CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH SURVEILLANCE
5 U60 OH008468
PROJECT PERIOD JULY 1, 2005 – JUNE 30, 2015

FINAL PROJECT REPORT
OCTOBER 21, 2015

Robert Harrison, MD, MPH, Principal Investigator
(510) 620-5769
Email: Robert.harrison@ucsf.edu

Barbara Materna, PhD, Co-investigator (OHI)
Rachel Roisman, MD, MPH, Co-investigator (Pesticides)
Jennifer Flattery, MPH, Co-investigator (Asthma)
Laura Styles, MPH, Co-investigator (Fatalities)

Project staff
John Beckman, Raymundus Butarbutar, Hank Cierpich, Carolina Espineli, Christine Hannigan, David Harrington, Wendy Harder, Egils Kronlins, Eleana Martysh, Susan Payne, Lillian Salcido, Debbie Shrem, Leesa Sopjes, Justine Weinberg

California Department of Public Health
850 Marina Bay Parkway
Building P, 3rd Floor
Richmond, CA 94804

TABLE OF CONTENTS

Abstract

The Occupational Health Branch (OHB) of the California Department of Public Health (CDPH) conducted an Expanded Program to reduce the incidence of work-related injury and illness by maintaining and enhancing our capacity for occupational health surveillance and intervention in California. The Expanded Program included the Occupational Health Indicator (OHI) component, as well as four focus areas (work-related asthma, fatalities, pesticide illness, and carpal tunnel syndrome). The specific activities conducted over these five years for the Expanded Program were to:

- Collect and analyze on an annual basis surveillance data for at least 21 Occupational Health Indicators (OHIs) and an Employment Demographics Profile, and conduct additional analyses using multiple data sources to enhance our understanding of California worker populations at high risk for injury and illness.
- Conduct case follow-up and intervention activities informed by case reports and analysis of surveillance data from multiple data sources
- Perform case-based or targeted workplace investigations and interventions to prevent illness and injury among selected occupations and industries
- Identify and respond to emerging and/or under-recognized occupational health issues, while mentoring and contributing to the development of the future occupational health workforce.
- Collaborate with California and national partners to obtain input to guide our program, gain support to further program goals, and have impact on public health and regulatory policies.
- Disseminate our surveillance data, investigation findings, public health recommendations, and educational resources through a variety of means to promote safer and healthier workplaces and a broader recognition of the impact of work on health.
- Regularly evaluate the accomplishments and impact of our occupational health program

Work-related injuries and illnesses in California cost over $30 billion each year with approximately 450 job-related injury deaths and 450,000 nonfatal injuries and illnesses. The Expanded Program in California tracks the extent of work-related injuries and illnesses, and has successfully developed and disseminated prevention strategies to reduce their impact. Impacts of the program were demonstrated in the distribution of information to employers, workers, and consumers to more easily find asthma-safer cleaning products; the implementation of better work practices to prevent work-related musculoskeletal disorders among dental hygienists; the use of social media to raise awareness of hazardous working conditions among Spanish-speaking agricultural workers; and digital video production as a training tool to reduce the risk of serious injuries among tree trimmers.

SIGNIFICANT FINDINGS

OCCUPATIONAL HEALTH INDICATORS AND OTHER DATA ANALYSES

- Published results from a collaboration with other states on analysis of new BRFSS questions regarding work injuries and payment by workers' compensation.
- With US Bureau of Labor Statistics (BLS) funding, enumerated and matched cases of amputations and carpal tunnel syndrome (CTS) from the Workers' Compensation Information System (WCIS) to healthcare facility and BLS survey data, identifying that only 35% of amputations and 14% of CTS cases from WCIS were matched to either data source; demonstrated that multi-source surveillance is necessary to more accurately assess injuries and illnesses.
- Used WCIS data to conduct analyses of workplace violence (WPV) in healthcare settings and musculoskeletal disorders (MSDs) among hotel housekeepers, in order to inform Cal/OSHA's development of new standards.
- Designed a "topic page" and web-based report format for displaying the Occupational Health Indicators (OHIs), which are annually calculated for all defined OHIs

EMERGING OCCUPATIONAL HEALTH ISSUES

- Investigated, with NIOSH and Cal/OSHA, lung disease related to diacetyl exposure among California flavor manufacturing workers, identified at least 12 probable cases of fixed obstruction and additional workers with abnormal declines in lung function over time; demonstrated a higher risk of illness in companies with higher diacetyl use and that good quality spirometry could be used to successfully detect declines within the normal range over time for intervention.
- Conducted a survey at Yosemite National Park of employee knowledge and hantavirus prevention practices and seroprevalence testing to identify hantavirus exposures; identified only one employee previously exposed to hantavirus at an unknown time but also provided recommendations for improving hantavirus prevention and respiratory protection programs.
- Conducted two field studies supported by NIOSH National Personal Protective Technology Laboratory (initially during the H1N1 influenza pandemic) to assess the use of respiratory protection in hospitals; produced recommendations for addressing program deficiencies.
- Conducted a survey of hardware stores and a summer intern project with painting contractors to assess knowledge about the hazards of methylene chloride in paint strippers and safer product availability; results informed the development of educational materials and an outreach campaign.
- Implemented an occupational coccidioidomycosis pilot surveillance system that identified outbreaks for investigation (the most significant one found 44 diagnosed cases among workers constructing solar power farms) and provided the basis for prevention recommendations.

IN-STATE AND NATIONAL COLLABORATIONS

Virtually all of our work involves collaboration with multiple partners, often at the local, state, and national level. Some key examples not described elsewhere in Section 1 include:

- Collaborated extensively with CDPH colleagues and local and federal health agencies on occupational infectious disease issues including coccidioidomycosis, hantavirus, Ebola virus disease, aerosol transmissible diseases, vector-borne diseases, and HIV/STDs.
- Selected OHIs were incorporated into CDPH's California Wellness Plan through our collaboration with the Division of Chronic Disease and Injury Control, and Occupational Health Branch (OHB) materials were used as documentation for CDPH's application for Public Health Accreditation.

DISSEMINATION OF DATA, PUBLIC HEALTH RECOMMENDATIONS, AND EDUCATIONAL RESOURCES

- Produced and widely disseminated the first nationally available factsheet on "Preventing Work-Related Valley Fever," based on investigation findings and practical prevention recommendations.

- Created "Implementing Respiratory Protection Programs in Hospitals: A Guide for Respirator Program Administrators" and other resources to improve the effectiveness of respirator use; and subsequently adapted the "Toolkit" into a NIOSH-OSHA co-branded national version.
- Created a topic page and multiple educational materials to highlight methylene chloride paint stripper hazards and to guide employers in selecting safer products and appropriate controls.
- Produced a health alert on Occupational HIV Transmission in the Adult Film Entertainment Film Industry to publicize CDPH's investigation and recommendations for prevention.
- Sent out 40 issues of our program newsletter, electronic Occupational Health Watch (e-OHW) to publicize our products and activities to several thousand key stakeholders.

PROGRAM EVALUATION

- Conducted a branch-wide initiative to improve effectiveness of and streamline processes used in our health promotion work, resulting in improved coordination, a communications policies and procedures manual and tools to assist communications and technical staff, and launch of a one-year "trial" implementation of the manual and tools, with staff training and evaluation plan.
- Used software analytics and a recipient survey to evaluate e-OHW's reach and reader reactions.

TRANSLATION OF FINDINGS

Our NIOSH-supported surveillance and intervention activities are integrated within the prevention activities of the broader public health infrastructure in California, including other CDPH programs, other state and local public health agencies, Cal/OSHA, academic institutions, the workers' compensation system, and organizations representing workers, employers, and health professionals. We embrace the premise of research to practice – completing the surveillance loop by translating findings from surveillance data and field investigations into practical interventions, prevention strategies, and policy recommendations; tailoring prevention messages to each target audience using stakeholder input during product development; gathering evaluation feedback to ensure that our guidance is useful; and continually improving our program's performance and effectiveness. Feedback from stakeholders suggests that OHB work assists in reduction of workplace hazards that could lead to injury or disease.

OUTCOMES/IMPACT

Significant impacts of this project, categorized as end, intermediate, or potential outcomes, include:

- A multi-year project with NIOSH and Cal/OSHA on lung disease among flavor manufacturing workers led to reduced use of diacetyl, improved use of control measures in flavor manufacturing, and increased awareness of the hazards associated with potential replacement chemicals [end].
- OHB's recommendations on preventing work-related coccidioidomycosis were used by employers to reduce dust generation and exposure, by local/state agencies to improve oversight of construction projects and conduct outreach, and by Cal/OSHA for successful enforcement [end].
- Respirator program administrators in hospitals across the U.S. and California have used OHB educational resources to better protect workers from infectious pathogen exposure [end].
- The National Park Service (and potentially other employers) used OHB recommendations to improve their hantavirus prevention and respiratory protection programs [end].
- Our state fire protection agency provided OHB's tailgate training material for Valley Fever prevention to fire crew leaders statewide to deliver worker training on this topic [intermediate].
- Cal/OSHA has used OHB recommendations and/or data analyses in the drafting of new or revised regulations on diacetyl, lead, STD prevention in the adult film industry, safe patient handling and workplace violence in healthcare, hotel housekeeper ergonomics, and heat illness [intermediate].
- Cal/EPA used OHB recommendations and other collected information to select methylene chloride paint strippers as a priority for safer alternatives assessment and future regulation [intermediate].

SECTION 2: SCIENTIFIC REPORT
OCCUPATIONAL HEALTH INDICATORS COMPONENT

I BACKGROUND

The Occupational Health Branch (OHB) in the California Department of Public Health (CDPH) is one of the largest state-based OH surveillance and intervention programs in the nation, with staff in epidemiology, medicine, industrial hygiene, toxicology, and health education, working collaboratively across four sections to prevent work-related disease and injury. OH activities have existed within CDPH since the 1940s, but legislation from 1978-2005 added new OHB mandates (e.g., to provide "early warning" of new or unappreciated workplaces hazards), established an occupational lead program funded by industry fees, and provided authority to access California workplaces for investigation of disease and injury. For 27 years, OHB has received NIOSH funding in partnership with the Public Health Institute, which has provided invaluable support in human resources, budget, reporting, and grant administration. NIOSH funding provides critical support for many OHB activities that would not otherwise be possible within our available state budget for occupational health, including our ability to conduct surveillance of work-related fatalities, asthma, pesticide illness, and carpal tunnel syndrome (the four Priority Focus Areas of this project period), as well as to carry out the more general, cross-cutting activities that are funded or partially funded under the Occupational Health Indicators Component of the project.

II SPECIFIC AIMS

From 2010-2015, we proposed to: 1) Collect and analyze surveillance data for 22 Occupational Health Indicators (OHIs) and an Employment Demographics Profile annually; 2) Identify and respond to emerging occupational health issues; 3)Collaborate with in-state partners to obtain input to guide our program, gain support to further program goals, and have impact on public health and regulatory policies; 4)Collaborate with other states, the Council of State and Territorial Epidemiologists (CSTE), and NIOSH on nationwide activities to reduce work-related injury and illness; 5)Disseminate our surveillance data, investigation findings, public health recommendations, and educational materials through a variety of means; and 6)Regularly evaluate the accomplishments and impact of our occupational health program, and develop recommendations for improving effectiveness.

III METHODS

PERFORM OCCUPATIONAL HEALTH INDICATORS AND OTHER DATA ANALYSES

Starting with their original conception and development, California has participated with other states, CSTE, and NIOSH to create and build upon a set of Occupational Health Indicators (OHIs) and How-To Guide as a means of enhancing public health surveillance. OHIs are selected based on the availability of easily-obtainable statewide data, public health importance of the health condition or exposure to be measured, and potential for workplace intervention. An Employment Demographics Profile is also defined to summarize important demographic characteristics of a state's industries and workforce. The OHIs offer a key method for states to: develop baseline data on OH status and track data over time; build relationships with data providers; enhance the usefulness of data for prevention purposes; develop skills among OHB staff and epidemiology fellows/interns in utilizing data sources and interpreting findings; and communicate findings to stakeholders. Generating the OHIs is now recommended as a minimum activity of state-based OH programs and required for states receiving NIOSH surveillance funding. NIOSH, CSTE, and the states share responsibility for various aspects of defining and modifying the OHIs, updating the How-To Guide, collecting data from states, performing quality control processes, and posting data on the CSTE website.

OHB has access to numerous data sources, including those used for the OHIs and others unique to California, for example: the BLS Survey of Occupational Injury and Illness (SOII) and Census of Fatal Occupational Injury (CFOI), Behavioral Risk Factor Surveillance System (BRFSS), California Health Interview Survey (CHIS), Patient Discharge Data (PDD), Emergency Department Data (EDD), Ambulatory

Surgery Data (ASD), Electronic Death Registration System (EDRS), Doctor's First Report of Occupational Injury and Illness (DFR), and Workers' Compensation Information System (WCIS). The latter two data sources are available through CDPH legislative authority and/or under Memoranda of Understanding with California's Department of Industrial Relations (DIR). To the extent that resources allow, we conduct additional data analyses using these data sources.

EMERGING OCCUPATIONAL HEALTH ISSUES

OHB strives to maintain the capacity to identify and respond in a timely manner to emerging OH issues, in addition to conducting the surveillance and intervention activities in areas where we have an ongoing major project with dedicated staff (e.g., our Priority Focus Areas, lead poisoning prevention).

We utilize our permanent civil service staff as needed, supplemented by personnel assigned to OHB through a variety of fellowships, internships, and residency programs. OHB's senior-level staff invest substantial time in recruiting and mentoring these temporary staff. Our state's diverse industries and workforce offer varied opportunities for conducting field investigations or epidemiological analyses, implementing communications strategies to disseminate our recommendations, and participating in OH policy development. OHB mentors and managers identify topics for new projects based on calls to OHB's Workplace Hazard Helpline, which fields requests from the public, and meetings where staff discuss incoming requests for assistance, disease reports, etc.

IN-STATE COLLABORATIONS

Key California stakeholders for OH include labor, occupational and environmental health advocates, employers and trade associations, and other state and local public health and labor agencies. We build and maintain strong relationships with our stakeholders to promote OH improvements in California workplaces. Our interaction with stakeholders: improves our understanding of constituent concerns and attitudes toward OH issues; helps us identify emerging OH issues and generate ideas on possible intervention and policy efforts for OHB and collaborators; encourages others to use our surveillance data, investigation findings, and prevention recommendations to make workplace OH improvements through their own efforts; and communicates OHB accomplishments, building support for our program and its long-term stability. Feedback from partners that use our findings and resources helps OHB demonstrate the impact of our work and improve our approaches.

Having a single, overarching OHB Advisory Group has not met our needs for nurturing stakeholder relationships. Because many of our projects focus on diverse topics and industries, and because of the resource demands of hosting state-wide meetings in such a large state, it is not practical to have one stakeholder group to advise OHB overall. Instead, we have created ad hoc advisory groups for most projects we conduct. Each of our PFAs usually has one or more advisory groups providing input into specific product development, dissemination, and evaluation (including ideas for future work). In addition, OHB has used other methods to engage our stakeholders, obtain input, develop new relationships, and initiate collaborative projects on OH topics important to California. These have included: hosting small or large groups for discussion of specific topics; initiating one-on-one meetings with key informants; and participating in activities sponsored by others such as by providing speakers/trainers for their events or articles for their newsletters.

NATIONAL COLLABORATIONS

Our collaborations with NIOSH and other states through participation in the CSTE OH Subcommittee, the network of State-Based Surveillance (SBS) grantees, and through interactions with other states interested in establishing OH programs have been critical. They have accomplished the following: 1) increased the likelihood that OHB work could be used by others to improve OH in workplaces outside the state; 2) increased our potential impact in workplaces by providing new ideas and building experience and expertise on our staff; and 3) allowed us to collectively conduct larger projects that benefit the nation as a whole. This concerted effort by states and NIOSH has moved us closer to establishing a comprehensive, national OH surveillance system and intervention capacity. In addition, OHB collaborates by supporting

Federal OSHA and NIOSH initiatives (e.g., National Occupational Research Agenda [NORA], falls and heat illness campaigns), participating in NIOSH Health Hazard Evaluations, working with specific research programs within NIOSH, and providing technical review and/or public comment for NIOSH and OSHA draft documents.

DISSEMINATION OF DATA, PUBLIC HEALTH RECOMMENDATIONS, AND EDUCATIONAL RESOURCES

Consistent with the NIOSH Research to Practice focus, we have performed these critical activities to ensure that our efforts will translate into actual workplace health and safety improvements in California. We have notified target audiences of the results of surveillance findings and site-specific investigations; publicized the consequences of unrecognized or uncontrolled exposure to workplace hazards; and promoted effective measures to prevent exposures, injury, and illness to others who can implement change.

Important dissemination methods we have used are OHB's website and electronic newsletter, Occupational Health Watch (e-OHW). e-OHW is a concise, approximately-monthly publication covering a single topic that features web links to new OHB products and projects and/or those of our partners and collaborators. Dissemination is customized as needed to make contact with various target audiences (usually 3,900-7,000 addresses per issue plus we forward it to listserves, etc.). OHB maintains a Contacts Database of >110,000 organizations and individuals, and continually updates these and adds new listings for electronic or mail dissemination.

Our target audiences and major objectives for dissemination, education, and outreach include: 1) workers, unions, and worker advocacy groups (improve illness recognition, knowledge of exposure control measures, and ensure awareness of employee legal rights to a safe and healthy workplace); 2) employers and industry-wide organizations (increase employer recognition of workplace hazards, and encourage implementation of effective control measures); 3) medical and public health professionals (increase recognition of occupational illness and injury, knowledge of reporting requirements, and improve treatment); 4) federal, state, and local governmental agencies (contribute to national OH surveillance efforts, and promote improvements in regulatory and public health prevention efforts); and 5) environmental and other community-based organizations (increase recognition of the linkage between exposures in the workplace and in the community, and promote exposure control measures consistent with primary prevention across all affected populations).

We disseminate information in a wide variety of formats, including materials for workers about prevention of illness and injury, workers' compensation procedures, and other workplace legal rights; fact sheets and hazard advisories; messaging through new and social media; worksite-specific letters with detailed findings and recommendations; scientific reports and peer-reviewed publications; presentations at worker, medical, public health, and industry conferences and trainings; written recommendations to other agencies on proposed and existing regulations; analyses of proposed legislation; participation on interagency, advisory, and other work groups; posting materials on our website; and data and reports for inclusion in national surveillance databases.

PROGRAM EVALUATION

OHB continually reviews and evaluates our activities from the standpoint of process and impact. Our case follow-up activities and field investigations are evaluated in terms of the number, type, and public health significance of risk factors identified; the extent to which our investigations are conducted in a manner consistent with OHB policies and procedures and ethical considerations; our ability to meaningfully involve the affected workers; and our ability to develop and implement effective strategies to improve health and safety.

Evaluation of our efforts to disseminate data and information addresses the quantity of materials distributed via various formats, the types of audiences to whom materials were disseminated, and the extent to which our findings and materials are used or further disseminated by others. We also evaluate the quality of our communications by whether our approaches are consistent with the language and

literacy needs of the target audiences, and whether they are presented in an understandable, culturally appropriate manner. Evaluation methods include analysis of web statistics, electronic surveys, key informant interviews, and focus groups.

In addition, OHB periodically assesses the effectiveness of our internal policies, procedures, and operations through facilitation of meetings and discussions with staff, the use of internal surveys, and by convening staff committees to focus on particular topical areas (e.g., field investigation policies and practices, employee health & safety committee, external communications efforts).

IV RESULTS AND DISCUSSION

PERFORM OCCUPATIONAL HEALTH INDICATORS AND OTHER DATA ANALYSES

This section and the following sections provide additional details about some of the activities described in Section 1 and describe some additional OHB activities.

Occupational Health Indicators: Starting with the year 2000, OHB has annually calculated California data for all defined OHIs (now 21) and the Employment Demographics Profile. Within OHB, multiple staff with epidemiological background or interest in learning about OH data sources generate the OHIs, and this task is considered a skills-building activity for new staff, interns, or fellows. We follow the specified deadlines for data submission, quality control checks, and review of postings on the CSTE website. OHB participates in the CSTE OHI Work Group to discuss and resolve OHI issues; update the definitions and How-To Guide as needed (we are responsible for OHI #11 and #13); and pilot test proposed new OHIs (including low back hospitalization, asthma, severe traumatic injury, and flu vaccination).

The OHB website has a topic page where all California OHI data are displayed, with introductory descriptive information and links to the CSTE OHI website and relevant resources. We annually update data tables, graphics, and reports so that data are presented for the latest six-year period, in addition to earlier years. As we update the website with new data, we also release an issue of our electronic newsletter to publicize it.

Enumeration of occupational injuries and illnesses. With US Bureau of Labor Statistics (BLS) funding, we enumerated and matched cases of amputations and carpal tunnel syndrome (CTS) from the Workers' Compensation Information System (WCIS) to healthcare facility and BLS survey data, identifying that only 35% of amputations and 14% of CTS cases from WCIS were matched to either data source; demonstrated that multi-source surveillance is necessary to more accurately assess injuries and illnesses. This was published in the American Journal of Industrial Medicine as part of a special issue on underreporting (see below).

BRFSS ascertainment of work-related injuries. As part of a multistate effort to utilize the BRFSS for estimating the burden of work-related injuries in the US, we participated in the analysis of industry and occupational survey data in California. This effort builds upon the long-range planning to add industry and occupation to the BRFSS core module; we anticipate that this will be ongoing in California (depending on funding) beginning in 2015.

Workers compensation claims data analysis. The OHB has a longstanding agreement with the California Department of Industrial Relations to access workers compensation claims data for ongoing surveillance. In the past 5 years, we have utilized this data set for the routine ascertainment of work-related asthma and pesticide illness; and performed specialized analyses for carpal tunnel syndrome, amputations, coccidioidomycosis, and acute traumatic hospitalizations. As of June 2015, we have initiated a 3-year cooperative agreement with NIOSH to collaborate with DIR on the analyses of workers compensation claims data, including utilization of employment data for rates and the development of a user interface for public access.

EMERGING OCCUPATIONAL HEALTH ISSUES

Throughout the grant period, OHB has successfully partnered with CDC for placements of Epidemic Intelligence Service Officers and Public Health Associates, with CSTE for 2-year Epidemiology Fellows, with the University of California (UC) and other institutions for occupational medicine residents and other interns, and with the national Occupational Health Internship Program (OHIP) for summer interns each year. These personnel represent the cultural and linguistic diversity of our workforce, and their participation enhances our ability to conduct investigations and other efforts that reach non-English speaking workers. Topics addressed by these individuals, their mentors, and other existing staff include the following:

Formaldehyde in hair-straightening products – A summer intern conducted a field survey of hair salon, as follow-up to previous activities related to the mislabeled, formaldehyde-containing product Brazilian Blowout, to assess the current usage of hair-straightening products and their ingredients and to inform future outreach efforts in this industry.

Methylene chloride-based paint strippers – OHB has conducted a multi-year, collaborative effort to highlight worker deaths from methylene chloride (MeCl) based paint strippers (see also report on Fatality Investigations (FACE) Priority Focus Area), promote further regulation of these widely available products, and increase contractor awareness of the hazards, appropriate control measures, and safer alternatives. For example, we developed and disseminated a poster and other materials to stores (paint, hardware, home improvement) with recommendations for purchasing non-toxic paint strippers and information for use of appropriate personal protective equipment. A CSTE epidemiology fellow surveyed hardware stores to assess the knowledge of retail sales personnel about paint stripper safety and to identify the extent to which safer alternatives were available. The following summer, we initiated a field project using summer interns under the supervision of OHB mentors, in which painting contractors were recruited to test and evaluate safer alternative paint strippers based on benzyl alcohol formulations (i.e., not containing MeCl or n-methyl pyrrolidone which has been identified as a reproductive toxin but is commonly in products marketed as "safer").

Most recently, OHB proposed and obtained funding for a digital video that can be used as a training tool/awareness piece to inform/educate construction workers, contractors and union apprenticeship programs about the hazards of DCM (methylene chloride) paint removers and the availability of well performing safer alternatives. This will be a 5-7 minute digital video (similar to those completed by the CDPH FACE program) (http://www.cdph.ca.gov/programs/ohb-face/Pages/Stories.aspx), where we will re-enact a construction trades-related DCM fatality or near-misses; present the general scope of problem; dangerous health effects; steps for prevention (work practices, PPE and most important substitution). Personal stories and testimonials from workers, foremen and contractors at job sites will be presented, with shots of actual job sites with paint removal underway. The video will be designed for wide distribution to the building trades apprentice programs, contractor trade association, district councils, union locals, health and safety funds, and day laborer centers. Release will be in December 2015.

Pilot surveillance of occupational cocciodiomycosis (Valley Fever, VF) – Following on our investigation of 44 employees diagnosed with VF who worked on the construction of two large solar energy generation facilities, we provided technical assistance to support Cal/OSHA in upholding the citations they issued to multiple employers, had a journal article accepted for 10/2015 publication in Emerging Infectious Diseases, and collaborated on the analysis of survey data from 600 employees that has identified additional undiagnosed cases and allowed comparison of risk factors for cases vs. controls. We are continuing distribution of our "Preventing Work-Related VF" fact sheet, assisted by local health departments in VF endemic areas, and provision of technical assistance to local health departments in

VF-endemic areas with new energy development projects in the planning stage. We also provided technical assistance to the California High Speed Rail Authority, a major railway construction project that runs directly through the Central Valley and highly endemic areas; we advised that the Authority incorporate language into contracts addressing occupational VF prevention and dust control measures, and encourage contractors and subcontractors to report any known cases of worker illness to the Authority in addition to complying with existing reporting requirements.

HIV transmission in the adult film industry – OHB collaborated with the CDPH Office of AIDS and STD Control Branch, local and state health departments, and Federal OSHA on a multi-state investigation involving the transmission of HIV and other STDs between performers in the adult film industry. OHB published a health alert early in the investigation to raise awareness about the initial case and CDPH prevention recommendations (https://www.cdph.ca.gov/programs/ohb/Documents/OccHIVinAFI.pdf). A male adult entertainment actor obtained a test for HIV that was negative. Over the following two-week period, the actor had unprotected sex with several other male actors during two separate film shoots. During the second film shoot, he had symptoms of a viral infection. The actor went to a clinic and had another blood test that showed he had recently become infected with HIV. The local public health department initiated follow-up with the sexual contacts of this actor. One of the male actors from the second film shoot has tested newly positive for HIV. Public health investigation and laboratory results provide very strong evidence that the actor transmitted HIV to the other actor as a result of unprotected sex during the film shoot. An MMWR report has been completed and is undergoing CDC review.

Chemical exposures in veterinary hospitals – OHB staff conducted site visits to two veterinary hospitals to evaluate a possible link between neurological symptoms and isofluorane (anesthetic gas) exposure, and to assess heavy metal exposures from onsite preparation of radiation shielding. We provided the two employers with customized recommendations for improvements in health and safety programs. We identified deficiencies in monitoring isoflurane exposures and employer responses to high exposures, as well as a lack of awareness that Cal/OSHA has a Permissible Exposure Limit for isofluorane. This has led to the initiation of an educational project where we have established new relationships with veterinarian and veterinary technician professional associations to further assess needs and inform the development of educational products.

Heat illness in outdoor construction workers – OHB investigated heat-related illness among lead/asbestos abatement workers in the San Francisco Bay Area. As part of the NIOSH-funded Occupational Health Internship Program (OHIP), we partnered with the Laborers' International Union of North America (LiUNA) Local 67 to conduct a heat illness needs assessment among unionized abatement workers. This assessment explored: 1) attitudes and behaviors related to general workplace health and safety, 2) attitudes, knowledge, and experience related to heat and work, 3) behaviors and barriers related to heat illness prevention, and 4) knowledge and perception of the Cal/OSHA Heat Illness Prevention Standard. A final report was submitted in August 2015 to the union and CPWR (who provided funding for the project).

IN-STATE COLLABORATIONS

Our accomplishments – from data analyses to field investigations, outreach, and policy efforts – are made possible through our established, long-term, and solid working relationships within California. Highlights include the following:

Policy development: a) made recommendations to Cal/OSHA to revise the lead standards (held symposium on the scientific basis for a CDPH-proposed Permissible Exposure Limit, based on new modeling of air lead/blood relationship; provided registry data to Cal/OSHA and assistance with draft regulatory language); b) participated in Cal/OSHA advisory committees on standards for safe patient handling, heat illness prevention, and hotel housekeeper ergonomics; c) provided input and technical

information to the Department of Toxic Substances Control in its Safer Consumer Product regulatory process, resulting in their proposal to focus on methylene chloride in paint strippers; and d) analyzed proposed legislation on OH topics for CDPH.

Collaborations with other CDPH programs: a) CA Biomonitoring (provided input to studies of exposures to flight attendants, firefighters), b) Division of Communicable Disease Control (collaborative work on Valley Fever, hantavirus, occupational infectious disease investigations on needlestick injuries and potential exposures to HIV and hepatitis, outreach to outdoor workers on vector-borne diseases, technical assistance on Ebola virus disease and appropriate personal protective equipment), c) Environmental Health Investigations and Laboratory Branches (collaboration on shared interests such as health effects related to oil and gas development or climate change, community and worker exposures from chemical spills/releases).

Integration of OH with mainstream public health: a) selected OHIs were incorporated into CDPH's California Wellness Plan through our collaboration with the Division of Chronic Disease and Injury Control, and OHB materials were used as documentation for CDPH's application for Public Health Accreditation; b) provided input to CDPH's Climate Change Action Team (heat illness); c) initiated contact with a new CDPH Office of Health Equity and made a presentation on "Injury and Illness in Low-Wage Workers: An Issue of Health Equity" to CDPH executive managers.

Interventions: a) assisted the University of California (UC) with trainings on the Aerosol Transmissible Diseases standard in northern and southern California; b) collaborated with UC researchers on promotion of new overhead drilling technologies for control of MSDs and silica exposures; c) made referrals to initiate Cal/OSHA enforcement actions in individual workplaces related to lead poisoning, chemical releases, and occupational infectious disease exposures, and provided technical assistance to support Cal/OSHA in developing Special Orders and upholding citations issued.

New in-state partners: a) created new partnerships with and provided technical assistance to the California Nurses Association and the local chapter of the Association of Occupational Health Professionals during the response to prepare for California hospital patients with Ebola; b) partnered with the Service Employees International Union and its local union to adapt OHB green cleaning and others' materials into a peer educator training on workplace health and safety for family home child care providers.

NATIONAL COLLABORATIONS

Some of our national collaborations during the project period not described elsewhere in this report include:

Western States Occupational Network (WESTON): OHB established and helped secure funding for ongoing annual meetings to promote OH activities in western states; sent several staff to each meeting; and planned and provided speakers for sessions.

CSTE OH Subcommittee: OHB has had two representatives participating on the Leadership Group; assisted with preparation of a proposal to NIOSH for continued funding of the Subcommittee; planned and participated in Subcommittee meetings and the OH program for the annual June CSTE meetings; participated in a project to highlight states' "success stories" through creation of a written document, a template for state submissions, and an ongoing new section of the CSTE website; participated in multi-state data analysis projects (e.g., BRFSS, motor vehicle deaths), participated in educational webinars, and contributed to national efforts to promote inclusion of industry and occupation in electronic health records and national health surveys.

NIOSH National Occupational Research Agenda (NORA) Sector Research Councils: OHB representatives have participated on councils for Health Care and Services sectors (including serving as Services Sector co-coordinator).

NIOSH Surveillance Coordination Group: An OHB staff served as CSTE representative, 2010-2013.

NIOSH outreach: OHB has contributed items to the NIOSH e-NEWs (two per year), Science Blog (silica in composite countertops, temporary workers), and State-Based OH Surveillance Clearinghouse (over 800 CA documents).

DISSEMINATION OF DATA, PUBLIC HEALTH RECOMMENDATIONS, AND EDUCATIONAL RESOURCES

OHB collaborative teams created materials and conducted outreach on a variety of work-related topics with formats that range from worker and employer letters, fact sheets, journal articles and investigation reports, to social media, NIOSH e-newsletter articles, and CSTE and NIOSH Science blogs. Projects that generated these communications products are described elsewhere in this report and include: a) work-related Valley Fever (first fact sheet in the nation on this topic, tailgate training for wildland firefighters, journal articles on investigations with public health recommendations), b) methylene chloride-based paint strippers (written recommendations to the Consumer Product Safety Commission and Cal/EPA to increase regulation, report on hardware store survey of safer alternatives availability, health alerts on fatality investigations, educational materials on appropriate personal protective equipment and selecting safer alternatives), c) respiratory protection in healthcare (journal article on field survey, California and NIOSH-OSHA toolkits for respirator program administrators), and d) HIV/STD transmission risks in the adult film industry (health alert, draft journal article). Also see the reports for our Priority Focus Areas for additional communications efforts related to those topics.

All of our materials and products are displayed on the OHB website, and dissemination efforts are conducted to direct our audiences to the appropriate links when new materials are posted. OHB's products may also be located within the broader CDPH website because they are included in A to Z listings of health topics and environmental hazards. A committee of OHB staff has convened to evaluate and improve the OHB home page of our website through a redesign effort, to make it more user friendly. During the project period we developed new website topic pages for Occupational Health Indicators, Respiratory Protection in Healthcare, Methylene Chloride-based Paint Stripper Hazards and Safer Alternatives, and Work-related Coccidiodoiomycosis (Valley Fever).

Our program newsletter, electronic Occupational Health Watch (e-OHW), which is sent approximately monthly to thousands of constituent groups and key contacts, is a primary method we use to promote the availability of new OHB educational materials, and occasionally to highlight new NIOSH materials or events (e.g., N95 Respirator Day) or important occupational health topics being discussed in the news media (e.g., an issue on temporary workers following the passage of new California legislation). We improved delivery and list segmentation of e-OHW by adoption of an email blast service, are consistently updating, expanding, and/or customizing our contact list with each issue, and have expanded distribution through postings to listservs, blogs, and other e-newsletters. We also have increased the relevance of e-OHW by scheduling issues to coincide with events and activities by OHB or its partners, including NIOSH, OSHA, Worksafe, Southern California COSH, and University of California programs.

In addition, during the 5-year project period we have increased our use of new and social media, including an mHealth (texting) pilot project to reach agricultural workers, videos on YouTube, Facebook posts, and Tweets. We continue to seek new opportunities to service our diverse, multilingual, hard-to-reach, and low-literacy audiences. For example, we expanded efforts to reach immigrant and low-wage vulnerable workers by providing OHB worker-targeted materials at the UC Los Angeles Labor Center, where many workers and advocacy groups meet. We have also used national NIOSH-OSHA campaigns (construction falls), Workers' Memorial Day events, and the annual Worksafe (advocacy organization) report Dying for Work in California to publicize our award-winning digital stories and our other activities with workers, advocates, and policymakers.

PROGRAM EVALUATION

Internal operations and effectiveness: OHB leadership surveyed staff in 2010 to gather initial input; held an all-staff retreat in March 2011 to discuss findings; and created seven workgroups that prompted changes in areas such as cross-branch communications, outreach, identifying funding partners, and

improving use of IT/administrative support. We identified communications efforts as an area for increased branch-wide focus.

Effectiveness of communications efforts: OHB conducted a branch-wide initiative to improve and streamline health promotion work, resulting in a) creation of a Communications Coordination Group (meets monthly; includes all health educators and Branch Chief) and Strategy Group (meets twice a year; includes managers, technical staff, and health educators) to decide on OHB-wide policies and procedures; b) development of a communications policies and procedures (P&P) manual and numerous tools (e.g., Product Development, Dissemination, and Evaluation Guides) to assist staff; and c) launch of a one-year "trial" implementation of the manual and tools, with staff training and evaluation plan. A main focus is to improve the overall impact of every OHB project and product by encouraging all staff when first starting to develop the product to carefully assess the need for the product, who we can partner with for its development and dissemination, the key messages and outcomes we wish to see, and possible methods for evaluation.

e-OHW evaluation: Distributing e-OHW with an email blast service has allowed us to use its analytics to better evaluate our reach (e.g., % and identity of recipients who open the document, frequency of clicks on web links). Our website tracking program has demonstrated that visitor page views and product downloads spike significantly after e-OHW publicizes them. A recipient survey in May 2013 found that 83% of respondents usually or sometimes read e-OHW, and 75% found useful information on our website as a result of reading it. Respondents were most often OH professionals, managers, and researchers, and most often worked in government agencies, construction, and health care. Respondents liked that e-OHW was "concise," "timely," and let people know about OH in California. When asked about possible improvements, they suggested covering a wider range of topics.

Field investigation procedures: OHB field staff reviewed our existing Field Investigations P&P, updated them, added useful tools, made the manual accessible to all staff electronically, and provided a staff training with participatory activity. Similar to the communications manual, our goal is promote adequate planning in advance of going into the field to enhance effectiveness and consistency of our approach, and to ensure clear communication with all parties involved, including our dissemination of results.

V CONCLUSIONS

The NIOSH funding associated with the Occupational Health Indicators (OHI) Component not only supports the annual generation, publication, and ongoing improvement of the OHIs, but it enables California's occupational health surveillance and intervention program to conduct additional data analyses that address timely topics of interest including Cal/OSHA's efforts to develop and pass new occupational health standards. The OHI Component also focuses on harnessing the efforts of students, interns, and newly trained public health professionals, who are placed temporarily at CDPH under the mentoring of permanent staff, to investigate and address new and emerging occupational health issues in California workplaces; this aspect of our program not only develops new scientific findings and information, but it also furthers the development of the occupational public health workforce of the future. It would not have been possible to conduct much of OHB's work described in this report, or to have the results actually used to improve conditions in workplaces in California or elsewhere in the U.S., without the many important partnerships we have established and nurtured at the community/local, state, and national level. The OHI Component provides much of the "glue" and enhances synergy between the activities conducted under the Priority Focus Areas, additional projects implemented in OHB to address new or emerging issues, statewide efforts focused on developing and maintaining stakeholder relationships, broad dissemination of our communications products, and ongoing program evaluation.

PUBLICATIONS

In the last five years, we have authored or co-authored the following publications (in addition to those listed under our Priority Focus Area reports):

- Centers for Disease Control and Prevention. Proportion of workers who were work-injured and payment by workers' compensation systems. MMWR 59(29): 897-900, July 30, 2010.
- Centers for Disease Control and Prevention. Occupational transmission of *Neisseria meningitidis*—California, 2009. MMWR 59(45):1480-1483, November 19, 2010.
- Harrison RJ, Flattery J: State-based Occupational Injury and Disease Surveillance. In Utterback DF, Schnorr TM, eds. Use of Workers' Compensation Data for Occupational Injury and Illness Prevention – Proceedings from September 2009 Workshop. DHHS (NIOSH) Document No. 2010-152, Washington DC, 2010.
- Kim TJ et al. Industry-wide surveillance of California flavor manufacturing workers: Cross-sectional results. Am J Ind Med 53:857-865, 2010.
- Lichterman et al. Preventing toxic exposures: Workplace lessons in safer alternatives. UC Berkeley Health Research for Action *Perspectives* Vol. 5, No. 1, July 2010.
- Centers for Disease Control and Prevention. Occupational highway transportation deaths --- United States, 2003—2008. MMWR 60(16):497-502, April 29, 2011.
- Roisman R et al. The role of state public health agencies in national efforts to track workplace hazards and the relevance of state experiences to nanomaterial worker surveillance. JOEM 53:S38-S41, 2011.
- Centers for Disease Control and Prevention. Chlorine gas exposure at a metal recycling facility – California, 2010. MMWR 60(28):951-954, July 22, 2011.
- Das R et al. Occupational coccidioidomycosis in California: Outbreak investigation, respirator recommendations, and surveillance findings. JOEM 54(5):564-571, 2012.
- Kreiss K et al. Longitudinal lung function declines among California flavor manufacturing workers. Am J Indus Med 55:657-668, 2012.
- Beckman S et al. Evaluation of respiratory protection programs and practices in California hospitals during the 2009-2010 H1N1 influenza pandemic. Am J Infect Control 41(11):1024-31, 2013.
- MacIsaac J et al. Fatalities due to dichloromethane in paint strippers: A continuing problem. Am J Ind Med 56(8):907-910, 2013.
- Joe L et al. Using multiple data sets for public health tracking of work-related injuries and illnesses in California. Am J Ind Med 57(10):1110-1119, 2014.
- Wilken J et al. Coccidioidomycosis among cast and crew at an outdoor television filming event – California, 2012. MMWR 63(15):321-324, April 18, 2014.
- Friedman GK et al. Notes from the Field: Silicosis in a countertop fabricator — Texas, 2014**.** MMWR 64(5):129-30, February 13, 2015.
- Wilken JA et al. Assessing prevention measures and Sin Nombre hantavirus seroprevalence among workers at Yosemite National Park. Am J Indus Med 58(6):658–667, 2015.
- Wilken JA et al. Coccidioidomycosis among workers constructing solar power farms, California, USA, 2011-2014. Emerg Infect Dis 21(11): 1997-2005, 2015.

SECTION 1: WORK-RELATED ASTHMA (WRA)

SIGNIFICANT FINDINGS

MAINTAIN AND ENHANCE MULTI-SOURCE SURVEILLANCE OF WORK-RELATED ASTHMA (WRA)

- Conducted surveillance using four data sources to identify over 10,500 potential WRA cases (3,071 in the five year award period); Confirmed 7,685 cases using the NIOSH case definition.
- Analyzed Behavioral Risk Factor Surveillance System Asthma Call Back Survey data to estimate that 974,000 adults in California have asthma caused or made worse by work conditions.
- Performed data analyses to examine and characterize cases associated with swimming pool chemicals, wood dust, cleaning and disinfecting products, pesticides, fragrances, ozone, scope and probe disinfecting chemicals, and poultry processing.
- Conducted analyses to evaluate cases that were confirmed but could not be classified, and to generate estimates of county burdens of WRA throughout the state.
- Expanded surveillance data system to store case reports that can be retrieved by any variable in the database to illustrate relevant points in dissemination materials and prevention efforts.
- The overall rate of WRA was 2.4 cases per 100,000 workers in California. Evaluation of case capture suggests that the rate may actually be much greater (7.3/100,000 workers).

PERFORM TARGETED CASE-BASED FOLLOW-UP AND WORKPLACE INTERVENTIONS

- Conducted targeted investigations of WRA associated with cleaning and disinfection in schools and childcare. Visited multiple school sites to observe cleaning practices, and conducted worksite observations and air monitoring of disinfectant and sanitizer use in child care.
- After identifying over 40 WRA cases associated with glutaraldehyde in health care, we visited 5 hospitals to investigate high level disinfectant use in scope and probe processing.
- Observed the use of ozone generators at a winery for disinfection of barrels and surfaces after identifying several WRA cases with ozone exposures in the beverage and wine industries.
- Conducted two worksite walk-throughs to observe processing practices and chemical use in both organic and conventional poultry processing facilities after identifying nearly 20 WRA cases in the poultry processing industry.
- Observed pool maintenance work practices after identifying over 20 WRA cases of workers exposed to pool disinfection chemicals.

COLLABORATE TO EXTEND REACH AND IMPLEMENT PREVENTION STRATEGIES

- Collaborated with 3rd party certification organizations and US EPA to ensure that standards for cleaning and disinfecting products included criteria to prohibit asthma-causing ingredients.
- Participated in local and national work groups to develop strategies and resources for safe cleaning and disinfection in schools and childcare settings.
- Partnered with schools, local, state and federal agencies, advocacy groups, labor, and school-related trade organizations to prevent school exposures to asthma-causing cleaning chemicals.
- Provided technical assistance to national advocacy organizations developing guidance on asthma-safe building materials.
- Participated on numerous interagency, advisory, and other work-groups addressing WRA.

DISSEMINATION, OUTREACH AND EDUCATION

- Produced and disseminated an award-winning document, "Healthy Cleaning and Asthma-safer Schools: A How-To Guide" and accompanying digital story to assist schools transition to asthma-safer cleaning practices and products. The guide has been distributed to over 2,100 recipients.
- Updated our website with all our educational resources, and have documented downloads of nearly 42,000 fact sheets (including nearly 3,000 in languages other than English), over 27,000 peer-reviewed journal articles, and over 31,000 reports and other documents.
- Provided educational materials to over 4,000 WRA cases and health care providers.

- Authored or co-authored six articles on WRA in the peer-reviewed literature.
- Ensured that WRA was addressed in other statewide publications focusing on community asthma and other public health issues.
- Gave 15 presentations and webinars to a diverse range of audiences locally and nationally on a variety of WRA prevention topics.
- Wrote a chapter on WRA in a statewide surveillance report on asthma that was distributed widely to a variety of asthma stakeholders.
- Authored and distributed 7 electronic newsletters on different WRA topics, each distributed to an average of 4,400 recipients, accompanied by Departmental tweets and Facebook posts.
- Created and distributed 8 new factsheets, 4 of which were translated into Spanish and/or Chinese.

EVALUATE SURVEILLANCE, INVESTIGATIONS, AND INTERVENTIONS

- Developed a logic model for our program, examining planned or proposed activities in light of anticipated intermediate outcomes and impact, and used the models to guide program planning and evaluation.
- Evaluated surveillance reporting trends, which documented a 250% increase in annual cases identified since 2005.
- Conducted an evaluation of the guidance in "Healthy Cleaning and Asthma-safer Schools: A How-to Guide" which estimated that exposure to unhealthy cleaning chemicals was reduced for hundreds of staff members and over 143,000 students in the schools that pilot-tested the Guide.
- Influenced six standards of 3rd party certification organizations to include prohibition criteria for asthma-causing chemicals, thereby ensuring primary prevention for users of certified products.

TRANSLATION OF FINDINGS

This program has demonstrated the value of establishing a surveillance system for WRA, and that WRA in California remains an important public health problem, affecting many workers with substantial impacts and cost. Ongoing data collection from multiple sources at the state level can lead to identification of occupations at high risk, followed by targeted investigations, outreach, and other dissemination efforts. The advent of electronic reporting systems has increased the efficiency and capture of work-related injury and illness data, although significant gaps remain for ascertaining chronic diseases. Findings from this project have been disseminated and used widely by a diverse audience including employers, unions, employees, advocates, and health and safety professionals, and have identified 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 asthma; inadequate worker training is common; and inadequate communication and regulation lead to unhealthful exposures in workplaces statewide.

OUTCOMES/IMPACT

This project has had significant impact on the risk of WRA in a number of industries and occupations. Expected *outcomes* include:

- End Outcome: Elimination of chemicals in cleaning agents that cause work-related asthma as manufacturers seek 3rd party certification using the standards this program has influenced.
- End: Continued increase in the numbers of staff and students no longer exposed to asthma-causing chemicals in cleaning products due to schools using the Healthy Cleaning How-To Guide.
- Intermediate: Reduced exposures to asthma-causing agents in workplaces that follow the prevention and exposure reduction guidance in our educational materials.
- Potential: Reduced exposures and morbidity for workers in environments targeted by the guidance of other organizations where we provided technical assistance and collaboration.

I BACKGROUND

Since 1993, the Occupational Health Branch (OHB) of the California Department of Public Health (CDPH) has maintained a NIOSH-funded program to conduct ongoing surveillance and a wide variety of intervention activities for work-related asthma (WRA). The WRA Prevention Program (WRAPP) utilizes multi-source surveillance data to characterize the nature and extent of WRA and to target case-based workplace investigations in order to generate and promote practical prevention/intervention strategies that can reduce the risk of WRA statewide.

II SPECIFIC AIMS

From 2010-2015, we maintained our existing model for the surveillance of WRA, and implemented new activities that enhanced our previous work. The overall goal during this last funding cycle was to maintain and enhance the California program for the prevention of WRA. Specific objectives were to: 1) Expand case ascertainment using multiple data sources; 2) Perform case-based field investigations and develop prevention strategies; 3) Collaborate with local and state agencies; 4) Disseminate results generated from project activities; and 5) Evaluate surveillance activities on an ongoing basis.

III METHODS

A SURVEILLANCE

Over the past 22 years, WRAPP has modified the original sentinel provider-based reporting system to include multiple sources of case ascertainment. We elected to initially utilize an existing statewide physician reporting system (Doctors' First Reports of Occupational Injury and Illness, DFR) and have added emergency department, hospital patient discharge, and workers' compensation data as routine data sources for case identification. All potential cases of WRA undergo a telephone interview to confirm the diagnosis and obtain data for case classification. This questionnaire includes core information collected by all NIOSH-funded WRA surveillance states and we use the WRA case definition and case classification criteria established by NIOSH. Medical records may also be used for case confirmation and classification. The study protocol has been approved by the California Health and Human Services Agency Committee for the Protection of Human Subjects. Data are thoroughly cleaned and edited, duplicates are eliminated, and data are transferred to NIOSH annually. A case report module has been added to our existing relational database to capture case summaries as data are key-entered, making them readily available to illustrate data presentations. Since each of the four data sources identifies many unique cases of WRA, capture-recapture analysis has been conducted to better estimate the true number of WRA cases in California. Analyses are conducted on a continual basis in order to identify trends and case clusters, as well as to characterize exposures of interest and focus prevention efforts. In addition to case-based surveillance, population-based data on WRA in California have been obtained and analyzed from the Behavioral Risk Factor Surveillance System on a regular basis since 2001.

B CASE FOLLOW UP AND WORKPLACE INTERVENTION

WRAPP performs workplace field investigations for selected cases to gather in-depth data about the worksite, work processes, and risk factors for WRA. The data provided by our investigations link the illness identified in the surveillance system with the context in which the hazardous exposures occurred. In this way, our field investigations enhance our capacity to formulate, evaluate, and disseminate effective prevention strategies. WRA reports are 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 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, a failure of recognized control measures or regulations to successfully control exposures, or an opportunity for prevention. OHB has statutory authority to gain access to the workplace

for the purpose of conducting investigations of work-related morbidity and mortality (California Health and Safety Code Sections 105175-105180). Site visits are conducted according to our written Field Investigations Policy and Procedures manual, and may include the following methods: on-site industrial hygiene assessment of the workplace and work processes; exposure sampling; interviews with employers, employees, and other individuals involved in the incident, and other key informants; symptom surveys of workers; review of written policy and procedures, medical records, and regulatory investigations; and analysis of the relevant scientific literature.

C COLLABORATION

Collaboration with relevant state and local agencies, advocacy groups, worker and trade organizations, and other interested parties have allowed us to expand our reach and increase our efficacy. By integrating our results and messages into mainstream public health and existing community asthma prevention activities, our work supports the efforts of others who can utilize our data and technical expertise to implement prevention strategies that will affect both worker and community asthma prevention. Our collaborative approach also strives to support more primary prevention-based activities by focusing on promoting safer alternatives to a wide range of audiences and constituencies.

D DISSEMINATION, EDUCATION AND OUTREACH

We conduct outreach and disseminate the findings and recommendations from our WRA program to notify our collaborators and target audiences of the results of significant surveillance findings and site-specific investigations; publicize the consequences of unrecognized or uncontrolled exposure to WRA agents in the workplace; and promote effective measures to prevent exposures and illness to all parties who can implement change. In addition to our WRA dissemination database of over 3,800 health care providers, we utilize a mailing list of over 12,000 organizations and individuals maintained by the OHB. We disseminate information in a variety of formats, including materials for workers about prevention of WRA, specific exposures, and workplace legal rights; worksite specific letters with findings and recommendations; scientific publications; materials about prevention for employers; conference presentations; grand rounds, and other presentations to health care providers; written comments to regulatory agencies and voluntary standard-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 website; digital stories highlighting cases and prevention; and data and reports sent to NIOSH for inclusion in national surveillance databases.

E EVALUATION

We recognize the important role that evaluation plays in ensuring that our surveillance system is effective in tracking and preventing work-related asthma. We have been using a logic model during the last 5 years to track our objectives, outputs, and outcomes. This allows us to quantify outputs and evaluate if they have had any impact. Over the past 22 years, we have conducted ongoing evaluation using the CDC Guidelines for Evaluating Surveillance Systems. We have also reviewed past evaluations of the SENSOR program and incorporated recommendations for both surveillance and interventions. We have taken many steps to assess the different components of our system, including surveillance capture and efficiency, worksite investigations, and information dissemination.

IV RESULTS AND DISCUSSION

A SURVEILLANCE

From 1993-2015, WRAPP identified over 10,500 potential cases of WRA (annual average 457) and has so far confirmed 7,685 cases using the NIOSH case definition. By expanding our case ascertainment to include files from ED, PDD and WCIS data systems, we have nearly quadrupled our confirmed cases compared to DFRs alone. We now identify 800-900 potential new cases from all data sources and confirm 600-650 previously unidentified cases per year, more than four times the number identified by any other state. For the most recent year, California accounted for nearly two-thirds (65%) of the national NIOSH WRA surveillance dataset. The overall rate of occupational asthma for all industries over 20 years is 2.4

per 100,000 employed in California. Because of the increased case finding, the rate has also been increasing-- the rate for just the year 2012 is 3.1 per 100,000 employed. Major industry categories with particularly high rates include transit and ground passenger transportation (16.5/100,000); hospitals (13.3/100,000); utilities (8.1/100,000); social assistance (7.1/100,000); and manufacturing of wood products (6.3/100,000). Occupations with particularly high rates include firefighters (26.8/100,000); miscellaneous science technicians (15.9/100,000); medical assistants/healthcare support (11.7/100,000) correctional officers (11.5/100,000); and respiratory therapists (11.2/100,000). Using DFR data reported directly to the WRA program from an HMO 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 of WRA asthma in California is actually higher than what we are able to capture.

Of the 7,685 confirmed cases with WRA from 1993-2012, 53% could be classified after interview and/or review of medical records. Of these, 53% were new onset and 47% were work-aggravated. Among the 1,778 new onset cases, 68% were classified as new onset, unknown inducer; 15% were new onset, known inducer; and 16% were new onset RADS cases. An additional 4,349 cases (57%) were confirmed but lacked temporal information necessary for case classification. The agents most commonly associated with the ten occupations with the highest rates of WRA during this time period are presented below.

Occupation	Most Common Exposures
Firefighters	Smoke
Science Technicians	Acids, chemicals, indoor air, rat antigens, glues, dust
Medical Assistants & Support	Glutaraldehyde, chemicals, smoke, latex, dust, perfume, paint
Correctional Officers & Bailiffs	Smoke, chemicals, pepper spray, mace, cleaning chemicals
Respiratory Therapists	Cleaning chemicals, latex, pharmaceuticals
Medical Records Technicians	Dust, smoke, perfume
Police Officers	Smoke, pepper spray, dust, indoor air, mold, animal antigens
Telephone Operators	Chemicals, perfume, paint, carpet dust
Chemical Technicians	Solvents, acids, chemicals
Govt Program Eligibility Workers	Roofing tar, chemicals, indoor air, toner, perfume, dust

Multiple analyses were completed to characterize exposures of interest, including pool chemicals, wood dust, cleaning chemicals, disinfectants, scope and probe disinfecting chemicals, pesticides, fragrances, ozone, poultry processing, and isocyanates. A preliminary capture-recapture analysis of one year of data was conducted to estimate the true number of WRA cases in California. This analysis found little overlap between the data sources and suggested that the true incidence of WRA in California is between 2,000 and 3,700 work-related asthma cases per year. Data analyses were also completed for the BRFSS ACBS for multiple years, estimating that over a million California adults have had WRA. These results were used as part of a model for estimating the number of WRA cases by county in a publicly available web tool for county-based asthma statistics.

B CASE FOLLOW-UP AND WORKPLACE INTERVENTION

From 2010-2015, WRAPP staff conducted focused follow-up investigations of exposures in seven industries related to agents associated with WRA. 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.

General Cleaning and Disinfection: Nearly every indoor workplace is cleaned, and one in nine WRAPP cases associated a cleaning agent with their asthma. We collaborated with CDPH's Indoor Air Quality Lab to conduct chamber studies on emissions from cleaning products and cleaning methods. Results showed

that the cleaning method impacts the extent of exposure, and anyone present during and after cleaning can be exposed. These findings were presented at national and international conferences. WRAPP researched several cleaning product ingredients associated with asthma, which influenced the designation of several chemicals as asthmagens on the AOEC exposure coding list.

Cleaning Agents used in Schools: WRAPP investigated a nearly fatal case of WRA in an office worker at a youth training facility. Disinfectants containing asthmagens were implicated. In addition to this case, WRAPP data showed a large number of cases in education associated with cleaning products. WRAPP initiated the Cleaning for Asthma Safe Schools (CLASS) program, which began with collaboration and fieldwork with a community-based organization (CBO), three school districts and one statewide charter school. As a result of the pilot project, guidelines for safer cleaning in schools were drafted, reviewed, and tested by six additional school districts. Three of those districts were then selected to field test the guidelines before they were finalized and released. Experts in the field also reviewed the guidelines.

Sanitizing and Disinfection Agents used in Childcare: We collaborated with the San Francisco Departments of Public Health and Environment and with two other CDPH Branches to analyze levels of metals produced by a device marketed as a sanitizer and cleaner and determine how they were released. To assist the San Francisco Department of Public Health in reducing the use of bleach in childcare, we conducted worksite observations and air monitoring of disinfectant and sanitizer use in child care. We provided WRA data and technical support throughout the project and for the subsequent report, "Bleach-free Disinfection and Sanitizing for Child Care."

Scope and Probe Disinfection: We identified over 40 confirmed cases of WRA associated with glutaraldehyde in medical settings. WRAPP has conducted field investigations with a major HMO as well as with a major manufacturer of a closed system. WRAPP has visited five facilities to learn about best practices and exposure control. We are awaiting results from the HMO's evaluation of safer alternatives and working with the manufacturer to validate its ability to control air emissions.

Poultry Processing: We identified nearly 20 confirmed WRA cases and began an investigation of disinfectant exposures to poultry processing workers, in collaboration with our NIOSH-funded Occupational Pesticide Illness Prevention Program. We have completed a walkthrough of two poultry processing plants, including interviewing the employers and the USDA inspectors assigned to the plants. We are now arranging to visit several more plants, including organic and conventional facilities with reported cases.

Pool Chemicals: After identifying nearly 30 cases of WRA associated with pool chemical exposures, we conducted worksite investigations at indoor pools, as well as accompanied a county pool inspector on pool inspections. Because pool chemicals are used for anti-microbial water treatment, this fieldwork was another collaboration with our pesticide illness surveillance program. Multiple educational materials and publications have been generated by this work.

Ozone in the Wine and Bottling Industries: Based on data showing worker illness, including asthma, due to ozone used as a disinfectant, we have begun to investigate ozone use in wineries in collaboration with our Occupational Pesticide Illness Prevention Program. We have conducted a preliminary site visit to observe ozone generator use and are planning further site visits to conduct air monitoring for ozone levels during various disinfection tasks. Based on our findings, we plan to create outreach materials for employers and workers in this setting.

C COLLABORATION

WRAPP has collaborated with federal, state, and local agencies, health care professionals, industries, trade associations, labor organizations, asthma advocacy groups, and community-based organizations in our ongoing program activities. We have participated on numerous interagency, advisory, and other work-groups addressing asthma.

Participation in national workgroups: WRAPP participated in the National Cleaning for Healthier Schools and Infection Control Workgroup that generated guidelines for the safe use of disinfectants in schools, as well as on the Alliance Team that created a Green Cleaning, Sanitizing, and Disinfecting Toolkit for Early Child Care. WRAPP reviewed multiple third party certification standards for cleaning and disinfecting products, and helped persuade these programs to prohibit asthma-causing agents (ECOLOGO, Greenseal, EPA Design for the Environment). WRAPP is also a participant in the Council for the Model Aquatic Health Code, an all-inclusive national model pool code.

Inclusion of Low-wage Workers: Low wage and/or immigrant workers are difficult to reach for surveillance and prevention activities. To try to address this challenge, WRAPP partnered with several organizations including the CHANGE coalition (domestic cleaning workers) and the Labor Occupational Health Program (domestic cleaners and home health workers). We also worked with a domestic violence shelter to switch to safer cleaning products. WRAPP trained community promotoras on safer cleaning products to bring these practices to Spanish-speaking workers and their communities.

Collaboration on external primary prevention efforts: WRAPP provided technical guidance and review, while ensuring the inclusion of WRA prevention strategies in numerous documents and prevention efforts statewide. Collaborations ranged from assisting local agencies, such as the San Francisco Departments of Public Health and Environment, to providing national advocacy groups (Healthy Building Network and Environmental Working Group) and statewide agencies (the CA Department of Education) with the information necessary to create guidance and documents about asthma-safer choices for cleaning and building materials. WRAPP is acknowledged in multiple white papers and guidance documents as providing valuable technical assistance.

Integration of WRA into mainstream public health efforts: Whenever possible WRAPP inserted WRA into mainstream public health efforts. We participated on the steering committee to plan and moderate two statewide Asthma Research Summit meetings, ensuring that WRA topics and speakers were on the agenda. We worked closely with our California NCEH asthma grantee program (CA Breathing) to develop a WRA chapter in a statewide asthma surveillance report, to include a WRA goal and objectives in the revised statewide strategic plan for asthma, and incorporate asthma-safer cleaning in their training videos and materials on asthma. We have also collaborated with our Chronic Disease Branch to ensure that WRA is included in their outreach and activities on asthma and workplace wellness.

Some of the other organizations WRAPP regularly collaborates with include school districts statewide, California EPA, University of California, Regional Asthma Management and Prevention Initiative (RAMP), the School Environmental Health and Asthma Collaborative (SEHAC), American Lung Association, California Thoracic Society, the Toxics Use Reduction Institute, Green Schools Initiative, Environmental Working Group, California Association of School Business Officials (CASBO), California Teachers Association, US EPA Children's Environmental Health Coordinators, Coalition of Adequate School Housing's (CASH), California School Nurses Association, SEIU, US EPA, Southern California Clean, Green, and Healthy Schools Partnership, Migrant Clinicians Network, and CDC.

D DISSEMINATION, EDUCATION AND OUTREACH

Effective translation of results into guidance and interventions is essential for surveillance and prevention programs to be successful. We conduct outreach and disseminate findings and recommendations from our WRA program to our collaborators and stakeholders; publicize the importance of recognizing, reporting, and controlling WRA in the workplace; and promote measures to prevent exposures and illness to all parties who can implement change. In addition to our WRA dissemination database of over 3,600 health care providers, we utilize a mailing list of over 12,000 organizations and individuals maintained by the OHB. Recently, our Branch developed a guidance document, "*OHB Communications Guidelines*," which includes communications principles, guidance for product development, dissemination and evaluation, and several tools for decision-making and standardization. Our target audiences and major objectives for education and outreach efforts include: 1)

employees, labor unions and/or other labor advocacy groups to improve WRA recognition, knowledge of exposure control measures, and ensure awareness of employee rights to a safe and healthy workplace; 2) employers and industry-wide organizations to increase employer recognition of workplace hazards, and to encourage implementation of effective exposure control and prevention measures; 3) medical and public health professionals to increase recognition of WRA and knowledge of reporting requirements, and to improve treatment of WRA; 4) federal, state, and local governmental agencies to contribute to national WRA surveillance efforts, and to promote regulatory and policy efforts to prevent WRA; and 5) environmental and other community-based organizations to increase recognition of the link between WRA and hazardous exposures at work and in the community, and to promote primary prevention.

We disseminate data and prevention recommendations in a wide variety of formats, including written materials for workers about prevention and management of WRA, workers' compensation and other workplace legal rights; surveillance summaries, fact sheets and hazard advisories; work site specific letters with detailed findings and recommendations; scientific reports and peer-reviewed publications; articles for trade organization publications; digital stories; presentations at worker, medical, public health, and industry meetings or conferences; written comments to regulatory agencies and standards setting organizations on 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. Highlights of our education and outreach efforts over the past five years include:

General WRA information and data: WRAPP has made many presentations over the last five years to diverse audiences. Our website has served as a valuable resource for stakeholders, as demonstrated by nearly 42,000 downloads of our fact sheets (including nearly 3,000 downloads in languages other than English), over 27,000 downloads of our peer-reviewed journal articles, and over 31,000 downloads of our reports and other documents. WRAPP has provided hard copy educational materials to over 4,000 workers and health care providers, and published our findings in newsletters, bulletins, reports and publications of other organizations. By including WRA data and findings in more general asthma publications, we reach a wider audience with a limited understanding of WRA. We included a chapter on WRA in a statewide surveillance report on asthma in California, and followed its publication with an electronic newsletter blast reaching 4,700 recipients, Department tweets, Facebook posts, and a webinar. We also included a chapter on WRA in the state's updated Strategic Plan for Asthma in California. In addition, we developed a low-literacy fact sheet for workers about WRA and translated it into Spanish, and inserted our findings into peer-reviewed publications and a national textbook on occupational and environmental health.

WRA and pool chemicals: We collaborated with our pesticide illness surveillance program to combine our pesticide illness and asthma surveillance findings to examine pool chemical exposures and WRA. We created a fact sheet on pool exposures and WRA for employers and a low literacy version for workers in English and Spanish. An electronic newsletter blast, a peer-reviewed publication, and presentation at a national conference expanded the audience receiving our results and recommendations.

WRA and cleaning and disinfecting chemicals: Over the past five years, WRA and cleaning and disinfecting exposures have been a major focus for WRAPP. Our dissemination efforts include a fact sheet for employers and a low literacy one for workers in English, Spanish and Chinese, announced by an electronic newsletter distribution to over 4,900 recipients. Labor organizations, federal agencies, and advocacy groups also included the newsletter in their own publications. Our findings and recommendations were presented in webinars and at multiple conferences. Our most significant effort is the development of "Healthy Cleaning and Asthma-safer Schools: A How-To Guide," a step-by-step protocol to guide school districts in switching to asthma-safer cleaning. The guide was created with extensive input and pilot testing by schools and maintenance staff. We also produced a digital story highlighting our surveillance case of a custodian to introduce the guidelines to schools. The guide and

digital story have been widely disseminated to over 2,100 recipients so far, and the Guide won a bronze medal in the 2015 National Public Health Information Coalition Excellence in Public Health Communications competition.

WRA and fragrances: Our surveillance data demonstrate that fragrance exposures contribute to a large number of WRA cases, and are the ninth most commonly identified exposure. We created fact sheets about fragrance exposures and WRA for employers and workers, as well as a model fragrance-free workplace policy. We announced the availability of the factsheets with an electronic newsletter reaching over 4,100 recipients. The announcement was opened over 7,400 times and was picked up and re-published in multiple organization newsletters.

Our program has made dozens of presentations over the last five years, including talks to public health professionals, health care providers, workers, employers, unions, and non-governmental and community-based organizations. Presentations were made on a variety of topics, including clinical diagnosis and management of WRA, wood dust exposures, cleaning and disinfecting in childcare and school settings, swimming pool chemicals, custodian participation in cleaning policies, WRA surveillance findings, and poultry processing chemicals,

In addition to the many presentations and written materials cited above, our program has also provided written comments on proposed or existing regulations to Cal/OSHA and NIOSH; submitted written comments to third-party certification organizations developing standard criteria for cleaning; provided WRA data to Cal/OSHA to assist in their assessment of several standards, as well as for consideration of sensitizer notations; provided data to local health departments for their jurisdictions and to other organizations on specific exposures or industries; and analyzed proposed legislation addressing the use of asthma-safe green cleaning chemicals in schools.

E EVALUATION

Surveillance

We continually conduct evaluation of our surveillance efforts. The overall capture of our surveillance system has continued to grow with the addition of several new data sources. A capture-recapture analysis was done to evaluate the overlap of each data source and estimate the total number of WRA cases in the population. This showed that, since there is little overlap between data sources, all are necessary, and the true number of cases that should be reported is estimated to be 2,000 to 3,700 per year. As the WCIS data have expanded, our evaluation identified the need to adjust our case selection algorithm to avoid selecting non-asthma cases with only a history of asthma. The *timeliness* of our surveillance system is adequate for case follow-up, with a median of 20 days between physician diagnosis and receipt of DFR by the WRA program. Hospital-based reports (ED and PDD) are less timely, as annual data are not available until July of the subsequent year. In evaluating *case classification*, our evaluation of WRA data shows an overall confirmation rate of 83%, with 1/3 of cases successfully interviewed and 20% of those reached refusing the interview. The *sensitivity* of the DFR reporting system in detecting WRA cases is relatively poor. A prior evaluation showed that 70% of cases may be missed using this source. The *predictive value positive* (PVP) of our surveillance of WRA is excellent, with 90% of WRA cases receiving interviews subsequently confirmed as true cases.

Workplace follow-up and interventions

To evaluate our WRA field investigations, we assess the capacity to respond to case reports in a timely manner; the quality of our investigations; and the public health impact of our efforts. We have evaluated each step in our field investigations to identify procedures that maximize our ability to gain access to the worksite, 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. All investigations initiated by the WRA 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 worksites without a union, we identified the need to emphasize collaboration with environmental, community-based, and other non-governmental organizations with access to, and the trust of workers. Participation rates for on-site worker interviews have been excellent, ranging from 60 to 70%. Our criteria for investigations have successfully identified incidents of broad public health significance, focusing on workplaces where we can maximize impact, such as schools, where prevention benefits workers and children. Assisting multiple schools switch to asthma-safer cleaning procedures has potentially reduced exposure to hundreds of staff members and over 143,000 students. Recommendations and findings from our investigations have had important effects on policy and standards, including influencing several third-party certification organizations to include asthmagen prohibitions in their standards for cleaning products. We direct recommendations toward the parties with the authority to implement changes—usually employers and trade associations, purchasing agents, and regulatory agencies.

Dissemination of information

The *quantity* of education materials distributed, the types of audiences to whom materials were disseminated, the number of talks or training provided, and the number of participants who have attended are evaluated continuously. The *quality* of our dissemination efforts is evaluated by whether our approaches are consistent with the language and literacy needs of the target audiences, and if they are presented in a culturally appropriate manner. For example, to guide the design of our worker-focused WRA materials, we have collaborated with the UC Berkeley Labor Occupational Health Program to convene worker focus groups to assess the efficacy of our written materials and provide guidance on how to improve them. The findings and recommendations of our field investigations are summarized in simple language and also translated into Spanish. In light of our limited resources and the diversity of the workforce, we do not have the capacity to conduct extensive outreach to individual workers beyond the worksite being investigated and individual case follow-up efforts. Rather, we conduct outreach and foster collaborative working relationships with non-governmental organizations. These organizations in turn disseminate the findings and recommendations of our project to their constituents.

V CONCLUSIONS

Over the last 5 years of the cooperative agreement, WRAPP has successfully maintained and significantly expanded the surveillance of work-related asthma in California. We have used targeted case investigations, collaboration with other organizations, and dissemination of our findings to implement prevention strategies for work-related asthma statewide. By focusing on primary prevention activities and coordinating our efforts with other asthma prevention programs, we have been able to maximize our impact. These successful approaches will be continued and expanded over the next 5 years of WRA surveillance and prevention activities.

PUBLICATIONS

In the last five years, we have authored or co-authored seven contributions on WRA in the peer-reviewed literature, books, or government reports:

- Flattery J: [2011] Asthma Surveillance in California: Combining Environmental and Occupational Health Surveillance. In: Occupational and Environmental Health: Recognizing and Preventing Disease and Injury, Sixth Edition, (eds Levy BS, Wegman DH, Baron SL, Sokas RK), Oxford University Press, p 57.
- Chen W, Miller R, Weinberg J, Waldman J, Flattery J, Shrem D, Kumagai K: [2011] Quantitative Assessment of Inhalation Exposures Generated from Floor Mopping Practices using Fullscale Chamber – A Pilot Study. Proceedings of Indoor Air 2011 - The 12th Int. Conf of Indoor Air Quality and Climate, Austin, U.S.A.
- White GE, Seaman C, Filios MS, Mazurek JM, Flattery J, Harrison RJ**,** Reilly MJ, Rosenman KD, Lumia ME, Stephens AC, Pechter E, Fitzsimmons K, Davis LK: [2014] Gender differences in work-related

asthma: surveillance data from California, Massachusetts, Michigan, and New Jersey, 1993-2008. J Asthma 51(7):691-702.
- Rosenman KD, Millerick-May M, Reilly MJ, Flattery J, Weinberg J, Harrison R, Lumia M, Stephenson A, Borjan M: [2015] Swimming Facilities and Work-Related Asthma. J Asthma 52(1):52-8.
- Milet M, Lutzker L, Flattery J. Asthma in California: A Surveillance Report. Richmond, CA: California Department of Public Health, 2013.
- Shrem D, Weinberg J, Flattery J. Healthy Cleaning & Asthma-Safer Schools: A How-to Guide. Richmond, CA: California Department of Public Health, 2014.
- Arneson C, Campbell Hicks S, Flattery J et al. Strategic Plan for Asthma in California: 2015-2019. Richmond, CA: California Department of Public Health, 2015.

SECTION 1: OCCUPATIONAL PESTICIDE ILLNESS (OPI)

SIGNIFICANT FINDINGS

MAINTAIN AND ENHANCE MULTI-SOURCE SURVEILLANCE OF OCCUPATIONAL PESTICIDE ILLNESS

- Conducted surveillance using five data sources to identify over 6,500 potential OPI cases (2,634 in the five year award period); Confirmed 4,407 cases using the NIOSH case definition.
- Performed data analyses to characterize cases associated with pool chemicals, pyrethrins and pyrethroids, disinfecting products, paraquat and diquat, ozone, and poultry processing.
- Conducted analyses to evaluate ten years of OPI data to generate estimates of county burdens of OPI, and to determine chemicals, work practices and health effects most often associated with OPI.
- Expanded surveillance to include all ascertained cases of OPI involving exposure to disinfectants.
- Finalized an agreement with the California Department of Pesticide Regulation (CDPR) to share case information, which has greatly increased the number of cases classified as definite, probable, or possible cases of pesticide illness.
- The overall rate of OPI was 1.2 cases per 100,000 workers in California.

PERFORM TARGETED CASE-BASED FOLLOW-UP AND WORKPLACE INTERVENTIONS

- Observed the use of ozone generators at a winery after identifying 7 OPI cases involving ozone.
- Conducted two worksite visits to observe practices and chemical use in organic and conventional poultry processing facilities after identifying 22 OPI cases in the poultry processing industry.
- Observed pool maintenance work practices after identifying 79 OPI cases of workers exposed to pool disinfection chemicals.
- Investigated illnesses that resulted when a produce washing facility switched from sodium hypochlorite to chlorine dioxide to treat the process water.
- Investigated OPI due to chloropicrin and sulfuryl fluoride exposure from a bank fumigation.
- Investigated pesticide drift onto non-agricultural worksites such as an asphalt plant and berry cooling facilities that resulted in OPI.
- Studied alternative pest control in public transportation after identifying OPI cases among drivers.

COLLABORATE TO EXTEND REACH AND IMPLEMENT PREVENTION STRATEGIES

- Collaborated with the CDPH Environmental Health Investigations Branch to geocode OPI cases on a map displaying pesticide use in California.
- Participated in local and national work groups to develop strategies and resources for safer disinfection in swimming pool, school, and childcare settings.
- Improved and expanded our collaboration with CDPR that permits extensive data sharing and allowed for the co-development and dissemination of two fact sheets.
- Collaborated with Planned Parenthood, Lideres Campesinas, and other community based organizations (CBOs) to pilot text messaging as a prevention tool for OPI.
- The US Environmental Protection Agency (USEPA) cited data from our program to substantiate their recommended changes to the Worker Protection Standard.
- Collaborated with CDPH Division of Communicable Disease Control to review and publicize a fact sheet on tick bite prevention in workers and make recommendations on controlling bed bugs.
- Worked with CDPR and California Occupational Safety and Health Administration (Cal/OSHA) to clarify that the Hazard Communication Standard and Injury and Illness Prevention Program Standard applies to bystander employees whose workplaces are treated with pesticides.
- Collaborated with the California Building Owners and Managers Association to disseminate information on safe building fumigation.
- Partnered with our work-related asthma program to develop educational materials to promote the safer use of pool chemicals.

- Collaborated with the Agency for Toxic Substance Disease Registry to develop a national webinar, webinar proceedings, and a white paper about pesticide exposures in schools.

DISSEMINATION, OUTREACH AND EDUCATION

- Co-authored four peer-reviewed articles: gender differences in acute pesticide-related illness among farmworkers, the extent of acute pesticide illnesses associated with off-target pesticide drift, health effects following exposure to phosphine gas, and the magnitude of OPI caused by pyrethrins and pyrethroids (Kasner 2012, Lee 2011, O'Malley 2013, Hudson 2014).
- Updated our website with our educational resources, and have documented nearly 102,000 downloads of our reports and related documents, over 33,000 downloads of our peer-reviewed journal articles, and over 7,000 downloads of our fact sheets and hazard alerts.
- Gave 19 presentations to a diverse range of audiences locally and nationally.
- Developed a web topic page focused on preventing worker illness from indoor pesticide exposure.
- Co-authored a chapter on OPI in a surveillance report that will be distributed widely to a variety of OPI stakeholders in November, 2015.
- Created and distributed seven new fact sheets aimed at preventing OPI.

EVALUATE SURVEILLANCE, INVESTIGATIONS, AND INTERVENTIONS

- Developed a logic model for our program, examining planned activities in light of anticipated intermediate outcomes and impact; used the models to guide program planning and evaluation.
- Evaluated our program using the CDC guidelines to determine where improvements could be made regarding timeliness, predictive value positive, sensitivity, worksite investigation capacity, outreach, and OPI prevention education.
- Evaluated surveillance reporting trends and increased case ascertainment from the worker's compensation information system by 15%.
- Collaborated with CBOs to evaluate the effectiveness of using text messaging to prevent OPI.
- Conducted a focus groups/sought stakeholder input for development of educational materials.

TRANSLATION OF FINDINGS

This program has demonstrated the value of establishing a surveillance system for OPI, and that OPI in California remains an important public health problem, affecting many workers with substantial impacts and cost. Ongoing data collection from multiple sources at the state level can lead to identification of occupations at high risk, followed by targeted investigations, and outreach. The advent of electronic reporting systems has increased the efficiency and capture of work-related injury and illness data, although significant gaps remain for ascertaining chronic diseases. Findings from this project have been disseminated and used widely by a diverse audience including employers, unions, employees, advocates, and health and safety professionals, and have identified issues critical for prevention: effective and widely available control measures or alternative chemicals are often not in use or are used incorrectly; pesticide use that is in compliance with the label can result in OPI; inadequate worker training is common; and inadequate communication and regulation lead to OPI in workplaces statewide.

OUTCOMES/IMPACT

This project has had significant impact on the risk of OPI in a number of industries and occupations. Expected outcomes include:

- Intermediate Outcome: Data from our program was cited extensively by the USEPA to substantiate recommended changes to the Worker Protection Standard.
- Potential Outcome: Conducted 17 investigations, wrote recommendations, and wrote and disseminated fact sheets based on recommendations, which, if implemented, will reduce OPI.
- Potential Outcome: Reduced exposures and morbidity for workers in environments targeted by the guidance of other organizations where we provided technical assistance and collaboration.

I BACKGROUND

Since 1997, the Occupational Health Branch (OHB) of the California Department of Public Health (CDPH) has maintained a NIOSH-funded program to conduct ongoing surveillance and a wide variety of intervention activities for **occupational pesticide illness (OPI).** The OPI Prevention Program (OPIPP) utilizes multi-source surveillance data to characterize the nature and extent of OPI and to target case-based workplace investigations in order to generate and promote practical prevention/intervention strategies that can reduce the risk of OPI statewide.

II SPECIFIC AIMS

From 2010-2015, we maintained our existing model for the surveillance of OPI, and implemented new activities that enhanced our previous work. The overall goal during this last funding cycle was to maintain and enhance the California program for the prevention of OPI. Specific objectives were to: 1) Expand case ascertainment using multiple data sources; 2) Perform case-based field investigations and develop prevention strategies; 3) Collaborate with local and state agencies; 4) Disseminate results generated from project activities; and 5) Evaluate surveillance activities on an ongoing basis.

III METHODS

A SURVEILLANCE

Over the past 19 years, OPIPP has modified the original sentinel provider-based reporting system to include multiple sources of case ascertainment. We initially elected to utilize an existing statewide physician reporting system (Doctors' First Reports of Occupational Injury and Illness, DFR) and have added emergency department, hospital patient discharge, poison control, and workers' compensation data as routine data sources for case identification. For each potential case of OPI ascertained, medical records are requested and reviewed to confirm OPI and obtain data for case classification. The information abstracted from the medical record includes core information collected by all NIOSH-funded OPI surveillance states and we use the OPI case definition and case classification criteria established by NIOSH. Case interviews are conducted for selected cases for which we are unable to obtain medical records. The study protocol has been approved by the California Health and Human Services Agency Committee for the Protection of Human Subjects. Data are thoroughly cleaned and edited, duplicates are eliminated, and data are transferred to NIOSH annually. Analyses are conducted on a continual basis in order to identify trends and case clusters, as well as to characterize exposures of interest and focus prevention efforts.

B CASE FOLLOW UP AND WORKPLACE INTERVENTION

OPIPP performs workplace field investigations for selected cases to gather in-depth information about the worksite, work processes, and risk factors for OPI. The details discovered during our investigations provide an important link between the illnesses identified by surveillance and the underlying causes leading to the hazardous exposures. In this way, our investigations enhance our capacity to anticipate, recognize, and evaluate hazards and to develop effective prevention strategies. OPI reports have been 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 or is deemed to be of public health importance; (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. OHB has statutory authority to gain access to the workplace for the purpose of conducting investigations of work-related morbidity and mortality (California Health and Safety Code Sections 105175-105180). Site visits are conducted according to our written Field Investigations Policy and Procedures manual, and may include the following methods: on-site industrial hygiene assessment of the

workplace and work processes; interviews with employers, employees, and other individuals involved in the incident, and other key informants; symptom surveys of workers; review of written policy and procedures, medical records, and regulatory investigations; and analysis of the relevant scientific literature.

C COLLABORATION

OPIPP continues to work with all stakeholders to encourage eliminating the use of the most toxic pesticides and substituting with less-toxic pesticides and using non-chemical pest-control treatments. We have also worked to increase the integration of occupational health into (1) mainstream public health practice, especially environmental health and other pesticide illness prevention activities undertaken on behalf of communities or consumers; (2) the identification of practical and safe alternatives; and (3) the work of advocacy organizations concerned about the health of low-wage, immigrant workers, and other populations at high risk for OPI. Given the relatively limited resources devoted to OPI surveillance, we leverage our efforts by collaborating with others who can use our data and technical expertise to jointly implement strategies to improve health. Our collaborative approach supports primary prevention-based activities by: (1) educating a wide-range of audiences about the occupational health implications of pesticide use; and (2) identifying strategies to improve worker health and safety through alternative methods for agriculture and pest control.

D DISSEMINATION, EDUCATION AND OUTREACH

We conduct outreach and disseminate the findings and recommendations from our OPI program to notify our collaborators and target audiences of the results of significant surveillance findings and site-specific investigations; publicize the consequences of unrecognized or uncontrolled exposure to OPI agents in the workplace; and promote effective measures to prevent exposures and illness to all parties who can implement change. We use a mailing list of over 12,000 organizations and individuals maintained by the OHB. We disseminate information in a variety of formats, including materials for workers about prevention of OPI, specific exposures, and workplace legal rights; worksite specific letters with findings and recommendations; scientific publications; materials about prevention for employers; conference presentations; grand rounds, and other presentations to health care providers; written comments to regulatory agencies on proposed and existing regulations and guidelines; written analyses of proposed legislation; participation on interagency, advisory, and other work groups; posting on our website; and data and reports sent to NIOSH for inclusion in national surveillance databases.

E EVALUATION

We recognize the important role that evaluation plays in ensuring that our surveillance system is effective in tracking and preventing OPI. We have been using a logic model during the last 5 years to track our objectives, outputs, and outcomes. This allows us to quantify outputs and evaluate if they have had any impact. Over the past 19 years, we have conducted ongoing evaluation using the CDC Guidelines for Evaluating Surveillance Systems. We have also reviewed past evaluations of the SENSOR program and incorporated recommendations for both surveillance and interventions. We have taken many steps to assess the different components of our system, including surveillance capture and efficiency, worksite investigations, and information dissemination.

IV RESULTS AND DISCUSSION

A SURVEILLANCE

From 1997-2015, OPIPP identified 5,032 case reports of OPI. Of these, we have coded and analyzed 98%. We classified a total of 3,242 (65%) cases as “definite,” “probable,” or “possible” using the NIOSH case definition. The overall pesticide illness rate is 1.4/100,000 workers. The top 5 industries with the highest rates are farm production and services (27/100,000 workers); food manufacturing (12); beverage manufacturing (5); highway, street, and bridge construction (5); and wholesale of nondurable goods (4).

The top 5 occupations with the highest rates are pest control operators (63/100,000); agricultural field workers (45); agricultural graders and sorters (26); chemical processing machine operators (18); and agricultural supervisors (16). From January 1, 2007, through June 30, 2015, we also identified 1,708 case reports of illness or injury caused by exposure to disinfectants. We have analyzed and coded 88% of these reports. 938 (62%) were case classified as "definite," "probable," or "possible" cases. From 1997-2012, California accounted for 39% of the national NIOSH OPI surveillance dataset which includes data from 12 states. The pesticides and disinfectants most commonly associated with OPI in California during this time period are presented below.

Pesticides	**% of cases involving pesticides**
Sulfur	8%
Glyphosate	6%
Chlorpyrifos	3%
Cyfluthrin	3%
Permethrin	2%

Disinfectants	**% of cases involving disinfectants**
Sodium Hypochlorite	31%
Benzyl Ammonium Chlorides	15%
Chlorine	15%
Glutaraldehyde	4%
Hydrochloric Acid	3%

Multiple analyses were conducted to characterize exposures of interest including exposure to glyphosate, paraquat and diquat, pyrethrins and pyrethroids, pool chemicals, ozone, and disinfectants used during poultry processing and food manufacturing.

B CASE FOLLOW-UP AND WORKPLACE INTERVENTION

From 2010-2015, OPIPP staff conducted focused follow-up investigations of exposures in multiple industries related to agents associated with OPI. 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.

Mapping pesticide drift into non-agricultural worksites: Investigations of pesticide drift into an industrial park, an asphalt plant, and two berry packing plants, led us to explore how geocoding can help characterize which non-agricultural workplaces may be at higher risk for pesticide drift. Mapping suggested potential locations for drift monitoring, enabling us to recommend monitoring locations more relevant to workers. We also shared the geocoding methodology with other states at a national conference. Also, in collaboration with CDPH's Environmental Health Investigations Branch, we combined pesticide illness case geocoding with pesticide application data to explore the geographical relationship between pesticide use and illness.

Building fumigation: We investigated pesticide illnesses due to chloropicrin and sulfuryl fluoride exposure in a bank. We sent a report of our findings and recommendations to the bank staff and

management and county agencies. We developed and disseminated a hazard alert about safer fumigation processes and pushed for better monitoring of chloropicrin prior to allowing building re-entry.

Phosphine exposure: We collaborated with CDPR on an investigation into phosphine exposure among 10 employees that resulted in at least one case of pulmonary edema (O'Malley, 2013).

Pesticides in public transit: Investigations into pesticide illnesses attributed to the use of pesticides on public transit, and research of integrated pest management (IPM) practices in two major municipal bus systems, prompted us to write and disseminate educational materials to discourage pesticide spraying and fogging and promote using IPM in public transit. We plan to partner with transit unions and trade organizations and to work with municipalities to implement IPM.

Poultry Processing: We identified 22 OPI cases and conducted an investigation of disinfectant exposures to poultry processing workers in collaboration with our NIOSH-funded Work-Related Asthma Prevention Program (WRAPP). We have completed a walkthrough of two poultry processing plants, including interviewing the employers and the USDA inspectors assigned to the plants. We are now arranging to visit several more plants, including organic and conventional facilities with reported cases.

Pool Chemicals: After identifying nearly 79 cases of OPI associated with pool chemical exposures, we conducted worksite investigations at indoor pools, as well as accompanied a county pool inspector on pool inspections. Because pool chemicals can cause or trigger asthma, this fieldwork was another collaboration with OHB's WRAPP staff.

Ozone in the Wine and Bottling Industries: Based on data showing worker illness due to ozone used as a disinfectant, we are investigating ozone use in wineries in collaboration with WRAPP staff. We have conducted a preliminary site visit to observe ozone generator use and are planning further site visits to conduct air monitoring for ozone levels during various disinfection tasks. Based on our findings, we plan to create outreach materials for employers and workers in wine and bottling industries.

Disinfectant use in work settings: We investigated disinfectant use in child care, schools, and hospitals. We provided technical review in several collaborations and developed our own educational materials. We are a team partner on the IPM Alliance Grant project that produced "Green Cleaning, Sanitizing, and Disinfecting: A Curriculum for Early Care and Education." We also initiated an investigation into pesticide illnesses caused by the use of paraformaldehyde to disinfect biological safety cabinets. Together with WRAPP we have conducted several visits to hospitals to investigate the use of disinfectants in scope and probe processing.

Food processing: Along with CDPR, we investigated illnesses that resulted when a produce washing facility switched from sodium hypochlorite to chlorine dioxide to treat the process water.

C COLLABORATION

Collaborators include partners in CDPH, federal agencies (NIOSH, US Environmental Protection Agency), state agencies (CDPR Worker Health and Safety Branch, the Office of Environmental Health Hazard Assessment), local agencies, university-based programs, and CBOs (Planned Parenthood, Lideres Campesinas, Migrant Clinicians' Network). We have also participated on numerous interagency, advisory, and other work-groups addressing pesticide illness, such as the Toxics Use Reduction Institute, and the CDPR Pesticide Registration and Evaluation Committee. Specific OPIPP projects have collaborators and an ad hoc advisory group. The Text4Salud project, for example, had up to 15 representatives from seven different organizations who met monthly to plan the pilot project. We have thousands of pesticide

program-related contacts in our database to whom we send materials and communicate with on an as-needed basis. Collaborations include:

- Improving and expanding our collaboration with CDPR with an MOU that permits extensive data sharing.
- With CDPR, conducting a joint investigation of occupational pesticide illness, and jointly developing and disseminating two fact sheets (one for employees, one for managers) to promote using IPM in the office work environment.

- Collaborating with Planned Parenthood, Lideres Campesinas, and other Central Coast CBOs, on a pilot project to evaluate whether text messaging is an effective way to emphasize pesticide illness prevention and reporting with farmworkers.
- Developing materials with CDPH Division of Communicable Disease Control (DCDC), and reviewing and publicizing a fact sheet on tick bite prevention in outdoor workers and bed bug treatment recommendations.
- Collaborative work with CDPR and California Occupational Safety and Health Administration (Cal/OSHA) helped clarify that the Hazard Communication Standard and Injury and Illness Prevention Program Standard apply to bystander employees whose workplaces are treated with pesticides. We continue to incorporate information about these two standards into our educational materials. We will work to ensure that employers understand workers' right to know about potential pesticide exposures in all work settings and will promote adequate worker training and education.
- The US Environmental Protection Agency (USEPA) cited data from our program to substantiate their recommended changes to the Worker Protection Standard. We also provided public comments to USEPA regarding their proposed revisions.

D DISSEMINATION, EDUCATION AND OUTREACH

Effective translation of results into guidance and interventions is essential for effective surveillance and prevention programs to be effective. We conduct outreach and disseminate findings and recommendations from our OPI program to our collaborators and stakeholders; publicize the importance of recognizing, reporting, and controlling OPI in the workplace; and promote effective measures to prevent exposures and illness to all parties who can implement change. We utilize a dissemination mailing list of over 12,000 organizations and individuals maintained by the OHB. Recently, our Branch developed a guidance document, "*OHB Communications Guidelines,*" which includes communications principles, guidance for product development, dissemination and evaluation, and several tools for decision-making and standardization. Our target audiences and major objectives for education and outreach efforts include: 1) employees, especially immigrant, non-English speaking workers - we inform affected workers about the results of our investigations, improve illness recognition and knowledge of exposure control measures, and ensure awareness of employee legal rights to a safe and healthy workplace; 2) employers - we increase employer recognition of workplace hazards, and encourage implementation of effective exposure control measures; 3) medical and public health professionals to increase recognition of OPI and knowledge of reporting requirements, to improve treatment of OPI, and create a constituency that will advocate for policy changes to prevent OPI; 4) federal, state, and local governmental agencies to contribute to national occupational illness surveillance efforts, and promote improvements in regulatory efforts to prevent occupational illness; and 5) environmental and other community-based organizations to increase recognition of the link between OPI and hazardous exposures at work and in the community, and to promote primary prevention.

We disseminate data and prevention recommendations in a wide variety of formats, including written materials for workers about prevention and management of OPI, workers' compensation and other workplace legal rights; surveillance summaries, fact sheets and hazard advisories; work site specific

letters with detailed findings and recommendations; scientific reports and peer-reviewed publications; articles for trade organization publications; presentations at worker, medical, public health, and industry meetings or conferences; written comments to regulatory agencies on 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 a national OPI surveillance database. We have analyzed proposed legislation and regulations addressing electronic reporting of first reports of injury and illness, laboratory reporting of cholinesterase results, more stringent regulatory status of pesticide active ingredients, and agricultural worker protection standards. Highlights of our education and outreach efforts over the past five years include:

General OPI information and data: OPIPP has made many presentations over the last five years to diverse audiences and our website has served as a valuable resource for stakeholders, as demonstrated by nearly 102,000 downloads of our reports and related documents, over 33,000 downloads of our peer-reviewed journal articles, and over 7,000 downloads of our factsheets and hazard alerts. The findings and recommendations of our field investigations are summarized in simple language and also translated into relevant languages. We co-authored four peer-reviewed articles: gender differences in acute pesticide-related illness among farmworkers, the extent of acute pesticide illnesses associated with off-target pesticide drift, health effects following exposure to phosphine gas, and the magnitude of OPI caused by pyrethrins and pyrethroids (Kasner 2012, Lee 2011, O'Malley 2013, Hudson 2014). We also Co-authored a chapter on OPI in a surveillance report that will be distributed widely to a variety of OPI stakeholders in November, 2015.

Bed bugs: We collaborated with CDPH DCDC on an Occupational Health Watch (http://us5.campaign-archive1.com/?u=4586a1ad0b7ecd671f7295e07&id=5fd77c9443&e=1af72cb27dOHW) e-newsletter, which included recommendations on safer bed bug control. OHW incorporates the findings from our occupational surveillance programs into an easily readable, accessible publication that has an impact on California policy makers. This OHW went to 5,770 recipients. We worked with DCDC to include our fact sheet and MMWR article about bed bugs and safe pesticide use on their website.

Texting pesticide safety messages: In 2013, we began a community-based research pilot project, Text4Salud, to evaluate whether text messaging is an effective way to emphasize pesticide illness prevention and reporting with farmworkers. We trained staff from CBOs to recruit farm workers to receive pesticide illness prevention texts in Spanish over a four-month period. The CBOs helped develop text messages that emphasized preventing take home exposures; we are currently in the process of evaluating this project.

Indoor pesticide exposure: Because nearly 20% of our cases involve pesticides used indoors or in interior spaces, we developed a web topic page on indoor pesticide exposure and continue enhancements. Dedicated to preventing worker illness from indoor and interior pesticide exposure, this topic page houses our fact sheets and links to resources. Products included are a FAQ about IPM, our safer bed bug treatment fact sheet, and a journal article on pyrethrin and pyrethroid use. Our public transit IPM fact sheet is housed here as well. We also published an article in the California Building Owners and Managers Association East Bay Fall 2012 newsletter about fumigating buildings safely.

Swimming pool chemical Illness: In collaboration with WRAPP, we are developing educational materials and a web topic page to promote the safer use of pool chemicals. We plan to disseminate materials through pool operator associations, as well as through CDPH's social media. We are exploring developing requested pool operator online training. We have also co-authored a publication on this subject.

Pesticide exposure in schools: We collaborated with the Interstate Chemical Threats Workgroup and the Agency for Toxic Substance Disease Registry to develop a national webinar, webinar proceedings, and a white paper about pesticide exposures in schools. The white paper promotes national discussion and legislation mandating best practices to prevent staff and student pesticide exposures

Our program has made dozens of presentations over the last five years, including talks to public health professionals, health care providers, workers, employers, unions, and non-governmental and community-based organizations. Presentations were made on a variety of topics, including indoor pesticide use, cleaning and disinfecting in childcare and school settings, swimming pool chemicals, ozone use in wine making, OPI surveillance findings, and poultry processing disinfectants.

E EVALUATION

Surveillance

We continually conduct evaluation of our surveillance efforts. The overall capture of our surveillance system has continued to grow with the addition of several new data sources. As the WCIS data have expanded, our evaluation identified the need to adjust our case selection algorithm to include additional cases of OPI The *timeliness* of our surveillance system is adequate for case follow-up, with a median of 20 days between physician diagnosis and receipt of DFR by the OPI program. Hospital-based reports (ED and PDD) are less timely, as annual data are not available until July of the subsequent year. In evaluating *case classification*, our evaluation of OPI data shows an overall confirmation rate of 63%. There was insufficient information to classify 27% of reports. Of these, 80% were not classifiable because they lacked information about a pesticide, and 34% documented only one health effect. The sensitivity of the DIR-based DFR reporting system in detecting OPI cases is relatively poor, as 90% of the case reports identified by the California Poison Control System (13% of total case reports) were not reported as DFRs. Similarly, an assessment of workers' compensation data suggests only a 10% overlap with the DFR system. The predictive value positive of our surveillance of OPI is relatively good, with 70% of OPI cases for which medical records are received subsequently confirmed as true cases.

Workplace follow-up and interventions

To evaluate our OPI field investigations, we assess the capacity to respond to case reports in a timely manner; the quality of our investigations; and the public health impact of our efforts. We have evaluated each step in our field investigations to identify procedures that maximize our ability to gain access to the worksite, 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. Investigations 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. Participation rates for on-site worker interviews have been excellent, with 100% participation among workers we have asked to interview. We direct recommendations toward the parties with the authority to implement changes—usually employers and trade associations, purchasing agents, and regulatory agencies.

Dissemination of information

The *quantity* of educational materials distributed, the types of audiences to whom materials were disseminated, the number of talks or training provided, and the number of participants who have attended talks and trainings are evaluated continuously. The *quality* of our dissemination efforts is evaluated by whether our approaches are consistent with the language and literacy needs of the target audiences, and if information is presented in a culturally appropriate manner. We disseminate surveillance and case investigation findings to our target audience through a variety of methods, including our OHB website, newsletters; peer-reviewed journals; articles in publications of scientific,

professional, labor, and industry-based organizations; presentations at professional meetings and to our collaborators and target audiences; and in training modules. Workers and employers at work sites with follow-up investigations receive written educational materials about the hazards encountered, and notification of results of our findings. In light of our increasing need to reach low-wage, non-English speaking populations, our primary mechanism for disseminating results to these populations is through our close collaboration with CBOs. We also stress dissemination to government and non-governmental organizations with the capacity to make change through regulatory and advocacy efforts.

V CONCLUSIONS

Over the last 5 years of the cooperative agreement, OPIPP has successfully maintained and significantly expanded the surveillance of occupational pesticide illness in California. We have used targeted case investigations, collaboration with other organizations, and dissemination of our findings to implement prevention strategies for occupational pesticide illness statewide. By focusing on primary prevention activities and coordinating our efforts with other pesticide illness prevention programs, we have been able to maximize our impact. These successful approaches will be continued and expanded over the next 5 years of OPI surveillance and prevention activities.

PUBLICATIONS

In the last five years, we have co-authored eleven contributions on OPI in the peer-reviewed literature and government reports:

- Lee SJ, Mulay P, Diebolt-Brown B, Lackovic M, Mehler L, Beckman J, Waltz J, Prado JB, Mitchell Y, Higgins SA, Schwartz A, Calvert GM: [2010] Acute illnesses associated with exposure to fipronil — surveillance data from 11 States in the United States, 2001–2007. Clinical Toxicology 48:737-44.
- Lee SJ, Mehler L, Beckman J, Diebolt-Brown B, Prado JB, Lackovic M, Waltz J, Mulay P, Schwartz A, Mitchell Y, Moraga-McHaley S, Gergely R, Calvert GM: [2011] Acute pesticide illnesses associated with off-target pesticide drift from agricultural applications: 11 States, 1998–2006. Environtal Health Perspectives 2011; 119;1162-1169.
- MMWR Morb Mortal Wkly Rep. [2011] Acute Illnesses Associated With Insecticides Used to Control Bed Bugs --- Seven States, 2003—2010. Morbidity and Mortality Weekly 60(37);1269-1274
- MMWR Morb Mortal Wkly Rep. [2011] Acute Illness and Injury from Swimming Pool Disinfectants and Other Chemicals --- United States, 2002—2008. Morbidity and Mortality Weekly 60(39);1334-1347
- Kasner EJ, Keralis JM, Mehler L, Beckman J, Bonnar-Prado J, Lee S, Diebolt-Brown B, Mulay P, Lackovic M, Waltz J, Schwartz A, Mitchell Y, Moraga-McHaley S, Roisman R, Gergely R, Calvert GM: [2012] Gender differences in acute pesticide-related illnesses and injuries among farmworkers in the United States, 1998-2007. American Journal of Industrial Medicine 55(7):571-583.
- MMWR Morb Mortal Wkly Rep. [2013] Notes from the Field: Acute Pesticide-Related Illness Resulting from Occupational Exposure to Acrolein — Washington and California, 1993–2009. Morbidity and Mortality Weekly 62(16);313-314
- O'Malley M, Fong H, Sanchez ME, Roisman R, Nonato Y, Mehler L: [2013] Inhalation of phosphine gas following a fire associated with fumigation of processed pistachio nuts. Journal of Agromedicine 18:151-173.
- Hudson NL, HHKasner EJ, Beckman J, Mehler L, Schwartz A, Higgins S, Bonnar-Prado J, Lackovic M, Mulay P, Mitchell Y, Larios L, Walker R, Waltz J, Moraga-McHaley S, Roisman R, Calvert GM:[2014] Characteristics and magnitude of acute pesticide-related illnesses and injuries associated with

pyrethrin and pyrethroid exposure—11 states, 2000-2008. American Journal of Industrial Medicine 57(1):15-30.

- Fortenberry GZ, Beckman J, Schwartz A, Prado JB, Graham LS, Higgins S, Lackovic M, Mulay P, Bojes H, Waltz J, Mitchell Y, Leinenkugel K, Orel MS, Evans E, Calvert GM: [2015] Magnitude and Characteristics of Acute Paraquat and Diquat Related Illnesses in the US: 1998-2011. Environmental Health Perspectives, in press.
- MMWR Morb Mortal Wkly Rep.: [2015] Acute Occupational Pesticide-related Illness and Injury-United States, 2007-2010. Morbidity and Mortality Weekly Surveillance Summary for Non-infectious Diseases, in press.
- MMWR Morb Mortal Wkly Rep.: [2016] Acute Occupational Pesticide-related Illness and Injury-United States, 2007-2011. Morbidity and Mortality Weekly Surveillance Summary for Non-infectious Diseases, in press

SECTION 1: WORK-RELATED INJURY FATALITIES (WRIF)

SIGNIFICANT FINDINGS

MAINTAIN AND ENHANCE MULTI-SOURCE SURVEILLANCE OF WORK-RELATED INURY FATALITIES

- Conducted surveillance using four data sources to identify over 2,454 WRIF cases (304 in the five year award period).
- Added the web-based Electronic Death Registry System (CA-EDRS) as a new surveillance source. Created an Access database to store and display CA-EDRS data.
- The overall rate of WRIF was 2.8 cases per 100,000 workers in California.
- Developed a web-based interactive fatality map that is awaiting approval.

PERFORM TARGETED CASE-BASED FOLLOW-UP AND WORKPLACE INTERVENTIONS

- Conducted 32 targeted investigations of WRIF since 2010, and 238 since 1992 - the greatest number from any state with a Fatality Assessment and Control Evaluation (FACE) program. Investigation findings and prevention recommendations are highlighted in California FACE (CA/FACE) investigation reports.
- Investigation findings from nine tree worker fatality investigations since 2010 led to prevention recommendations that were used to revise tree work regulations, enhance worker trainings, and to add 'asphyxia' to the list of OSHA tree work hazards.
- Conducted four fatality investigations involving workers falling through skylights. Our findings resulted in our participation on the American Society for Testing and Materials committee to develop skylight testing methods.
- Conducted an investigation involving the workplace violence death of a psychiatric technician at a forensic facility. Provided technical information in regard to legislative and regulatory proposals to require workplace violence prevention plans in acute care hospitals, and participated in the Cal/OSHA advisory committee to develop a new comprehensive workplace violence regulation.
- Investigated two fatalities involving workers who inhaled toxic amounts of methylene chloride (MeCl) found in paint strippers. Findings contributed to MeCl being included on the CA Department of Toxic Substances Control *Priority Products* list of the most hazardous products.
- Prevention recommendations from three solar installer investigations addressed hazards such as lack of fall protection and proximity to overhead power lines. Written CA/FACE educational materials and the video *Preventing Falls in the Solar Industry* are featured on the national Fall Prevention Campaign and used in solar worker and student trainings.
- CA/FACE has ongoing collaboration with the NIOSH Western States office and the Fed OSHA Office of Occupational Medicine to investigate a series of deaths linked to volatile organic hydrocarbons among flowback operators in oil and gas production.

COLLABORATE TO EXTEND REACH AND IMPLEMENT PREVENTION STRATEGIES

- Collaborated with Cal/OSHA and CFOI for case ascertainment, fatality investigations and data sharing. Findings from our tree care investigations were used by Cal/OSHA to revise tree work regulations. Currently commenting on proposed revisions to skylight screens and covers.
- Participated in national work groups with industry and NIOSH/OSHA to develop strategies and educational materials for fall prevention and tree worker safety.
- Collaborated with UCLA Labor Occupational Safety and Health (LOSH) program to provide education and outreach to low-wage, immigrant workers.
- Provided technical assistance to state and national advocacy organizations developing guidance on workplace violence prevention plans in acute care hospitals.
- Participated on numerous interagency, advisory, and other work-groups addressing WRIF.

DISSEMINATION, OUTREACH AND EDUCATION

- Produced and disseminated five award-winning bilingual digital stories (short safety videos) involving workers who died when they were thrown against a wood chipper, fell off a roof, fell

through a skylight, were crushed by palm tree fronds, and drowned. These videos were promoted nationally and have received a combined 87,452 YouTube views since 2011. These videos have been embraced by industry and government as valuable teaching tools for workers.
- Updated the CA/FACE website and documented nearly 1 million downloads of our publications, including 454,790 fact sheets and over 505,976 fatality investigation reports.
- Provided 31,565 hard-copy fact sheets to workers and employers.
- Investigation findings have been reported in 13 peer-review and trade publications.
- Published and distributed nine one-page fact sheets (also in Spanish), a total of 28 since 1992.
- Gave 40 presentations to local and national audiences on a variety of WRIF prevention topics.
- Authored and distributed 8 electronic newsletters and 12 email notifications on different WRIF topics, each disseminated to an average of 4,400 recipients.

EVALUATE SURVEILLANCE, INVESTIGATIONS, AND INTERVENTIONS

- Developed a CA/FACE logic model, examining planned or proposed activities in light of anticipated intermediate outcomes and impact, and used the model to guide program planning and evaluation.
- Our evaluation of temporal reporting trends shows a decrease in the number of WRIF cases that have been reported (152 in 1992, 71 in 2012) in LA County to the CA/FACE program.
- Follow-up interviews with 31 employers from investigated cases showed that CA/FACE investigation reports are 'Excellent' or 'Good' (93%), that they implemented at least one of the FACE recommendations (93%); and shared the report with their employees (83%).
- Almost 240 workers, supervisors, and safety trainers rated the CA/FACE videos 'excellent' or 'good' (92%). The videos have been adopted as key training tools for the National Fall Prevention Campaign, the Tree Care Chipper Initiative, and used in safety trainings for DIRECTV, the CA State Building and Construction Trades, large solar companies, unions and municipalities nationwide.

TRANSLATION OF FINDINGS

This program has demonstrated the value of establishing a surveillance system for WRIF, and that WRIF in California remains an important public health problem, affecting many workers with substantial impacts and cost. Ongoing data collection from multiple sources at the state level can lead to identification of occupations at high risk, targeted investigations, outreach, and other dissemination efforts. Findings from this project have been disseminated and used widely by diverse audiences, and have identified issues critical for prevention: effective and widely available control measures or alternative chemicals are often not in use or are used incorrectly; inadequate worker training is common; and inadequate communication and regulation lead to hazards in workplaces statewide.

OUTCOMES/IMPACT

This project has had a significant impact on the risk of WRIF in a number of industries and occupations. Expected *outcomes* include:

- Potential Outcome: Conducted 31 worksite fatality investigations, wrote and disseminated prevention recommendations and nine fact sheets, which, if implemented could decrease workplace fatalities.
- Intermediate Outcome: Findings from nine CA/FACE tree worker fatality investigations led to prevention recommendations that were used to revise tree work regulations, enhance worker trainings, and add 'asphyxia' to the list of OSHA tree work hazards.
- Intermediate Outcome: Findings from two CA/FACE fatality investigations involving methylene chloride (MeCl) exposure contributed to MeCl being included on the CA Department of Toxic Substances Control *Priority Products* list of the most hazardous products.

I BACKGROUND

Since 1992, the Occupational Health Branch (OHB) of the California Department of Public Health (CDPH) has maintained a NIOSH-funded program to conduct ongoing surveillance and a wide variety of intervention activities for work-related injury fatalities (WRIF). The California Fatality Assessment and Control Evaluation (CA/FACE) program utilizes multi-source surveillance data to characterize the nature and extent of WRIF and to target case-based workplace investigations in order to generate and promote practical prevention/intervention strategies that can reduce the risk of WRIF statewide.

II SPECIFIC AIMS

From 2010-2015, we maintained our existing model for the surveillance of WRIF, and implemented new activities that enhanced our previous work. The overall goal during this last funding cycle was to maintain and enhance the California program for the prevention of WRIF. Specific objectives were to: 1) Expand case ascertainment using multiple data sources; 2) Perform case-based field investigations and develop prevention strategies; 3) Collaborate with local and state agencies; 4) Disseminate results generated from project activities; and 5) Evaluate surveillance activities on an ongoing basis.

III METHODS

A SURVEILLANCE

Over the past 23 years, CA/FACE has refined and improved a multi-source reporting system for WRIF in Los Angeles (LA) County. We recognized that the size of California and the relatively large number of fatalities would require a staff beyond the resources available from NIOSH and/or CDPH. Sources for case ascertainment include Cal/OSHA Accident Report Forms (Form 36), the Census of Fatal Occupational Injuries (CFOI), the Los Angeles Department of Coroner (LACCO), the CA-EDRS and Google alerts, news clipping services, police reports and obituaries as routine data sources for case identification. The case definition includes traumatic occupational fatalities resulting from external causes, as established by NIOSH. The "Operational Guidelines for Determination of Injury at Work" published by the Association for Vital Records and Health Statistics are followed. After determining that the case is work-related, the CA/FACE Field Investigator decides in conjunction with the Principal Investigator and Research Scientist which is a potential case for investigation. The final cause of death is determined after the investigation is complete and the coroner's report is received. We have established a relational database for data management and analyses that facilitates tracking of multi-source data collection, data entry administrative tasks, and data quality control/validation. All traumatic occupational fatalities in LA County are selected for data entry and management. Analyses are done on a regular basis using MS Access and SAS to generate rates and descriptive statistics; evaluate data and project progress; monitor trends; and identify high-risk worksites that would benefit from field investigation and the development of prevention strategies.

B CASE FOLLOW UP AND WORKPLACE INTERVENTION

CA/FACE performs workplace field investigations for selected cases to gather in-depth data about the worksite, work processes, and risk factors that led to the fatality. The goal of our field investigations is to identify risk factors for WRIF in order to develop, implement, evaluate, and disseminate prevention strategies. Since 1992, the CA/FACE program has followed various NIOSH-recommended targets for investigation, and added state-specific targets based on: 1) a high number or rate of cases in a particular industry or occupation; 2) a new or emerging hazard or industry; 3) if our findings and intervention potentially have impact on a large number of workers. Over the past 5 years, cases were chosen for investigation based on the NIOSH-recommended targets of machine-related, foreign-born workers, energy production (oil and gas industry), and falls in construction. Since 2010, we have added two state-specific targets: Hispanic worker falls in residential construction and in the renewable energy industry (focus on solar). Staff review new cases and any falling within the selected targets are considered eligible

for investigation. OHB has statutory authority to gain access to the workplace for the purpose of conducting investigations of work-related morbidity and mortality (California Health and Safety Code Sections 105175-105180). Site visits are conducted according to our written Field Investigations Policy and Procedures manual, and include the following methods: on-site industrial hygiene assessment of the workplace and work processes; interviews with employers, employees, and other individuals involved in the incident, and other key informants; photograph and measure the incident scene; review written Injury and Illness Prevention Programs (IIPP), procedures, training records, company history, and machine manuals; coroner and death certificate records; and analysis of the relevant scientific literature and regulatory investigations. In addition, a letter is sent to family members informing them that a CA/FACE investigation has been initiated, and that they can request the final investigation report. The Field Investigator obtains the Cal/OSHA, fire department and/or paramedic reports, equipment testing or failure analyses, and medical records. Once approved, the final fatality investigation report is posted on the CA/FACE and NIOSH websites, including the state-based Occupational Health Clearinghouse; mailed to the employer, family members, and other interested parties; emailed to FACE stakeholders; and promoted via social media.

C COLLABORATION

Collaboration with relevant state and local agencies, advocacy groups, worker and trade organizations, and other interested parties have allowed us to expand our reach and increase our efficacy. By integrating our results and messages into mainstream public health and existing community workplace fatality prevention activities, our work supports the efforts of others who can utilize our data and technical expertise to implement prevention strategies that will decrease WRIF. Our collaborative approach also strives to support more primary prevention-based activities by focusing on promoting safer workplaces to a wide range of audiences and constituencies.

D DISSEMINATION, EDUCATION AND OUTREACH

We conduct outreach and disseminate the findings and recommendations from our CA/FACE program to notify our collaborators and target audiences of the results of significant surveillance findings and site-specific investigations; publicize the consequences of unsafe work practices; and promote effective measures to prevent workplace fatalities to all parties who can implement change. In addition to our WRIF dissemination database of over 2,200 CA/FACE stakeholders and employers we utilize a mailing list of over 12,000 organizations and individuals maintained by the OHB. We disseminate information in a variety of formats, including materials for workers about prevention of WRIF, specific exposures, and workplace legal rights; worksite specific letters with findings and recommendations; scientific publications; materials about prevention for employers; conference presentations; grand rounds, and other presentations to health care providers; written comments to regulatory agencies and voluntary standard-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 website; and digital stories highlighting cases and prevention.

E EVALUATION

We recognize the important role that evaluation plays in ensuring that our surveillance system is effective in tracking and preventing work-related fatalities. We have been using a logic model during the last 5 years to track our objectives, outputs, and outcomes. This allows us to quantify outputs and evaluate if they have had any impact. Over the past 23 years, we have conducted ongoing evaluation using the CDC Guidelines for Evaluating Surveillance Systems. We have also reviewed past evaluations of the CA/FACE program and incorporated recommendations for both surveillance and interventions. We have taken many steps to assess the different components of our system, including surveillance efficiency, worksite investigations, and information dissemination.

IV RESULTS AND DISCUSSION

A SURVEILLANCE

From 1992-2012, CA/FACE identified and confirmed 2,375 cases of WRIF in LA County. The average number of fatalities per year (113) in LA County ranks 18th when compared to other *states*. Both the number and rate of WRIF in LA County has declined during the 21 year period (1992-2012), paralleling the overall trend in California and nationwide. The overall rate of WRIF from 1992 to 2012 is 2.8/100,000 employed. The rate of WRIF among Hispanic workers (3.7/100,000) was 62% higher than non-Hispanic workers (2.3/100,000). The fatality rate in LA County has decreased from 2.8/100,000 (2006) to 1.8/100,000 (2012), compared with a decrease nationally from 4.2/100,000(2006) to 3.4/100,000 (2012). Although there has been a significant downward trend in both total occupational fatality and homicide rates in LA County, transportation, falls and machine-related fatality rates have not seen a significant downward trend. Homicide is the leading cause (30%) of work-related death, followed by transportation-related (19%), falls (13%) and machine-related (8%). Major industry categories with the highest rates from 2008 to 2012 are transportation, warehousing & utilities (5.5/100,000), and construction (5.2/100,000). The five occupations with the highest rates are fishing and hunting workers (113.6/100,000), counter & rental clerks (33.2/100,000); roofers (26.7/100,000); taxi drivers & chauffeurs (22.9/100,000); construction workers (17.3/100,000), and security guards (15.8/100,000). CA/FACE developed a web-based interactive fatality map and this is now posted on a test web site as it awaits approval. The CA/FACE fatality map allows the viewer to easily search (using filters) for workplace fatalities based on location (zip code), demographics (year, age, sex, race, and ethnicity) and other variables (occupation, industry, cause of death).

B CASE FOLLOW-UP AND WORKPLACE INTERVENTION

From 2010-2015, CA/FACE staff conducted 31 worksite fatality investigations. On average, 11 fatality investigation reports have been published each year since 1992. The leading causes of death in investigated cases were machine-related, falls, electrocution, confined space and highway/roadway construction work zones. Numerous recommendations have been made as a result of our investigations and have been used to affect change in regulations or work practices:

Tree Care Workers: Investigation findings from nine fatality investigations since 2010 led to recommendations about staging and inspection of debris, trimming palm trees from above frond growth, the importance of having a safety watch, and proper worker training and certification. CA/FACE supported increased tree worker protections in our comments to the proposed Cal/OSHA Revision of *General Industry Safety Orders, Tree Work, Maintenance or Removal*. Since 2012 CA/FACE has participated in a tree care safety work group with NIOSH, OSHA, the Tree Care Industry Association (TCIA) and the International Society of Arboriculture (ISA). Using findings from seven CA/FACE tree worker fatality investigations since 2010, we prioritized educational efforts and dissemination methods with other work group members. The CA/FACE digital story and fact sheet, *Preventing Palm Tree Worker Fatalities*, were identified as priority educational needs.

Falls Through Skylights: CA/FACE investigated four fatalities where workers fell through rooftop skylights. Our recommendation to use skylight screens, covers, guardrails or personal fall protection systems when working within six feet of a skylight has led to our participation on the American Society for Testing and Materials (ASTM) International committee to establish a new test method for human impact on commercial skylights (ASTM WK17797). Our findings are helping to determine the weight of worker to protect, distance of fall, material/equipment selection, testing protocol, weathering effects, and labeling. We are also participating in current Cal/OSHA advisory meetings on skylight fall protection. In addition, our skylight fact sheets and digital story, *Preventing Falls Through Skylights*, are featured in the National Fall Prevention Campaign.

Workplace Violence: Based on our investigation findings from the death of a psychiatric technician at a large forensic facility, we provided technical information in regard to legislative and regulatory proposals

to require workplace violence prevention plans in acute care hospitals. CA/FACE participated in the Cal/OSHA advisory committee process to develop a new comprehensive workplace violence regulation.

Methylene Chloride: CA/FACE investigated two workers who died after they inhaled toxic amounts of methylene chloride (MeCl) found in paint strippers. Our investigation findings and other OHB materials contributed to MeCl being included on the Priority Products list of the most hazardous products by the California Department of Toxic Substances Control (DTSC). DTSC is asking manufacturers to begin to identify alternatives.

Solar Industry: Prevention recommendations from three CA/FACE solar installer fatality investigations addressed hazards such as pitched roofs, working too close to the edge, lack of fall protection, and proximity to overhead power lines. Multiple educational materials and presentations about 'green job safety' were given at solar industry and national conferences, and our solar digital story, *Preventing Falls in the Solar Industry*, is featured on the National Fall Prevention Campaign and used in worker and student trainings.

Oil and Gas Industry: CA/FACE has ongoing collaboration with the NIOSH Western States office and the Fed OSHA Office of Occupational Medicine to investigate a series of deaths linked to volatile organic hydrocarbons among flowback operators in oil and gas production.

C COLLABORATION

CA/FACE has collaborated with federal, state, and local agencies, health care professionals, industries, trade associations, labor organizations, worker advocacy groups, and community-based organizations in our ongoing program activities. We have participated on numerous interagency, advisory, and other work-groups addressing workplace fatalities.

Participation in national workgroups: CA/FACE participated in topic area work groups within NIOSH, OSHA, trade associations, and other FACE surveillance states. CA/FACE was a partner in the national Fall Prevention Campaign and participated in tree care worker safety and oil and gas workers in the Western States work groups. We mentored other FACE states on how to develop digital stories, and participated in the California Department of Toxic Substances Control workgroup to publish Priority Products list for hazardous products including MeCl, and with the American Society for Testing and Materials (ASTM) International committee to establish new testing methods for human impact on commercial skylights.

Inclusion of Low-wage Workers: Low wage and/or immigrant workers are difficult to reach for surveillance and prevention activities. To try to address this challenge, CA/FACE partnered with several organizations including the UC Berkeley Labor Occupational Health Program, the UCLA Labor Occupational Safety and Health Program, and the Hispanic Arborist Association to develop Spanish-language educational materials and disseminate them to low-wage and/or immigrant workers.

Collaboration on external primary prevention efforts: CA/FACE provided technical guidance and review while ensuring the inclusion of workplace fatality prevention strategies in numerous documents and prevention efforts statewide. Collaborations ranged from assisting local agencies, to providing national advocacy groups and statewide agencies with the information necessary to create guidance, articles and publications about workplace fatality prevention.

D DISSEMINATION, EDUCATION AND OUTREACH

Effective translation of results into guidance and interventions is essential for effective surveillance and prevention programs to be effective. We conduct outreach and disseminate the findings and recommendations from our CA/FACE program to notify our collaborators, stakeholders and target audiences of the results of significant surveillance findings and site-specific investigations; publicize the consequences of unrecognized or uncontrolled exposure to workplace hazards; and promote effective illness and injury prevention measures to all parties who can implement change. In addition to our CA/FACE-specific dissemination database of over 2,200 stakeholders and employers, OHB maintains a mailing list (contacts database) of over 12,000 stakeholder organizations and individuals. Recently, the OHB developed a guidance document, '*OHB Communications Guidelines*', which includes communications

principles, guidance for product development, dissemination and evaluation, and several tools for decision-making. Our target audiences and major objectives for education and outreach include: 1) employees, labor unions and/or other labor advocacy groups to improve WRIF recognition, knowledge of exposure control measures, and ensure awareness of employee rights to a safe and healthy workplace; 2) employers and industry-wide organizations to increase employer recognition of workplace hazards, and to encourage implementation of effective exposure control and prevention measures; 3) medical and public health professionals to increase recognition of WRIF and knowledge of reporting requirements, and create a constituency that advocates for policy changes to ensure safer workplaces; 4) federal, state, and local governmental agencies to contribute to national WRIF surveillance efforts, and to promote regulatory and policy efforts to prevent WRIF; and 5) environmental and other community-based organizations to promote recognition of the linkage between exposures to hazards and toxic agents in the workplace and in the community, and promote workplace hazard control measures.

We disseminate data and prevention recommendations in a wide variety of formats, including written materials for workers about prevention and management of WRIF, workers' compensation and other workplace legal rights; surveillance summaries, fact sheets and hazard advisories; work site specific letters with detailed findings and recommendations; scientific reports and peer-reviewed publications; articles for trade organization publications; presentations at worker, medical, public health, and industry meetings or conferences; written comments to regulatory agencies and standards setting organizations on 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. Highlights of our education and outreach efforts over the past five years include:

Digital stories**:** CA/FACE pioneered the use of digital stories to bring FACE investigations 'to life'. Written findings and recommendations from fatality investigations are highlighted with video re-creations, photos, co-worker and family memories and narration, and clear explanations of how these tragedies can be prevented. Since 2010 we have produced five award-winning (APHA, National Public Health Information Coalition) digital stories involving workers who died when they were thrown against a wood chipper, fell off a roof, fell through a skylight, were crushed by palm tree fronds and drowned in a lake. These videos are promoted through social media, newsletters, APHA Film Festival, the national Fall Prevention Campaign and stakeholder publications. These five videos have received a combined 87,425 YouTube views since 2011, making them among CDPH's most popular videos. CA/FACE has mentored other FACE states and NIOSH in creating new digital stories, and they are featured on the NIOSH website topic page *FACE Reports Brought to Life*.

Fact sheets and fatality alerts**:** Nine one-page *fact sheets* have been published in both English and Spanish since 2010, a total of 27 published since 1992. Fact sheets highlight investigation findings and recommendations and warn workers of hazards associated with certain tasks, occupations, and industries. The target population is workers, so each is written at a sixth-grade reading level. Approximately 31,565 hard-copy fact sheets have been disseminated since 2010. *Fatality alerts* feature preliminary recommendations from ongoing fatality investigations, and are rapidly published to seek maximum media attention (usually within two weeks of the initial investigation site visits). Three alerts have been published since 2010 highlighting deaths from MeCl and palm tree suffocations. Both fact sheets and alerts are posted on the CA/FACE website and disseminated through employer mailings, social media, email notifications, and worker centers, community events, and conferences.

Fatality investigation reports**:** Thirty-three in-depth investigation reports have been published and posted on the CA/FACE and NIOSH FACE websites since 2010. We disseminate our investigation findings and recommendations to a broad audience of workers, employers, labor, trade associations and community-based organizations.

Peer-reviewed and trade publications**:** Investigation findings have been reported in thirteen publications since 2010. By including our findings in more general trade publications, we reach a much wider audience with our prevention messages.

Presentations**:** Project staff has presented the results of surveillance data and investigations to diverse audiences including public health professionals, health care providers, workers, employers, unions, and non-governmental and community-based organizations, and at 40 national conferences and professional meetings, reaching almost 2,500 attendees.

Occupational Health Watch newsletter and FACE email notifications: Findings and publications from CA/FACE have been featured in 12 e-mail notifications (blasts) to over 2,000 FACE stakeholders, and in eight monthly issues of our OHB electronic newsletter, *Occupational Health Watch* (OHW). OHW is a monthly e-newsletter highlighting updates of recent Branch activities, and is distributed to over 4,000 OHB stakeholders including health care professionals, trade associations, labor organizations, health and safety professionals, and community-based organizations.

Website and social media efforts**:** All investigation reports, fact sheets, and worker fatality alerts are posted on the CA/FACE website**.** Since 2010, we have created nine new website topic pages, clustering our publications and resources into topic-specific information portals (pages). The CA/FACE website has received 296,040 views since July 2010 – an average of 4,934 per month. We have documented nearly 1 million downloads of our publications, including 454,790 fact sheets and over 505,976 fatality investigation reports. In addition, our *occupational fatalities Wikipedia page* has averaged over 2,000 views per month. Select CA/FACE publications are promoted through CDPH and NIOSH FACE Facebook and Twitter, as well as other organizational blogs.

Worker trainings**:** CA/FACE published bilingual *Fall Prevention Tailgate Training Cards* in four fall prevention topic areas (skylights, roofs and floor openings, scaffolds, and ladders) to pair with our solar and skylight digital stories. CA/FACE staff used these tailgate materials to train almost 180 construction workers, foremen and superintendents in fall prevention. These and other program materials have been used as teaching tools in worker and student trainings for the California State Building and Construction Trades Council 'Train the Trainer' courses, The UCLA Worker Occupational Safety and Health Training and Education Program (WOSHTEP), OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER), the Center for Occupational and Environmental Health (COEH), UCSF School of Nursing, UC Berkeley School of Public Health, the University of California Davis and University of Florida 'Fumigation School', Coordinating Committee for Automotive Repair (CCAR), and several large national employers and municipalities including the City and County of San Francisco, and DIRECTV.

Hispanic worker outreach**:** Special efforts to reach foreign-born and low-wage vulnerable workers include: translating all fact sheets, tailgate training cards, and digital stories into Spanish; featuring all Spanish publications on a CA/FACE 'En Español' web page; disseminating fact sheets at community events such as health and training fairs, Worker's Memorial Day events, Latino symposiums, Ventanilla de Salud at the Mexican and Central American Consulates, Instituto de Educacion Popular del Sur de California (IDEPSCA) safety sessions, bilingual WOSHTEP worker trainings, and labor centers.

In addition to the many presentations and written materials cited above, our program has also provided written comments on proposed or existing regulations to Cal/OSHA and NIOSH; provided fatality prevention recommendations to Cal/OSHA to assist in their assessment of several standards.

E EVALUATION

Surveillance

Our evaluation of temporal reporting trends shows a decrease in the number of WRIF cases that have been reported (152 in 1992, 71 in 2012) in LA County to the CA/FACE program. This decrease parallels the reduction in cases reported from the CFOI program in California, and nationally (BLS CFOI 2014). Since CFOI is the most comprehensive reporting system for WRIF, we believe the case count decrease reflects a true decline in overall cases (rather than due to reporting problems). The *timeliness* of our

surveillance system is adequate for case follow-up, with a median of eight days elapsed between work-related fatal incident onset and investigator notification. In evaluating *case classification*, out of a total of 2,729 cases reported from LA County as possibly due to work from 1992 through 2012, 2,375 (87%) met the NIOSH FACE definition for work-relatedness.

Workplace follow-up and interventions

To evaluate our CA/FACE field investigations, we assess the capacity to respond to case reports in a timely manner; the quality of our investigations; and the public health impact of our efforts. We have evaluated each step in our field investigations to identify procedures that maximize our ability to gain access to the worksite, 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. All investigations initiated by the CA/FACE program resulted in the development and wide dissemination of comprehensive written recommendations for fatality prevention and the development of incident summaries that were transmitted to NIOSH. In worksites without a union, we identified the need to emphasize collaboration with environmental, community-based, and other non-governmental organizations with access to, and the trust of workers. Participation rates for on-site worker interviews have been excellent, averaging 85% for work-related fatality investigations since 2010. Follow-up interviews via phone have about a 60% participation rate, as some workers were no longer in the U.S. Our selection criteria for investigations have been very successful in identifying incidents with broad public health significance. Due to resource limitations, we can only follow-up on a small proportion of eligible cases. The results of investigations have provided useful information regarding potential workplace hazards, and have had important effects on policy and standards. The recommendations in our investigation reports are directed towards the parties with the authority to implement changes - usually employers, trade associations, and regulatory agencies.

Dissemination of information

The *quantity* of education materials distributed, the types of audiences to whom materials were disseminated, the number of talks or training provided, and the number of participants who have attended are evaluated continuously. The *quality* of our dissemination efforts is evaluated by whether our approaches are consistent with the language and literacy needs of the target audiences, and if they are presented in a culturally appropriate manner. For example, to guide the design of our worker-focused materials, we have collaborated with the UCLA Labor Occupational Safety and Health program to increase outreach to foreign-born, low-wage workers. The findings and recommendations of our field investigations are summarized in simple language and also translated into Spanish. In light of our limited resources and the diversity of the workforce, we do not have the capacity to conduct extensive outreach. Rather, we conduct outreach and foster collaborative working relationships with trade associations, unions, government and community based organizations. These organizations in turn disseminate the findings and recommendations of our project to their constituents.

V CONCLUSIONS

Over the last 5 years of the cooperative agreement, CA/FACE has successfully maintained and expanded the surveillance of WRIF in California. We have used targeted case investigations, collaboration with other organizations, and dissemination of our findings to implement prevention strategies for work-related asthma statewide. By focusing on primary prevention activities and coordinating our efforts with other asthma prevention programs, we have been able to maximize our impact. These successful approaches will be continued and expanded over the next 5 years of CA/FACE surveillance and prevention activities.

PUBLICATIONS

In the last five years, we have authored or co-authored two contributions on WRIF in the peer-reviewed literature, books, or government reports:

- Joe L, Harrison R, Shusterman D, McNary J, Krishnaswami J. Dichloromethane (Methylene Chloride) in Paint Strippers: Survey of Retail Stores. Richmond, CA: California Department of Public Health, 2012.
- MacIsaac J, Harrison R, Krishnaswami J, McNary J, Suchard J, Boysen-Osborn M, Cierpich H, Styles L, Shusterman D: [2013] Fatalities Due to Dichloromethane in Paint Strippers: A Continuing Problem. Am J Ind Med 56(8):907-910.

SECTION 1: CARPAL TUNNEL SYNDROME (CTS)

SIGNIFICANT FINDINGS

REESTABLISH AND ENHANCE OUR PREVIOUS SURVEILLANCE SYSTEM FOR CTS

- Continued our analysis of workers' compensation data that can be used for efficient and timely targeting of occupations and industries for intervention and prevention activities.
- Extracted 89,762 possible and probable cases of CTS from the 2006-2011 Workers' Compensation Information System (WCIS) datasets, developed a series of procedures that allowed us to assign a Census Industry Code (CIC) to 95% of these cases, and used the NIOSH Industry and Occupation Computerized Coding System (NIOCCS) to assign Census Occupation Codes (COC). With industry and/or occupation codes assigned to cases, we calculated industry specific rates of CTS and ascertain the major occupational groups within these high rate industries.
- Coded CTS industry rates for the top 30 industries using a multistep process, finding demographic case characteristics and occupations within the top 10 industries (presented at the 2014 annual CSTE meeting).
- Identified California establishments with two or more claims of CTS among employees with the same job title within any 12-month period between 2006 and 2011.
- Identified the ten leading occupations with CTS and reviewed this data to determine whether (1) there is evidence in the medical or scientific literature of ergonomic interventions for these occupations that can reduce the risk of MSDs; (2) information is already widely available to employers and employees about how to reduce the risk of MSDs; and (3) targeted ergonomic interventions are feasible and have an opportunity for collaboration.
- Selected dental hygienists for ergonomic evaluation and interventions.

UTILIZE SURVEILLANCE DATA TO PERFORM SELECTED CASE FOLLOW-UP AND WORKPLACE INTERVENTIONS WITH PREVENTION RECOMMENDATIONS FOR EMPLOYERS AND EMPLOYEES

- Conducted targeted evaluation of the risk of CTS associated among dental hygienists. Visited dental offices to observe work practices and the risk of MSDs including CTS. Findings were incorporated into extensive prevention recommendations for dental hygienists that were used to inform our in-depth ergonomic video series.

COLLABORATE WITH LOCAL AND STATE AGENCIES AND A WIDE RANGE OF OTHER PARTNERS TO TRACK CTS IN THE WORKPLACE AND IMPLEMENT PREVENTION STRATEGIES

- Collaborated extensively with the UC Berkeley Ergonomic Program (David Rempel, MD) to develop a selection of industries and occupations that would most benefit from ergonomic education programs designed to prevent CTS. Dr. Rempel and his team worked with us to design and complete a series of short instructional videos aimed at preventing CTS among dental hygienists,
- Collaborated with the California Dental Hygienist Association (CDHA), San Francisco Component, on an advisory board that created scripts, storyboards and published five videos to educate dental hygienists about CTS, MSDs, and how to prevent work-related injuries.
- Collaborated with CDHA to produce a "home study" article for the CDHA Journal that will allow dental hygienists to complete two continuing education units based on the videos and an accompanying article.

DISSEMINATE USING A VARIETY OF MEANS OUR SURVEILLANCE DATA, FINDINGS OF CASE INVESTIGATIONS AND INTERVENTION RESULTS

- Completed a major report of CTS surveillance findings in California, and presented summary of results to BLS, NIOSH and State research partners in July 2012. A peer-reviewed paper has been published.

- Developed a series of five educational videos on dental hygiene and ergonomics.

EVALUATE THE RESULTS OF SURVEILLANCE, FIELD INVESTIGATIONS AND INFORMATION DISSEMINATION

- Developed a logic model for our program, examining planned or proposed activities in light of anticipated intermediate outcomes and impact, and used the models to guide program planning and evaluation.
- Evaluated surveillance reporting trends, which documented a substantial burden of CTS in California
- Demonstrated feasibility and utility of using workers' compensation data to enumerate cases of CTS in California.
- Identified employers with multiple cases of CTS that may benefit from public health education and intervention efforts to implement and effective ergonomic program.

TRANSLATION OF FINDINGS

An ongoing multisource surveillance system for CTS in California has the potential to identify high-risk occupations and industries that can implement effective ergonomic programs to reduce the known risk factors for work-related musculoskeletal disorders (MSDs). In 2011, California enacted a standard for Safe Patient Handling in acute care hospitals that may significantly lower the rate of MSDs. The methods for CTS surveillance can be applied to tracking the incidence of other MSDs such as back injuries that occur to healthcare personnel in these settings. Likewise, the California Safety and Health Standards Board is considering a new standard to reduce MSDs among hotel housekeepers. This standard is expected to set the benchmark for improving ergonomic work practices in this major industry (http://www.dir.ca.gov/dosh/doshreg/Hotel_Housekeeping.html). The surveillance methods and systems for tracking CTS cases are currently being used to evaluate the risk of MSDs among this population, and to inform the rulemaking process. The ongoing analysis of surveillance data on the risk of CTS and other MSDs in selected occupations and industries has lead to public health and regulatory interventions that reduce the medical and other costs associated with these disorders.

OUTCOMES/IMPACT

This project has had impact on the risk of CTS in dental hygienists and potentially other occupations at risk for CTS. Expected *outcomes* include:

- End Outcome: Reduction in the risk and incidence of CTS among high risk occupations in California
- Intermediate: Reduction in ergonomic hazards among dental hygienists who follow the prevention and exposure reduction guidance in our educational materials.
- Potential: Reduced exposure to ergonomic hazards and development of CTS in environments targeted by the guidance of other organizations where we provided technical assistance and collaboration.

SECTION 2: SCIENTIFIC REPORT
CARPAL TUNNEL SYNDROME (CTS)

I BACKGROUND

The Occupational Health Branch (OHB) of the California Department of Public Health (CDPH) reestablished and expanded our previous NIOSH-funded occupational injury and illness surveillance program for carpal tunnel syndrome (CTS). California has had a 28-year history of NIOSH-funded cooperative agreements for State-based surveillance under the SENSOR and Enhanced surveillance programs, including work-related asthma (1992-present), carpal tunnel syndrome (1987-1992, 1997-2002, 2010-2015), pesticide illness (1987-1992, 1997-present), traumatic fatalities (FACE) (1992-present), silicosis (1997-2002), non-fatal construction falls (1997-2002), and tuberculosis (1992-1997).

The California CTS program is integrated into the overall goals of our surveillance program, including the implementation of models that can be used by other States for targeted surveillance of occupational injuries, illnesses and hazards, and demonstration of practical prevention/intervention activities that can reduce the risk of work-related injuries and illnesses, The CTS Program utilizes multi-source surveillance data to characterize the nature and extent of CTS and to target case-based workplace investigations in order to generate and promote practical prevention/intervention strategies that can reduce the risk of CTS statewide.

II SPECIFIC AIMS

From 2010-2015, we maintained our existing model for the surveillance of CTS, and implemented new activities that enhanced our previous work. The overall goal during this last funding cycle was to maintain and enhance the California program for the prevention of CTS. Specific objectives were to:

- Resume conducting *multi-source surveillance* for CTS, relying on our existing statewide reporting system using workers' compensation data while improving our data management capabilities.
- Perform selected *case-based investigations* based on our review of surveillance data. *In addition*, we identified and recommended sustainable ergonomic interventions, and performed targeted investigations to prevent CTS among dental hygienists. Data was also used to target worksites with multiple cases of CTS in order to evaluate the impact of the California Division of Occupational Safety and Health (Cal/OSHA) ergonomic standard.
- *Collaborate with a diverse range of local and state agencies and other organizations* to develop and implement CTS prevention strategies, as well as continue outreach to employers, labor organizations, health care providers, and community-based organizations.
- *Disseminate surveillance and case investigative findings* to our target audience through a variety of methods including fact sheets, newsletters, field investigation reports, web site content, and peer-reviewed scientific publications. *In addition*, we incorporated the results of our findings and recommendations into an electronic periodical of occupational health surveillance and workplace interventions *(Occupational Health Watch).*
- Perform routine *evaluation* of the CTS surveillance system for case ascertainment (temporal reporting trends, timeliness or reports, sensitivity), case follow-up and field investigations (medical records retrieval, work site employer and employee participation rates), and information dissemination (timeliness of reports, number distributed). *In addition*, we will conduct a formal evaluation of our surveillance system using published CDC guidelines and evaluate the impact of our work site recommendations.

III METHODS

A SURVEILLANCE

1. Identify and Evaluate Reporting Sources for Case Ascertainment

California implemented an electronic system for workers' compensation information that is consistent with national data standards in 2000. This system collects First Reports of Injury for all workers who have filed a workers' compensation claim, as well as Subsequent Reports of Injury, and Medical Billing data. The OHB surveillance program has established an MOU with the Department of Industrial Relations to access WCIS data on an ongoing basis.

Cases were extracted from WCIS using nature of injury, cause of injury, part of body injured, injury description, ICD-9 diagnosis, and procedure codes, were classified as probable, possible, or uncertain cases as previously described. We followed a systematic stepwise process: (1) Several injury classifications were excluded *a priori* based on their inability to be MSDs. For example any injury caused by burn, cold exposure, or motor vehicle was excluded; any injury with a nature of poisoning, cancer, contagious disease, dermatitis, poisoning, or laceration was excluded; and any injury affecting the head was excluded. (2) Text description of the injury and medical billing data of a set of cases for each injury classification were reviewed to determine if different parts of body, nature of injury, or causes of injury should be included in the case definition. We set a 90% threshold for including each part of body, nature of injury, and cause of injury classification, and reached a consensus about each case we viewed. Through this process, we excluded injuries caused by being caught in or between an object; caused by a cut, puncture, scrape, or caused by a fall or slip. This process produced the list of acceptable injury classifications. (3) Finally, we decided on the relationship between the three injury classification fields.

While it is theoretically possible that a claim that matches only an acceptable cause of injury or nature of injury should be satisfactory to include it as a case, previous experience and examination of the data let us to believe that a combination of all three fields is necessary for a valid case definition. We examined three sets of potential cases: 1) claims with an acceptable nature of injury, cause of injury and part of body, 2) claims with an acceptable cause of injury and either nature of injury or part of body, and 3) claims with an acceptable part of body and either cause of injury or nature of injury. We decided that the more restrictive definition of claims that matched on all three classifications was preferable.

A case was classified as probable if it had a diagnosis or procedure code indicating CTS and 3-4 acceptable criteria variables. Possible cases had 2 acceptable criteria values with an acceptable ICD-9 code, or four criteria values without a diagnosis or procedure. Probable and possible cases of CTS from 2006-2011 were included in our analysis.

Case Classification matrix

Procedure code	ICD-9 Dx Code	Number of Acceptable Criteria Variables				
		4	3	2	1	0
64721 or 29848	Any	Probable	Probable	Possible	Uncertain	Uncertain
Any	354 or 354.0	Probable	Probable	Possible	Uncertain	Uncertain
Other or N/A	Other or N/A	Possible	Uncertain	Uncertain	Uncertain	Uncertain

Criteria Variable	Acceptable Values
Nature of injury	78, Carpal tunnel syndrome 49, Sprain or tear 52, Strain or tear 80, All other cumulative injury
Cause of injury	97, Repetitive motion 60, Strain or injury by 98, Cumulative 94, Rubbed or abraded by
Part of body	33, Lower arm 34, Wrist 35, Hand 36, Finger(s) 37, Thumb 39, Wrist(s) & Hand(s) 30, Multiple upper extremities 90, Multiple body parts
Injury description	Contains a variation of the term "carpal," "CTS," etc. or "numbness" or "tingling"

The WCIS does not require a specific industry coding system such as North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC). Some claims administrators submit NAICS codes, some submit SIC codes, and some do not submit industry codes because they are not required to do so. Furthermore, rate calculation requires a numerator and a denominator, and WCIS does not collect the number of employees' hours worked for use as a denominator. Because some workers are part time and some are full time, it has been shown that rates for workers are more accurate and easily understood when the full time equivalent (FTE) is used as a unit of measurement for the denominator. An FTE is equal to the total number of hours worked divided by 2,000 hours, which is equivalent to 50 work weeks at 40 hours per week.

Among identified CTS cases, 26% of claims had a NAICS code, 49% had an SIC code, and 25% had no code for industry. Fifty-three percent (53%) of CTS claims ascertained from WCIS originally had a SIC or NAICS code that could be cross walked directly to a CIC code using a cross walk table from the U.S. Census Bureau. Our manual coding of the remaining cases resulted in 83% of all claims being coded.
We then used the American Community Survey (ACS) to calculate a denominator. The ACS is a publicly available dataset that replaced the decennial census long form in 2010. The ACS utilizes the Census Industry Code (CIC) system to classify respondent's industries. The ACS provides Public Use Microdata Sample (PUMS) files that contain 1% of the housing units sampled for each year, and a weight for each record. The ACS asks each survey respondent to report the number of weeks she or she worked in the last 12 months and the usual hours he or she worked per week. The FTE is calculated by summing the weighted annual hours worked by industry and dividing by 2,000 hours.

In order to calculate rates of CTS, we assigned a CIC code to cases ascertained from the WCIS. We chose to assign a CIC code to each case to match the industry coding of the ACS denominator data. Preliminary review of the data determined that due to differing degrees of completeness of industry coding among

industries, some manual coding of claims would be necessary to generate accurate rates of injury. We developed a 12-step process for coding the injury. This involved crosswalks for existing coded claims, using employer name to determine industry, consolidating similar industries, and using class codes. Because we could not accurately assign a CIC code to some cases we were required to create eight industry descriptions that are groupings of two or more industry groupings: power generation, transmission, and distribution; banking services; wired and wireless telecommunications; offices of physicians and outpatient care centers; nursing care and residential care facilities; beauty, nail, and barber salons; aircraft and aerospace manufacturing, and government services excluding justice, public order, and safety. The industry code of cases among industries with the 30 highest rates of carpal tunnel syndrome was individually validated by manually reviewing the accuracy of coding of the employer.

Denominators and rates were calculated using SAS. From the PUMS data sets for each year, we excluded federal workers, individuals who were self-employed, people in the armed forces, and workers under 14 years of age to match cases eligible for inclusion into the WCIS. We used the NIOSH Industry and Occupation Computerized Coding System (NIOCCS) to aid us in assigning a 2010 Census Occupation Code (COC) to each case in the ten industries with highest rates of CTS.

2. Maintain and Enhance Case Definition and Case Classification Criteria

We utilize our previous reporting guidelines and NIOSH case definitions for CTS surveillance. This allows comparison with work-related CTS rates from previous time periods of our program in California, and is consistent with the published literature regarding population-based CTS surveillance. This CTS case definition is relevant to surveillance only, as it does not rely on clinical confirmation using electro diagnostic studies, and should not be used for clinical or diagnostic purposes.

3. Maintain and Enhance Case and Data Management Systems

We continue to include all procedures for data coding and standardization, quality control and confidentiality of data, and added features to track data source, flag worksites with more than one case, and track additional follow-up data. In addition, data management tools were developed to accommodate and assess WCIS data, including methods to evaluate the efficacy of report selection criteria. Once selection criteria were finalized and the query code refined, a system was developed to transfer WCIS data into our existing CTS database. An algorithm for record linking based on unique identifiers was created to streamline duplicate checking with the current CTS database. Code was written to translate WCIS data into existing data formats, and to import new data into our surveillance database.

4. Perform Data Analysis for Surveillance Data

We performed surveillance data analyses including basic descriptive statistics, multivariate analysis to evaluate relationships between cases and a wide variety of variables, and relative capture of the various data sources for case ascertainment.

B CASE FOLLOW UP AND WORKPLACE INTERVENTION

We continued to link the results of our surveillance activities with work site follow-up. Our ergonomic consultant (David Rempel) reviewed CTS reports based on the magnitude of the public health impact represented by the incident report(s): (1) CTS cases involving a large number of workers, or involving an ergonomic exposure that is common to a large population of workers; (2) a large number or rate of CTS reports related to a single hazard, occupation, industry, or task; (3) an ability to reduce the physical risk factors for CTS or where we believe work site evaluation suggests that prevention recommendations are feasible (including possibly tool/equipment redesign) and/or there is an opportunity to distribute industry-wide prevention materials; and (4) “sentinel events,” which are case reports that may represent a new or emerging hazard, or a failure of recognized control measures or regulations to effectively control exposures. Based on our analysis of the CTS surveillance data, and evaluation of in-depth case follow-up and workplace interventions conducted over 5 years, we conducted targeted evaluation of the ergonomic hazards among dental hygienists.

California is the only state with a specific ergonomics standard. Under this standard (Section 5110 - Repetitive Motion Injuries), an employer must implement an ergonomics program when a repetitive motion injury (RMI) has occurred to more than one employee under the following conditions: (1) the repetitive motion injuries (RMIs) are predominantly caused (i.e., 50% or more) by a repetitive job, process, or operation; (2) the employees incurring the RMIs were performing a job process, or operation of identical work activity (identical work activity means that the employees were performing the same repetitive motion task, such as but not limited to word processing, assembly, or loading); (3) the RMIs are musculoskeletal injuries that a licensed physician has objectively identified and diagnosed; and (4) the RMI cases have been diagnosed within the previous 12 months. If the standard is triggered, the employer must include the following three elements in a program designed to minimize RMIs: (1) each job, process, or operation of identical work activity, or a representative number of such jobs, processes, or operations of identical work activities shall be evaluated for exposures which have caused RMIs; (2) any exposures that have caused RMIs shall, in a timely manner, be corrected or if not capable of being corrected have the exposures minimized to the extent feasible; and (3) employees shall be provided training that includes an explanation of the employer's program, the exposures which have been associated with RMIs, the symptoms and consequences of injuries caused by repetitive motion, the importance of reporting symptoms and injuries to the employer; and the methods used by the employer to minimize RMIs.

Our surveillance system for CTS provided a unique opportunity to determine the extent to which employers in California have implemented the essential elements of an ergonomics program. First, the NIOSH case definition for CTS used in our surveillance system should be *de facto* evidence for both criteria (1) and (3) above; e.g., an RMI injury is "predominantly caused" by work and that a licensed physician has "objectively identified and diagnosed." Second, in cases where the physician or patient describes in detail the work process among the same occupation (such as keyboard use), it is probably safe to assume that criteria (2) above can be applied, e.g., the same repetitive motion task. Therefore, when we receive WCIS reports of two or more cases of CTS within a 12-month period among employees performing the same repetitive motion task at the same work site, we believe that an ergonomics program under CalOSHA regulations should have been implemented by that employer.

Between 2006 and 2011, we identified all employers in industries with the highest statewide rates of CTS, where we have received two or more cases of CTS among employees performing the same repetitive motion task within a 12-month period (“repeater”). A CTS claim matched the repeater criteria if the same employer had at least one other claim in our CTS data set with the exact same occupation description and the two claims fell within 365 days of each other.

As can be seen in the Table below, there were 2,428 employers with 28,034 claims for CTS in which these claims were “repeaters” that should have triggered an ergonomics program to comply with the California RMI standard.

Year	Distinct Employer Names	Distinct Employees	Claims
2006	811	4,881	5,011
2007	1,044	5,360	5,503
2008	918	4,677	4,776
2009	938	4,714	4,805
2010	892	4,203	4,294
2011	712	3,586	3,645

C COLLABORATION

We continued to coordinate and collaborate with relevant state and local agencies, and with other organizations and individuals in efforts to integrate occupational health into mainstream public health and thereby leverage our efforts to prevent work-related CTS. 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 CTS. In addition to these ongoing efforts, we initiated a collaborative project with the UC Ergonomics program (David Rempel, MD). This program has a well-established history of developing alternative technologies to perform tasks at high-risk for musculoskeletal disorders. A number of interventions have been developed, including alternatives for overhead drilling and cake decorating, and our collaboration with this program enabled us to offer the dental hygiene community a comprehensive set of interventions and a state-wide educational program.

D DISSEMINATION, EDUCATION AND OUTREACH

We continued to disseminate the findings and recommendations of the CTS program to our target audiences, with the format based on the nature of our findings and recommendations. Findings and recommendations for prevention from our surveillance and intervention activities were disseminated on our Occupational Health Branch website, through newsletters, peer-reviewed journals, articles in publications of scientific, professional, labor and industry-based organizations, presentations at professional meetings and to our collaborators and target audiences, and in training modules. We continued to stress dissemination to government and non-governmental organizations (such as CalOSHA and local COSH groups) with the capacity to implement needed changes through regulatory and advocacy efforts.

E EVALUATION

We recognize the important role that evaluation plays in ensuring that our surveillance system is effective in tracking and preventing work-related asthma. We have been using a logic model during the last 5 years to track our objectives, outputs, and outcomes. This allows us to quantify outputs and evaluate if they have had any impact. Over the past 27 years, we have conducted ongoing evaluation using the CDC Guidelines for Evaluating Surveillance Systems. We have also reviewed past evaluations of the SENSOR program and incorporated recommendations for both surveillance and interventions. We have taken many steps to assess the different components of our system, including surveillance capture and efficiency, worksite investigations, and information dissemination.

IV RESULTS AND DISCUSSION

A SURVEILLANCE

There were 89,762 possible and probable cases of CTS identified over the study period. The average rate of CTS among workers in California is 106.8 cases per 100,000 FTE. The rate of CTS increased with increasing age category up to individuals aged 45-54 (145.1 per 100,000 FTE) and then declined. Woman had over three times the risk of CTS as men (50.5 and 177.8 per 100,000 FTE, respectively) **(Table 1).**

Table 1 Case Characteristics

Characteristic	Cases	Rate per 100,000 FTE (95% CI)
Overall	89,762	106.8 (106.3—107.3)
Age Category		
15-24	4,663	50.4 (49.6—51.1)
25-34	18,178	85.7 (84.9—86.5)
35-44	23,390	110.1 (109.0—111.2)
45-54	28,126	145.1 (143.8—146.4)

55-64	13,877	128.5 (130.3—126.7)
65 +	1,254	58.2 (56.4—60.1)
Gender		
Male	24,116	50.8 (50.6—51.1)
Female	65,121	177.8 (176.5—179.0)
Year		
2006	16,223	113.8 (113.4—114.3)
2007	17,211	119.3 (118.8—119.9)
2008	15,210	104.7 (104.2—105.3)
2009	14,830	106.6 (107.1—106.2)
2010	13,426	99.8 (99.4—100.3)
2011	12,862	95.2 (94.8—95.6)

Four industries had rates higher than 300 workers per 100,000 FTE **(Table 2):** Textile, fabric finishing, and coating mills (393), animal slaughtering and processing (342), sugar and confectionery products (325), and telecommunications (325). Four industries in the manufacturing sector had high rates of CTS: miscellaneous petroleum and coal manufacturing, apparel and accessory manufacturing, pottery, ceramics, and plumbing fixture manufacturing, and footwear manufacturing. The largest number of claims was among public administration (4752 cases); insurance carriers (n); justice public order, and safety (n); and banks (3174).

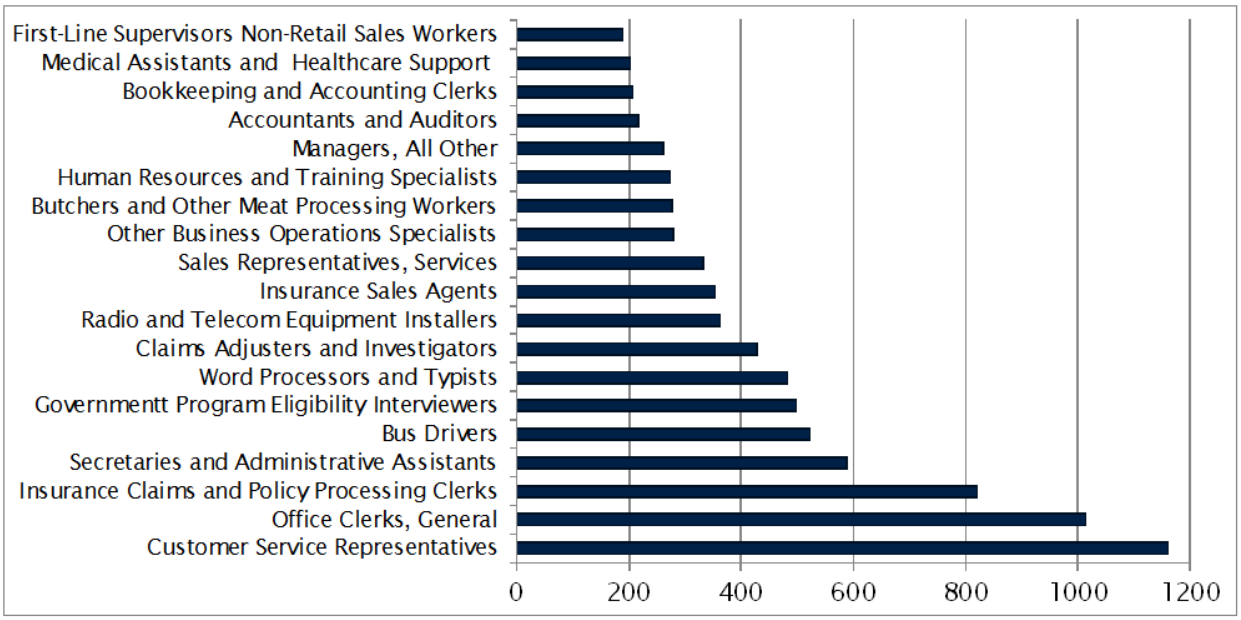
Table 2 Number and rate of CTS Cases by Census Industry Code (CIC) California, 2006-2011

Rank	Industry	Cases	Rate x 100,000 FTE (95% CI)
1	Textile and fabric finishing and coating mills	54	**393** (245, 985)
2	Animal slaughtering and processing	396	**342** (282, 435)
3	Sugar and confectionery products	148	**326** (255, 452)
4	Telecommunications	2674	**325** (297, 358)
5	Navigational and control instruments manufacturing	588	**280** (246, 325)
6	Public administration	4752	**268** (243, 299)
7	Insurance carriers and related activities	3632	**262** (250, 276)
8	Aluminum production and processing	67	**252** (185, 395)
9	Bus service and urban transit	808	**238** (214, 267)
10	Miscellaneous petroleum and coal products	27	**234** (153, 504)
11	Power companies (AAAA)	1179	**231** (200, 272)
12	Employment services	1267	**229** (212, 249)
13	Apparel accessories and other apparel manufacturing	22	**228** (136, 711)
14	Data processing, hosting, and related services	158	**228** (184, 299)
15	Pharmaceutical and medicine manufacturing	809	**215** (195, 240)
16	Software publishers	268	**203** (175, 242)
17	Pottery, ceramics, and plumbing fixture manufacturing	26	**195** (130, 397)
18	Department stores and discount stores	1925	**189** (179, 201)
19	Seafood and other miscellaneous foods, n.e.c.	279	**188** (161, 226)
20	Grocery stores	2859	**178** (170, 188)

21	Bakeries, except retail	261	**172** (147, 207)
22	Offices of physicians and HMOs	2509	**172** (160, 185)
23	Justice, public order, and safety activities	3309	**168** (161, 176)
24	Dry cleaning and laundry services	331	**155** (135, 182)
25	Banks	3174	**155** (145, 167)
26	Carpet and rug mills	24	**150** (101, 293)
27	Radio and TV broadcasting and cable programming	661	**150** (137, 166)
28	Footwear manufacturing	32	**150** (103, 278)
29	Business, professional, and political organizations	139	**149** (123, 187)
30	Newspaper publishers	292	**148** (129, 173)

Among the industries with the highest rates of CTS, customer service representatives, office clerks, and insurance claims and policy processing clerks were the most prevalent occupations **(Figure 1).**

Figure 1 Occupations in the 10 Industries with the highest CTS Rates California, 2006-2011



B CASE FOLLOW-UP AND WORKPLACE INTERVENTION

After identifying that interventions to prevent MSDs (including CTS) were feasible among dental hygienists, we developed a series of five educational videos on dental hygiene and ergonomics. The purpose of the peer-to-peer video series is to educate dental hygienists about the risks of CTS, MSDs, and the steps that can be taken to prevent CTS and MSDs. Using interviews with dental hygienists to bring the subject to life, the video topics include: an overview of CTS and MSDs, proper patient positioning, the importance of selecting and using the correct dental instrument for the task at hand, the use of loupes, and creating a work schedule that prevents workers from doing high risk activities for extended time periods. The videos were reviewed by academics, dental hygienists, and trade associations. The videos have been posted online at a new CDPH web site (https://www.cdph.ca.gov/programs/ohb/Pages/ErgonomicsDentalHygiene.aspx) and are available for download. These videos are eligible for continuing education units for dental hygienists (registered dental hygienists in the state of California are required to complete 25 units of continuing education (CEUs) every two years as part of their licensure renewal – see http://cdha.org/lifelonglearning-spring-

2015). Thus far, there are over 2,000 views on the CDPH YouTube channel; the video has been shown at the CDHA delegates convention; shared with the California Dental Hygiene Educators Association and the 25 local components of CDHA at their Trustees meeting; and provided to the National Dental Hygienists' Association for their 2016 convention.

C COLLABORATION

The CTS project has collaborated with federal, state, and local agencies, health care professionals, industries, trade associations, labor organizations, asthma advocacy groups, and community-based organizations in our ongoing program activities. We have participated on interagency, advisory, and other work-groups addressing MSDs among health care personnel and housekeepers; had extensive collaboration with the California Dental Hygiene Association in the preparation and dissemination of our ergonomic videos; and collaborated with Soo-Jeong Lee, PhD on an ongoing study using workers' compensation data on the impact of the SPH handling standard among health care workers.

D DISSEMINATION, EDUCATION AND OUTREACH

Effective translation of results into guidance and interventions is essential for surveillance and prevention programs to be successful. We conduct outreach and disseminate findings and recommendations from our CTS program to our collaborators and stakeholders; publicize the importance of recognizing, reporting, and controlling CTS in the workplace; and promote measures to prevent exposures and illness to all parties who can implement change. Recently, our Branch developed a guidance document, "*OHB Communications Guidelines*," which includes communications principles, guidance for product development, dissemination and evaluation, and several tools for decision-making and standardization. Our target audiences and major objectives for education and outreach efforts include: 1) employees, labor unions and/or other labor advocacy groups to improve CTS recognition, knowledge of exposure control measures, and ensure awareness of employee rights to a safe and healthy workplace; 2) employers and industry-wide organizations to increase employer recognition of workplace hazards, and to encourage implementation of effective exposure control and prevention measures; 3) medical and public health professionals to increase recognition of CTS and knowledge of reporting requirements, and to improve treatment of CTS; and 4) federal, state, and local governmental agencies to contribute to national CTS surveillance efforts, and to promote regulatory and policy efforts to prevent CTS.

We disseminate data and prevention recommendations in a wide variety of formats, including written materials for workers about prevention and management of CTS, workers' compensation and other workplace legal rights; surveillance summaries, fact sheets and hazard advisories; work site specific letters with detailed findings and recommendations; scientific reports and peer-reviewed publications; articles for trade organization publications; digital stories; presentations at worker, medical, public health, and industry meetings or conferences; written comments to regulatory agencies and standards setting organizations on regulations and guidelines; written analyses of proposed legislation; participation on interagency, advisory, and other work groups; and posting on our CDPH website.

E EVALUATION

Surveillance

We continually conduct evaluation of our surveillance efforts. As the WCIS data have expanded, our evaluation has shown that the *timeliness* of this surveillance system is adequate for case follow-up, and overall *case confirmation* rates for many endpoints are over 80%. This system is very *sensitive* in detecting *CTS* cases, but the *specificity* is relatively poor given the lack of nerve conduction data to confirm the diagnosis.

Workplace follow-up and interventions

To evaluate our CTS case follow-up and field investigations, we assess the capacity to respond to case reports in a timely manner; the quality of our investigations; and the public health impact of our efforts.

We have evaluated each step in our field investigations to identify procedures that maximize our ability to gain access to the worksite, 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. The dental hygiene evaluation initiated by the CTS program resulted in the development and wide dissemination of comprehensive written recommendations for prevention and the development of digital videos that were transmitted to all gthe affected parties. Participation rates for on-site worker interviews in this evaluation were excellent, ranging from 60 to 70%. Our criteria for follow-up successfully identified a problem of broad public health significance, focusing on a workplace where we were able to maximize impact, such as dental office, where prevention benefits both dental hygienists and the employer (typically dentists). Assisting dental hygienists in developing best ergonomic practices has potentially reduced MSD hazards to to hundreds of employees in California.

Dissemination of information

The *quantity* of education materials distributed, the types of audiences to whom materials were disseminated, the number of talks or training provided, and the number of participants who have attended are evaluated continuously. The *quality* of our dissemination efforts is evaluated by whether our approaches are consistent with the language and literacy needs of the target audiences, and if they are presented in a culturally appropriate manner. To guide the design of our worker-focused CTS materials, we collaborated extensively with the CDHA to convene worker focus groups to assess the efficacy of our approach to the digital videos and provide guidance on how to improve them. At the conclusion of the videos, the CDHA in turn disseminated the findings and recommendations of our project to their constituents. A survey included when we disseminated the videos to dental hygienists has found that they consider them useful and feel that the inclusion of worker interviews is critical to the messaging.

V CONCLUSIONS

Over the last 5 years of the cooperative agreement, the CTS project has successfully maintained and significantly expanded the surveillance of CTS in California. We have significantly improved the use of workers compensation claims data and now use this data source as a routine method for tracking of CTS and many other work-related conditions in California. As a result of our improved CTS surveillance capabilities using workers compensation claims data, we have recently been awarded a new 3-year cooperative agreement with NIOSH to enhance state-based collaboration between Health and Labor Departments. We have used targeted case evaluation (dental hygienists), collaboration with other organizations, and dissemination of our findings to implement prevention strategies for CTS in an important occupation statewide.

PUBLICATIONS

Joe L, Roisman R, Beckman S, Jones M, Beckman J, Frederick M, Harrison R: Using multiple data sets for public health tracking of work-related injuries and illnesses in California. Am J Ind Med. 2014 Oct; 57(10):1110-9.

Cumulative Inclusion Enrollment Report

This report format should NOT be used for collecting data from study participants.

Study Title: California Occupational Safety and Health Surveillance: Work-Related Pesticide Illness

Comments:

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native		2						1		3
Asian	11	8		0	1		4	1		25
Native Hawaiian or Other Pacific Islander										0
Black or African American	10	5					10	12		37
White	66	61		13	30		52	106		328
More Than One Race	2			32	78		7	10		129
Unknown or Not Reported	3	6		230	409		1,966	3,383		5,997
Total	**92**	**82**	**0**	**275**	**518**	**0**	**2,039**	**3,513**	**0**	**6,519**

Cumulative Inclusion Enrollment Report

This report format should NOT be used for collecting data from study participants.

Study Title: Work-related Asthma: California Surveillance of Occupational Illnesses and Injuries

Comments:

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native	56	26	0	14	3	0	2	1	0	**102**
Asian	149	56	0	6	6	0	1	0	0	**218**
Native Hawaiian or Other Pacific Islander	4	4	0	0	0	0	0	0	0	**8**
Black or African American	340	132	0	6	3	0	3	1	2	**487**
White	1,221	612	0	232	169	0	16	8	0	**2,258**
More Than One Race	78	34	0	242	154	0	5	3	0	**516**
Unknown or Not Reported	5	3	1	10	15	2	3,507	2,581	12	**6,136**
Total	**1,853**	**867**	**1**	**510**	**350**	**2**	**3,534**	**2,594**	**14**	**9,725**

Cumulative Inclusion Enrollment Report

This report format should NOT be used for collecting data from study participants.

Study Title: California Occupational Safety and Health Surveillance:Work-related injury fatalities

Comments:

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native		8			1					9
Asian	20	247		1	4			2		274
Native Hawaiian or Other Pacific Islander										0
Black or African American	25	180		1	5					211
White	51	715		69	1,090			8		1,933
More Than One Race										0
Unknown or Not Reported		10			2			15		27
Total	**96**	**1,160**	**0**	**71**	**1,102**	**0**	**0**	**25**	**0**	**2,454**

Cleaning for Asthma-Safer Schools Reduces Asthma Risk, Saves Money

A 43-year-old high-school custodian started having breathing problems he associated with using a bathroom disinfectant and a floor stripper. When he was away from the chemicals for a few months, his breathing problems improved. The problems came back once he returned to work. He visited the emergency room several times, and healthcare providers repeatedly told him he had bronchitis. The custodian was finally diagnosed with asthma. About a year later, he left his job because of his work-related asthma.

The Challenge

A paradox exists for cleaning many of the nation's schools. While ridding schools of contaminants and microbes to keep students and staff healthy, cleaning may expose them to harmful chemicals in cleaning products, sanitizers, and disinfectants. Some ingredients in conventional products such as floor strippers, disinfectant wipes, and bathroom cleaners, or chemicals used by themselves or mixed with water, like ammonia, and bleach, pose avoidable risks for the health of school occupants – custodians, teachers, administrators, and students.

An estimated 40% of adults in California with current asthma report that their asthma was caused or aggravated by work. The Work-Related Asthma Prevention Program (WRAPP) in the California Department of Public Health found that 11% of the work-related asthma cases in its surveillance database were related to cleaning products. Of those cases, about 20% had occupations where cleaning tasks were part of their job, such as custodians. The other 80% were bystanders working in areas where cleaning was occurring or recently happened--their asthma symptoms were attributed to the cleaning products used nearby. Cases included many workers in schools.
In a school setting, workers and students share the same space. Improvements made for workers can also benefit the health of students. People deserve to work and learn in the safest and healthiest school environment possible. Substitution with safer cleaning products and practices can help create such an environment.

The Response

WRAPP developed "Healthy Cleaning & Asthma-Safer Schools: A How-To Guide," to help school districts transition to asthma-safer cleaning products and practices. A companion video features California custodian and administrator successes using the handbook's strategies. The Guide was created following extensive pilot testing of the approach with volunteer school districts across California.
The handbook explains to school administrators, facility managers, and other school advocates how to switch to asthma-safer cleaning in simple, manageable steps. It provides ready-to-use tools, resources, and forms to assist districts in making changes and promoting safer cleaning successes within the school community.
Some cleaning products that are marketed as "natural" or "green" contain ingredients that can cause asthma. The handbook directs school districts to resources to help them find asthma-safer products and practices to help prevent asthma or asthma symptoms.

These methods also help to prevent other health effects—like cancer and endocrine disruption—and minimize environmental degradation.

The Impact

Nationwide, school districts that have transitioned to safer cleaning products and methods found that they often saved funds on cleaning products and reduced absenteeism among staff and students. It is estimated that exposure to unhealthy cleaning chemicals was reduced for hundreds of staff members and over 143,000 students in the schools that pilot-tested the Guide in California. The Guide has been distributed to over 2,100 recipients.

Among the ten school districts that WRAPP worked closely with, one was a small rural district near the California/Arizona border in the Colorado Desert. This district had few resources, and 75% of the students qualified for free and reduced lunch.

The district's maintenance and operations supervisor had this to say about the Guide: "I have been hearing about green cleaning for years, but I never knew how to go about getting it started in a green cleaning program. Also learning what green products really mean, all kinds of companies claim to be green but they are not. Your information has been most helpful in not buying products that aren't really green. Also helping our department to see the safety of students and staff is most important." Four years after working with WRAPP on the pilot, the district continues to make important changes, like cleaning with steam and working to transition all their schools to green products.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH SURVEILLANCE
#5 U60 OH008468
Robert Harrison, MD, MPH, Principal Investigator
California Department of Public Health
850 Marina Bay Parkway
Building P, 3rd Floor
Richmond, CA 94804

California's Work-Related Asthma Prevention Program - Developing Safer Substitutes through the use of Third-Party Certified Product Standards

The Challenge

Cleaning products are used in virtually every building but they can be hazardous – can burn eyes and skin, are toxic, and can cause asthma and other breathing problems. Custodians, cleaners, and maintenance workers are most at risk from exposure to cleaning agents. The Work-Related Asthma Prevention Program (WRAPP) within the California Department of Public Health has found that work-related asthma among custodians and cleaners is double the rate in the overall workforce. Other building occupants are also affected by the use of cleaning chemicals, which can linger in the air even after the cleaning work is completed.[1] WRAPP has found that nearly 11% of work-related asthma cases tracked in California were associated with cleaning products.

When looking for ways to prevent worker illness, public health prioritizes methods that will most effectively stop exposure. Employers should give highest priority to eliminating the hazard with methods that use no chemicals or, if that is not possible, substituting with a safer, lower toxicity formulation before they rely on other types of controls such as engineering or administrative. Personal protective equipment is considered a last resort and should be used only if these other methods have been tried and still do not fully protect workers. Elimination or substitution are more protective of workers because these strategies get rid of the more hazardous chemicals, so even if spills occur or unprotected workers enter an area where chemicals are being used, workers are safer.

However, finding and recommending specific safer products to employers and workers can be a difficult task. The pitfalls are many: public health agencies can't recommend specific products, formulas frequently change, individual chemicals are not always listed on the label or product safety data sheets, and a chemical may be safe for people but may be hazardous for the environment (or vice versa). Employers and consumers cannot rely on label language since manufacturers may claim that their products are "green," "natural," or "earth-friendly," but such claims are often meaningless or misleading or don't prevent exposure to hazards like asthmagens.

The Response

WRAPP, in order to help employers, workers, and consumers find safer products, and also to influence how these products are created, has participated in the development of many third-party certification standards. Two independent organizations, UL ECOLOGO and Green Seal, publish standards that define which attributes a product must have in order to receive certification. Manufacturers must submit their products for review and are subject to audits to ensure that the products comply with the published standards. These standards typically include toxicity and corrosivity limits, and prohibition of carcinogens, reproductive toxicants, and some endocrine disruptors. These standards also have environmental and performance criteria that must be met. However, in earlier versions of these standards, products could receive certification even while containing

chemicals known to cause asthma. Our participation in the development and revision of these criteria has helped ensure that chemicals that cause allergic-type asthma are also prohibited from the products carrying these certifications. This multi-attribute approach makes these products preferable in many ways.

The Impact

The impact of these standards is wide-reaching, as many policies and guidelines nationwide require the use of certified products, which now cannot contain asthmagens. WRAPP has promoted the use of products certified under the revised Green Seal and UL ECOLOGO standards as a way for employers, workers, and consumers to more easily find asthma-safer cleaning products: these standards are featured in our "Healthy Cleaning and Asthma-Safer Schools How-to-Guide" as well as several WRAPP fact sheets. Also, eleven states currently have laws that either require or encourage the use of third-party certified cleaning products in schools. Additionally, the United States Green Building Council's Leadership in Energy and Environmental Design (LEED) Existing Buildings Operations and Maintenance Ratings system gives points for the use of Green Seal and US ECOLOGO certified products in buildings seeking LEED green building certification. When employers or building managers switch from conventional cleaning products to third-party certified products that are developed using these multi-attribute criteria, everyone in the building benefits from an asthma-safer and healthier workplace, whether it's a school, hospital, office, or child care center.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH SURVEILLANCE
#5 U60 OH008468

Robert Harrison, MD, MPH, Principal Investigator
California Department of Public Health
850 Marina Bay Parkway
Building P, 3rd Floor
Richmond, CA 94804

Pain Is NOT in the Job Description: Training for Dental Hygienists

To prevent job-related pain for dental hygienists, California created a five-part video series on ergonomics. The California Department of Public Health (CDPH) successfully partnered with the University of California, Berkeley (UCB), Ergonomics Program and the California Dental Hygienists' Association (CDHA) to produce and distribute the series.

The Challenge

Many dental hygienists work in pain or know others suffering from musculoskeletal disorders (MDSs). Dental hygienists and their employers can prevent MSDs by paying attention to ergonomics. This means taking practical steps to design or arrange the workplace for safe and efficient work. Research has shown that using larger instruments and making other simple ergonomic changes can reduce the risk of MSDs for dental hygienists. Our team wanted to design a communications product and process that would reach dental hygienists who were just starting their careers, as well as more experienced clinicians.

The Response

Dental hygienists and their trade group were involved in creating this "digital story" project from the beginning. The San Francisco Component of the CDHA acted as an advisory group that provided messages, themes, and interviews for the videos. The dental hygienists appeared in the videos, telling their personal stories. They reviewed both the script and the final products. Because of their input and feedback, the stories and prevention messages are tailored to resonate with new and experienced dental hygienists. UCB provided the research-based technical content in the series. The statewide CDHA endorsed and agreed to promote the videos. The Spring 2015 edition of its trade journal features the videos in an article co-authored with CDPH and UC. CDHA will provide Continuing Education Units to dental hygienists who complete the "home study" course based on reading the article and viewing the videos.

The Impact

CDPH's January 2015 e-newsletter on this topic reached almost 4,600 recipients. The CDHA journal and newsletter reach over 4,000 members by mail and electronically. Dental hygienists in California (and their employers) can now learn about how to prevent MSDs and complete continuing education units by taking a CDHA home-study course based on the online video series.

> "Pain isn't part of the job. We should not be going to work and feeling pain."
> - **Shelly Azevedo**,

View the home study course or videos:
CDPH website - http://www.cdph.ca.gov/programs/ohb/Pages/ErgonomicsDentalHygiene.aspx
YouTube - http://bit.ly/1x01B69

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH SURVEILLANCE
#5 U60 OH008468

Robert Harrison, MD, MPH, Principal Investigator
California Department of Public Health
850 Marina Bay Parkway
Building P, 3rd Floor
Richmond, CA 94804

California FACE Program Addresses Palm Tree Hazards in a Compelling Digital Story

The Challenge

While preliminary data from the Census of Fatal Occupational Injuries (CFOI) data for California in 2014 showed a downward trend in workplace fatalities for Latinos and all workers, the news wasn't all good. The number of grounds maintenance workers who died continues to rise – from 8 in 2011 to 20 in 2014. And tree trimmers' fatality rate is twice the national average for worker fatalities. These workers are largely poorly paid day laborers who are paid in cash and not considered employees. Palm tree trimmers face unique risks. Inadequate or improper climbing techniques and equipment can cause fatal suffocation, falls, and electrocution.

The Response

It's a story that no one wants to hear, yet it's a story that carries an important lesson – a lesson that will save other workers from injury and death. This story is about Roberto, a tree trimmer in California who died tragically in June, 2012, when the palm fronds he was cutting fell on him. He suffocated when co-workers and first responders couldn't reach him in time. This story is told through a compelling video produced by the California Fatality Assessment and Control Evaluation (CA/FACE) program. These videos are a solid strategy in the program's prevention effort – written findings and recommendations from fatality investigations are brought to life with video re-creations, photos from the investigation, interviews with co-workers and family members, and clear explanations of how these tragedies can be prevented.

The Impact

Our evaluation of these videos shows that messages delivered visually resonate with workers as they experience first-hand the personal devastation that these incidents cause. The video has been widely disseminated to employers and workers, unions, trade associations, community-based job training programs, health and safety professionals, and government agencies. Nationally, the video has been praised as a useful training tool, and is a powerful story that has raised awareness of tree trimming hazards. It is being used as an educational trigger that can be shown at the beginning of a training session to facilitate discussion. The CA FACE palm tree investigation reports and digital story led to the addition of a *new hazard category - asphyxia* on the Occupational Safety and Health Administration's tree care industry topic page. The video has 34,000 YouTube views making it the second most popular California Department of Public Health video. It is available in both English and Spanish.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH SURVEILLANCE
#5 U60 OH008468

Robert Harrison, MD, MPH, Principal Investigator
California Department of Public Health
850 Marina Bay Parkway
Building P, 3rd Floor
Richmond, CA 94804

Text4Salud: Evaluating an mHealth Intervention for Farm Workers on Pesticide Illness Prevention

To test and evaluate a texting intervention for Spanish-speaking farm workers, the California Department of Public Health (CDPH) partnered with a mobile health expert and community-based organizations (CBOs). The texting project evaluated results based on participants' increased awareness of and/or self-reported behavior change regarding pesticide illness prevention messages.

The Challenge

The agricultural worker population in California is primarily Latino/Hispanic. Research has shown that 92% of the Hispanic population owns a cell phone, and this group has one of the highest rates of text messaging (87%). Agricultural employers are required to provide health and safety training to farm workers, but workers and advocacy groups say that this training is often inadequate. This community-based pilot project sought to supplement required training with text messages over a four month period.

The Response

CDPH and its partners – including CBOs Lideres Campesinas, Planned Parenthood Mar Monte, and the Watsonville Law Center – designed and implemented this project. The CBOs helped to write 170-character texts on four subject areas: workers rights, pesticide illness/symptoms, take-home exposures, and protecting oneself and co-workers. The CBOs provided staff and members to recruit farm worker participants for the texting project and to interview nearly half of them afterward to evaluate results. The Public Health Institute mHealth expert, Iana Simeonov, sent 43 texts to 37 farm workers every few days over a four month period in 2014. Evaluation interviews were completed by the end of that year.

"I changed my routine to protect my family, separating my clothes from the rest of the family, leaving my shoes outside. These texts emphasized above all else that for nothing in the world should I enter the house with my work clothes on, nor my work shoes, nor sit at the table nor on the sofa with my work clothes on."

- Farm worker participant

The Impact

Participants responded to five of the texts that required "yes" or "no" responses at a high rate. The majority of participants who completed interviews reported reading most or all of the texts. The majority reported learning "a lot" or "very much" from the texts. They self-reported changing actions to avoid take home exposures "a lot" or "very much." These responses, together with their responses to open-ended questions about the texts and the texting project, indicated that texting is a feasible and effective method of reinforcing health and safety messages among hard to reach, Spanish-speaking workers.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH SURVEILLANCE
#5 U60 OH008468

Robert Harrison, MD, MPH, Principal Investigator
California Department of Public Health
850 Marina Bay Parkway
Building P, 3rd Floor
Richmond, CA 94804

MATERIALS TO BE SHARED WITH OTHER RESEARCHERS

Project name	Description	Releasable to public?	Format
Adult Blood Lead Registry	Adult blood lead levels from laboratories	Aggregate only	Access or Excel
Work-related asthma	Cases and claims of work-related asthma from physicians and workers compensation claims	No	SAS
Pesticide poisoning	Cases and claims of pesticide poisoning from physicians, workers compensation claims and agricultural commissioner investigations	No	SAS
Carpal tunnel syndrome	Claims of work-related CTS	No	SAS
Acute traumatic fatalities	Coroners reports, OSHA reports, death certificates – LA County only	No	Excel