

FINAL PROGRESS REPORT  
Colorado Occupational Health and Safety Surveillance  
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## **LIST OF TERMS AND ABBREVIATIONS**

ABLES: Adult Blood Lead Epidemiology and Surveillance

BLL: Blood lead level

BLS: Bureau of Labor Statistics

BRFSS: Behavioral Risk Factor Surveillance System

CDPHE: Colorado Department of Public Health and Environment

CFOI: Census of Fatal Occupational Injuries

CSTE: Council of State and Territorial Epidemiologists

NIOSH: National Institute for Occupational Safety and Health

## **ABSTRACT**

### Colorado Occupational Health and Safety Surveillance

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Colorado shares the large U.S. burden of occupational illnesses and injuries. As compared to averages for all U.S. workers, Analyses completed in 2009 indicated that Colorado had a higher rate of fatalities and pesticide poisoning as well as an employment base that encompassed some of the nation's highest risk industries, including mining, construction, and agriculture. Based on these analyses and others, it was recognized that a strong occupational surveillance program was needed to collect baseline data, monitor trends, respond to occupational health threats and prioritize occupational health issues that are specific to Colorado

The purpose of this cooperative agreement was to establish a fundamental, state-based occupational health surveillance program to collect, analyze, and interpret surveillance data and information to promote occupational health and safety in Colorado. This program relied on existing data sources in state and federal public health and labor agencies, from public and private healthcare providers and from workers compensation insurers to create a single repository of valid, reliable and useful occupational safety and health information. The program supported public health in Colorado by providing surveillance data about occupational injuries, illnesses, and exposures in Colorado to influence policy and intervention efforts.

Through this cooperative agreement, Colorado was able to establish an effective and sustainable occupational health surveillance program. Highlights of the accomplishments during this funding period included:

- For the first time, we generated and reported Colorado's Occupational Health Indicator (OHI) data to the National Institute for Occupational Safety and Health (NIOSH) for 17 of the 20 (or later 22) standardized indicators including data from 2008-2012.
- We successfully integrated occupational health into public health through a number of channels including the use of occupational data in community health profiles, adding questions on industry and occupation to the major adult public health survey (BRFSS) in Colorado, and the use of county-level occupational health data to inform public health planning.
- We developed a number of partnerships and collaborations to 1) improve surveillance activities at the health department (Colorado Surveillance Advisory Committee), 2) assist in the development of technical guidelines for high risk industries (Marijuana Industry Occupational Health and Safety Workgroup), 4) provide occupational health educational activities for high risk industries (Worksafe Colorado).
- The capacity provided by this agreement allowed us to provide technical and investigative assistance for Colorado employers on issues including an occupational infectious disease outbreak, a cluster of unusual respiratory diseases among spa workers, and several contentious indoor air quality problems.
- Our outreach and dissemination activities improved the occupational health knowledge of hundreds of Colorado citizens and occupational health professionals through more than 53 presentations, 21 non peer-reviewed publications, and three peer-reviewed publications.

## **SECTION 1**

### **SIGNIFICANT (KEY) FINDINGS**

Through this cooperative agreement, Colorado was able to establish an effective and sustainable occupational health surveillance program. Highlights of the accomplishments during this funding period included:

- For the first time, we generated and reported Colorado's Occupational Health Indicator (OHI) data to the National Institute for Occupational Safety and Health (NIOSH) for 17 of the 20 (or later 22) standardized indicators including data from 2008-2012. These data were published by the Council of State and Territorial Epidemiologists (CSTE).
- From 2012 through 2014, we reported Colorado's cases of adult elevated blood lead reported to NIOSH's Adult Blood Lead Epidemiology and Surveillance (ABLES) Program
- From 2012 through 2014, we reported Colorado's Census of Fatal Occupational Injuries (CFOI) cases to the Bureau of Labor Statistics (BLS).
- Our activities and new relationships improved access to important occupational health surveillance data sets such as poison center call volume data from the Rocky Mountain Poison and Drug Center.
- We successfully integrated occupational health into public health through a number of channels including the use of occupational data in community health profiles, adding questions on industry and occupation to the major adult public health survey (BRFSS), and the use of county-level occupational health data to inform public health planning.
- We developed a number of partnerships and collaborations to 1) improve surveillance activities at the health department (Colorado Surveillance Advisory Committee), 2) assist in the development of technical guidelines for high risk industries (Marijuana Industry Occupational Health and Safety Workgroup), 4) provide occupational health educational activities for high risk industries (Worksafe Colorado), or 5) identify new opportunities for occupational health outreach or research (collaborations with Colorado State University and the Colorado School of Public Health).
- The capacity provided by this agreement allowed us to provide technical and investigative assistance for Colorado employers on issues including an occupational infectious disease outbreak, a cluster of unusual respiratory diseases among spa workers, and contentious indoor air quality problems.
- Our outreach and dissemination activities improved the occupational health knowledge of hundreds of Colorado citizens and occupational health professionals through more than 53 presentations, 21 non peer-reviewed publications, and three peer-reviewed publications.

### **TRANSLATION OF FINDINGS**

Through this cooperative agreement, Colorado produced a number of work products that can be used to guide and evaluate interventions or policy changes to prevent workplace injury and disease. Our most general product, the Colorado Occupational Health Indicator report, can be used to monitor injuries and illnesses over time in Colorado providing baseline data for evaluation of any policy change or state-wide interventions. This report can also be used to prioritize interventions for particular types of occupational injuries or diseases. Our program has used this report to prioritize efforts for additional data collection and injury interventions in the oil and gas industry during our next funding cycle.

More specific work products generated by the project can also be translated to prevent occupational injuries and illnesses including:

- Our pending Occupational Health and Safety Guide for the Marijuana Industry will be used to provide education to marijuana cultivators and product manufacturers to educate them on best practices to prevent occupational injuries.
- Our research on exposures of pesticide applicators can be used to improve training to prevent acute exposures.
- The findings from our analyses on industry and occupation data among respondents to the Behavioral Risk Factor Surveillance Survey can be used to target specific industries for interventions such as increased seatbelt use and smoking cessation.
- Our lead surveillance data can be used to directly educate exposed workers on best practices of lead exposure prevention.
- Our county-level implementation of occupational health indicators can be used by local public health departments in community health planning efforts.

### OUTCOMES/IMPACT

While the focus of this initial cooperative agreement was primarily on development of a new surveillance program and work products that could be translated to outcomes during subsequent funding cycles, there were a number of outcomes based on specific activities.

#### Potential Outcomes

- We provided educational materials on lead exposure reduction directly to all reported adult cases of elevated blood lead (approximately 30 per year).
- Our public health data portal, which includes publically available data queries for the following occupational health and safety indicators: 1) County level unemployment rate, 2) County level non-fatal lost-time workers' compensation claims, 3) Regional level work-related hospitalizations, and 4) State-level occupational fatalities. This portal is being used by local and regional health departments to set and meet goals that are aligned with the state's Public Health Improvement Plan.
- Our county-level implementation of occupational health indicators was used by Northeast County Health Department for community health planning efforts.
- Our Colorado Occupational Health Indicator report is being used by the NIOSH Mountain and Plains Educational Resource Center to set priorities for regional occupational health and safety research.

#### Intermediate Outcomes

- Our analyses of adult elevated blood lead data in Colorado were used to update Colorado Board of Health lead test reporting rules in 2012 to require public health reporting of all adult (> age 18) blood lead level (BLL) tests  $\geq 10$   $\mu\text{g}/\text{dL}$  to align Colorado's reportable blood lead levels (BLL) with recommendations of the CDC and the NIOSH ABLES Program.
- Implementation of our recommendations after investigation of an *E.coli* outbreak at a correctional center linked to inmate workers at an on-site dairy reduced the risk of infection for these workers.
- Implementation of our recommendations after investigation of hypersensitivity pneumonitis (HP) among local resort spa workers in a Colorado resort community reduced risk of exposure for future workers.
- Implementation of our recommendations after investigation of rashes among employees at a driver license office reduced exposure for these workers.
- Implementation of our recommendations after investigation of an indoor air quality problem at a middle school reduced symptoms and exposure for teachers at the school. Surveys were shared with the school district in conjunction with air monitoring recommendations.

## **SECTION 2**

### **BACKGROUND FOR THE PROJECT**

Colorado shares the large U.S. burden of occupational illnesses and injuries. As compared to averages for all U.S. workers, Analyses completed in 2009 in preparation for this grant application recognized that Colorado had a higher rate of fatalities [1] and pesticide poisoning [2]. Furthermore, between 2001 and 2006, an average of 2.4 million individuals were employed in Colorado [3] and on average, 124 people died per year. This accounted for approximately 5.3 worker deaths for every 100,000 Colorado workers compared to 4.0 worker deaths for every 100,000 workers in the U.S. [4]. Between 2001 and 2006, an average of 30,000 Colorado workers filed a non-fatal work-related injury or illness claim annually, and approximately 55% of these claims resulted in greater than 10 days of temporary disability benefits (average between 2001 and 2006 = 16,296 claims) [5]. During this time period, Colorado paid more than \$782 million dollars in workers compensation claims, or approximately \$371 per covered worker [6]. These work-related events result in substantial human and economic costs, not only for workers and employers, but also for the state of Colorado as a whole.

Colorado's occupational landscape continues to encompass some of the nation's highest risk industries, including mining, construction, and agriculture [7] and Colorado consistently ranks higher than the US average for the number of workers employed in high-risk industries [8]. Colorado is a "right to work" state with a very independent spirit. Colorado is also developing new technologies whose impact on worker health is unknown. This includes nanotechnology, [9] new techniques for oil & gas drilling [10], and "green" technology "[11]. here is also a growing immigrant population that makes up a large part of the highest risk workforce [12].

A strong occupational surveillance program was needed to collect baseline data, monitor trends, respond to occupational health threats and prioritize occupational health issues that are specific to Colorado While Colorado had a strong foundation from which to build an excellent occupational health surveillance program that supports academic and public health efforts. The capacity and funding was not available. The purpose of this cooperative agreement was to establish a fundamental, state-based occupational health surveillance program to collect, analyze, and interpret surveillance data and information to promote occupational health and safety in Colorado. This program relied on existing data sources in state and federal public health and labor agencies, from public and private healthcare providers, in academic institutions and from workers compensation insurers to create a single repository of valid, reliable and useful occupational safety and health information. The program supported public health in Colorado by providing surveillance data about occupational injuries, illnesses, and exposures in Colorado to influence policy and intervention efforts.

### **SPECIFIC AIMS**

The primary goal of this funding was to initiate a state based occupational health surveillance program that builds upon the occupational illness, toxic exposure, and injury surveillance activities that exist in Colorado. Specific long-term and short-term objectives of this program were to identify and describe the magnitude and distribution of occupational exposures and illnesses, track trends, and target prevention efforts to workers, industries or work processes with the most risk of illness or injury. The specific activities during the five-year period of this award will be to:

1. Identify and interact with state partners, local public health agencies, and other stakeholders to disseminate findings and obtain input on the priority conditions in Colorado and to disseminate surveillance information. Establish and maintain contacts

with appropriate organizations, groups, and individuals who may provide or use surveillance data.

2. Establish and maintain an advisory board, and participate in other process(es) to obtain stakeholder input and to identify relevant state-specific issues and priorities for state surveillance.
3. Address the utility and limitations of existing databases for collecting and analyzing occupational illnesses and injuries. Collect, analyze, and interpret surveillance data for as many of the national Occupational Health Indicators as possible using existing data sources.
4. Produce and periodically disseminate data on the magnitude of occupational injuries and illnesses identified from existing data sources. These data will include as many of the Occupational Health Indicators as can be produced with Colorado data. Surveillance reports should include the following whenever possible: trends, emerging issues, and high-risk occupations, industries, and worker populations.
5. Consult with The National Institute for Occupational Safety and Health scientists as needed on issues related to data limitations, statistical questions and emerging issues.
6. Actively participate in National Institute for Occupational Safety and Health or recipient convened meetings or conference calls of grantees to share experiences, lessons learned, questions, and materials created.
7. Prepare an annual report of the accomplishments and impact of Colorado's surveillance program, along with lessons learned, appropriate for public release.
8. As the program develops, delineate objectives and approaches for establishing and enhancing the state-based occupational surveillance program.
9. Disseminate significant findings, e.g., in the peer-reviewed literature, trade journals, webpages, and other sites. The type of publication will be selected to achieve the best distribution to the targeted audience and the greatest impact.

## **METHODOLOGY**

The funding requested under this proposal was used to carry out these specific activities:

***Activity 1 Identify and interact with state partners, local public health agencies, and other stakeholders to disseminate findings and obtain input on the priority conditions in Colorado and to disseminate surveillance information. Establish and maintain contacts with appropriate organizations, groups, and individuals who may provide or use surveillance data.***

- Throughout the funding cycle, the health department continued to build and enhance its partnerships with Colorado's occupational public health community. This included partnerships with educational institutions, unions, government agencies, and internal programs to obtain input and support for an occupational health surveillance program.
- Throughout the funding cycle, the health department established and maintained contacts with appropriate organizations, people, and institutions that use surveillance data to cultivate occupational research opportunities. The health department partnered with these organizations to identify priority occupational conditions, occupations and industries, and used these partnerships to assist with acquiring and accessing the surveillance data to carry out the research; identify emerging issues based on surveillance data; and utilize the results of research to identify additional surveillance needs and influence occupational health practice in Colorado.

***Activity 2 Establish and maintain an advisory board, and participate in other processes to obtain stakeholder input and to identify relevant state-specific issues and priorities for state surveillance.***

- In July 2010, a broad based scientific advisory board was established.
- Advisory board members met at least biannually basis to assist with the development and evaluation of the surveillance infrastructure, facilitate data collection, and review indicator findings. Members also addressed issues of data quality and completeness, encouraged agencies with surveillance data to participate, identified the expectations and needs of their constituencies in using the surveillance data, and foster a network of on-going commitment to the program.
- The advisory board assisted with developing and implementing policy and intervention plans to reduce occupational related illnesses and injuries in Colorado.
- Throughout the funding cycle, advisory board members assisted with the identification of priority focus areas for Colorado in future years.
- The health department partnered with stakeholders to develop a strategic in the spring/summer of 2010 and which was implemented in fall 2010.

***Activity 3 Address the utility and limitations of existing databases for collecting and analyzing occupational illnesses and injuries. Collect, analyze, and interpret surveillance data for as many of the national Occupational Health Indicators as possible using existing data sources.***

- Throughout the funding cycle we continued the ongoing evaluation of existing databases utilizing CDC's *Updated Guidelines for Evaluating Surveillance Systems* [23]. As databases were identified, the occupational health surveillance staff will evaluate each dataset using the *Guidelines for Evaluating Surveillance Systems*
- Annually, we developed and revisited formalized MOU's and data sharing agreements with the different internal and external departments throughout Colorado that are needed to collect the Occupational Health Indicator Data and other priority occupational health and safety data. This included establishing operating procedures for sharing and reporting of the data.
- Annually, we updated Occupational Health Indicator data for the subsequent year if data are available. Data requests were made to the owner of the dataset on a yearly basis to update the Occupational Health Indicators including the following datasets
  - The Census of Fatal Occupational Injuries (CFOI)
  - Colorado Health Information Dataset (CoHID)
  - Rocky Mountain Poison and Drug Center Database
  - Colorado Hospital Association Hospital Discharge Data (CHA HDD)
  - Salud Family Health Uniform Data System (UDS)
  - Colorado Central Cancer Registry at the health department
  - Colorado Workers' Compensation Database
  - Blood Lead Database (PbDb) at the health department
  - Colorado Trauma Registry at the health department
  - Colorado Violent Death Reporting System at the health department
- On a yearly basis, we developed a profile of state-specific characteristics associated with work and occupational risks, including the distribution of illnesses and injuries by industry, occupational types and demographics
- On a yearly basis, we utilized statistical guidance provided at the 2009 Council of State and Territorial Epidemiologists Annual Meeting to analyze trends and make comparisons for Occupational Health Indicator Data within, or between states.
- We successfully established an MOU with NIOSH to participate as an Adult Blood Lead Epidemiology and Surveillance state.

- Throughout the funding cycle, we worked with internal and external partners to include occupation and industry coding in available local, state, and national datasets.

***Activity 4 Produce and periodically disseminate reports on the magnitude of occupational injuries and illnesses identified from existing data sources. These data will include as many of the Occupational Health Indicators as can be produced with Colorado data. Surveillance reports should include the following whenever possible: trends, emerging issues, and high-risk occupations, industries, and worker populations.***

- On a yearly basis, we published a profile of state-specific characteristics associated with work and occupational risks, including trends, emerging issues, high-risk occupations, industries, and worker populations.
- As needed, we updated the occupational health surveillance program website to include information about emerging occupational safety and health issues, other Colorado specific occupational health surveillance reports and white papers, and on occupational safety and health organizations and resources in Colorado.
- Throughout the funding cycle, we reviewed surveillance reports published within the health department to identify opportunities to insert data related to occupational health aspects on these subjects.
- We submitted Colorado's Occupational Health Indicators data to the Council of State and Territorial Epidemiologists where the data was subsequently posted on the Council of State and Territorial Epidemiologists website.

***Activity 5 Consult with The National Institute for Occupational Safety and Health scientists as needed on issues related to data limitations, statistical questions and emerging issues.***

- The National Institute for Occupational Safety and Health Regional Director served as an occupational health surveillance board member.
- Throughout the funding cycle, we continued to develop partnerships with the National Institute for Occupational Safety and Health scientists, epidemiologists, and industrial hygienist for technical assistance and support to the health department staff.

***Activity 6 Actively participate in National Institute for Occupational Safety and Health or recipient convened meetings or conference calls of grantees to share experiences, lessons learned, questions, and materials created.***

- The principal investigator and/or project manager attended yearly occupational health surveillance meetings with NIOSH.
- The principal investigator and/or the project manager travelled to the Council of State and Territorial Epidemiologists and Consortium of Occupational State-based Surveillance workgroup meetings on an annual basis.
- The project director participated in the Council of State and Territorial Epidemiologists, Consortium of Occupational State-based Surveillance (COSS), and Adult Blood Lead Epidemiology and Surveillance listservs, meetings, and conference calls.

***Activity 7 Prepare an annual report of the accomplishments and impact of Colorado's surveillance program, including the lessons learned, appropriate for public release.***

- An annual report was prepared for stakeholders, the State of Colorado, and for the National Institute for Occupational Safety and Health. This report highlighted strategic planning goals, program activities, accomplishments, lessons learned and outcomes.

***Activity 8 As the program develops, delineate objectives and approaches for establishing and enhancing the state-based occupational surveillance program.***

- We used the surveillance data and input from advisory board members to develop occupational safety and health education, intervention, and prevention programs based on input from advisory board members and key stakeholders.
- Occupational health surveillance staff attended occupational, environmental, and public health trainings and activities throughout the funding cycle.
- We developed a comprehensive list of internal and external occupational, environmental and public health subject matter experts to assist with inquiries and requests.
- Throughout the funding cycle, we continued to apply for pilot programs through the Mountain and Plains Education and Research Center to conduct occupational health research based on surveillance to help guide intervention and prevention efforts in Colorado.

***Activity 9 Disseminate significant findings, e.g., in the peer-reviewed literature, trade journals, webpages, and other sites. The type of publication will be selected to achieve the best distribution to the targeted audience and the greatest impact.***

- As needed, we updated the occupational health surveillance program website to include information about emerging occupational safety and health issues, other Colorado specific occupational health surveillance reports and white papers, and occupational safety and health organizations and resources in Colorado.
- We contributed at least one article a year to the National Institute for Occupational Safety and Health e-News electronic newsletter related to emerging issues and topics in Colorado.
- At least annually, we submitted an abstract or article to be presented at a local/state/national conference or published in a local/state/national peer-reviewed journal.

## **RESULTS**

### Surveillance Activities

We successfully initiated and sustained a state-based occupational health surveillance program in Colorado. This is evidenced by the following:

- We generated and reported Colorado's Occupational Health Indicator (OHI) data to the National Institute for Occupational Safety and Health (NIOSH) for 17 of the 20 (or later 22) standardized indicators including data from 2008-2012. These data were published by the Council of State and Territorial Epidemiologists (CSTE).
- We updated Colorado's baseline OHI report, which contains data from 2001 through 2011, including alternate methods for indicators we were unable to collect according to standard methods.
- From 2012 through 2014, we reported Colorado's cases of adult elevated blood lead reported to NIOSH's Adult Blood Lead Epidemiology and Surveillance (ABLES) Program
- From 2012 through 2014, we reported Colorado's Census of Fatal Occupational Injuries (CFOI) cases to the Bureau of Labor Statistics (BLS).

Over the course of this cooperative agreement, we successfully added new data sources and enhanced occupational health surveillance in Colorado including:

- Updating Colorado Board of Health lead test reporting rules in 2012 to require public health reporting of all adult (> age 18) blood lead level (BLL) tests  $\geq 10$   $\mu\text{g/dL}$  to align Colorado's

reportable blood lead levels (BLL) with recommendations of the CDC and the NIOSH ABLES Program.

- Entering into a Memorandum of Understanding (MOU) with the NIOSH ABLES program to begin data submission to the national program in October 2011. This allowed us to report Colorado's elevated blood lead cases to NIOSH from 2012-2014.
- Evaluation of Colorado's blood lead surveillance program by a CSTE fellow to identify opportunities for higher quality and more efficient data collection.
- Establishing a strong relationship including an MOU with the Rocky Mountain Poison and Drug Center (RMPDC) for direct access to Colorado case-level data in the National Poison Data System (NPDS). We conducted a complete epidemiologic review of occupational exposure data captured by this system. This work was conducted by an MPH student intern. This project became a springboard for the Colorado Cooperative Program for Environmental Health Assessments (CCPEHA) to investigate utility of the NPDS data as a surveillance source for pesticide exposure (environmental and occupational).
- Generating an extensive county- and regional-level profile of OHI measures and other relevant data sources (e.g. the Bureau of Labor Statistic Labor Market Information system) available for sub-state analysis. Results and methods were published on our website for other counties interested in conducting similar studies. This effort is also informing activities of the CSTE/NIOSH OHI Workgroup, which is drafting guidelines for sub-state level analysis and use of OHI.
- Successfully adding NIOSH's Industry and Occupation questions to the 2012 and 2014 Colorado Behavioral Risk Factor Surveys (BRFSS). These questions were asked of all employed participants in the Colorado BRFSS (approximately 12,000). In addition to creating a new surveillance source for occupational health, these data were useful in linking occupation data to a number of other health conditions and behaviors, informing CDC's and Colorado's Winnable Battle initiative and guiding targeted public health policy changes. Our report of industry and occupation (I/O) data from the 2012 Colorado Behavioral Risk Factor Surveillance Survey (BRFSS) was published in a peer-reviewed journal with findings that showcase numerous public health opportunities, such as validating reports of influenza vaccination rates among healthcare facility workers, identifying groups of workers that would benefit from health promotion activities (e.g. tobacco cessation and obesity prevention), and identifying occupations and industries that are prime candidates for safety interventions (e.g. seatbelt use policies).
- Taking over operations and oversight for the Colorado Census of Fatal Occupational Injuries (CFOI) program. This program previously resided in the CDPHE Vital Statistics Unit. Operating these two surveillance programs under one umbrella is expected to provide additional opportunities to analyze and utilize fatality surveillance data in novel ways. This unique arrangement allowed us to have an active role in improving the CFOI, including establishing new source documents, and in helping other NIOSH surveillance states access and utilize CFOI data.
- Beginning in 2015, initiating follow-back surveys for adults with blood lead levels of 10 µg/dL and above to determine the most common sources of adult lead exposure in Colorado. We have mailed these surveys every six months as part of on-going surveillance. In addition to the survey, we include educational brochures to educate those with elevated blood lead levels on how to reduce their levels. When we find a cluster of workers from the same workplace with elevated blood lead levels, we notify the employer.

#### Partnerships and Collaboration

Over the course of this cooperative agreement, we established a number of partnerships and collaborations. These partnerships and collaborations helped to: 1) improve surveillance

activities at the health department, 2) assist in the development of technical guidelines for high risk industries, 4) provide occupational health educational activities for high risk industries, or 5) identify new opportunities for occupational health outreach or research. These partnerships and collaborations have included:

- We established a 15 member Surveillance Advisory Committee. The fifteen committee members represent academic and research institutions, local public and environmental health agencies, industry safety professionals, a labor union, workers' compensation, OSHA's Denver Regional Office, NIOSH's Western States Office, and the Mountain and Plains Education and Research Center, as well as internal surveillance partners at the CDPHE. This committee helps to establish surveillance priorities and provides input on health department work products. Over the course of our cooperative agreement, we met at least annually with this committee.
- We established an occupational health and safety professional network, called Worksafe Colorado. This network involved over 60 partners and was the result of Colorado's strategic planning process in 2010. The goals of this network are to promote and ensure safe and healthy workplaces for all of Colorado through collaboration, mentorship, and messaging about occupational health and safety issues. Open meetings of this network occurred approximately quarterly from 2011-2013 and covered a variety of topics, including NIOSH's Total Worker Health program, advancing young worker safety, preventing workplace violence, and hepatitis B incidence related to methamphetamine use in an oil and gas boom-town. In 2013, WorkSafe Colorado established an executive board and director, launched a new website ([www.worksafecolorado.org](http://www.worksafecolorado.org)), and applied to the Colorado Non-profit Development Center to become a 501(c)(3) organization. Important accomplishments of this group included an awareness campaign for National Safety Month (June 2013), which included a display in the lobby of CDPHE, weekly announcements in CDPHE's Hot Topics Newsletter, and Colorado's Governor signing a Workplace Health and Safety Proclamation for the state.
- In 2014, we convened a 30-person, multi-disciplinary workgroup to identify and address health and safety issues of Colorado's new retail marijuana industries. This workgroup has performed worksite walkthroughs and written the first health and safety guidance for the marijuana industry which is expected to be published in 2015.
- In 2014, we also convened a new Injury Surveillance Workgroup at CDPHE, which provides ongoing opportunities to share findings and brainstorm surveillance approaches with other divisions and programs.
- In September 2011, we hosted a presentation by a NIOSH industrial hygienist on worker risks related to oil and gas drilling sites. Public health staff from across CDPHE, including the manager of the oil and gas permitting unit, were in attendance. As a result, the oil and gas unit reviewed their safety protocol for field inspectors to ensure adequate protection measures were in place.
- In 2012, we secured a pilot research grant to conduct a survey study for certified pesticide applicators in Colorado. This project is being conducted in partnership with the Colorado Department of Agriculture and researchers at Colorado State University. The data collected informed potential improvements to education and training for pesticide applicators, as well as best practices for pesticide injury surveillance and prevention activities.
- In 2014, we successfully helped to secure a pilot research grant with collaborators in the communicable disease branch of CDPHE and the University of Colorado Denver to analyze and improve Colorado's infectious disease surveillance system through the lens of occupation.

- In 2013, we conducted a pilot project with Northeast Colorado Health Department (NCHD) to recognize and address employment factors and occupational injury and illness risk as part of their public health community assessment and improvement plan. The products generated were resources for the Colorado Health Assessment and Planning System, so that other counties and regions can implement similar strategies in their communities.

#### Training and Program Development

Over the course of this five-year cooperative agreement, we actively participated in the training and development of occupational health and safety professionals. This effort provided our program with additional capacity and provided trainees with opportunities to develop their occupational health surveillance skills. These activities included the following:

- We hosted three MPH student capstone projects to conduct expanded evaluation of existing surveillance data. The students investigated the topics of 1) Workplace violence and suicide, 2) Occupational health disparities, and 3) Work-related hospitalizations.
- We were preceptors for a graduate student for a Master's Thesis on evaluating pesticide exposures among certified applicators in Colorado.
- We successfully secured a CSTE Applied Epidemiology Fellow, who worked in our program for two years starting in July 2014. This fellow participated on a number of projects including our marijuana industry workgroup and an evaluation of our lead surveillance system.
- We hosted an occupational medicine resident who developed a profile of injury, illness and fatality among Colorado's oil and gas workers.
- In partnership with a local day labor organization (El Centro Humanitario) we secured two Occupational Health Internship Program (OHIP) fellows who developed and provided safety training to over 100 local day laborers.
- Our PI directed a graduate level course (Environmental Exposures and Health Effects) at the Colorado School of Public Health in 2013 and 2014.

In addition to hosting and advising trainees, we were also able to expand the capabilities of our program by securing two pilot research grants from the NIOSH Mountain and Plains ERC. One of these grants was to conduct a survey study for certified pesticide applicators in Colorado and the other was focused on incorporating occupational risk factors into Colorado's infectious disease surveillance.

#### Worksite Investigations and Technical Assistance

Over the course of our five-year cooperative agreement, our program served as the occupational health technical experts for the health department. As such, we participated in a number of activities to provide direct technical assistance to employers. Examples of these activities are included below:

- *E.coli* outbreak at a correctional center linked to inmate workers at an on-site dairy: This investigation was a prime example of collaboration across sectors of public health and resulted in several presentations by us and our partners. The final report includes several low- or no-cost administrative changes which would decrease opportunities for worker/inmate illness.
- State office workers hospitalized for acute onset of respiratory illness symptoms: We coordinated technical assistance from the NIOSH Western States Office to review and provide input on the industrial hygiene assessment and hazard communication strategy. This investigation also provided a training opportunity for a preventive medicine resident training within our Section.

- In September 2013, we launched an investigation of hypersensitivity pneumonitis (HP) among local resort spa workers in a Colorado resort community. A complete report with recommendations to prevent further exposure was provided to the employer in November 2013. To our knowledge, these recommendations were adopted soon after.
- In May 2015, we responded at the request of a local public health agency for an investigation of rashes among employees at a driver license office. With local public health, we completed a report with recommendations to halt the outbreak of rashes. The employer implemented the recommendations, and no other employees developed rashes after the site visit.
- In March 2015, we began work to address the staff indoor air quality concerns at a middle school in Boulder, Colorado. We conducted our first survey to obtain rates of health symptoms among employees in April. To continue to monitor health symptoms through all seasons, we will conduct three more surveys throughout this upcoming school year. The results of these surveys were shared with the school district in conjunction with air monitoring recommendations.

#### Information Dissemination

Over the course of our five-year cooperative agreement, staff of the program delivered over 54 presentations at local or national conferences or meetings. Some of the presentation topics included: an overview of occupational health surveillance in Colorado, methods to enhance occupational health surveillance such as use of county level data and industry/occupation questions on BRFSS, and technical topics such as mold exposure and health and safety in the marijuana industry. A detailed listing of program presentations is presented in Table 1.

Table 1 - Presentations

<b>Date</b>	<b>Event</b>	<b>Title/Description</b>
9/2010	American Industrial Hygiene Association (AIHA) Rocky Mountain Chapter Technical Conference	<i>Occupational Health Surveillance in Colorado and the Worksafe Colorado Network</i>
11/2010	CSTE Occupational Health Subcommittee and NIOSH State-based Surveillance meeting. Austin, TX	<i>The Colorado Story: Developing Occupational Health Surveillance and Strategic Planning</i>
12/2010	American Association for Safety Engineers (ASSE) Northern Colorado Chapter	<i>Occupational Health Surveillance in Colorado and the Worksafe Colorado Network</i>
4/2011	Colorado Risk Management Office Champion Health and Safety Everyday (CHASE) meeting	<i>Occupational Health &amp; Safety Surveillance in Colorado and the Worksafe Colorado Network</i>
4/2011	Colorado Association of Local Public Health Officials (CALPHO) meeting	<i>Occupational Health &amp; Safety Surveillance in Colorado and the Worksafe Colorado Network</i>
4/2011	Colorado School of Public Health, Introduction to Public Health Surveillance (graduate-level course)	<i>Occupational Health Surveillance in Colorado</i>
4/2011	Colorado Board of Health Meeting	<i>Colorado's New Occupational Health Surveillance Program</i>
5/2011	Western Regional Epidemiology Network (WREN) webinar	<i>Integrating Occupational Health with Mainstream Public Health: Investigation of an Escherichia coli O111 Outbreak, Colorado 2011</i>

6/2011	Council of State and Territorial Epidemiologists (CSTE) Annual Conference	<i>Integrating Occupational Health with Mainstream Public Health: Investigation of an Escherichia coli O111 Outbreak, Colorado 2011</i>
6/2011	Colorado Oil and Gas Conservation Commission meeting	<i>Occupational Health &amp; Safety Surveillance Program</i>
8/17/2011	Colorado Lead Coalition Meeting	Occupational Health & Safety Surveillance in Colorado...Including Adult Lead Exposure and Toxicity
8/23/2011	Colorado Environmental Leadership Program CEP Meeting	Occupational Health and Safety Surveillance & Worksafe Colorado
9/20/2011	AIHA - ASSE Fall Technical Conference	Update on Occupational Health & Safety Surveillance in Colorado
9/21/2011	Colorado Public Health Association (CPHA) Annual Conference	Occupational Health & Safety Surveillance in Colorado
9/23/2011	NIOSH Western Occupational Network (WestON) Meeting	Epidemiologic and Occupational Investigation of an <i>E.coli</i> O111 Outbreak Associated with a Correctional Facility Dairy, Colorado, 2010
11/09/2011	AgriSafe Network Webinar	Epidemiologic and Occupational Investigation of an <i>E.coli</i> O111 Outbreak Associated with a Correctional Facility Dairy, Colorado, 2010
12/14/2011	Colorado Board of Health Rule Making Request	Adult Occupational Lead Exposure and Reporting
02/15/2012	Colorado Board of Health BOH Rule Making Hearing	Adult Occupational Lead Exposure and Reporting
03/13/2012	CDPHE, Disease Control Division Grand Rounds Meeting	Review of Work-related Poisoning Exposures Reported to a Poison Center Helpline, Colorado, 2000-2010
05/17/2012	Western Region Epidemiology Network (WREN)	Review of Work-related Poisoning Exposures Reported to a Poison Center Helpline, Colorado, 2000-2010
06/04/2012	CSTE June Meeting (ABLES)	Changing State Lead Reporting Rules: The Colorado Story
06/04/2012	CSTE June Meeting (Student Track)	Review of Work-related Poisoning Exposures Reported to a Poison Center Helpline, Colorado, 2000-2010
06/05/2012	CSTE June Meeting (Occupational Health Track)	Use of Workers' Compensation Data for Occupational Health Indicators Surveillance
9/21/2012	Colorado Public Health Association 2012 Annual Conference	Know the Benefits of Worksite Wellness and Injury Prevention
9/25/2012	AIHA - ASSE Fall Technical Conference	Occupational Health and Safety Surveillance in Colorado, 2012 Update
1/3/2013	Media release via CDPHE Communications Department	Work-Related Injury Deaths in Colorado, 2011
12/18/2012	CDPHE Grand Rounds	Public Health Survey of Certified Pesticide Applicators in Colorado, 2012
1/28/2013	High-Plains Intermountain Center for Agricultural Health and Safety Research Symposium	Public Health Survey of Certified Pesticide Applicators in Colorado, 2012
1/28/2013	Colorado Department of Ag. Pesticide Advisory Committee	Public Health Survey of Certified Pesticide Applicators in Colorado, 2012
4/18/2013	Colorado Public Health Association 2013 Annual Conference	What's Work Got to Do With It? Incorporating Occupational Data into your Public Health Improvement Plan
5/7/2013	Colorado School of Public Health Graduate Course	Overview of the CDPHE Occupational Health and Safety Surveillance Program

4/25 & 5/23/2013	Rocky Mountain Poison and Drug Center	Review of Work-related Exposures Reported to a Poison Center Helpline, 2000-2010
6/10/2013	CSTE 2013 Annual Conference	Public Health Survey to Assess Acute Pesticide Poisoning Experiences of Certified Applicators in Colorado, 2012
6/10/2013	CSTE 2013 Annual Conference	Colorado's 2012 BRFSS: Adding Value By Adding Industry and Occupation
6/25/2013	CDPHE Grand Rounds	Colorado's 2012 BRFSS: Adding Value By Adding Industry and Occupation
9/11/2013	Colorado Association of Property and Evidence Technicians	Allergens, mold and marijuana
9/17/2013	American Industrial Hygiene Association – Rocky Mountain Chapter 2013 Technical Conference	Occupational health and safety in Colorado: What's new in public health?
9/19/2013	Colorado Public Health Association 2013 Annual Conference	What's work got to do with it? Incorporating occupational data into your public health improvement plan
9/26/2013	Western Occupational Network 2013 Annual Conference	Potential occupational exposures in marijuana grow houses
9/27/2013	Western Occupational Network 2013 Annual Conference	How CFOI works, from the inside-out
10/01/2013	Education & training session for workers at Colorado correctional center	Uranium in drinking water
10/7/2013	WorkSafe Colorado Group Meeting	What's work got to do with it? Incorporating occupational data into your public health improvement plan
12/4/2014	Colorado Pesticide Applicator Annual Conference	Public health survey to assess acute pesticide poisoning experiences of certified applicators in Colorado, 2012
12/9/2014	NIOSH Western States Office - Internal Staff Meeting	CDPHE Occupational Health & Safety Program Update: Starring the 2012 BRFSS data
1/9/2014	NIOSH BRFSS Workgroup	Colorado 2012 BRFSS: Adding value by adding industry and occupation
2/3/2014	WorkSafe Colorado Group Meeting	Potential occupational exposures in marijuana grow houses
3/18/2014	Colorado Marijuana Industries Health & Safety Workgroup	Public health and marijuana: State role in occupational health and safety
6/24/2014	Council of State and Territorial Epidemiologists 2014 Annual Conference	What's work got to do with it? Incorporating occupational health into local public health assessment and improvement plans
6/24/2014	Council of State and Territorial Epidemiologists 2014 Annual Conference	Potential occupational exposures in marijuana grow houses
8/12/2014	CDC BRFSS Data Users' Webinar	Colorado 2012 BRFSS: Adding Value by Adding Occupation
9/12/2014	Western Occupational Network 2014 Annual Conference	Violent Deaths and Occupation in Colorado
9/16/2014	American Industrial Hygiene Association – Rocky Mountain Chapter 2013 Technical Conference	Hashing Out the Issues: Health and Safety in the Marijuana Industry
10/29/2014	Colorado Coroners Association	Census of Fatal Occupational Injuries (CFOI)
12/12/2014	New Coroner Institute	Census of Fatal Occupational Injuries (CFOI)

1/30/2015	Rocky Mountain Academy of Occupational and Environmental Medicine	Drilling Down into Colorado Hospitalization Data: Exploring Injury in the Extraction Industry
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Occupational health information was also disseminated through a number of publications. The program generated 21 non-peer reviewed publications and contributed on three peer reviewed publications during the five-year cooperative agreement. Peer reviewed publications are cited below and non peer-reviewed publication are listed in Table 2.

Peer-Reviewed Publications

Towle, M. contributor: Green, MK et al.: [2011] Occupational Highway Transportation Deaths: United States, 2003-2008. CDC MMWR 60(16):497-502.

Towle, M. contributor: Ray, W et al.: [2012] Outbreak of Shiga Toxin–Producing *Escherichia coli* O111 Infections Associated with a Correctional Facility Dairy — Colorado, 2010. CDC MMWR 61(9):149-152.

Towle M, Tolliver R, Bui AG, Warner A, Van Dyke M: [2015] Adding industry and occupation questions to the behavioral risk factor surveillance system: new opportunities in public health surveillance. Public Health Rep. 130(2):153-60.

Table 2 – Non peer-reviewed publications

Date	Title
7/2011	Occupational Health and Safety is Public Health and Safety (Poster)
9/12/2011	Occupational Health Indicators in Colorado, 2011 Update (CDPHE website)
9/19/2011	“Notes From Dan” - Editorial notes mention potential for lead exposure through “pipe-dope” used by oil and gas rig workers (Mountain States Energy Alliance Newsletter)
10/29/2011	Don’t Take Lead Home From Your Job! (Brochure)
11/22/2011	Press Release: 2010 Occupational Fatalities (CDPHE website)
02/21/2012	Announcement of Adult Lead Test Reporting Rule Change and Surveillance Data (CDPHE Hot Topics Newsletter)
02/28/2012	Announcement regarding MMWR which documented risks of methylene chloride exposure in bathtub finishers (Worsafe email distribution)
11/1/2012	Review of Work-related Exposures Reported to a Poison Center Helpline, 2000-2010 (CDPHE website)
1/7/2013	Occupational Health Indicators in Colorado, 2012 Update (CDPHE website)
1/3/2013	Census of Fatal Occupational Injuries Press Release and 2011 prelim data tables (CDPHE website)
1/31/2013	NIOSH E-news: Colorado Surveys Certified Pesticide Applicators
9/2013	Census of Fatal Occupational Injuries in 2012 (CDPHE press release)
9/2013	State and Federal Occupational Health and Safety Programs & Offices in Colorado (CDPHE Brochure)
9/2013	Resources to Ensure Worker Health and Safety in Colorado (CDPHE Brochure)
9/2013	Funding Opportunities for Occupational Health and Safety Programming in Colorado (CDPHE Brochure)
1/2014	Colorado BRFSS: Adding value by adding occupation (NIOSH E-news)
6/2014	Occupational Health Indicators in Colorado, 2013 Update (CDPHE website)
9/2014	Census of Fatal Occupational Injuries in 2013 (CDPHE press release)
1/2015	Occupational Health Indicators in Colorado, 2015 Update (CDPHE report)

2/2015	FAQ: Oil and Gas Extraction Occupational Health and Safety Surveillance (CDPHE report)
5/2015	Protect Yourself & Your Family From Lead in Your Home (two versions, CDPHE brochures)

## **DISCUSSION/CONCLUSIONS**

Through this cooperative agreement, Colorado was able to establish an effective and sustainable occupational health surveillance program. Highlights of our accomplishments include:

- For the first time, we generated and reported Colorado’s Occupational Health Indicator (OHI) data to the National Institute for Occupational Safety and Health (NIOSH) for 17 of the 20 (or later 22) standardized indicators including data from 2008-2012. These data were published by the Council of State and Territorial Epidemiologists (CSTE).
- From 2012 through 2014, we reported Colorado’s cases of adult elevated blood lead reported to NIOSH’s Adult Blood Lead Epidemiology and Surveillance (ABLES) Program
- From 2012 through 2014, we reported Colorado’s Census of Fatal Occupational Injuries (CFOI) cases to the Bureau of Labor Statistics (BLS).
- Our activities and new relationships improved access to important occupational health surveillance data sets such as poison center call volume data from the Rocky Mountain Poison and Drug Center.
- We successfully integrated occupational health into public health through a number of channels including the use of occupational data in community health profiles, adding questions on industry and occupation to the major adult public health survey (BRFSS), and the use of county-level occupational health data to inform public health planning.
- We developed a number of partnerships and collaborations to 1) improve surveillance activities at the health department (Colorado Surveillance Advisory Committee), 2) assist in the development of technical guidelines for high risk industries (Marijuana Industry Occupational Health and Safety Workgroup), 4) provide occupational health educational activities for high risk industries (Worksafe Colorado), or 5) identify new opportunities for occupational health outreach or research (collaborations with Colorado State University and the Colorado School of Public Health).
- The capacity provided by this agreement allowed us to provide technical and investigative assistance for Colorado employers on issues including an occupational infectious disease outbreak, a cluster of unusual respiratory diseases among spa workers, and contentious indoor air quality problems.
- Our outreach and dissemination activities improved the occupational health knowledge of hundreds of Colorado citizens and occupational health professionals through more than 53 presentations, 21 non peer-reviewed publications, and three peer-reviewed publications.

## **LITERATURE CITED**

1. US Bureau of Labor Statistics. National census of fatal occupational injuries in 2007. U.S. Washington, DC: US Dept of Labor; 2008.
2. Bronstein, A. Medical Director Rocky Mountain Poison Control Center, (Personal communication, July 27, 2009)
3. US Bureau of Labor Statistics. Local Area Unemployment Statistics, Current Population Survey, 2007. U.S. Washington, DC: US Dept of Labor; 2008.
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6. National Academy of Social Insurers. 2008. Workers' compensation: benefits, coverage, and costs. Available at <http://www.nasi.org>.
7. US Census Bureau. DataFerrett, *BLS Current Population Survey, January 2009*.
8. US Census Bureau. DataFerrett, *BLS Current Population Survey January 2009*.
9. Colorado Nanotechnology Alliance. Doing business in Colorado. Available at <http://www.coloradonanotechnology.org>
10. Colorado Oil and Gas Commission. Available at <http://cogcc.state.co.us/>
11. Ritter, B., (2009, February 21. Testimony before the U.S. Senate Committee on Environment and Public Works & Subcommittee on Green Jobs and the New Economy "Clean Energy Jobs, Climate-Related Policies & Economic Growth – State & Local Views", Washington, D.C.)
12. National Immigration Law Center - 2002, based on 1990, 2000 Census data.

**INCLUSION OF GENDER AND MINORITY STUDY SUBJECTS:** Not applicable

**INCLUSION OF CHILDREN:** Not applicable

**MATERIALS AVAILABLE FOR OTHER INVESTIGATORS:** Not applicable