

*SURVEILLANCE AND PREVENTION OF WORK-RELATED
ASTHMA AND OCCUPATIONAL PESTICIDE ILLNESS IN
CALIFORNIA*

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LIST OF TERMS AND ABBREVIATIONS

Cal/OSHA – California Occupational Safety and Health Administration

CDPH – California Department of Public Health

DFR – Doctor's First Report of Occupational Injury or Illness

DIR – Department of Industrial Relations

OPI – Occupational Pesticide Illness

PETR – Pesticide Episode Transmittal Report

PIR – Pesticide Illness Report

SENSOR – Sentinel Event Notification System for Occupational Risks

NCIS – Workers' Compensation Information System

NRA - Work-related Asthma

ABSTRACT

The Occupational Health Branch (OHB) of the California Department of Public Health aimed to characterize and prevent work-related asthma (WRA) and occupational pesticide illness (OPI) in California by developing a program of surveillance and intervention over a 5 year period. This was accomplished through a comprehensive program funded by a cooperative agreement from the National Institute for Occupational Safety and Health (NIOSH). The WRA and OPI program sought to describe and monitor trends using surveillance, to conduct both case-based and targeted worksite investigations in high risk occupations, to develop and provide prevention recommendations, to further develop collaborations that enhanced program impact, and to evaluate the program to ensure effectiveness. Key findings and accomplishments include:

- A comprehensive surveillance system which identified over 3,100 cases of WRA and 2,700 cases of OPI statewide in 5 years.
- An evaluation of reporting sources determined that multiple data sources are valuable and lead to improved surveillance.
- Surveillance and follow-up data collection efforts generated important findings for prevention, including identifying high risk occupations, industries, and exposures. They also documented important information on disability and the impact of WRA and OPI on workers.
- The overall rate of WRA and over 10 years was 2.3 per 100,000 employed in California. Particularly high rates of WRA were seen among local transit, lumber and wood product manufacturing, electric, gas and sanitary services, heavy construction, health services and social services industries. The highest rates of OPI were seen among nursery workers, pest control operators, and farm workers.

Over the duration of the project, OPI and WRA staff conducted nearly 50 work site investigations. These investigations identified several common problems critical for prevention: effective and widely available control measures or alternatives are not installed or used correctly; exposures below regulatory limits (when they exist) may result in pesticide illness and asthma; inadequate training is common; and inadequate communication and regulation lead to unhealthful exposures in workplaces statewide.

- Many interventions were accomplished, including policy and regulatory recommendations; the development of educational materials with a wide distribution among employers, public health professionals, trade groups, and workers; worker trainings; and the addition of prevention and exposure information into vocational training curricula.

HIGHLIGHTS/SIGNIFICANT FINDINGS

The highlights of the project are organized by the specific aims of the original project proposal

AIM 1: Maintain and enhance our existing surveillance systems for WRA and OPI.

Surveillance efforts identified 3,126 cases of work-related asthma and 2,732 cases of occupational pesticide illness over 10 years, indicating that these conditions pose a major public health problem for the working population of California.

The overall rate of WRA and OPI over the 10 year period is 2.3 per 100,000 employed in California. Particularly high rates of WRA were seen among local transit, lumber and wood product manufacturing, electric, gas and sanitary services, heavy construction, health services and social services industries. Occupations with particularly high rates of WRA include correctional officers, firefighters, welfare eligibility clerks, health technicians, radiological technicians and licensed vocational nurses. Applying findings from other data sources used to evaluate DFR case capture suggests that the overall rate of WRA in California is actually much greater (7.7/100,000 workers). A total of 47% of OPI reports were classified as definite, probable or possible cases of OPI. The most common agents among OPI cases were the organophosphates, inorganics, and pyrethroids. The highest rates of OPI were seen among nursery workers, pest control operators, and farm workers.

Doctor's First Reports (DFRs) of Occupational Injury or Illness are a critical tool for identifying cases, but an evaluation using other data sources demonstrated that DFRs provide a significant undercount, only identifying about 113 of the cases reported through a comparison data source.

The Workers' Compensation Information System was pilot tested as a data source and was shown to be an effective tool for identifying many cases of WRA and OPI that were not identified through existing data sources.

AIM 2: Utilize surveillance data to perform selected case follow-up and workplace interventions with prevention recommendations for employers and employees.

Follow-up data gathered through telephone interviews and medical record retrieval generated important information on treatment and disability, demonstrating that WRA and OPI are a cause of significant disability and cost among California workers. Follow-up information also illustrated that intervention and prevention measures in workplaces are often inadequate to address or prevent WRA and OPI in workers.

Over the duration of the project, OPI and WRA staff conducted nearly 50 work site investigations. Workplace investigations for WRA were conducted in a wide variety of environments for various exposures, including: graffiti removal in schools, public transportation, and utility settings; wood dust in skateboard, pencil, furniture, and lumber manufacturing plants; cleaning agents in health care facilities; glutaraldehyde in the manufacture of bioprosthetic heart valves; and a variety of asthma-inducing agents in medical stream waste processing plants. Investigations of OPI included incidents involving 27 workers exposed to cyfluthrin drift, exposure of flight attendants from residual aircraft disinsection using a permethrin formulation, and methyl bromide drift onto a vineyard from a neighboring field. These investigations identified multiple common conclusions and issues critical for prevention: effective and widely

available control measures or alternative chemicals are often not in use or are used incorrectly; exposures below regulatory limits (when they exist) can result in pesticide illness and asthma; inadequate worker training is common; and inadequate communication and regulation lead to unhealthful exposures in workplaces statewide.

AIM 3: Collaborate with local and state agencies to track WRA and OPI in the workplace and implement prevention strategies.

This project demonstrated a successful integration of occupational health issues and data into mainstream public health at the multiple levels by collaborating with other agencies, nongovernmental organizations, employers, and workers to provide WRA and OPI surveillance data and recommendations for prevention. Both conditions provide an excellent opportunity for wide collaboration, as asthma and pesticide illness are issues addressed in both the occupational setting, as well as by organizations focused on environmental exposures.

By leveraging the relationships between the workplace and community environments, our work supports the efforts of others who can utilize our data and technical expertise to implement prevention strategies that will affect worker and community health. Our collaborative approach also strives to support more primary prevention-based activities by: (1) educating a wide range of audiences about the occupational health impact of their activities/decisions; (2) building a constituency for prevention of WRA and OPI to create incentives for change; (3) affecting decisions in an upstream, proactive manner.

The WRA and OPI programs have collaborated with many state and local agencies, health care professionals, industries, trade associations, labor organizations, and community-based organizations in our ongoing program activities. Staff have participated on numerous inter-agency, advisory, and other work-groups addressing WRA and OPI.

AIM 4: Disseminate using a variety of means our surveillance data, findings of case investigations, and intervention results

The WRA and OPI surveillance programs have disseminated results and prevention recommendations through a variety of methods to a wide audience. This includes over 27 WRA presentations during the project period. The California WRA program has also provided written educational materials to over 5,000 workers and health care providers, and published our findings in newsletters and professional organization publications such as the *Guide to Occupational Respiratory Disease in California (California Thoracic protective devices)*; published several peer-reviewed journal articles: provided WRA data to Cal/OSHA to assist in their assessment of the isocyanate and glutaraldehyde standards; and analyzed proposed legislation addressing electronic reporting of first reports of injury and illness and state funding for a California asthma surveillance and prevention program.

The OPI program presented results in numerous oral presentations and poster sessions, and has updated the program website to include data and links to many other important resources. Funding from the AOEC allowed OPI staff to develop a Pesticide Illness Curriculum on CD-ROM, which has had wide distribution among clinicians statewide. OPI surveillance results and prevention strategies have also been distributed widely through several issues of the Branch newsletter.

AIM 5: Evaluate the results of surveillance, field investigations, and information dissemination

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Evaluation of the WRA and OPI surveillance programs is ongoing and includes tracking reporting sources and volume, system sensitivity, specificity and positive predictive value, and timeliness. We have used the CDC surveillance evaluation guidelines to quantify system performance and to identify areas for improvement. We also continuously evaluate the field investigation component of the program by determining the capacity, timeliness, quality and public health impact of our investigations. We have also evaluated our dissemination efforts by measuring the quantity of materials disseminated, the number of hits and download from our websites, and through evaluations provided by recipients of our materials.

TRANSLATION OF FINDINGS

This project documented that WRA and OPI among workers in California remain important public health problems, with many workers affected and substantial impacts in terms of disability and cost. Our investigations identified multiple common conclusions and issues critical for prevention: effective and widely available control measures or alternative chemicals are often not in use or are used incorrectly; exposures below regulatory limits (when they exist) can result in pesticide illness and asthma; inadequate worker training is common; and inadequate communication and regulation lead to unhealthful exposures in workplaces statewide.

OUTCOMES/RELEVANCE/IMPACT

The California WRA and OPI surveillance program demonstrated that a significant burden of these important work-related problems exists in California, and that particular high-risk occupations and industries can be targeted for investigation and prevention recommendations. A multi-source surveillance system was successfully utilized to capture physician reports of OPI and WRA, and demonstrated that successful public health surveillance can be utilized as an adjunct to OSHA logs and BLS data systems. Case-based and outbreak investigations were conducted that led to several recommendations for feasible, low cost interventions that can prevent work-related WRA and OPI.

SCIENTIFIC REPORT

For over two decades, The Occupational Health Branch (OHB) of the California Department of Health Services (CDPH) has maintained NIOSH SENSOR programs. During this time, we have identified work-related asthma (WRA) and occupational pesticide illness (OPI) as high priorities in California for ongoing surveillance and a wide variety of intervention activities. During the first five-year funding period for SENSOR (1987-1992), we established a case-based surveillance system for carpal tunnel syndrome (CTS) and OPI. During the second funding period for SENSOR (1992-1997), we initiated field-testing for surveillance of WRA and developed a model surveillance system for tuberculosis. During the third funding period for SENSOR (1997-2002), we continued field-testing for both WRA and OPI, as well as conducted surveillance for CTS as an experimental condition.

In 2001, we established one of the first NIOSH-funded Core Surveillance Model Programs, and placed several conditions under sentinel surveillance including WRA, OPI, CTS, work-related fatalities (Fatality Assessment and Control Evaluation, FACE), selected nonfatal injuries, lead poisoning and silicosis. The SENSOR WRA and OPI programs are integrated into the overall goals of our Core Program, which include the implementation of models that can be used by other States for targeted surveillance of occupational injuries, illnesses and hazards, with demonstration of practical prevention/intervention activities that can reduce the risk of work-related injuries and illnesses.

From 2002-2005, we maintained our existing SENSOR model for the surveillance of WRA and OPI, and implemented several activities that enhanced our previous work. The overall goal during this last funding cycle was to maintain and enhance the California SENSOR program for the prevention of WRA and OPI. Specific objectives were to:

1. Maintain and enhance our existing surveillance systems for WRA and OPI;
2. Utilize surveillance data to perform selected case follow-up and workplace interventions with prevention recommendations for employers and employees;
3. Collaborate with local and state agencies to track WRA and OPI in the workplace and implement prevention strategies;
4. Disseminate using a variety of means our surveillance data, findings of case investigations, and intervention results; and
5. Evaluate the results of surveillance, field investigations, and information dissemination

A SURVEILLANCE

1 CASE ASCERTAINMENT

Over the past 12 years, the California SENSOR WRA and OPI surveillance program has developed a multi-source surveillance system for efficient and timely case reporting. Our primary source of data has been the Doctors' First Report of Occupational Injury or Illness (DFR). Other reporting sources are also used, as described below.

a. Doctors First Reports of Occupational Injury and Illness (DFR)

For over six decades, all physicians in California have been required to complete a written report for suspected work injury or illness. The DFR is sent by the physician to the workers' compensation insurance carrier within five days after treating a suspected work-related injury or illness. The DFR includes demographic and occupational information, narrative about the injury-causing event, examination findings, diagnosis, and the treatment plan. In addition, the industry, occupation, and exposure are abstracted, coded and key entered by CDPH staff from each DFR. The workers' compensation insurance carrier forwards the DFR to the California Department of Industrial Relations (DIR), Division of Labor Statistics and Research. A Memorandum of Understanding has been established between CDPH and DIR that allows the WRA and OPI programs to have access to these reports. As of March 1, 2002, all DFRs have been forwarded directly by DIR to the SENSOR program offices. Project staff review approximately 600,000 DFRs annually in order to retrieve those meeting specific case ascertainment criteria.

b. Direct reporting by an HMO

In addition to utilizing DFR reports sent by all insurance carriers to DIR, the largest health maintenance organization in Northern California (Kaiser Permanents) functioned as a reporter for WRA surveillance and sent copies of DFRs directly to the WRA program from 1997-2002. DFRs included all work-related visits with an ICD-9 code of 493.00 or the term asthma in the report. Direct reporting by Kaiser not only identified additional cases, but also provided a unique opportunity to evaluate the completeness of case identification through the existing DFR reporting system. The cases received directly from Kaiser were compared to the existing DFR datasets to determine how much overlap there is between data sources. This direct Kaiser reporting has documented that up to 70% of DFRs are not submitted by insurance carriers to DIR as required by law.

c. Workers' Compensation Information System (WCIS)

In 2000, California switched from a paper-based system for workers' compensation information, to an electronic system that is consistent with national data standards. This system collects First Reports for all workers who have filed a workers' compensation claim. The SENSOR program has established an MOU with the Department of Industrial Relations to access WCIS data on a quarterly basis. Experience with the WCIS thus far shows that the addition of WCIS data more than doubles the current level of case ascertainment for WRA and OPI. A pilot comparison of cases collected through DFRs during 2000-2001 was conducted using a data file from WCIS for the same time period, and only a 10% overlap between the two data sources was identified. This suggested that the addition of WCIS for regular case ascertainment would provide an important additional source for case ascertainment.

We have now implemented WCIS data as a significant source of case ascertainment. We have developed selection criteria using key words from the narrative field describing the incident, as well as using coded variables that are of potential interest in identifying potential SENSOR WRA and OPI reports. The appropriate query code was written and records that meet our criteria are routinely extracted from the WCIS database. We then perform a matching routine to identify cases already identified in our system through other data sources. The evaluation of WCIS reports and query code was amended and repeated as necessary until we developed the query code that reliably selects cases meeting case ascertainment criteria. WCIS has now been implemented as a routine data source with data transfer to the SENSOR program on a regular basis.

d. Pesticide Illness Reports (PIR)

Since 1971, all California physicians have been required to report all illnesses or injuries suspected of having been caused by a pesticide exposure to the local health officer within 24 hours. The local health officer is mandated to notify the county agricultural commissioner, who completes a PIR. A PIR may also be completed by the reporting physician or by the local health officer. The PIR is sent within seven days to the California Environmental Protection Agency (Office of Environmental Health Hazard Assessment (OEHHA) and the Department of Pesticide Regulation (DPR)) and the Division of Industrial Relations (DIR). The OPI program obtains the PIR from DIR, pursuant to our Memorandum of Understanding, and from OEHHA.

e. Pesticide Episode Transmittal Reports (PETR)

A PETR is immediately completed by DPR for pesticide exposure incidents that meet any of the following criteria: extensive environmental effects (pollution of soil and/or air, or killing of non-target species), extensive property loss, or human health effects (death or hospitalization for 24 hours or longer and provision of medical therapy, or if 5 or more symptomatic people seek medical evaluation). These reports include information on type of exposure, location, number of workers involved, occupation, pesticide used, and narrative of the incident. The PETR is sent by facsimile directly to the SENSOR program and contributes to OPI surveillance.

f. Hospital Discharge Data

Using the appropriate ICD-9 codes and payer indicated to be workers' compensation from the hospital discharge data set, we annually identify cases of WRA and OPI. Hospital discharge data with personal identifiers have recently begun to be obtained and evaluated for utility as a routine data source. We also perform a matching analysis with cases in our existing database for the same time period to determine how many previously unidentified cases are identified. Approval by the DI-IS Committee for the Protection of Human Subjects has already been obtained by the SENSOR project for this analysis. While the hospital discharge data set contains unique identifiers that can be used for matching purposes (such as social security number and date of birth), it does not contain the necessary narrative or patient demographic information (address and telephone number) that is necessary for case classification for WRA and OPI. As a result, we will request medical records from the relevant hospitals. We have shown that this approach is successful for silicosis surveillance, where 87% of hospitals have forwarded copies of medical records to our Core Surveillance program. The results of case ascertainment obtained through these efforts will be added to our existing surveillance data systems, with follow-up and analysis using the same protocols as our other data sources.

2 CASE DEFINITIONS AND CASE CLASSIFICATION

Reports are initially reviewed by project staff to determine if they meet our broad case selection criteria. Reports that suggest pesticide exposure and those involving inhalation exposures are then further evaluated. All DFRs that involve an inhalation exposure, respiratory symptoms, or diagnosis of any lung disease (including asthma) are reviewed by the PI (Robert Harrison) and designated a potential case of WRA. DFRs that suggest pesticide exposure and PIRs suggesting work-relatedness are designated as potential cases of OPI.

All potential cases of WRA then undergo an interview by WRA project staff to confirm the diagnosis and obtain data for case classification. A trained interviewer makes up to six attempts to conduct a telephone interview of every case of WRA that has been identified. A structured questionnaire was developed to collect information regarding exposure, occupational and non-occupational risk factors, medical history, and worker demographics. This questionnaire includes core information collected by all SENSOR asthma states. The

study protocol has been approved by the California Health and Human Services Agency Committee for the Protection of Human subjects, with verbal consent obtained from all subjects. We then apply the established NIOSH surveillance case definitions for WRA (Jajosky 1999). Following interviews and medical record retrieval, final case classification is performed for WRA by the project epidemiologist in consultation with the PI.

For all potential OPI cases, project staff request medical records from the treating physician or secondary referring physician. Medical records are requested through a computerized faxing system (MS Office 97). Three faxed requests are sent 30 days apart for each potential OPI case. In addition, we request County Agricultural Commissioner reports for selected pesticide illness incidents. Data obtained from these reports was used to enhance coding and case classification.

3 DATA MANAGEMENT AND ANALYSES

We have established PC-based relational database systems in MS Access to maintain data collected from reporting sources, follow-up interviews, and medical records review. Our system facilitates tracking of multi-source data collection, data entry, administrative tasks, and data quality control/validation. Database systems have administrative features to assist with case management, including components to summarize case interview status, generate letters to send out with educational materials, and automate medical record requests. Standardized procedures for data input and quality control of the data are routinely performed, and include a comparison of all entered records with original reports for accuracy. The core set of variables that have been established by NIOSH for minimum data collection and reporting have been included in both our data collection instruments and database systems (NIOSH 1998, 2005).

All cases are assigned a unique identification number and are coded for industry and occupation using the North American Industry Classification System and Census Occupational Classification codes. Until the year 2003, occupation and industry coding were conducted using Standard Industrial Classification and Census Occupation Classification coding schemes. Coding of WRA exposure data is performed utilizing the Association of Occupational and Environmental Clinics (AOEC 2000) exposure database employed by all SENSOR asthma states (Michigan, Massachusetts, New Jersey). For OPI cases, exposure, illness, and other individual data are coded using the NIOSH standardized variables list (NIOSH, 2005). To assist with efficient data management and case classification, we utilize electronic coding of pesticide chemical class, functional use, and pesticide formulation with the aid of the EPA Product and Ingredient Tables. The EPA Tables contain information on generic and brand name, chemical and functional class, and EPA registration and distributor number.

Occupation and industry-specific rates are calculated using denominator data from the California Employment Development Department Labor Market Information (California EDD 2004). Prior to data analysis, data are thoroughly cleaned and edited, including removal of duplicates. Surveillance data analyses are reported annually to NIOSH in standardized formats using the WRA and OPI core variables. The NIOSH Respiratory Disease Surveillance System software (NIOSH 2002) is used to validate and transfer our WRA data to NIOSH on an annual basis. OPI data is annually transmitted to NIOSH as a SAS data table.

4. RELATED STUDIES

As a direct result of the WRA and OPI programs, we have initiated several related projects and studies that demonstrate our experience and capabilities in conducting surveillance of WRA and OPI. The results of these efforts are used to improve our programs by enhancing our sources for data reporting, focusing our workplace intervention activities on high-risk occupations, and improving our methods for outreach and education.

OPI

a. Laboratory-Based Surveillance for Cholinesterase Reporting

In this NIOSH-funded study, three clinical laboratories reported cholinesterase test results directly to the OPI program. Co-investigators on this study included staff from the University of California, Davis, and the California Environmental Protection Agency. The goal of this project was to determine whether direct clinical laboratory reporting of cholinesterase test results could improve case ascertainment of OPI. Of the 6317 reports received over two years, 622 (9.8%) reports were abnormal according to the study definition (had depressed cholinesterase levels). There were 463 work-related case incidents, representing 255 individuals. None of the cases with depressed cholinesterase levels have been reported by other sources to the SENSOR pesticide program. Although laboratory reporting did not appreciably contribute to the number of pesticide illness cases, several important findings emerged from this study, including the ability to obtain voluntarily reported cholinesterase results from clinical laboratories and to track them for illness surveillance. A final report is in progress.

b. Farm Worker Survey

OPI staff collaborated with several community-based organizations to conduct an EPA-funded study of farm workers in San Luis Obispo County. The objective of this study was to determine whether farm workers had received required pesticide safety training, and to assess their understanding of hazard communication, personal protective equipment, and reporting and treatment of pesticide-related illness. Interviews were completed for 138 farm workers in 2000/2001, with significant gaps identified in pesticide safety training, knowledge of hazards and notification of suspected pesticide exposure or illness.

WRA

a. Surveillance of Agricultural Respiratory Disease

In collaboration with the University of California, Davis Western Center for Agricultural Health and Safety, we maintained a NIOSH-funded statewide agricultural respiratory disease surveillance system (including WRA). The primary objective of this surveillance system was to identify selected cases for potential investigation and development of prevention recommendations. Over five years of data collection (through 2000), a total of 984 cases were reported, largely among farm laborers; pesticides were the most frequent cause of lung injury, with sulfur the leading cause of pesticide-associated respiratory problems.

b. Work-Related Lung Disease in California

Cases of all acute work-related respiratory disease in California reported by physicians were analyzed by the WRA staff for the five-year period 1993 -1998. The primary objectives of this project were to determine the industries and occupations at high risk of work-related lung disease, identify important risk factors for exposure, and to compare these results with our WRA findings. A total of 12,834 physician reports of acute lung disease were received during the five-year surveillance period. The overall rate of respiratory disease across all industries was 28.8/100,000 (compared with 2.4/100,000 for WRA), with the highest rates in government

(74.9) followed by transportation/communications/public utilities (49.6), farm/forestry/fishing (47.5) and manufacturing (31.1).

c. Management and Outcome of Individuals Diagnosed with WRA

A cross-sectional, retrospective study of 155 WRA cases was conducted to evaluate follow-up care and work-related disability due to WRA. Specific aims of this study were to assess the extent to which health care providers were able to identify and treat WRA based on the current standard of care, educate workers about their asthma, and remove workers from exposure. This study confirmed previous findings that only a small minority of physicians use objective measures (e.g., pulmonary function testing) for the diagnosis of WRA, and also demonstrated significant gaps in workplace follow-up and patient education (Processes of Care in Individuals Diagnosed with Work-Related Asthma (WRA): Initial and Follow-up Treatment Characteristics and Impact of Asthma on Work. AAOHNJ, 52(8), August 2004).

d. Behavioral Risk Factor Surveillance System

In conjunction with the Massachusetts and Michigan SENSOR WRA programs, two questions regarding work-related asthma were added to the 2001 California Behavioral Risk Factor Surveillance System. The primary objective was to estimate the proportion of respondents with current asthma whose asthma may be attributable to work. A total of 4,188 California adults were interviewed by telephone and completed the survey instrument. Thirteen percent of respondents stated that they had asthma in their lifetime, and 7.5% have current asthma. Of those reporting current asthma, 7.4% stated that their asthma was worse at work. Based on the proportion of California adults with current asthma who report asthma made worse by work, approximately 137,000 individuals are estimated to have WRA in California. These data have been important for documenting the extent of the problem in California, the role of surveillance, and the need for better recognition and diagnosis of WRA cases.

B CASE FOLLOW UP AND WORKPLACE INTERVENTION

To link the findings from surveillance data to the prevention of WRA and OPI, we conducted follow-up investigations of selected cases. WRA and OPI reports were selected for follow-up based on the magnitude of the public health impact represented by the incident report(s): (1) incidents involving a large number of workers, or involving an exposure that is common to a large population of workers; (2) a large number or rate of illness reports related to a single agent, industry, or task; (3) illness severity (i.e., long-term disability, hospitalizations and deaths); and (4) "sentinel events", which are reports that may represent a new or emerging hazard, or a failure of recognized control measures or regulations to effectively control exposures. Due to resource limitations, we did not investigate all incidents that met our case follow-up criteria.

OHB has the authority to gain access to the workplace for the purpose of conducting investigations of work-related morbidity and mortality (California Health and Safety Code Section 105175-105180). Investigations were initiated by contacting the incident case(s) at home, and workers are asked to participate in a voluntary interview describing the incident, their symptoms, medical treatment, workplace and take-home exposures, control measures, and other information. Subsequent to the worker interview, the employer is contacted to arrange the work site investigation. Site visits are conducted according to our standard OHB policies and procedures, and include employer and employee representatives, (unions, other worker advocacy organizations, and/or individual workers, as available). Worker interviews were conducted by multi-cultural and bilingual staff in a private location (private office at the workplace or in their homes). Educational materials and a toll-free phone number were provided to workers to facilitate ready access to information about health, safety and workers'

rights, as well as to SENSOR staff. Workplace investigations included the following: on-site industrial hygiene assessment of the workplace and work processes; interviews with employers, employees and other individuals involved in the incident; symptom surveys of workers; review of written policy and procedures, medical records, and regulatory investigations; and review and analysis of Material Safety Data Sheets and relevant scientific literature.

Structured questionnaires were utilized for both WRA and OPI investigations to obtain occupational, demographic and health data from employees in facilities where it is not feasible to interview every potentially exposed employee at length during field. For OPI investigations, staff also obtained the written report from the local County Agricultural Commissioner's (CAC's) office. All pesticide exposure incidents in California are investigated by the local CAC staff, and these reports contain useful information regarding the application and type of pesticides, use of personal protective equipment, and regulatory citations issued. Following the conclusion of our investigation, preliminary recommendations were made in writing via a letter sent within 2-3 weeks to the employer, labor representatives and/or monitored workers. The complete report with detailed findings and recommendations is usually completed and distributed within 6 months.

b. Asthma Case Follow-Up and Workplace Interventions

Chemical Exposure During Graffiti Removal

FINDINGS: Investigations of ten work sites with reports of WRA among workers removing graffiti demonstrated a large, diverse population of workers (painters, laborers, custodians, bus cleaners, telephone booth cleaners) at risk of developing irritant-associated asthma, with inadequate controls to prevent exposure to multiple chemicals including solvents and amine compounds.

INTERVENTION: As a result of our investigations, we completed the illustrated booklet "Removing Graffiti Safely" and presented the findings and recommendations of our investigations to hundreds of workers, employers, health and safety professionals, and purchasing agents in affected industries.

Hazards of Wood Dust

FINDINGS: Investigations of WRA involving exposure to wood dust in skateboard, pencil, furniture manufacturing plants and lumber manufacturing demonstrated that exposures below the OSHA Permissible Exposure Levels may result in sensitizer-induced asthma; exposure to other irritants (preservatives, dyes, and glues) may contribute to the risk of WRA; and effective and widely available control measures are not installed or used correctly.

INTERVENTION: As a result of our investigations, we developed and disseminated detailed, site-specific prevention recommendations for each work site; developed the fact sheet "Wood Dust and Occupational Asthma," and made presentations of our findings and recommendations to trade associations (California Lumberman Accident Prevention Association), labor organizations, and the California Industrial Hygiene Council. Our findings on wood dust provided critical impetus for amending the Cal-OSHA hazard communication standard for wood dust exposure. Specifically, an amendment was added to clarify that the hazard communication exemption for wood and wood products does not apply to wood that will be sawed or cut, generating wood dust.

Hazards of Cleaning Agents

FINDINGS: Investigations of WRA asthma among janitors and health care workers exposed to cleaning agents, and health care workers exposed to glutaraldehyde (used to disinfect heat-

sensitive, reusable medical devices), demonstrated the need for sustainable, less toxic alternatives to the use of sensitizers and strong irritants for cleaning and disinfection.

INTERVENTION: We assessed the alternatives to the use of glutaraldehyde for high-level disinfection of reusable medical devices using toxicological, industrial hygiene, and infection control criteria and provided our evaluation in writing to the Service Employees International Union; developed a fact sheet on glutaraldehyde that addresses the issue of selecting less hazardous alternatives; participated in a conference on "Alternatives Assessment The Practice of Evaluating Alternatives" where we provided input on the occupational health aspects of alternatives assessment; provided written recommendations for preventing WRA to "Green Guidelines for Health Care Construction (a metric for evaluating health and sustainability of building design construction, maintenance and operations for the health care industry); provided training to janitors as part of the San Francisco City College Custodial Training Program; and developed written comments by OHS regarding the inclusion of WRA criteria to "Green Seal" (an organization that sets standards for and certifies cleaning agents and other products on the basis of environmental and performance characteristics).

Glutaraldehyde Exposure in the Manufacture of Bioprosthetic Heart Valves

FINDINGS: We investigated WRA among workers exposed to glutaraldehyde at two facilities that together manufacture 90% of all the 100,000 bovine and porcine heart valves used annually throughout the world. Our results lend support to recent challenge studies indicating that glutaraldehyde exposures below the OSHA Permissible Exposure Levels may result in sensitizer-induced asthma. The results of our investigations demonstrate the need for a rational scientific basis to guide employers and policy makers in setting prevention-based exposure limits for agents that cause asthma.

INTERVENTION: We initiated collaboration with CDHS Environmental Health Investigations Branch to address this far-reaching policy void. A field investigation and report were completed of WRA at two heart valve manufacturing plants responsible for 90% of the world's heart valves, and results were provided to management, workers and other interested parties. Final reports were mailed to over 800 recipients and the report is available on the program's website. The report included recommendations to reduce worker exposure to glutaraldehyde during the manufacturing process. Dissemination recipients included affected workers, employers, state and federal regulatory agencies with oversight of the medical device industry, physicians, surgeons and surgical nurses, manufacturers and other related specialties, and to heart disease patient advocacy organizations. We also participated in the public comment meetings and provided written comments to the California Division of Occupational Safety and Health on its current proposal to lower the permissible exposure limit for glutaraldehyde.

Medical Waste Stream Workers

FINDINGS: We have collaborated with Health Care Without Harm (an international coalition working to reduce harmful exposures in the health care industry) on the prevention of WRA among medical waste treatment workers exposed to multiple asthma-causing agents,. Including formaldehyde, glutaraldehyde, cleaning agents, deodorants, steam, disinfectants, as well as other chemical, biological and physical hazards. We have demonstrated the relationship between environmental health decision-making and WRA, including the need for medical waste generators to segregate regulated medical waste from other waste to prevent hazardous exposures downstream of the health care facility.

INTERVENTION: We have presented our findings and recommendations for prevention (including the importance of integrating occupational health with environmental health decision-making) at the American Public Health Association 2003 annual meeting, and to the City of Berkeley

Department of Public Health. Also, results were presented to management and workers at the plant investigated. A final report has been mailed to over 400 recipients, and has received approximately 4,000 visits on our website. These results were also disseminated nationally via two 'Hospitals for a Healthy Environment teleconferences, in a local presentation to the California Public Health Association-North, and at the national Clean Med Conference.

C COLLABORATION

We continued to coordinate and collaborate with relevant state and local agencies, and with other organizations and individuals to prevent work-related illness and injury. Our efforts have been to increase the integration of occupational health into: (1) mainstream public health practice, especially environmental health and other existing asthma prevention or related activities undertaken on behalf of communities or consumers (NIOSH 2001); (2) upstream materials, product and job design, such as chemical alternatives assessment; and (3) the work of advocacy organizations concerned about the health and well being of women, low-wage immigrant workers, and other special populations at high risk for WRA and OPI. This included participation in interagency, advisory, and other working groups, and provision of written comments and analyses of regulations, legislation and other policy issues related to the prevention of WRA and OPI. We also participated in a collaborative project of special interest, the development of a statewide plan for the implementation of an environmental health surveillance system.

D DISSEMINATION, EDUCATION AND OUTREACH

We have disseminated information in a wide variety of formats, including written materials for workers about prevention of illness, workers' compensation procedures and other workplace legal rights; fact sheets and hazard advisories; scientific reports and peer-reviewed publications; presentations at worker, medical, public health, and industry conferences; grand rounds, and other presentations to health care providers in clinics and hospitals; educational modules; written comments to regulatory agencies and voluntary standards setting organizations on proposed and existing regulations and guidelines; written analyses of proposed legislation; participation on interagency, advisory, and other work groups; posting on our CDPH website; and data and reports sent to NIOSH for inclusion in national surveillance databases.

Workers and employers at work sites with follow-up investigations received written educational materials about the hazards encountered and notification of results of our findings and recommendations. In some cases, the findings of an investigation were presented to the workers and employers in person. However, because of our limited resources, and our increasing need to reach low wage, non-English speaking populations, our primary mechanism for disseminating results to these populations was through our close collaboration with community-based organizations. We also stressed dissemination to government and nongovernmental organizations with the capacity to implement needed changes through regulatory and advocacy efforts.

E EVALUATION

We continued to evaluate the specific elements of our surveillance systems, including temporal reporting trends, timeliness, case classification, and sensitivity of DFR reporting. In addition, in preparation for conducting a formal, written evaluation of our surveillance systems for WRA and OPI we initiated the following:

(1) We began to identify the stakeholders that benefit from our surveillance data to assess that the most useful and appropriate data are being collected. We plan to convene a meeting of

these stakeholders, and/or conduct individual key informant interviews by telephone, to seek input regarding the evaluation and design of our surveillance systems.

(2) We continued to assess our surveillance systems with respect to the major attributes of simplicity, flexibility, data quality, acceptability, sensitivity, predictive value positive, representativeness, timeliness, and stability. Due to the relatively limited resources available, our reporting and data collection mechanisms are as *simple* as possible. *Flexibility* was evaluated in an ongoing manner as stakeholders requested data and as we adapted to changes in information capture and transfer technology (such as WCIS, direct laboratory reporting, and NEDSS). Although our surveillance system relies primarily on secondary data sources, interviewed workers are primary sources of data and acceptability was evaluated using interview and survey completion rates. *Sensitivity* was evaluated by several means: comparison of WRA cases submitted by Kaiser Permanents with WRA cases ascertained from the conventional DFR system; comparison of WCIS reports and those in the DFR data base; comparison of OPI data with cases obtained from DFRs and PIRs. The *predictive value positive* was evaluated through data generated by worker interviews, medical record retrieval, and inclusion of information obtained from agricultural commissioner reports. The *representativeness* of the system was more difficult to evaluate, as self-employed and undocumented workers are unlikely to be reported through any of the proposed data sources. However, all data sources were compared to determine differences in the populations captured. Finally, *timeliness* was evaluated according to the statute governing the submission of DFRs and the electronic transmittal of WCIS data (which requires reporting within 5 days of the initial examination).

(3) We monitored the timeliness and number of investigations performed, ability of current investigation criteria to identify cases of broad public health significance for follow-up, timeliness of investigations, access to the workplace, and interview participation rates. We use the OHB Field Investigation Policy and Procedures manual on an ongoing basis to ensure that investigations are conducted in a manner consistent with our program policy and ethics. Finally, we evaluated the number of secondary cases of WRA and OPI, and the number and type of new risk factors for WRA and OPI that are identified by our investigations.

(4) We involved stakeholders in the development of new materials, monitored the timeliness and number of materials developed, and documented the type and number of stakeholders who received our reports and presentations.

A SURVEILLANCE FINDINGS

a. WRA

For ten years the California WRA surveillance system received a total of 3,126 cases of WRA (annual average 313 cases). Asthma surveillance data are routinely analyzed and include frequencies of WRA cases by year of receipt, gender, age, SIC code, Census Occupational Code, and rates by industry and occupation. Data for cases that completed an interview are also included for the period 1993 through 2000.

The overall rate of occupational asthma for all industries over 10 years is 2.3 per 100,000 employed in California, with particularly high rates seen among local transit, lumber and wood product manufacturing, electric, gas and sanitary services, heavy construction, health services and social services industries. Occupations with particularly high rates include correctional

officers, firefighters, welfare eligibility clerks, health technicians, radiological technicians and licensed vocational nurses (**Figures 1 and 2**). Using DFR data reported directly to the WRA program from Kaiser to evaluate case capture through the standard DFR system, we determined that only about one-third of DFRs are captured through the standard system of physician reports to workers' compensation insurers. This finding suggests that the overall rate

Fig. 1 - Top Ten Industries by Rate

Surveillance of work-related asthma in California –

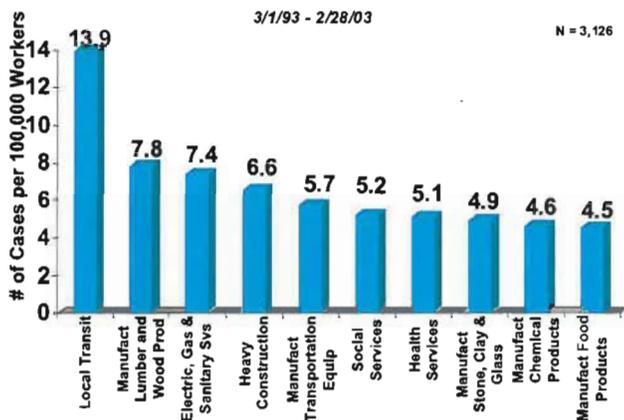
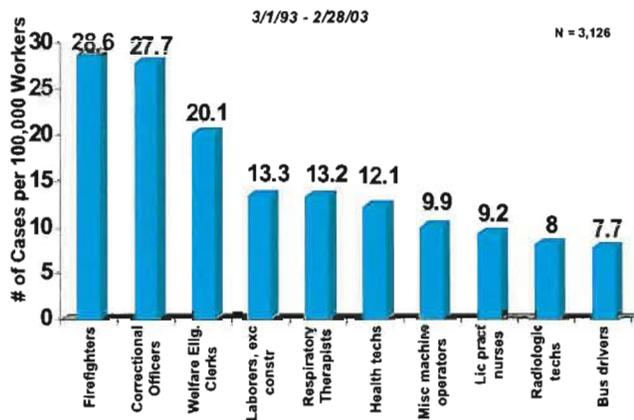


Fig 2. - Top Ten Occupations by Rate

Surveillance of work-related asthma in California –



of WRA asthma in California is actually much greater (7.7/100,000 workers).

Of the 1,144 interviewed cases with WRA from 1993-2000, 6% were case classified as Reactive Airways Dysfunction Syndrome, 10% as new onset asthma associated with a known asthma inducer, 46% as new onset cases associated with an unknown asthma inducer, and 38% as work-aggravated asthma.

b. Pesticide Illness

For seven years of surveillance (January 1, 1998 through December 31, 2004), the SENSOR pesticide program received a total of 2,732 unique case reports of suspected OPI. An average of 390 cases were reported annually. Pesticide surveillance data are routinely analyzed and include frequencies of report source, case classification, occupation, industry, chemical category, age, and gender. A total of 47% of reports were classified as definite, probable or possible cases of OPI. The most common agents were the organophosphates, inorganics, and pyrethroids. The overall annual rate of OPI for all industries is 2.3 per 100,000, with the highest rates seen among nursery workers, pest control operators, and farm workers.

B FOLLOW UP FINDINGS AND ACCOMPLISHMENTS

1. WRA

Through May of 2004, WRA staff have conducted follow-up investigations for 19 incidents related to agents associated with WRA (average of 2-3 investigations per year). The findings of selected investigations illustrate how our approach to case follow-up investigations ensures that the results of the surveillance system are linked to illness prevention.

a. Chemical Exposure During Graffiti Removal

FINDINGS: Investigations of ten work sites with reports of WRA among workers removing graffiti demonstrated a large, diverse population of workers (painters, laborers, custodians, bus cleaners, telephone booth cleaners) at risk of developing irritant-associated asthma, with

inadequate controls to prevent exposure to multiple chemicals including solvents and amine compounds.

INTERVENTION: As a result of our investigations, we completed the illustrated booklet "Removing Graffiti Safely" and presented the findings and recommendations of our investigations to hundreds of workers, employers, health and safety professionals, and purchasing agents in affected industries.

b. Hazards of Wood Dust

FINDINGS: Investigations of WRA involving exposure to wood dust in skateboard, pencil, furniture manufacturing plants and lumber manufacturing demonstrated that exposures below the OSHA Permissible Exposure Levels may result in sensitizer-induced asthma; exposure to other irritants (preservatives, dyes, and glues) may contribute to the risk of WRA; and effective and widely available control measures are not installed or used correctly.

INTERVENTION: As a result of our investigations, we developed and disseminated detailed, site-specific prevention recommendations for each work site; developed the fact sheet "Wood Dust and Occupational Asthma," and made presentations of our findings and recommendations to trade associations (California Lumberman Accident Prevention Association), labor organizations, and the California Industrial Hygiene Council. Our findings on wood dust provided critical impetus for amending the Cal-OSHA hazard communication standard for wood dust exposure. Specifically, an amendment was added to clarify that the hazard communication exemption for wood and wood products does *not* apply to wood that will be sawed or cut, generating wood dust.

Hazards of Cleaning Agents

FINDINGS: Investigations of WRA among janitors and health care workers exposed to cleaning agents, and health care workers exposed to glutaraldehyde (used to disinfect heat-sensitive, reusable medical devices), demonstrated the need for sustainable, less toxic alternatives to the use of sensitizers and strong irritants for cleaning and disinfection.

INTERVENTION: We assessed the alternatives to the use of glutaraldehyde for high-level disinfection of reusable medical devices using toxicological, industrial hygiene, and infection control criteria and provided our evaluation in writing to the Service Employees International Union; developed a fact sheet on glutaraldehyde that addresses the issue of selecting less hazardous alternatives; participated in a conference on "Alternatives Assessment: The Practice of Evaluating Alternatives" where we provided input on the occupational health aspects of alternatives assessment; provided written recommendations for preventing WRA to "Green Guidelines for Health Care Construction" (a metric for evaluating health and sustainability of building design construction, maintenance and operations for the health care industry); provided training to janitors as part of the San Francisco City College Custodial Training Program; and developed written comments by DHS regarding the inclusion of WRA criteria to "Green Seal" (an organization that sets standards for and certifies cleaning agents and other products on the basis of environmental and performance characteristics).

d. Glutaraldehyde Exposure in the Manufacture of Bioprosthetic Heart Valves

FINDINGS: We investigated WRA among workers exposed to glutaraldehyde at two facilities that together manufacture 90% of all the 100,000 bovine and porcine heart valves used annually throughout the world. Our results lend support to recent challenge studies indicating that glutaraldehyde exposures below the OSHA Permissible Exposure Levels may result in sensitizer-induced asthma. The results of our investigations demonstrate the need for a rational

scientific basis to guide employers and policy makers in setting prevention-based exposure limits for agents that cause asthma.

INTERVENTION: We initiated collaboration with CDPH Environmental Health Investigations Branch to address this far-reaching policy void (see IV B, Obj 2). We are in the process of writing a report of the findings of our field investigations including recommendations to reduce worker exposure to glutaraldehyde during the manufacture of heart valves. The report will be disseminated to affected workers, employers, state and federal regulatory agencies with oversight of the medical device industry, physicians, surgeons and surgical nurses, manufacturers and other related specialties, and to heart disease patient advocacy organizations. We also participated in the public comment meetings and will provide written comments to the California Division of Occupational Safety and Health on its current proposal to lower the permissible exposure limit for glutaraldehyde.

e. Medical Waste Stream Workers

FINDINGS: We have collaborated with Health Care Without Harm (an international coalition working to reduce harmful exposures in the health care industry) on the prevention of WRA among medical waste treatment workers exposed to multiple asthma-causing agents,, including formaldehyde, glutaraldehyde, cleaning agents, deodorants, steam, disinfectants, as well as other chemical, biological and physical hazards. We have demonstrated the relationship between environmental health decision-making and WRA, including the need for medical waste generators to segregate regulated medical waste from other waste to prevent hazardous exposures downstream of the health care facility.

INTERVENTION: We have presented our findings and recommendations for prevention (including the importance of integrating occupational health with environmental health decision-making) at the American Public Health Association 2003 annual meeting, and to the City of Berkeley Department of Public Health. We are completing a comprehensive report that will be disseminated widely in collaboration with Health Care Without Harm, and will be making a follow-up presentation on this issue at the American Public Health Association annual meeting in 2004.

2. OPI

Through December 2005, OPI staff have conducted follow-up investigations for 28 incidents related to agents associated with OPI (average of 3-4 investigations per year). The findings and recommendations of the following selected investigations illustrate how our approach to case follow-up investigations ensures that the results of the surveillance system are linked to illness prevention recommendations.

a. Worker Illnesses Following Cyfluthrin Drift

Findings: Cyfluthrin drift was determined to be the cause of symptoms in 27 farmworkers and six emergency responders following ground rig application to an orange orchard in May, 2005. Pyrethroid pesticides are now in widespread use for both agricultural and structural applications. Although considered to be a safer alternative to many other pesticides, we showed that pyrethroid pesticides such as cyfluthrin can cause pesticide illness even at low doses. A combination of factors led to this illness incident, including inadequate communication, inadequate regulations, the method of application, and the unpredictability of weather conditions. The results of this investigation have been published: "Worker Illness Related to Ground Application of Pesticide --- Kern County, California, 2005". MMWR 2005; 55:486-488.

<http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5517a4.htm>

Recommendations: As a result of our investigation, we recommend that all workers, not just applicator employees, within a quarter mile be notified of planned ground rig pesticide applications; two-way radios be installed in all tractor cabs, eliminating the need for hand signals for communication; engineering controls be considered to reduce overspray due to ground rig pesticide application; physicians receive regular educational updates on the recognition, management, and treatment of pesticide illness; and non-toxic, sustainable methods of control of thrip on oranges be pursued for primary prevention of pesticide illness. We plan to submit these recommendations to CDPR, the state pesticide regulatory agency. We are in the process of preparing a letter summarizing relevant findings and recommendations for workers. A copy of the report will also be sent to the employers.

Occupational Illness Among Flight Attendants Due to Aircraft Disinsection

Findings: In 2003, residual aircraft disinsection using a permethrin formulation was found to cause illness in 12 flight attendants involved in three separate incidents. Aircraft "disinsection" involves applying pesticides inside an aircraft to kill insects that may be on board and that may be a threat to the health of humans, plants, animals, and agriculture. Currently, airlines perform this procedure to comply with quarantine regulations of 18 countries. We found that residual disinsection poses a health hazard to flight attendants because of the toxicity of the pyrethroid pesticide formulation; the conditions of use involve pesticide application and exposure within a confined area without egress; and current assumptions about the health risks of this procedure underestimate the human health risks.

Recommendations: As a result of our investigation, we worked with the Association of Flight Attendants to recommend that nontoxic alternatives to disinsection be implemented aboard aircraft. Until these methods are implemented, we recommended that airlines adopt interim measures, such as educating all potentially exposed workers about the hazards of aircraft disinsection; restricted entry for all workers to the aircraft cabin after disinsection; implementation and enforcement of maximal ventilation procedures on every treated aircraft; quality control measures for every pesticide application; discontinuing spraying pesticides in the crew rest area (bunk room); notifying in advance passengers who may be exposed to a pesticide-treated aircraft of the procedure and the potential health risks; scheduling flights to countries that require disinsection so that the number of aircraft treated is minimized; and initiating active illness surveillance among exposed workers and passengers.

c. Pesticide Drift onto an Organic Grape Vineyard

Findings: In 2003, we received notification of four illness cases on an organic vineyard. Based on a site visit to the vineyard, interviews of the injured workers and the county agricultural commissioner, and review of the agricultural commissioner's investigation report, we determined that four cases of OPI were the result of methyl bromide drift onto the vineyard from the neighboring field. Drift was due to changing weather conditions and wind-induced tarp disruption.

Recommendations: Regulators at the local and federal level should reevaluate the buffer zone for methyl bromide application. Regulators should reevaluate the conditions under which methyl bromide application can be performed; this evaluation should take into account the poor ability to predict weather conditions. Researchers and government strongly support the complete phase-out of methyl bromide; they should evaluate and promote safer alternatives to methyl bromide, including non-chemical methods of soil pest control.

d. Utility Workers and Sulfuryl Fluoride Exposure

Findings: In 2003, we responded to a request for technical assistance from a union of utility workers regarding the health and safety issues involved in re-igniting pilot lights in sulfuryl fluoride-fumigated dwellings. We found that utility workers are potentially at risk of illness as a result of exposure to both sulfuryl fluoride and chloropicrin following entry into a fumigated structure, even when it has been cleared for entry. Factors contributing to this risk include: the toxicity of the chemicals; inadequate warning properties due to unequal dispersion of chloropicrin and sulfuryl fluoride; tendency to accumulate in low and confined areas; lack of instructions for Pest Control Operators to conduct monitoring for chloropicrin in spaces where pilot lights are found; and insufficient training of utility workers to anticipate, recognize, and avoid exposures to fumigants.

Recommendations: Utility workers should report any suspected signs or symptoms of exposure to either chloropicrin or sulfuryl fluoride to a supervisor and to a physician immediately. Pest Control Operators should consider systematically identifying spaces which require entry to restart pilot lights. Instantaneous readings of concentrations in these areas should be documented and posted for utility worker reference at the entrance of a structure once it is cleared for entry. Employees should enter confined areas only after reviewing documentation that sulfuryl fluoride was not detected in the area. Utility companies should train their employees to recognize the signs and symptoms of fumigant and warning agent exposure; understand what measures to take to prevent exposures; and to report suspected worker exposures to physicians and employers.

C COLLABORATION FINDINGS AND ACCOMPLISHMENTS

By leveraging the relationships between the workplace and community environments, our work supports the efforts of others who can utilize our data and technical expertise to implement prevention strategies that will affect worker and community health. Our collaborative approach also strives to support more primary prevention-based activities by: (1) educating a wide range of audiences about the occupational health impact of their activities/decisions; (2) building a constituency for prevention of WRA and OPI to create incentives for change; (3) affecting decisions in an upstream, proactive manner.

The WRA and OPI programs have collaborated with many state and local agencies, health care professionals, industries, trade associations, labor organizations, and community-based organizations in our ongoing program activities. Staff have participated on numerous inter-agency, advisory, and other work-groups addressing WRA and OPI. Our collaborative efforts include the following:

- American College of Occupational and Environmental Medicine (distribution of OPI and WRA publications and educational materials)
- California Department of Health Services Environmental Health Investigations Branch (linkage of WRA to environmental-based prevention efforts, development and implementation of the California Strategic Plan for Asthma)
- California Department of Pesticide Regulation (pesticide illness reporting, surveillance, investigation, and training, Pesticide Registration and Evaluation Committee (PREC), Worker Safety Regulations Work Group (WSRWG))
- California Division of Occupational Safety and Health (health and safety training, isocyanate and glutaraldehyde standards development)
- California Conference of Local Health Officers (OPI, WRA, environmental tracking)
- California-Mexico Health Initiative (health issues on both sides of the California-Mexico border, Binational Forum on Migrant Health at the University of California Berkeley, Binational Health Week)
- California Office of Binational Border Health (assessment of health needs among migrant populations in California, particularly in the areas of occupational and environmental health: OPI among farmworkers)
Center for Occupational and Environmental Health (data analysis, education and outreach)

- University of California, Davis (agricultural respiratory disease surveillance; OPI train the trainers and other educational seminars)
- University of California, Berkeley Labor Occupational Health Program (education and outreach) • University of California, Los Angeles (education and outreach)
- State Compensation Insurance Fund (SCIF) (case ascertainment)
- Environmental and local community-based organizations, such as Health Care Without Harm, Center for Environmental Health, WorkSafe, Pesticide Action Network of North America, Environmental Center of San Luis Obispo, Environmental Defense Fund, and California Rural Legal Assistance (research, investigations, policy development, education and outreach)
- Trade associations, such as the California Lumberman Association and Western Growers Association
- Labor organizations, such as California Labor Federation, Building and Construction Trades Council, American Nurses Association, Utility Workers Union of America, and Service Employees International Union (technical assistance, outreach and education)
- Medical organizations, such as the California Thoracic Society and Kaiser Permanents (health care provider education, case reporting)
- Labor Occupational Health Program, University of California Berkeley (health and safety among young agricultural workers)
- Office of Environmental Health Hazard Assessment (pesticide illness reporting, education)

D. DISSEMINATION/OUTREACH FINDINGS AND ACCOMPLISHMENTS

1. WRA

Approximately 27 WRA presentations were completed from 1993 through the end of the reporting period. The California WRA program has provided written educational materials to over 5,000 workers and health care providers, and published our findings in newsletters and professional organization publications such as the *Guide to Occupational Respiratory Disease in California (California Thoracic protective devices)*; published findings in multiple peer-reviewed journal articles; included multiple articles in the Branch newsletter; provided WRA data to Cal/OSHA to assist in their assessment of the isocyanate and glutaraldehyde standards; and analyzed proposed legislation addressing electronic reporting of first reports of injury and illness and state funding for a California asthma surveillance and prevention program.

2. OPI

In addition to numerous didactic sessions and oral and poster presentations, OPI has made significant contributions in the following areas:

Website

We have updated the Occupational Health Branch website: <http://www.dhs.ca.gov/ohb/>. The pesticide section of the website now provides information on and links to OPI publications and presentations, a brief description of staff activities, and links to related sources of information on pesticides and agriculture, including the NIOSH website: <http://www.dhs.ca.gov/ohb/OHSEP/pesticide.htm>.

Association of Occupational and Environmental Clinics (A OEC)

Funding from the AOEC allowed OPI staff to develop a Pesticide Illness Curriculum on CD-ROM. This CD has been distributed at seminars and conferences. A downloadable version is available from the AOEC website: <http://www.aoec.org/LLDIR.htm#PowerPoint>. In the near future, we plan to distribute this CD even further, to physicians working in California Migrant Health Clinics.

Occupational Health Watch

Our branch newsletter has featured the following articles on OPI projects:

Summer 2002 <http://www.dhs.ca.gov/ohb/ohwl.pdf>
Case Study: Workers ill after pesticide drift exposure

Farm workers, others, poisoned by pesticides

Spring 2003 <http://www.dhs.ca.gov/ohb/ohw2.pdf>
San Luis Obispo farm workers receive safety training

Summer 2004 <http://www.dhs.ca.gov/ohb/ohw3.pdf>
Pesticide use onboard airliners poses health risks
Monitoring pesticide exposure

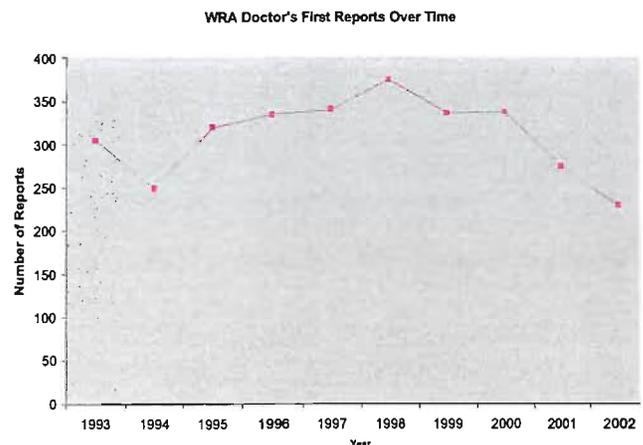
Fall 2005 <http://www.dhs.ca.gov/ohb/ohw4.pdf>
Pesticides continue to harm workers

E. EVALUATION FINDINGS AND ACCOMPLISHMENTS

a. Surveillance

Our evaluation of temporal reporting trends shows recent decreases in DFR reporting for WRA and OPI. Total numbers of cases have fluctuated over time: WRA with a high of 375 in 1998 and a low of 231 in 2002; and OPI with a high of 592 in 1998 and a low of 262 in 2004. There are several possible explanations for this observation: variability due to chance; workers' compensation insurance carriers may not recognize that DFRs must still be submitted to DIR even though electronic data reporting has been initiated (see IV.B); physician recognition and reporting of occupational illness may be decreasing; and workplace exposures may be declining due to changes in work practices, alternative chemicals used, or reductions in employment in certain high-risk industries and occupations.

The *timeliness* of our surveillance systems is adequate for case follow-up, with a median of 1 day elapsed between WRA onset and physician diagnosis, and a median of 20 days between physician diagnosis and receipt of report by the WRA program. The OPI system exhibits similar timeliness, with a median of 0 days elapsed between OPI onset and physician diagnosis, and a median of 13 days between physician diagnosis and receipt of report by the OPI program.



In evaluating *case classification*, our evaluation of WRA interview data shows an overall completion rate of 43%, with 45% of cases unreachable by telephone and 12% refusing the interview. These interview findings have not changed significantly over time or with different interviewers. The OPI program's *case classification* system is used by multiple states participating in the SENSOR Pesticides program (NIOSH 2002a). To be classified as a case, written documentation of the following is required: exposure to a specific pesticide, two adverse health effects, and literature evidence of exposure-effect association. For 1998—2005, there was insufficient information to classify 39% (1064/2732) of cases. Of these, 81% were not classifiable because they lacked information about a pesticide, and 19% documented only one health effect.

The *sensitivity* of the DIR-based DFR reporting system in detecting WRA and OPI cases is relatively poor. 70% of the cases reported directly by Kaiser to the WRA program are not received by DIR. An analysis of PIR reporting indicates a similar underreporting of OPI cases from the DFR system. A preliminary assessment of the WCIS data source suggests only a 10% overlap with the DFR system for both WRA and OPI. As already noted, we suspect that this reflects inadequate compliance with the reporting law by insurance carriers. The *predictive value positive* of our surveillance of WRA is excellent, with 98% of WRA cases receiving interviews subsequently confirmed as true cases. The *predictive value positive* of

our surveillance of OPI is relatively good, with 59% of OPI cases for which medical records and/or CAC reports are received subsequently confirmed as true cases.

b. Workplace follow-up and interventions

To evaluate our field investigations, we assess the capacity to respond to case reports in a timely manner; the quality of our investigations (if they were conducted according to the standards set forth in our policy and procedures); and the public health impact of our investigations (if the investigations produced public-health based recommendations for prevention and if they were recommendations implemented).

CAPACITY: We initiate our investigations in a timely manner, generally within two weeks after we receive notification of an incident that meets our case follow-up criteria. In virtually all cases, we have been able to gain access to work sites for purposes of conducting incident investigations. In only one case were we unable to obtain access to the work site for investigation (a federal facility to which our statutory right-of-access does not apply).

QUALITY: One important measure of the quality of field investigations is our ability to gather sufficient information to develop meaningful recommendations for prevention. This involves gaining the trust of, and communicating effectively with, workers to learn about their work. We have evaluated each step in our field investigations to identify procedures that maximize our ability to gain access to the work site while minimizing the potential negative impacts of our investigations on the well-being of vulnerable workers. This evaluation has been formalized in *our Policy and Procedures for Field Investigations*, which provides the legal and ethical framework for our investigations and a practical step-by-step methodology for site visits.

A key finding of our evaluation is that high-quality investigations require substantial resources (personnel, time and a diversity of scientific, technical, language, and other communication skills). All 19 investigations initiated by the WRA program and 28 investigation initiated by the OPI program resulted in the development and wide dissemination of comprehensive written recommendations for prevention and the development of incident summaries that were transmitted to NIOSH. In work sites without a union, we identified the need to emphasize collaboration with environmental, community-based, and other nongovernmental organizations with access to, and the trust of workers.

Participation rates for on-site worker interviews have been excellent, ranging from 60 - 70% for WRA work site investigations and over 70% for OPI investigations. Although workers have been willing to participate in initial investigations, follow-up studies for WRA and OPI have had lower participation. Reasons for the lower participation for the follow-up studies included the following: some workers had returned to their homes in Mexico; some workers did not have access to telephones; and some were unavailable when numerous follow-up calls were made.

PUBLIC HEALTH IMPACT OF OUR INVESTIGATIONS: Our selection criteria for investigations have been very successful in identifying incidents with broad public health significance. Due to resource limitations, we are able to conduct follow-up of a small proportion of eligible cases. Our collaboration with governmental and non-governmental agencies is a key evaluation tool to further pinpoint the most pressing public health issues for follow-up. The results of investigations have provided useful information regarding the adequacy of existing regulations.

The recommendations in our investigation reports are directed towards the parties with the authority to implement changes—usually employers and trade associations, purchasing agents, and regulatory agencies. Adherence to applicable regulations is not the focus of our investigations, although regulatory compliance may be assessed if it is relevant to the findings.

D LIMITATIONS – PROBLEMS AND ALTERNATIVE APPROACHES

Our WRA and OPI surveillance programs are marked by a few limitations. First, our surveillance system relies on passive methods for case ascertainment. Although this is preferred in terms of simplicity and cost-effectiveness, passive reporting may not be representative and may fail to detect outbreaks. In addition, there may be significant case underreporting due to poor physician recognition and diagnosis of work-related illness and injury, inadequate knowledge of reporting requirements, and administrative failures. For example, our comparison of direct Kaiser DFR reporting with those DFRs received through DIR suggests significant administrative problems with the current paper-based reporting system. We have

taken some steps to address these limitations, including providing continued physician education and most importantly, evaluating electronic workers' compensation data to extract additional case reports.

Second, our WRA and OPI programs have relatively limited ability to conduct case-based investigations and in-depth prevention activities. We have addressed this issue by training staff in addition to industrial hygienists to assist with field investigations and by targeting high-risk industries and occupations where problems are the greatest and prevention strategies are feasible.

Third, the scope of our education and outreach activities is constrained by our relatively limited resources. We have attempted to address this issue by working with existing community-based organizations concerned with preventing WRA and OPI.