with the health ministries and other related governmental and nongovernmental organizations within the respective countries. In 1994, Nicaragua and Costa Rica were the first countries to participate in PLAGSALUD. An expansion of the program to the remaining Central American countries occurred in 1997: Belize, Panama, Guatemala, Honduras, and El Salvador were added.

The goal is to implement surveillance systems for detection of APIs and strengthen national capacity to respond to pesticide problems. Recently, the author was involved in a survey to estimate the overall prevalence of APIs and to determine the degree of case underreporting for the two highly agricultural districts where surveillance occurs. Belize has 240,000 residents, with approximately 21,400 persons (9% of the population) involved in agricultural activities. The country is highly agricultural, with this industry contributing 15% of the gross domestic product. The API surveillance system has been operational in Cayo and Stann Creek Districts since 1999. In 2000, there were 22 API cases, including two fatalities (annual incidence rate of 2.9 cases/10,000 residents). In June 2001, a questionnaire survey of the country was conducted with sampling from three pesticide-exposure risk strata: high (vector control and quarantine officers, farm workers, farmers, pest-control workers, pesticide handlers and applicators); medium (rural residents living close to agricultural activity); and low (remaining rural residents and urban dwellers). The standardized interview asked about demographic data, current work and home characteristics, exposure to pesticides, and any associated symptoms, medical visits, or hospitalizations. A total of 1,059 questionnaires were completed: 294 high-, 441 medium-, and 324 low-risk individuals. In addition, API records from the major hospitals and clinics were obtained using an adaptation of the WHO pesticide exposure record form. Data analysis is currently under way to derive estimated national and regional incidence rates for API, as well as to compare API cases identified from the surveillance system, clinical/hospital records, and the questionnaire survey. Recommendations will be made for improvement of the API surveillance system, intervention measures, and usefulness of this model for other countries in Central America.

South Africa—Evaluation of Pesticide Poisoning Surveillance

A recent example of an API surveillance evaluation was conducted for the system in the Western Cape Province

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of South Africa.[13] In South Africa, pesticide intoxication has become a major public health problem as increasing usage of pesticides has occurred in the last decade. The pesticide poisoning surveillance system in South Africa relies primarily on reports from health care practitioners (mandatory notification), the Department of Labor (occupational cases), and the Department of Home Affairs (death certificate information). Furthermore, local environmental health officers are responsible for follow-up investigations and remediation. On average, from 100 to 200 cases of human pesticide poisoning are reported annually, with 10–20 of these being fatal. By conducting an intensive survey and intervention project in the Western Cape Province, the researchers were able to compare the results from this project with those of the routine surveillance system. The community-based project provided free cholinesterase testing, information, training, and educational materials to local health care providers.

The findings during this intensive survey included: a nearly tenfold increase in case reporting (40.5 cases/100,000 residents for the year of the project versus 4.2/100,000 average for the prior five-year period), doubling of female cases (61% female for intensive survey versus 30% for routine provincial surveillance data), increased occupational cases (86% intensive data versus 12% routine data), and decreased suicide cases (9% intensive data versus 35% for routine data). The intensive survey suggests that there is an API underreporting rate of 90% for the routine surveillance system. Furthermore, many of the exposure situations detected by the intensive survey indicated circumstances of normal use or involving factors that were beyond the control of the index case. Conversely, the Health Department has stated that in local studies derived from surveillance reporting, the main cause of pesticide poisoning is ignorance. Suggestions for improving the routine system include: collecting appropriate data that are linked to intervention activities, better effort to understand the exposure circumstances of the cases and avoid the tendency to blame the case for all exposure incidents, and better cooperation between the different reporting sources and the participating governmental and nongovernmental groups..

Nicaragua—Underreporting of Pesticide Intoxications

To determine the true extent of pesticide intoxication and the degree of underreporting of the existing surveillance system, an agricultural area (grain, cotton, and cattle) was studied during the period of heavy pesticide use.[14] In 1988, a survey was conducted at agricultural cooperatives and nearby private farms that were convenient to a regional health center. A short standardized questionnaire was administered to agricultural workers asking whether the individual had ever been made ill due to pesticides, and if yes, what were the location, date, symptoms, and other circumstances associated with the incident. If three of the following symptoms commonly seen in cholinesterase inhibition were reported, then the individual became a verified API case: lightheadedness, blurred vision, nausea, vomiting, weakness, excessive sweating, tremor, excessive salivation, headache, difficulty breathing, convulsions, and loss of consciousness. In addition, the number of cases identified by the questionnaire survey were compared to the cases reported with the regional pesticide poisoning registry.

Of the 633 interviews conducted, there was no refusal during study recruitment at the 25 agricultural cooperatives in the study area. There were 520 persons (82%) reporting pesticide use and 158 (25%) reporting a pesticide-related illness during the prior 12 months. Among the 304 persons (48% of total study group) reporting at least one lifetime poisoning or illness due to pesticides, 225 (74%) were verified cases as per the study definition. The names of the medically treated cases were compared with the API registry list, with only eight of 23 cases being identified. Thus, an estimated underreporting rate of 65% was derived. The representativeness of the study population may be in question due to using only agricultural workers and not employing a stratified random sample of the population. Furthermore, the broad case definition with the focus on the acute symptoms of cholinesterase-inhibiting pesticides may lead to an inaccurate overall API rate. Nonetheless, there is still a very large rate of cases that are not being detected by the existing surveillance system due to ill people's not seeking medical attention (24 of 47 total ill, or 51%), and cases that were treated but not reported (15 of 47, or 32%).

MEDICAL MONITORING OF WORKERS EXPOSED TO PESTICIDES

In California, state law requires that medical supervision be established for a particular group of pesticide-exposure workers. An employer is required to provide medical supervision for workers that regularly handle an organophosphate or carbamate pesticide with "Danger" or "Warning" on the label.[15] Regular handling is defined as mixing, loading, or applying the pesticide for more than six days in any 30 day period. These pesticides act through the inhibition of the enzyme cholinesterase and can produce a wide variety of health effects (Table 1). Once a medical supervisor is selected, several components are required to be in place to fully implement a medical monitoring program (Table 6).

The described program constitutes the bare minimum needed for compliance with a regulation. The general principles of a surveillance system and good medical practice need to be kept in mind. For example, one may choose to include field workers who poten-

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TABLE 6 Medical Supervision for Workers Exposed to Cholinesterase Inhibitors*

Program Element	Action Required
Medical supervisor	Employer contracts with licensed physician to become Medical Supervisor of program
Cholinesterase (ChE) testing	Obtain erythrocyte (RBC) and plasma ChE levels; because of variability between laboratories, use the same laboratory for all ChE testing
Baseline ChE level	Taken when worker has not been exposed to organophosphates or carbamates for 30 days
New employee testing	Test at end of each of the first three 30-day periods of regular handling; then, do periodic testing every 60 days or as recommended by the medical supervisor
Action criteria for ChE levels:	
ChE drops 20% below baseline level	Employer must evaluate workplace and correct any unsafe situations
RBC ChE drops 30% or lower	Exposure to organophosphates or carbamates must stop
Plasma ChE drops 40% or lower	Exposure to organophosphates or carbamates must stop
Criteria for resuming work with potential organophosphate or carbamate exposure	Both RBC and plasma ChE levels return to at least 20% of baseline

*This program is based on the California Code of Regulations, Title 3, and is required of employers with workers who handle cholinesterase or carbamate pesticides.[15]

tially get secondary, bystander, or unintentional direct exposures, one would want to assess other chemical and physical agents that might pose hazards and exacerbate any health problems, there should be integration of this medical supervision with any medical evaluation for respirator use, emergency response and decontamination procedures, and worker or management safety and health training. Furthermore, the surveillance principles of ongoing standardized data collection, analysis, interpretation, dissemination and follow-up intervention need to be considered. For a medical supervision program these items translate into collection of all pertinent health and exposure data, analysis not only of an individual response but also of the entire work group to identify any trends (e.g. use of epidemic curve), interpretation of any changes in biological measurements in conjunction with workplace and personal medical factors, routine reporting of findings to both the workers and management (with appropriate attention to confidentiality issues), and possible in-depth outbreak investigations, as needed.

PESTICIDE EXPOSURE MONITORING

California Pesticide Use Data

An example of a pesticide-exposure surveillance system is that found in California. Since 1990, the state has required the reporting of all agricultural pesticide use.[9] Each year, 45,000 to 50,000 operator identifications for pesticide use are issued in California, representing 135,000 to 200,000 fields or sites. There are approximately 2.5 million pesticide products applied to agricultural fields. The data collection involves site identification numbers, commodity treated, planted and treated acreage, pesticide(s) used, amount applied, application method, time and date of application, and township or section of state where activity occurred. The types of pesticide uses reported include agriculture production, postharvest commodity treatment, structural fumigation, landscape maintenance and all other reported agricultural uses. The mandatory reporting does not apply to home and garden use and most industrial and institutional uses. Figure 4 shows the gradual increase of agricultural pesticide use reported over the period 1991 through 1998. Annual statewide summaries of pesticide use categorized by chemicals and crops are available online. These online data have been used for risk assessment, evaluation of regulatory action, and research purposes.

National Report on Human Exposure to Environmental Chemicals

The National Center for Environmental Health, Centers for Disease Control, has recently issued a report on a project that will conduct a more precise type of exposure assessment by conducting biologic monitoring of selected toxicants for the general population.[16] The National Report on Human Exposure to Environmental Chemicals provides the first of an ongoing assessment of the U.S. population exposure to 27 chemicals, including organophosphate pesticide metabolites in the urine. The urine samples are from the 1999 National Health Nutrition and Examination Survey (NHANES), which is a continuous national sample of the U.S. population. NHANES conducts a standardized health interview, physical examination, and testing of biologic fluids. The

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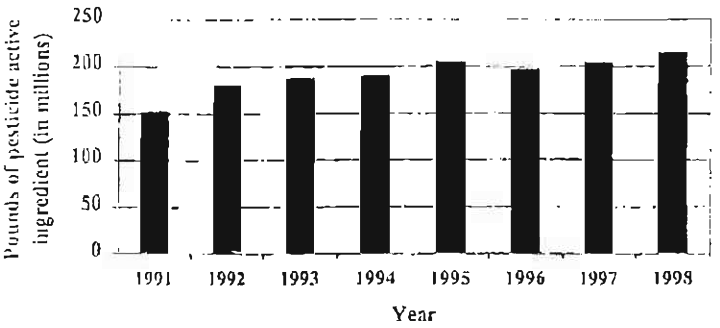

Figure 4—Total amounts of reported pesticide use as pounds of active ingredient.[9]

goal is to issue annual updates that will combine the analysis results with those of other large exposure studies within the United States. The first preliminary results include the following organophosphate urinary metabolites: dimethylphosphate (DMP), dimethylthiophosphate (DMTP), dimethyldithiophosphate (DMDTP), diethylphosphate (DEP), diethylthiophosphate (DETP), and diethyldithiophosphate (DEDTP) (Table 7). These six metabolites are non-pecific breakdown products of a wide variety of organophosphate pesticides including chlorpyrifos, diazinon, fenthion, malathion, parathion, phosmet, temephos and methyl parathion. This type of pesticide exposure trend data (especially when paired with the NHANES health information) promises to be a more precise assessment of body burden than the usual measurement of external pesticide use.

INFORMATION SOURCES

The following are sources that provide information about pesticide exposures, health effects, and surveillance systems (both exposure- and disease-based):

Recognition and Management of Pesticide Poisonings, 5th Edition, 1999

This book provides diagnostic and medical management information for acute pesticide intoxications (for all EPA-registered and noteworthy non-registered pesticides). This manual can be ordered in English or Spanish by calling the Office of Pesticide Programs, US EPA, at (703) 305-7666 or via Web site <www.epa.gov/pesticides/safety/healthcare>. At this site, one can also access the manual in electronic format.

National Pesticide Telecommunications Network (NPTN) <http://ace.orst.edu/info/nptn/>

NTPN is based at the Oregon State University and is cooperatively sponsored by the University and the U.S. EPA. This network provides information about pesticide poisonings, handling information, environmental and occupational health effects, referrals for investigations of pesticide incidents, emergency treatment for humans and animals, and cleanup and disposal procedures. The telephone hotline and e-mail query serve the United States and its territories: (800) 858-7378

TABLE 7 Distribution of the Organophosphate Urinary Metabolites as Geometric Mean (GM) and Percentile Levels for the U.S. Population, Aged 6–59 Years, NHANES Data, 1999*

N = 703	GM (95% CI)	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
DMP	1.84[1] (1.10–2.59)	< LOD[2]	0.49	1.56	4.02	10.1
DMTP	2.61[1] (1.77–3.45)	< LOD[3]	0.59	3.08	7.87	23.6
DMDTP	0.51[1] (0.39–0.62)	< LOD[4]	< LOD[4]	0.42	1.57	5.33
DEP	2.24 (1.11–3.37)	0.43	0.81	1.87	5.85	12.13
DETP	0.71 (0.56–0.87)	0.26	0.38	0.64	1.25	2.32
DEDTP	0.16 (0.12–0.21)	0.04	0.07	0.14	0.33	0.70

*See text for explanation of metabolite abbreviations. Sample size for all metabolite categories was 703 individuals. Units for metabolite levels are microgram per gram creatinine in urine except where elsewhere noted.
[1]Unit is µg/L urine.
[2]Limit of detection is 0.51 µg/L urine.
[3]Limit of detection is 0.18 µg/L urine.
[4]Limit of detection is 0.08 µg/L urine.

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(9:30 AM–7:30 PM EST daily except for holidays), and <nptn@ace.orst.edu>. Pesticide-related information and links to other online informational sources can be found at the Web site.

Association of Occupational and Environmental Clinics (AOEC)
<http://152.3.65.120/oem.htm>
This association is a network of over 60 clinics representing more than 250 specialists. Their Web site is very useful for general medical information and links to other sites dealing with all types of occupational and environmental health issues (including pesticide exposures).

Extension Toxicology Network (EXTOXNET)
<http://ace.ace.orst.edu/info/extoxnet>
EXTOXNET provides toxicologic information about pesticide-related health effects and is maintained as a cooperative effort by the University of California–Davis, Oregon State University, Michigan State University, Cornell University, and the University of Idaho.

Integrated Risk Information System (IRIS)
<http:/ace.ace.orst.edu/info/extoxnet>
IRIS is an electronic database maintained by the U.S. EPA that deals with human health effects resulting from exposures to various chemicals in the environment. IRIS is intended for those persons without extensive training in toxicology but with some knowledge of the health sciences. Information is provided on hazard identification and dose–response assessment, with extensive supporting documentation available online.

Agency for Toxic Substances and Disease Registry (ATSDR)
<http://atsdr1.atsdr.cdc.gov:8080/toxfaq.html>
ATSDR publishes fact sheets and other information about pesticides and other toxic substances.

California Pesticide Data Bases
<www.cdpr.ca.gov/docs/database/database.htm>
This Web site includes Pesticide Chemical Ingredients Queries, links to the U.S. EPA Office of Pesticide Programs chemical dictionary, Pesticide Product and Label Data Base Queries (updated nightly), access to reports from the California Pesticide Illness Surveillance Program, and the Pesticide Use Report Data.

Note added in proof Since the writing of this article, two new resources have become available: 1) SENSOR Web site, www.cdc.gov/niosh/potsurv and 2) Updated guidelines for evaluating public health surveillance systems, MMWR. 2001, 50, July 27, no. RR-13.

The author is grateful to Jerry Blondell, US EPA, Louise Mehler, California Department of Pesticide Regulation, Rony Maza, PAHO/ WHO Belize Regional Office, and Geoffrey Calvert, NIOSH, for their encouragement and assistance during the preparation of the manuscript. Furthermore, a heartfelt thank you to the many students, colleagues, patients, and workers who have helped in refining my understanding of disease surveillance and kept a human face on all the numbers.

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FINANCIAL STATUS REPORT

(SHORT FORM)

1. Federal Agency and Organizational Element to Which Report is Submitted	2. Federal Grant or Other ID Number Assigned By Federal Agency	OMB Approval No.	Page 1 Of 1
DEPT OF HEALTH & HUMAN SRVCS CENTERS FOR DISEASE CONTROL & PREV	U60/CCU602983-16	0348-0039	Pages

3. Recipient Organization (Name and complete address, including ZIP code)

Texas Department of Health
1100 West 49th Street
Austin, Texas 78756

4. Employer Identification Number	5. Recipient Account or Id Number	6. Final Report	7. Basis
1-7466000182-A1	Sensor Fund 570 FY 03	[X]Yes [ ]No Revised-Final	[ ]Cash [x]Accrual

8. Funding/Grant period (see instructions) From: (MM/DD/YY)	To: (MM/DD/YY)	9. Period Covered by this report From: (MM/DD/YY)	To: (MM/DD/YY)
09/30/1987	09/29/2005	09/30/2002	09/29/2003

10. Transaction	I Previously Reported	II This Period	III Cumulative
a. Total outlays	126,886.70	(6,658.55)	120,228.15
b. Recipient share of outlays	0.00	0.00	0.00
c. Federal share of outlays	126,886.70	(6,658.55)	120,228.15
d. Total Unliquidated obligation			0.00
e. Recipient share of unliquidated obligation			0.00
f. Federal share of unliquidated obligations			0.00
g. Total Federal share (Sum of lines c & f)			120,228.15
h. Total Federal funds authorized for this funding period			150,000.00
i. Unobligated balance of Federal Funds (Line h minus line g)			29,771.85

11. Indirect Expense	a. Type of Rate (Place "X" in appropriate space) [ ] Provisional [ ] Predetermined [ ] Final [X] Fixed			
	b. Rate	c. Base	d. Total Amount	e. Federal Share
	SEE ATTACHED	SEE ATTACHED	10,866.25	10,866.25

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation.

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purpose set forth in the award documents.

Typed or Printed Name and Title	Telephone (Area code, number and ext.)
Deborah Lewis, Manager Grant Reporting Budget and Revenue Grant Reporting	(512) - 458 - 7520
Signature or Authorized Certifying Official	Date Report Submitted

Standard Form 269A
Prescribed by OMB Circulars A-102 and A-110

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TEXAS DEPARTMENT OF HEALTH
SENTINEL EVENT NOTIFICATION SYSTEM FOR OCCUPATIONAL RISKS
GRANT NO. U52/CCU602983-16
INDIRECT COST COMPUTATION
FOR THE PERIOD
09/30/02-09/29/03

			Modified Direct Cost	Rate	Total Amount
FY 03	OFFSITE	10/02 - 08/03	0.00	14.1%	0.00
	ONSITE		104,180.75	9.9%	10,313.89
	LHD		0.00	2.5%	0.00
	HOSPITAL		0.00	90.3%	0.00
FY 04	OFFSITE	09/03 - 09/03	0.00	18.8%	0.00
	ONSITE		5,260.53	10.5%	552.36
	LHD		0.00	11.3%	0.00
	HOSPITAL		0.00	70.6%	0.00
	Cumulative Indirect Cost		**10/02-09/03**		**10,866.25**

FINANCIAL STATUS REPORT

(SHORT FORM)

1 Federal Agency and Organizational Element to Which Report is Submitted	2 Federal Grant or Other ID Number Assigned By Federal Agency	OMB Approval No.	Page 1 Of 1 Pages
DEPT OF HEALTH & HUMAN SRVCS CENTERS FOR DISEASE CONTROL & PREV	U60/CCU602983-17	0348-0039	

3. Recipient Organization (Name and complete address, including ZIP code)
Texas Department State Health Services
1100 West 49th Street
Austin, Texas 78756

4 Employer Identification Number	5. Recipient Account or Id Number	6 Final Report	7 Basis
1-7466000182-A1 (Old TDH) **1-32-0113643-A1 (New DSHS)**	**Sensor Fund 570 FY 04**	[X]Yes [ ]No **Final**	[ ]Cash [x]Accrual

8 Funding/Grant period (see instructions) From (MM/DD/YY)	To (MM/DD/YY)	9 Period Covered by this report From (MM/DD/YY)	To (MM/DD/YY)
09/30/1987	**09/29/2005**	**09/30/2003**	**09/29/2004**

10. Transaction	I Previously Reported	II This Period	III Cumulative
a Total outlays			78,270 90
b. Recipient share of outlays			0 00
c Federal share of outlays			78,270.90
d Total Unliquidated obligation			0 00
e Recipient share of unliquidated obligation			0 00
f Federal share of unliquidated obligations			0 00
g Total Federal share (Sum of lines c & f)			78,270 90
h Total Federal funds authorized for this funding period			149,973 00
i Unobligated balance of Federal Funds (Line h minus line g)			71,702 10

11 Indirect Expense	a Type of Rate (Place "X" in appropriate space) [ ] Provisional [ ] Predetermined [ ] Final [X] Fixed			
	b Rate	c Base	d Total Amount	e Federal Share
	SEE ATTACHED	SEE ATTACHED	7,439.50	7,439.50

12 Remarks Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13 Certification I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents

Typed or Printed Name and Title	Telephone (Area code, number and ext)
Gary Lawrence, Manager Funds Reporting Branch	**Contact Joy Counce(512) 458-7111 x2405**
Signature of Authorized Certifying Official	Date Report Submitted

Standard Form 269A
Prescribed by OMB Circulars A-102 and A-110

TEXAS DEPARTMENT OF STATE HEALTH SERVICES
SENTINEL EVENT NOTIFICATION SYSTEM FOR OCCUPATIONAL RISKS
GRANT NO. U52/CCU602983-17
INDIRECT COST COMPUTATION
FOR THE PERIOD
09/30/03-09/29/04

			Modified Direct Cost	Rate	Total Amount
FY 04	OFFSITE	10/03 - 08/04	0.00	18.8%	0.00
	ONSITE		63,752.37	10.5%	6,694.00
	LHD		0.00	11.3%	0.00
	HOSPITAL		0.00	70.6%	0.00
FY 05	OFFSITE	09/04 - 09/04	0.00	18.8%	0.00
	ONSITE		7,100.03	10.5%	745.50
	LHD		0.00	11.3%	0.00
	HOSPITAL		0.00	70.6%	0.00
	Cumulative Indirect Cost		10/03-09/04		7,439.50

FINANCIAL STATUS REPORT

(SHORT FORM)

1. Federal Agency and Organizational Element to Which Report is Submitted	2. Federal Grant or Other ID Number Assigned By Federal Agency	OMB Approval No.	Page 1 Of 1
DEPT OF HEALTH & HUMAN SRVCS CENTERS FOR DISEASE CONTROL & PREV	1 U60 OH008349-01	0348-0039	Pages

3. Recipient Organization (Name and complete address, including ZIP code)
Texas Department of State Health Services 1100 West 49th Street Austin, Texas 78756

4. Employer Identification Number	5. Recipient Account or Id Number	6. Final Report	7. Basis
1-320113643-A2	Sensor Fund 570 FY 05/06	[X]Yes [ ]No	[ ]Cash [x]Accrual

8. Funding/Grant period (see instructions) From: (MM/DD/YY)	To: (MM/DD/YY)	9. Period Covered by this report From: (MM/DD/YY)	To: (MM/DD/YY)
09/30/04	09/29/06	09/30/04	09/29/2006

10. Transaction	I Previously Reported	II This Period	III Cumulative
a. Total outlays			139,293.08
b. Recipient share of outlays			0.00
c. Federal share of outlays			139,293.08
d. Total Unliquidated obligation			0.00
e. Recipient share of unliquidated obligation			0.00
f. Federal share of unliquidated obligations			0.00
g. Total Federal share (Sum of lines c & f)			139,293.08
h. Total Federal funds authorized for this funding period			148,351.00
i. Unobligated balance of Federal Funds (Line h minus line g)			9,057.92

11. Indirect Expense	a. Type of Rate (Place "X" in appropriate space) [ ] Provisional [ ] Predetermined [ ] Final [X] Fixed			
	b. Rate	c. Base	d. Total Amount	e. Federal Share
	SEE ATTACHED	SEE ATTACHED	14,204.30	14,204.30

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation.

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purpose set forth in the award documents.

Typed or Printed Name and Title	Telephone (Area code, number and ext.)
For Gary Lawrence, Manager Funds Reporting Branch	(512) - 458 - 7111
Signature of Authorized Certifying Official	Date Report Submitted
[signature]	12/12/06

Standard Form 269A

Prescribed by OMB Circulars A-102 and A-110

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TEXAS DEPARTMENT OF HEALTH
SENTINEL EVENT NOTIFICATION SYSTEM FOR OCCUPATIONAL RISKS
GRANT NO. 1 U60 OH008349-01
INDIRECT COST COMPUTATION
FOR THE PERIOD
9/30/04-09/29/06

			Modified Direct Cost	Rate	Total Amount
FY 05	OFFSITE	10/04 - 08/05	0.00	39.9%	0.00
	ONSITE		43,905.30	11.4%	5,005.20
	LHD		0.00	0.0%	0.00
	HOSPITAL		0.00	15.9%	0.00
FY 06	OFFSITE	09/05 - 09/05	0.00	39.9%	0.00
	ONSITE		80,693.88	11.4%	9,199.10
	LHD		0.00	0.0%	0.00
	HOSPITAL		0.00	15.9%	0.00
	Cumulative Indirect Cost		**as of 11/06**		**14,204.31**

Form Approved Through 9/30/2007
OMB No. 0925-0001

Department of Health and Human Services

Final Invention Statement and Certification

(For Grant or Award)

DHHS Grant or Award No.

1 U60 OH008349-01

A. We hereby certify that, to the best of our knowledge and belief, all inventions are listed below which were conceived and/or first actually reduced to practice during the course of work under the above-referenced DHHS grant or award for the period

09/30/2002 *original effective date* through 09/29/2006 *date of termination*.

B. Inventions (Note: If no inventions have been made under the grant or award, insert the word *"NONE"* under Title below.)

NAME OF INVENTOR	TITLE OF INVENTION	DATE REPORTED TO DHHS
	NONE	
(Use continuation sheet if necessary)		

C. First Signature —The person responsible for the grant or award is required to sign (in ink). Sign in the block opposite the applicable type of grant or award.

TYPE OF GRANT OR AWARD	WHO MUST SIGN *(title)*	SIGNATURE
Research Grant	Principal Investigator or Project Director John F. Villanacci,	
Health Services Grant	Director	
Research Career Program Award	Awardee	
All other types (*specify*):	Responsible Official	

D. Second Signature — This block ***must*** be signed by an official authorized to sign on behalf of the institution.

Title
Budget Section Director, Texas Department of State

Typed Name
Wilson M. Day, Budget Section Director

Signature: Wilson M Day

Date: 12/21/06

Name and Mailing Address of Institution

Texas Department of State Health Services
1100 W. 49th Street
Austin, TX 78756-3199

HHS 568 (Rev. 9/2004)

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