



HICAHS Annual Report

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Center Summary

Since its inception in 1991, the High Plains Intermountain Center for Agricultural Health and Safety (HICAHS) has safeguarded and promoted the health and well-being of those working in agriculture. HICAHS primarily serves the states of Colorado, Montana, North Dakota, South Dakota, Wyoming, and Utah, but its impact extends nationally and internationally. We work closely with NIOSH, other NIOSH Agricultural Centers, and agricultural organizations to learn more about the root causes of injury and illness in the agriculture industry. The Agriculture, Forestry, and Fishing Industries have the highest rate of fatalities of any industries in the United States. Our primary focus for our projects in 2012-2016 is to learn more about the relationship between organic dust aerosols on farms and respiratory disease, improve the ergonomic health of farm workers through better equipment design, develop and improve safety training, and engineer tractor rollover protective structures (ROPS). A major effort involves occupational health and safety programs for the dairy industry.

HICAHS Vision:
“A Healthy and Safe Workforce
for U.S. Agriculture, Forestry,
and Fishing.”

HICAHS has developed several advisory boards to assist with the direction and development of its projects. The HICAHS Dairy Network, Dairy Advisory Board, and International Dairy Research Consortium exemplify our integrative model of HICAHS partnership among researchers and stakeholders within the dairy industry. HICAHS also continues collaborative relationships with its general Advisory Board members.

The HICAHS Dairy Health and Safety Network builds on our work with the dairy industry over the past decade. Following up on a highly successful Dairy Workshop in 2009 co-sponsored with the Southwest Center for Agricultural Health, Injury Prevention and Education, we organized a HICAHS Dairy Advisory Board with representatives from Montana, Wyoming, North Dakota, South Dakota, Utah, Colorado, Texas, New Mexico, Minnesota, Nebraska, and Iowa. Researchers from the NIOSH-funded Ag Centers in Texas, California, Iowa, Wisconsin, and Nebraska are important collaborators on this HICAHS Dairy Advisory Board. In 2010, we initiated an International Dairy Research Consortium to address the global health and safety concerns of the dairy industry more effectively. Participants now include 11 partner countries including Australia, Brazil, Canada, Denmark, Finland, Germany, Ireland, Italy, Netherlands, New Zealand, and Sweden.

HICAHS Goals and Specific Aims:

Our goal is to integrate new and existing knowledge and to utilize multiple routes of dissemination to move from research to improved agricultural health and safety practice.

The specific aims are to:

1. Conduct interdisciplinary research related to prevention or reduction of agricultural causes of acute and chronic illness and disease;
2. Provide oversight to ensure the conduct of scientifically sound research;
3. Implement and evaluate intervention/prevention programs to promote health and reduce hazards in agricultural production;
4. Expand the use of effective interventions through engaging partners among appropriate agricultural groups;
5. Listen and respond to input from advisory boards, agricultural groups, and collaborators;
6. Use input from advisory boards, agricultural groups and collaborators to formulate and enhance outreach efforts;
7. Utilize a comprehensive evaluation model to assess the achievements of the Center;
8. Continue to build agricultural partnerships to enhance diffusion of innovations;
9. Building on our substantial work with the dairy industry, establish and provide leadership for a regional HICAHS Dairy Health and Safety Network, HICAHS Dairy Advisory Board, and International Dairy Research Consortium to comprehensively address the industry's needs; and
10. Develop new partnerships and capacity to address health and safety in Beef and Forestry.

Relevance

HICAHS promotes health and reduces work hazards among high-risk industries of agriculture and forestry. Our work focuses on the vulnerable population of the Spanish-speaking workforce that is found in the agriculture industry in our region (especially the dairy industry). We are using new, innovative tools to characterize hazards such as the human lung cell sampler in the "Bioaerosol Exposures and Models of Human Response in Dairies and Cattle Feedlots" project. The "Injury Risk Analysis in Large-Herd Dairy Parlors" project is also the first of its kind address ergonomic hazards and interventions among U.S. large-herd dairy operations

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Outreach

Outreach is teaching, research, and service that engages HICAHS with external constituencies. Outreach activities generate knowledge, share resources, and apply the expertise of HICAHS in ways that advance health and safety among agriculture, forestry and fishery workers for the public good.

- **Research and Service Outreach.** Much outreach occurs through the advice and consultation provided while visiting farms to collect data for HICAHS research. Since collaborating with the dairy industry a decade ago, researchers have visited over 65 large-herd operations in 9 U.S. states and 3 countries. Strategic partnerships have been formed with representatives of U.S. dairies and producer organizations. Producers and other industry stakeholders now view HICAHS researchers as trustworthy and capable partners to address the occupational health and safety needs on large-herd dairy operations. See our initiatives specifically for the dairy industry on page 14.
- **Teaching and Service Outreach.** HICAHS provided educational brochures on the respiratory illness hazards at several meetings with farmers and ranchers. At the **Colorado Farm Bureau's** annual meeting approximately 30 farmers received free pulmonary function assessments and advised to see a physician if results were abnormal. Informational brochures and 100 respirators were also distributed at the meeting, held on November 18, 2011.

The **Yuma Farm Show** draws farming families from a 100-mile radius in a remote part of Colorado. The Colorado Farm Bureau, Farm Safety 4 Just Kids and the High Plains Intermountain Center for Agricultural Health and Safety presented a farm safety and health workshop at the Yuma Farm Show on August 17, 2011. The Colorado Farm Bureau's trailer containing educational farm hazard displays was funded through the HICAHS "Small Community-Initiated Grants Program." The event focused primarily on helping farm families learn about the dangers on the farm, injury prevention and ways to educate others about farm safety. Demonstrations included the following topics: grain handling, PTOs, tractor roll-overs, ATVs and equestrian helmets. Various resources were distributed and pulmonary function testing was provided by HICAHS throughout the day. The HICAHS booth featured its interactive computer program to educate kids on farm hazards.

American Agri-Women is a national organization of female agricultural producers with 35,000 members from 50 states. HICAHS co-sponsored the American Agri-Women's 2012 national conference to increase the visibility of the Ag Centers to agricultural producers. HICAHS hosted a booth at the conference from November 9-11 highlighting ATV Safety.

- The “**Community-Initiated Small Grants Program**” provides money and expertise to outside agricultural organizations to do a health and safety project of their choice. Several educational DVDs have been produced as a result of these collaborative projects. For details, see the section in this report titled “Small Community-Initiated Grants Program” below.

Community-Initiated Small Grants Program

Challenge and Approach

Agricultural organizations and State Extension Programs do not have the resources to adequately provide health and safety training to their membership and their related agricultural populations. Through community-initiated small grants, community organizations and HICAHS researchers are engaged together in developing and conducting agricultural health and safety education and training programs to agricultural end-users. Based on our current network of agricultural stakeholders we provide and support agricultural community-initiated small grants in the six-state HICAHS Region (and sometimes to neighboring states that share common agricultural health and safety issues). Agricultural partners in each state are notified of the availability of grant money from HICAHS for community-initiated projects aimed at improving agricultural health and safety specific to their community. The HICAHS personnel assist the grant recipients (primarily agricultural organizations and State Extension Programs) with their projects in a variety of ways ranging from conducting evaluation assessment to assisting with dissemination of their final products.

Impact

The recent focus for HICAHS has involved the support of four community-initiated projects aimed at improving all-terrain vehicle (ATV) safety within the agricultural community in Montana. Through a partnership with Montana State University Extension, ranchers, and HICAHS, we successfully identified four primary agricultural tasks that involve intensive ATV use: (1) animal handling, (2) fence building and mending, (3) weed control/spraying, and (4) general transportation. Recognizing the need for ATV safety education materials specific to agriculture, a project led by an Extension Agent focused on the development of Safety Awareness posters for each of the key areas of intensive ATV use. This project also included the development of a website providing electronic copies of safety posters to users in Montana and across the nation: <http://www.safeatv.org/>. A major barrier for ranchers to obtain the current ATV Safety Institute (ASI) training was the lack of qualified trainers within the region. Thus, subsequent projects supported the ASI Certification for four Montana State University Extension Agents who have now provided the five-hour ASI training to eight agricultural producers and eight additional Extension Agents. Program evaluation indicated significant knowledge gains and improved operational performance with retention of knowledge. The most recent community-initiated project has been focused on the development of an “ATV Safety Training Kit” for Ag Extension Agents. The kit includes poster placards, a PowerPoint presentation, an educational script and evaluation materials. The momentum continues to grow in Montana for increased awareness of ATV safety through partnerships. As a result, Montana Extension Agents were able to secure ATV safety training approval for Pesticide

licensing because ATVs are used for pesticide application. In addition, the Extension Agents have forged a partnership with the Montana Farm Bureau that will include 90 minutes of ATV safety training at the annual education events. These projects have yielded effective products and set into motion activities and collaborations that would not exist otherwise to support safer ATV use in the agriculture community. The Montana State Fund has provided data on work-related injuries and fatalities involving ATVs so that we will be able to evaluate the impact of these programs on trends in morbidity and mortality.

Pilot Program

Challenge and Approach

HICAHS offers funding to academic researchers for projects in agricultural health and safety research. HICAHS established a program to support feasibility projects, with priority given to student investigators or any investigator who is new to the field of agricultural and forestry health and safety research. Pilot research funding enables investigators to establish preliminary success and experience in agricultural health research, meanwhile increasing the likelihood of future funding.

The goals of the HICAHS Pilot/Feasibility Project program are: (1) To develop new and creative research, prevention, intervention, outreach, education, evaluation or translation findings and outcomes related to agricultural and forestry safety and health at institutions in federal Region VIII (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming); (2) to foster the development of new, collaborative partnerships between HICAHS members, private industry, and regional State and Federal agencies with stakeholder interests in agricultural and forestry health and safety; (3) to build research capacity related to health and safety in agriculture and forestry in the HICAHS region.

Impact

Since September 2011, the HICAHS Pilot Program has funded four projects to young investigators. One project is in response to the listeria outbreak in cantaloupes that occurred during summer 2011. The project “Bioaerosol Monitoring: preventing the spread of infectious diseases among farmers” is evaluating whether air monitoring tools can be used to detect listeria in produce-packing facilities.

The Colorado Department of Public Health collaborated with the Colorado Department of Agriculture and Colorado State University to design and administer a survey that would capture data on worker characteristics, and events and outcomes associated with occurrences of acute pesticide poisoning. A survey was mailed to pesticide applicators in the state of Colorado. Of the 932 total respondents, 31 (3.3%) reported at least one acute pesticide exposure event.

The Pilot/Feasibility began funding for a project in fall 2012 to improve analytical methods for quantifying pesticide residues in spray tanks and determining methods for improving tank clean-out. Studies suggest that cleaning practices for spray tanks are inconsistent, potentially leading to pesticide residues in tanks. Pesticide residues in spray tanks can lead to unintentional

worker exposures and to unintended application of pesticides to agricultural areas.

Pilot/Feasibility Projects (2011-2013):

- “Acute Pesticide Poisoning Experiences of Certified Applicators in Colorado” by Amy Warner and Meredith Towle, Colorado Department of Public Health and Environment
- “Bioaerosol Monitoring: preventing the spread of infectious diseases among farmers” by Margaret Davidson and Lawrence Goodridge, Colorado State University
- “Improving pesticide tank clean-out” by Cynthia Walker and Delphine Farmer, Colorado State University
- “In vitro microsystem for determining acute pesticide toxicity” by Meghan Mensack, Colorado State University

Evaluation

Challenge

The goal of the Ag Centers is to reduce injury and fatality in the agricultural industry. Each Agricultural Research Center is charged with the task of evaluating the public health impact of their Center in achieving this goal. To this end, the HICAHS Evaluation Team proposed a comprehensive program of evaluation that evaluates the products, outcomes, and impact of our activities.

Approach

The evaluation team developed and utilized an instrument to measure research to practice (R2P) on all HICAHS projects. This data will provide a baseline with which to compare constituency feedback at the end of the grant period for all relevant projects.

In addition, a satisfaction survey was developed and administered to all HICAHS personnel to determine areas for continued improvement related to HICAHS Administration.

A second major task was the development, testing and implementation of an SQL database for collecting and storing information on each of the HICAHS projects. This database will allow the Evaluation Team to quickly and efficiently access HICAHS activities and products so that they can be evaluated for public health impact. A formative evaluation was conducted during the development and implementation phases to determine if improvements to the system were needed and methods for training. All HICAHS personnel were trained to use the new system as well as HICAHS-funded grant recipients.

Impact

The database was developed, tested and shared with other Ag Center Evaluators nationwide. We presented the database at a workshop in Minneapolis, Minnesota in October 2012 and other Ag Centers are interested in incorporating the database with their Evaluation programs. Based on feedback from the evaluation meeting in October, the HICAHS evaluation team is in the midst of planning a workshop scheduled for April 2013 with the purpose of continuing to enhance evaluation efforts at all Ag Centers.

Development and Evaluation of a Computer-based ROPS Design Program

Challenge

To reduce the number of fatalities during tractor rollovers, there has been an effort to retrofit old tractors with a roll-over protective structure (ROPS). ROPS retrofit programs have encountered the problem of tractor owners wanting ROPS on their tractors, but there is no commercial ROPS (or a ROPS design) available. ROPS designs are needed so that they meet the performance criteria outlined in the ROPS Standards and Federal regulations.

Approach

The major specific aim of this project is to develop and evaluate a computer-based ROPS design program that will assist in quickly developing ROPS designs based on tractor weights and dimensions. The final product from the model will be ROPS design drawings with specifications that can be used to construct the ROPS. To date, the initial framework, platforms, required tractor dimension inputs and ROPS design outputs for the Computer-based ROPS Design Program (CRDP) have been established.

Impact

The model input parameters (46 tractor dimensions and tractor mass) were organized into a form and tested at the 2012 National Agricultural Machinery show in Louisville, Kentucky. Model parameter inputs were determined for 10 tractor/ROPS combinations and a tractor/ROPS dimension database was initiated. The 28 required ROPS design dimensions were defined and incorporated into the ROPS output computer-aided design (CAD) drawing, which will be used for ROPS construction.

Preliminary ROPS design relationships for the CRDP have been observed as described below:

- ROPS thickness and box dimensions increase with tractor weight, but thicknesses are less sensitive.
- ROPS heights increase with distance of the seat reference point (SRP) above the axle housing.
- ROPS slant angle increase with horizontal distance of the (SRP) behind the axle housing mount.

These are obvious trends, but the mathematical relationships have been developed. The project results have been presented at the June 2012 conference of the International Society for Agricultural Safety and Health (ISASH), the July 2012 conference of the American Society of Agricultural and Biological Engineers (ASABE) and the September 2012 conference for Safety, Health, and Welfare in Agriculture (SHWA). The feedback from these meetings has been incorporated into the development of the Computer-based ROPS Design Program.

HICAHS Focus on the Dairy Industry

Challenge

The dairy industry in the United States has moved to a large-herd, mass production model with a goal of increased milk production at lower cost. Expanding production capacity has required a larger workforce, primarily comprised of non-English speaking Latino workers (> 90%) with minimal experience in agriculture. Dairy farming is among the most dangerous occupations and accounts for a disproportionately large percentage of all injuries in livestock-related agriculture. Dairy workers also experience relatively high rates of respiratory disease associated with inhalation of dusts during milking, feeding, and other tasks.

High employee turnover and lost work time are significant concerns for dairy owners and managers. A new challenge to dairy producers, who are seeking to ensure safe working environments and to comply with state or federal occupational safety and health regulations, is the increased employee numbers. Many owners and managers are now responsible for managing human resources and safety programs while not having formal training in employee management or occupational health and safety. Complying with a large number of health and safety regulatory standards while simultaneously training a predominantly non-English speaking workforce is a daunting challenge. In a highly competitive global market it is critical that owners and managers have the knowledge, tools, skills and support needed to effectively address these challenges and sustain a healthy, productive workforce.



Photograph courtesy of Evelyn te Velde

Agriculture, forestry, fishing and hunting was one of only two private industry sectors to experience an increase in the rate of injuries and illnesses in 2011 compared to 2010, driven by increases in both the crop production and animal production (primarily dairy cattle and milk production) industries.-- BLS Workplace Injury and Illness Summary, Economic News Release, October 25, 2012

Approach

Over the past decade and particularly in the last five years, HICAHS has worked closely with dairy industry stakeholders to understand the causes and impact of work-related injuries and illnesses, develop and evaluate effective education and engineering interventions, and build a network of partners with capacity to address the health and safety needs of the U.S. dairy industry. **At the core of all of our projects and interventions has been a focus on stakeholder engagement and partnership building. The HICAHS approach to address health and safety on**

dairy farms is to ***LISTEN*** to dairy stakeholders, and ***RESPOND*** to expressed needs and concerns with ***sound and relevant*** research and outreach efforts.

Initiatives

HICAHS initiatives include the establishment of a Regional Dairy Advisory Board and network, as well as an International Dairy Consortium which have been instrumental in this effort. Additionally, HICAHS personnel have been invited to assume national and international leadership roles in workshops, grant proposals, and publications. At present, HICAHS researchers are partnering with producers and industry service companies to develop tools and strategies to improve human resource management practices.

Recent outreach efforts have included providing training for producers on the Occupational Safety and Health Administration (OSHA) and on management approaches such as Lean Six Sigma. Longer term efforts to develop Occupational Health and Safety Management Systems and effective worker training programs are in progress. More specific activities are outlined below:

Research and Service Outreach.

- In addition to dairy producers, HICAHS researchers have engaged industry-leading service and equipment companies to address health and safety issues on the farm. HICAHS and DeLaval (global market leader in dairy equipment and supplies) have formed a collaborative partnership to address the health and safety needs in the United States as well as internationally. HICAHS has also formed a collaborative partnership with Alpha Technology, Inc., manufacturer of a new milking tool. We are working closely with DeLaval and Alpha Technology to design milking tools that will enable workers to perform milking tasks more efficiently, productively, and with reduced risk for the development of musculoskeletal disorders.
- HICAHS has partnered with AgriMetrica, a technology supplier dedicated to providing turn-key solutions exclusively to the dairy industry, to develop state-of-the-art occupational health and safety management tools.

Research Outreach.

- Research partnerships have been formed with domestic and international dairy researchers with the goal of increasing research capacity, and optimizing resources. We have partnered with the University of Texas Health Science Center in Tyler, TX (Southwest Ag Center), University of Iowa (Great Plains Ag Center), University of

California Davis (Western Center for Agricultural Health and Safety), University of Nebraska (Central States Center for Agricultural Safety and Health), Wisconsin National Farm Medicine Center (National Children's Center for Agricultural Health and Safety) and University of Minnesota (Upper Midwest Agricultural Safety and Health Center).

- Partnerships have been formed with researchers at the Swedish University of Agriculture Sciences in Alnarp, Sweden, to form the HICAHS International Dairy Research Consortium to address health and safety on dairy farms in the U.S., Europe and other dairy producing countries. New members of the consortium represent Italy, Germany, Denmark, Australia, Canada, Brazil, New Zealand, and Ireland.

Research and Teaching Outreach.

- Drs. Reynolds and Douphrate are leading preparation of a special issue of the Journal of Agromedicine focusing on "International Dairy Health and Safety." This issue, to be published in summer 2013, comprehensively addresses the current state of occupational health and safety in the dairy industry, and identifies research and program needs. Authors include HICAHS personnel and partners in the HICAHS Dairy Network and International Dairy Consortium.
- Dr. Reynolds was invited to organize a 3 day Pre-Conference *Workshop on Agricultural Health and Safety with Emphasis on Dairy* in conjunction with the 11th World Conference on Injury Prevention and Safety Promotion, in Wellington, New Zealand from September 28 – 30, 2012. Forty one researchers and practitioners from around the globe participated in field visits, hands-on approaches to training for ATV/quad bikes, and a seminar/discussion to share best practices. Drs. Douphrate and Hagevoort and other members of the International Dairy Consortium participated.

Teaching Outreach.

- Dr. Reynolds will provide a keynote presentation on *Managing Worker Safety, Productivity, and Regulatory Issues* at the upcoming Western Dairy Management Conference in March of 2013.
- Dr. Douphrate will be presenting two days of instruction on worker health and safety and labor management at the upcoming Southern Great Plains Dairy Consortium Program in June 2013. This 6-week program, sponsored by 11 academic institutions and industry service corporations, provides hands-on dairy farm management training to current and future farm managers and owners.

- Dr. Douphrate has been invited to write a new monthly column on Dairy Worker Safety and Health for Progressive Dairyman beginning in January 2013. The Progressive Dairyman is an e-Newsletter with over 10,000 readers. HICAHS personnel and partners in the HICAHS Dairy Network and International Dairy Consortium will contribute.

Impact

The human and economic impact of illness, injury, and fatalities on the dairy industry is significant. In an industry with low profit margins and highly volatile global markets, reducing employee turnover and production costs may make the difference in economic survival. HICAHS efforts will help the dairy industry take a systematic approach to risk management needed to sustain a healthy, productive workforce as an integral component of production, food safety, and animal welfare.

Dairy Exposure Assessment in Large-Herd Dairy Parlors

Challenge and Approach

Over the past two decades the U.S. dairy industry has moved to a more industrialized, mass production model. With the goal of increased milk production at lower cost, dairy capacity will continue to grow leading to increases in task specialization for workers. These new large-herd dairy operations will likely increase occupational risk factors for workers. Higher repetitions, reduced rest time, awkward postures, and high muscle loads all increase the risk for musculoskeletal injuries. This 5-year project is addressing the health and safety of large-herd dairy workers through physical exposure assessment and intervention analysis. The study is significant because of the national trend toward mass milk production operations and the lack of intervention research addressing these challenging working environments.

Impact

The potential impact of this project is significant due to the industry trend towards large-herd operations. Since the initiation of data collection in September of 2011, a total of 33 parlor workers have been sampled. Each worker was monitored for a full-shift (8+ hours). Data collected includes shoulder and trunk motion (i.e. posture, repetition, rest), upper extremity muscle activity (i.e. muscle force, rest, repetition), and physiological performance including heart and breathing rates and body temperature. While full-shift data collection continues, we have embarked on the first intervention analysis to evaluate a new ergonomically-designed milking cluster. We will evaluate this new piece of equipment and its effectiveness in reducing ergonomic exposures to the worker. Year 1 of this 5-year project has been completed and more details will be forthcoming as the project progresses.

Enhancing Dairy Safety Training Effectiveness

Challenge

The critical need for effective safety training specific for Latino workers in the large-herd dairy industry was highlighted at the HICAHS Dairy Health and Safety Workshop in October 2009 in Denver and emphasized by members of the I-29 Dairy Consortium during a series of safety workshops organized by HICAHS personnel. Additionally, our own studies revealed that traditional safety training had no protective effect on the reported incidence of injury among dairy workers. The study findings suggested that a combination of organizational, management and worker characteristics play a critical role in effectiveness and transfer of dairy safety training in the field.

Approach

We are employing a cultural anthropological approach in seeking to understand the farmers'/owners' and the workers' perspectives regarding the barriers and facilitators that influence safety behaviors and accidents. The goal is to integrate knowledge of the safety barriers and facilitators into the development and refinement of more effective safety training programs for large-herd dairies. In order to influence behavior it is necessary to understand the lives and motivators of people we are working with in our project. Thus, we are employing a cultural anthropological perspective and qualitative methods to collect data for this project. These approaches align directly with the National Academies Program Evaluation Recommendations 5a, 5b, and 7b of NIOSH.

Impact

We have conducted participant observation in 3 dairies in South Dakota and Colorado. In addition to fieldwork that involved living and working with the dairy employees in their quarters, we conducted direct observation in 6 dairies (Texas, New Mexico and Colorado), and 14 focus groups in South Dakota and Colorado with a total of 68 participants. All of the above was done bilingually in Spanish and English since 98% of the workers in our study are native Spanish speakers.

In order to contextualize this knowledge and meet the needs of the dairy industry and the perspectives of the farmers/owners, we have attended and/or sponsored the following conferences:

- 2013 I-29 (Sioux Falls, South Dakota)
- 2012 High Plains Dairy Conference (Amarillo, Texas)
- 2012 Central Plains Dairy Expo (Sioux Falls, South Dakota)
- 2012 Western States Occupational Network (WestON) Fifth Annual Meeting Building and Sustaining Partnerships NIOSH/CSTE/MAPERC
- 2012 Colorado State University Vulnerable Workers (Fort Collins, CO)

It is relevant to emphasize the importance of cultivating and creating partnerships and collaborations by building trusting relationships. This was articulated during the process of recruiting and visiting dairies in South Dakota, Colorado, New Mexico and Texas. A photo essay was also created to visually document segments of the lives of dairy workers and managers in their natural environment. A DVD was produced from the data collected and given to the workers.

Bioaerosol Exposures and Models of Human Response in Dairies and Cattle Feedlots

Challenge

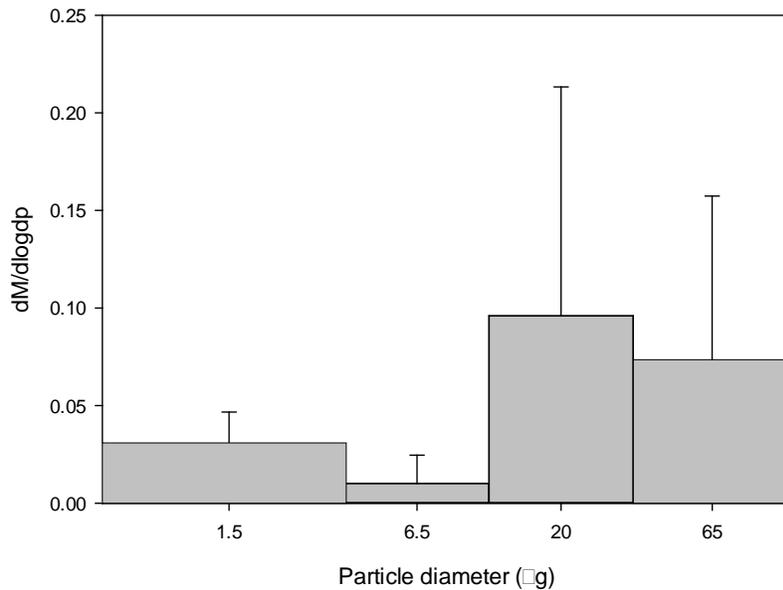
Research into respiratory disease and exposures in agricultural settings has focused primarily on Gram-negative bacterial endotoxins. Recent application of new molecular biology techniques has shown that bioaerosols in swine, dairy, and poultry environments are dominated by diverse population of Gram-positive bacteria. Improved characterization of agricultural aerosols is needed to explain the causes of respiratory diseases in these environments and to develop interventions that effectively reduce exposures.

Approach

The objectives of this research are to apply powerful new tools to better characterize bioaerosols in dairies and cattle feedlots and to compare three different approaches for measuring the effects of bioaerosols in the human lung: a traditional model using submerged lung cells; a novel model using an aerosol sampler which includes human lung cells; and nasal samples taken from workers in these environments. Two highlights from this first year of the project include; 1) development of a new method for sampling nasal inflammation in workers in the field using the Rhinoprobe; and 2) adaptation and application of a novel high volume sampler to characterize size distribution of aerosols in dairies.

Figure 1 presents a summary from these field studies where the mass or quantity of aerosol (dM) is standardized relative to the size range of the particles collected (dLogdp - the logarithm of the upper and lower size interval).

Aerosol Size Distribution



It is clear from these results that the aerosols in these dairies fall into two major groups that are likely generated by different sources. The large quantity of mass in the upper size intervals indicates that deposition in the upper portion of the respiratory system may have important implications for inflammation and lung disease among workers and livestock in these environments.

Impact

This project will develop better tools for understanding agricultural lung disease, and will provide data to help develop effective interventions. The Rhino-probe nasal sampling method is a significant improvement over nasal lavage. It is less invasive, easy to use in the field, and allows the evaluation of inflammatory response before and after an exposure. To our knowledge, this study is the first attempt to characterize such a wide range of particle sizes in agricultural aerosols, ranging from respirable to inhalable fractions. Most studies have focused on respirable size fractions of organic dust, which ultimately deposit in the alveolar region of the respiratory system. More information is needed on the amount of dust that can deposit in the upper respiratory system, as well as the alveolar region of the lungs. An aim of this study is to narrow this gap in knowledge and provide a first step in understanding upper respiratory injury from exposure to larger particles in the agricultural workplace. The project has broad implications for evaluating and reducing exposures to inflammatory aerosols in a wide range of industries.