



# CLOSEOUT REPORT

Project Period: September 15, 2011-March 31, 2017

CDC/NIOSH Cooperative Agreement No. 2 U54 OH008085

September 30, 2017

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## List of Terms and Abbreviations

ACE	Agricultural Center Evaluation
AFF	Agriculture, Forestry, and Fishing
AFF Centers	Agriculture, Forestry, and Fishing Centers sponsored by NIOSH, also known as “Ag Centers” or “U.S. Agricultural Safety and Health Centers”
ACGIH	American Conference of Industrial Hygienists
ASHCA	Agricultural Safety and Health Congress of America
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
ASSE	American Society of Safety Engineers
ATV	All-Terrain Vehicles
CDC	Centers for Disease Control and Prevention
Co-I	Co-Investigator
CSU	Colorado State University
ECO	Evaluators, Coordinators, and Outreach Personnel Group
EHB	Environmental Health Building
ERC	Education and Research Center
FReSH	Farm and Ranch eXtension Safety and Health
HICAHS	High Plains Intermountain Center for Agricultural Health and Safety
IDRC	International Dairy Research Consortium
ISASH	International Society for Agricultural Safety and Health
MAP-ERC	Mountain and Plains Education and Research Center
n/a	Not Applicable
NAS	National Academies of Sciences
NCBA	National Cattlemen's Beef Association
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NORA	National Occupational Research Agenda
NTSI	National Tractor Safety Initiative
ONES	Outstanding New Environmental Scientist Award
OSHA	Occupational Safety and Health Administration
PAR	Program Announcement Received
PHS	Public Health Service

PI	Principal Investigator
RA	Research Associate
RFP	Request for Proposals
ROPS	Roll-Over Protective Structures
WestON	Western States Occupational Network

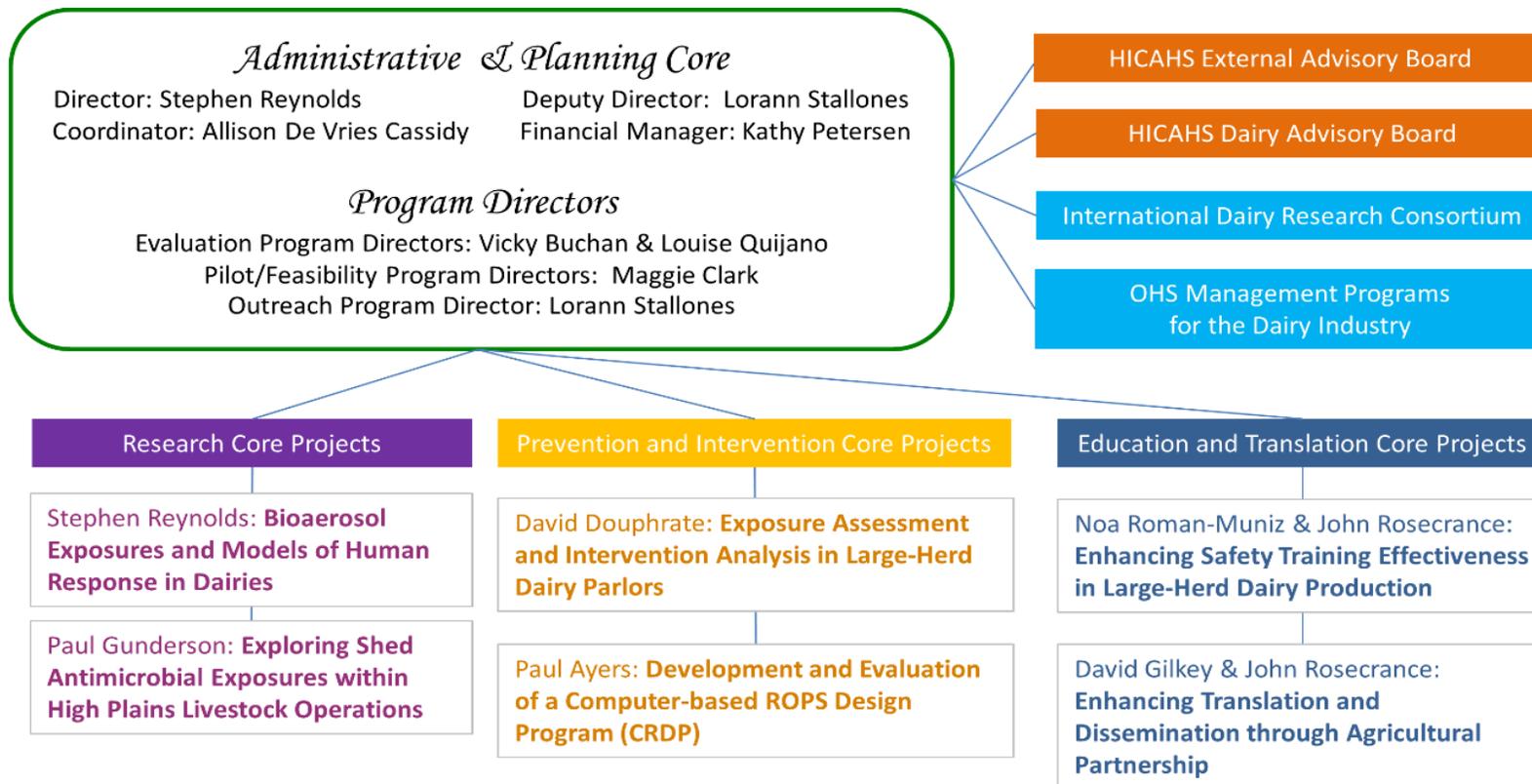
# Abstract

## 2011-2017 High Plains Intermountain Center for Agricultural Health and Safety

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The High Plains Intermountain Center for Agricultural Health and Safety (HICAHS) has served the states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming since 1991. In 2011 to 2017 we brought together an internationally recognized leadership team, outstanding young investigators, and a well-developed regional partnership network to address the promotion of health and reduction of work hazards among the high risk industries of agriculture and forestry in Federal Region VIII. Our substantial accomplishments are grounded on *engaging* and *listening* to our stakeholders and responding to their needs with *sound* and *relevant* research and outreach efforts. Over the past 5 years we have fostered a One Health approach which optimizes health of people, animals, and the environment with the rapidly expanding dairy industry in our region, by establishing a regional Dairy Network and an International Dairy Research Consortium (IDRC) ([www.hicahs.colostate.edu/dairy-initiatives.html](http://www.hicahs.colostate.edu/dairy-initiatives.html)), and have developed strong partnerships in occupational safety with the logging industry in Montana. We have developed a highly successful model for advancing Research to Practice (R2P) – moving from etiological research to assessment of efficacy in practice, toward adoption and implementation (effectiveness). Building on a Regional Needs Assessment, we worked to advance health and safety in dairy production, and more broadly address the emerging needs (e.g., forestry safety, all-terrain vehicle safety (ATV) on ranches, and vulnerable workers) of this region with cross-cutting, innovative research, intervention, outreach, and translation. With our industry partners in the regional HICAHS Dairy Health and Safety Network, and International Dairy Research Consortium we have: conducted research to understand the factors contributing to high rates of illness, injury, and fatalities; and developed and tested engineering, training, and management interventions. We have created the environment and opportunity for synergy leading to new initiatives. We are now trusted and valued partners for the Dairy industry. These collaborations have augmented HICAHS resources, and led to greater impact regionally, nationally, and internationally. We have built on this successful model and extended it beyond Dairy to include Forestry and ATV Safety. Through our Community grant program we have focused on increasing the effectiveness of the translation and dissemination activities by our network of agricultural and forestry community partners involved in occupational safety and health. Projects supported under this initiative have ranged from ATV safety campaigns, to safer logging practices on Large Logging Operations.

# HICAHS Organizational Chart



## Administrative and Planning Core

Director: Stephen Reynolds  
Deputy Director: Lorann Stallones  
Coordinator: Allison Cassidy  
Financial Manager: Kathy Petersen

### Summary Overview

#### Specific Aims

Aim 1: To provide leadership and management;

Aim 2: To ensure interdisciplinary coordination and synergy through the structure and functions of the advisory boards (Internal Advisory Board; External Advisory Board; and Dairy Advisory Board) and continued engagement of HICAHS researchers and staff;

Aim 3: To coordinate an active outreach program;

Aim 4: To provide funding for Pilot/Feasibility Projects on topics of regional priority and on emerging issues in Public Health Service Region VIII;

Aim 5: To conduct continuous evaluation and feedback based on the Systems Theoretical Model and a RE-AIM Framework.

Aim 6: To establish a HICAHS Dairy Health and Safety Network and an International Dairy Consortium.

#### Summary of Results

**Aim 1:** The HICAHS leadership team or Internal Advisory Board consisting of the Director, Deputy Director, Coordinator, and PIs of the projects and programs meets on a bi-monthly basis to review progress and coordinate follow up actions. **Aims 3, 4, and 5** are facilitated through these meetings and through more focused efforts as needed to provide direction, coordination, and resources. **More detailed information on Aims 3-5, is provided in the Progress Reports for Outreach, Pilots, and Evaluation.** Dr. Stallones serves on the Leadership Team for the Farm and Ranch eXtension Safety and Health (FReSH) Community of Practice. Dr. Douphrate writes a popular monthly column in the Progressive Dairyman online trade publication. Ms. Cassidy continues to serve in a leadership role for U.S. Agricultural Safety and Health Centers YouTube initiative and serves on the NORA AFF Outreach Working Group. Dr. Reynolds represents the AFF Centers on the NORA AFF Sector Council. He has been on the organizing committees for several national and international meetings (SHARP Saskatoon 2014, including IDRC workshop, Colorado School of Public Health Symposium and Workshop on Anti-Microbial Resistance 2015). In addition, Dr. Reynolds continued to serve as Chair of the NIOSH Ag Center Directors through fall 2014. In preparation for the competitive grant application for 2016-2021, HICAHS conducted an internal strengths, weaknesses, opportunities, and threats (SWOT) analysis. *Additional information on programs managed by the Administrative Core follow:*

#### **Policy and Program Leadership**

**Our faculty continue to provide Leadership on a National and International level.** A few examples include: Dr. Reynolds served as Chair of the NIOSH AgFF Center Directors (2011 – 2015), and represents them on the NORA AgFF Sector Council. Dr. Stallones is on the leadership team for the Farm and Health Safety (FReSH) Community of Practice (CoP) which operates through the Cooperative Extension eXtension program. She also contacted all other Ag Centers to identify a point of contact for those interested in participating in eXtension opportunities such as Ask an Expert, article reviews, and article writing. Dr. Reynolds

addressed Occupational Risks at the Institute of Medicine National Academy of Sciences, Roundtable on Environmental Health Sciences, Research, and Medicine. [see: IOM (Institute of Medicine) 2014. The nexus of biofuels, climate change, and health. Washington D.C. The National Academies Press]. Dr. Stallones serves as an Associate Editor for the Journal of Agromedicine and the Journal of Agricultural Safety and Health. Drs. Buchan and Quijano have continued to provide leadership to AFF Center Evaluators. Dr. Buchan served as coordinator in 2012-13. Mrs. Cassidy (nee DeVries) serves on the NORA AFF Outreach Working Group. Paul Ayers provides leadership to the US National ROPS Rebate Program, and the National Tractor Safety Coalition.

### **Capacity Development - Trainees**

HICAHS provides rich research and service experiences and support for graduate and undergraduate students in multiple colleges at CSU. Close collaboration with the Mountain and Plains Education and Research Center (MAP ERC) is important to the success of our educational efforts, fostering a strong interdisciplinary approach. In the reporting period **7 PhD, 14 MS, and one undergraduate degrees were awarded to HICAHS students. Two Post-Doctoral Fellows were supported. Currently HICAHS supports or trains more than 15 graduate and undergraduate students** in industrial hygiene, epidemiology, ergonomics, occupational health psychology, social work, education, communications, engineering, animal science, and production agriculture. Our impact is highlighted by three graduates (among others) who have rapidly become national and international leaders, with excellent scientific and management skills. Dan Autenrieth, recently completed his PhD focusing on OHS Management Systems as defined by OSHA Consultation and their applicability to Dairy. He is now an Assistant Professor at Montana Tech. Joshua Schaeffer completed Post-Doctoral studies, and is now an Assistant Professor at CSU and HICAHS helping lead metagenomic approaches to bioaerosols. Brie Hawley completed a PhD with HICAHS support and an EPA Star Award to use a novel air to human lung/nasal cell interface to evaluate the pro-inflammatory effects of dairy aerosols. She is now at NIOSH Morgantown. A noteworthy new student this fall is Emily Prisco who is the EHS Manager at Aurora Dairy. She was admitted to CO SPH and is working with HICAHS on her project.

### **Capacity Development – Agricultural Health and Safety Researchers**

Overall programmatic success of the Pilot/Feasibility Projects Program has been demonstrated by an increased research capacity to address the health and safety needs in agriculture and forestry. Effectiveness of the program is evident in the career advancement of recipients into respected positions as well as by a high number of prestigious grants being awarded to pilot awardees since 2002 (e.g., NIOSH R21 [Paul Gunderson, PI, currently the Director of the Dakota Precision Ag Center], NIOSH R01 [Stephen Reynolds, PI; based on collaboration with two previous pilot project recipients], NIEHS ONES Outstanding New Environmental Scientist award [Jill Poole, PI, currently an Associate Professor at the University of Nebraska Medical Center], NIOSH R01 [David Douphrate, currently an Assistant Professor at the University of Texas School of Public Health, and John Rosecrance, currently a Professor at Colorado State University, PIs], and the National Cattlemen's Beef Association [Lawrence Goodridge, PI, currently an Associate Professor at McGill University]). During the 2011-2017 cycle, the HICAHS distributed 17 pilot/feasibility awards totaling \$333,175 in total costs. The 2011-2017 cycle (initial pilot funding released in 2012) recently produced its first three peer-reviewed journal publications. The two previous cycles resulted in 18 publications (published between 2007-2015). Thirteen presentations have been conducted for the 2011-2017 cycle (4 international, 6 national/regional, 3 local conferences); twenty presentations were reported from the two previous cycles (12 international, 6 national/regional, 2 local conferences). For the 2011-2017 cycle, two pilot awardees have secured institutional internal grants as PI or co-I to leverage their research programs (grants awarded total \$65,000) and one has secured an EPA Small Business Innovation Research award (grant awarded at \$99,000). Valued outputs also include industry-training curriculum; Cynthia Walker's 2013 pilot award resulted in more than 30 workshops on effective pesticide application cleanout methods to over 1,750 industry producers and pesticide applicators and

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(from the previous cycle) David Douphrate's 2009 pilot award resulted in six industry-training workshops as well as eight industry conference presentations on dairy farm safety and leadership.

### **Network Capacity Development – Producer and Community Partners**

Through our **Community grant program** we have focused on increasing the effectiveness of the translation and dissemination activities by our network of agricultural and forestry community partners involved in occupational safety and health. Projects supported under this initiative have ranged from all-terrain vehicle (ATV) safety campaigns, dairy safety “tool box talks” to safer logging practices. The occupational fatality rate among loggers is 28 times higher than the national average of 3.2 deaths per 100,000 FTE workers. Partnering with Montana Logging Association we have now expanded to Logging Safety on Large Operations: There are approximately 600 large logging operations in northwestern Montana and northern Idaho that represent 1400 professional loggers.

Beginning in 2009 under the leadership of the NIOSH Western States Office and Alaska Pacific Office, HICAHS and the MAP ERC partnered with Wyoming government to form a *Wyoming Colorado Occupational Safety and Health Coalition (WY-CO OSH)*. Participants include the Wyoming Departments of Workforce Services R&P (Workers Compensation), OSHA, and Public Health, the Wyoming State Occupational Epidemiologist, Wyoming Extension, and University of Wyoming researchers. The WY-CO OSH Coalition has made important progress in organizing and fostering alliances among industry sectors in Wyoming – starting with Oil and Gas, Refinery, Transportation, Construction, and now Nursing and Agriculture. The goals of the alliances are to improve occupational health and safety, engaging more established businesses to mentor smaller businesses and share resources such as their occupational health and safety management programs. HICAHS and the MAP ERC provide expertise and additional resources to the alliances. Wyoming Extension now has representation on the HICAHS External Advisory Board. Wyoming OSHA has also established a safety improvement program. Participating businesses receive a premium discount on their Workers Compensation premiums. While rates are not available for the most recent year (2013), the WY State Occupational Epidemiologist Report documents a significant reduction in workplace fatalities in Wyoming primarily driven by a drop in transportation–related fatalities. Workers Compensation claims and hospitalizations have also decreased.

A result of our engagement with stakeholders in the dairy industry has been the development of a robust HICAHS Dairy Health and Safety Network. The goals of the network are to: 1) create a structure and mechanism to enhance multi-directional communication among dairy producers and HICAHS researchers, and 2) disseminate evidence-based information including best practices and other resources (R2P) to improve health and safety on dairies. With our industry partners in the regional HICAHS Dairy Health and Safety Network, and International Dairy Research Consortium we have: conducted research to understand the factors contributing to high rates of illness, injury, and fatalities; and developed and tested engineering, training, and management interventions. We have created the environment and opportunity for synergy leading to new initiatives. We are now trusted and valued partners for the Dairy industry. These collaborations have augmented HICAHS resources, and led to greater impact regionally, nationally, and internationally.

The International Dairy Research Consortium (IDRC), led by Dr. Reynolds, has engaged researchers from Sweden, Italy, Germany, Finland, Canada, Australia, New Zealand, Ireland and Brazil. In the first meeting (July 2011) attendees identified current research, needs and issues in their respective countries and were able to establish short term, intermediate and long term objectives. Reynolds, Douphrate, and DeVries also organized and led an International Dairy Research Consortium Workshop (July 25 – 26, 2013) in Fort Collins, CO. A key outcome of this meeting was the establishment of working groups to address important gaps identified in this publication. The IDRC uses upcoming international meetings to make progress towards the addressing gaps and needs identified. Meetings of the Consortium were held in Spain (July 2012), Sweden

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(August 2012), and New Zealand (September 2012), Saskatoon, Saskatchewan (Fall 2014) and Milan, Italy (Fall 2015), Sweden (Summer 2015), Wisconsin (2015), and Denmark (Summer 2016.)

Partnering with the dairy industry, we are developing an ambitious Occupational Health and Safety Management approach for the dairy industry that builds on an existing platforms for managing dairy productivity. The initial system was beta-tested and evaluated beginning in summer 2014. We have established partnerships with industry-leading service and equipment companies (DeLaval and Alpha Technology, Inc.) to develop and evaluate the design of milking tools that will enable workers to perform milking tasks more efficiently, with reduced risk for musculoskeletal disorders. One example of outcomes is sponsorship (in partnership with the I-29 Dairy Consortium) of health and safety workshops in five states (MN, IA, SD, and NE) entitled *What You Need to Know About OSHA Before OSHA Needs to Know About You*.

### **A Few Examples of Outreach and Dissemination of Knowledge**

Drs. Reynolds and Douphrate led a collaboration with dairy researchers (35 authors) from the International Dairy Research Consortium to edit and publish 10 manuscripts in a special issue in the *Journal of Agromedicine*, "A Global Perspective on Modern Dairy: Occupational Health and Safety Challenges and Opportunities" Vol. 18 No. 3, 2013

Dr. Rosecrance led the IDRC collaboration on the publication of a special topics issue in the international journal *Frontiers in Public Health*. The special topics issue was titled "International Perspectives on Health and Safety among Dairy Workers: Challenges, Solutions and the Future." Co-Topic Editors included Professors Martina Jakob and John Rosecrance. This special edition resulted in 10 scientific papers co-authored by 32 leading international researchers in dairy worker health and safety from seven countries. As of September 2017, there were more than 20,000 views and 2,300 downloads of the papers in this special edition

Dr. Douphrate, in collaboration with HICAHS and IDRC members, continues to write a monthly column in *Progressive Dairyman* to discuss improving operational productivity and efficiency, along with the health and safety of dairy workers. *Progressive Dairyman* has the largest industry subscription distribution well over 94,000. Dr. Douphrate has published 21 articles on various health and safety topics. There have been over 1,000 views of these articles since 2014, which can be found at [www.progressivedairy.com](http://www.progressivedairy.com), or at [www.hicahs.colostate.edu/progressive-dairyman.html](http://www.hicahs.colostate.edu/progressive-dairyman.html).

Ms. Cassidy led an all AgFF Centers YouTube initiative. HICAHS Co-Sponsored the First Workshop on Research Translation with Vulnerable Workers at Colorado State University (June, 2012). Dr. Reynolds served as a Member of the Planning Committee: 2012 - 2013 North American Agricultural Safety Summit (September 25-27, 2013). He has been on the organizing committees for several national and international meetings (ASHCA 2013, SHARP Saskatoon 2014). Drs. Reynolds and Magzamen served as Co-Chairs of the Planning Committee for the Annual Public Health Symposium at CSU, part of the Colorado School of Public Health at CSU. HICAHS co-sponsored the symposium on antimicrobial resistance and hosted a one day workshop preceding the symposium. A newsletter highlighting the symposium was widely disseminated.

### **Emerging Needs**

Responding to the need for Dairy Management and Leadership, funding was provided to assist with development and delivery of training Dairy producers' management skills and OSHA compliance. As an Authorized OSHA Trainer, Dr. Douphrate delivered training to over 100 owners and managers in Colorado, South Dakota, New Mexico, Texas and Kansas. Utilizing a national OSHA Consultation database, HICAHS conducted research into the implementation and efficacy of the OSHA Form 33 on dairies. The form is used by OSHA Consultants to evaluate management systems. Funds were used to support a PhD student, Dan Autenrieth to conduct an evaluation of the usefulness of the Revised OSHA Form 33 from the perspective of

Colorado OSHA consultation clients. The majority of respondents indicated that the Revised OSHA Form 33 accurately reflected their Occupational Health and Safety Management System (OHSMS) and that information provided on the Revised OSHA Form 33 was helpful for improving their systems. Specific outcomes reported by the respondents included increased safety awareness, reduced injuries, and improved morale. The results indicate that the OHSMS assistance provided by OSHA consultation is beneficial for clients and that the Revised OSHA Form 33 can be an effective tool for assessing and communicating OHSMS results to business management<sup>7</sup>. Funds were also used to help develop training incorporating worker health and safety with livestock productivity, and for a joint research effort with the SouthWest Center to identify novel pro-inflammatory small molecules in poultry dust. In collaboration with the SouthWest Center we also supported the production of the video series "Considering Human and Animal Safety" developed by Dr. Hagavoort. Best practices are outlined on how to safely and productively care for dairy cows while reducing risk of injury to yourself. These videos are available on the HICAHS website and have been used widely throughout the world.

## Evaluation

Drs. Buchan and Quijano hosted a NIOSH-Ag Center Evaluation Workshop in Fort Collins, Spring 2013. Outcomes of the workshop included: Agreement to form a collaborative, cross-center working group of Evaluators, Coordinators, and Outreach personnel (ECO) from all 10 U.S. U.S. Agricultural Safety and Health Centers; Establishment of working subgroups of the ECO to: 1) work with NIOSH on data coordination opportunities, 2) share evaluation methodologies, and 3) coordinate all center outreach efforts and information distribution. The ECO Awareness Team promoted National Farm Safety Week from September 21-27, 2015 and National Ag Day, March 18, 2015. Ms. Cassidy played a leadership role in launching the U.S. Agricultural Safety and Health Centers YouTube videos program. The ECO group continues to function through quarterly calls, and email initiatives.

*Leveraged Projects:* In collaboration with colleagues in the Department of Veterinary Medicine and Extension Services at CSU, Drs. Buchan and Quijano developed the model, theoretical base and evaluation plan for a USDA/NIFA funded project (2012-2014) to assist 12 communities in Colorado to create emergency response plans for pets and service animals. Phase I of this project was to develop and evaluate a "how to" manual based upon the work with Extension Services. An additional year of funding was granted in 2014 to develop an Extension agent narrated video of community capacity building and disaster planning which will accompany the manual to be distributed throughout the country.

*Internal Evaluation Efforts:* The Evaluation Team evaluated advisory board meetings including the regional and International Dairy Advisory groups to gain valuable stakeholder insights and feedback related to regional-international needs. Improvements were made to the HICAHS database to increase ease of data collection among PIs. Another major undertaking was a combined regional/national needs assessment to help develop priorities for the 2016-2021 funding cycle. A review of the top commodities in the region was conducted and constituents, producers, Extension, Agricultural Commissioners, leadership of agricultural organizations, and health care providers, both regionally and nationally were surveyed. The evaluation team also strove to connect with individuals identified with forestry and logging in the region. A needs assessment survey instrument was developed and piloted. The survey was conducted electronically and by telephone.

## Planning and Needs Assessment

To prepare for this competitive renewal, we conducted a strategic planning process that included a Regional Needs Assessment (noted above), Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis, and input from our external advisory boards. HICAHS has an active and engaged External Advisory Board that has met every year of the current funding cycle. The Board has provided significant input in program directions and assisting HICHAS in identifying gaps in work needed to improve health and safety in the region. In this

cycle the board has also worked on re-defining their roles and responsibilities to improve their engagement and effectiveness in guiding and assisting HICAHS.

We solicited pre-proposals that would contribute to the overarching framework of the HICAHS center renewal and in particular facilitate synergism within HICAHS 2016 - 2021. We sought projects that addressed a One Health approach, incorporated partnerships, focused on vulnerable populations, or education and training to help move occupational health and safety in agriculture and forestry further towards effective practice. In particular, we sought projects with potential for strong, measurable impact on injuries and illnesses in the agriculture and forestry industries. Projects that contributed to the HICAHS Dairy Initiatives ([www.hicahs.colostate.edu/dairy-initiatives.html](http://www.hicahs.colostate.edu/dairy-initiatives.html)) were welcome, but not required. Ten Pre-Proposals were reviewed by the HICAHS Internal Advisory Committee based on: Innovation: Scientific merit: Alignment with HICAHS and NIOSH priorities; Investigators experience and expertise; and potential for High impact.

The projects selected for this proposal address the top priorities determined by the Regional Needs Assessment and our Advisory Boards. They include: Etiological Research, Intervention Research, and Translation Research, as well as Pilot Grants and Emerging Issues programs. Our highly successful Community Grants program enhances synergy of the other components of the Center. This application is also responsive to the goals of the National Occupational Research Agenda, the National Academy of Sciences Review of Agriculture, Forestry and Fishing recommendations, Healthy People 2020, and the PAR 15-353. This application brings together an internationally recognized leadership team, outstanding new investigators, and a mature regional partnership network with a proven record of performance in an innovative center building on our strengths to address top priorities of the region, while also being responsive to the unique and diverse needs of this region, including a mechanism to develop capacity to address health and safety in Forestry. Our collaborators include: stakeholders/partners including HICAHS External Advisory Board members, researchers from other NIOSH Agricultural Centers and leading international researchers. These partnerships, and the proposed HICAHS programs and projects will augment research efforts for HICAHS investigators, leverage resources, and lead to research with greater impact regionally, nationally, and internationally.

Please see the HICAHS Website (<http://csu-cvmb.colostate.edu/academics/erhs/agricultural-health-and-safety/Pages/default.aspx>), and individual projects for further detail.

### Outputs and Outcomes:

Please see 2011 – 2017 HICAHS Publications and Reports for more publications and products.

## Journal Articles

### 2016

1. Autenrieth, D. A., Brazile, W. J., Sandfort, D. R., Douphrate, D. I., Román-Muñiz, I. N., & Reynolds, S. J. (2016). The associations between occupational health and safety management system programming level and prior injury and illness rates in the U.S. dairy industry. *Safety Science*, 84, 108-116. doi: [doi: 10.1016/j.ssci.2015.12.008](https://doi.org/10.1016/j.ssci.2015.12.008)
2. Autenrieth, D. A., Brazile, W. J., Douphrate, D. I., Román-Muñiz, I. N., & Reynolds, S. J. (2016). Comparing Occupational Health and Safety Management System Programming with Injury Rates in Poultry Production. *Journal of Agromedicine*, 21(4), 364-372. doi: [10.1080/1059924x.2016.1211575](https://doi.org/10.1080/1059924x.2016.1211575)
3. Ayers, P. D., Khorsandi, F., John, Y., & Whitaker, G. (2016). Development and Evaluation of a Computer-Based ROPS Design Program. *Journal of Agricultural Safety and Health*, 22(4), 247-260. doi: [10.13031/jash.22.11745](https://doi.org/10.13031/jash.22.11745)
4. Menger, L. M., Pezzutti, F., Tellechea, T., Stallones, L., Rosecrance, J., & Roman-Muniz, I. N. (2016). Perceptions of Health and Safety among Immigrant Latino/a Dairy Workers in the U.S. *Front Public*

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*Health*, 4, 106. [doi: 10.3389/fpubh.2016.00106](https://doi.org/10.3389/fpubh.2016.00106)

5. Menger, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2016). A Guide to the Design of Occupational Safety and Health Training for Immigrant, Latino/a Dairy Workers. *Front Public Health*, 4, 282. [doi: 10.3389/fpubh.2016.00282](https://doi.org/10.3389/fpubh.2016.00282)
6. Tinc, P. J., Ayers, P., May, J. J., Purschwitz, M. A., Park, S., Bayes, B., & Sorensen, J. (2016). Implementing a National Tractor Safety Program: Using “Whole System in a Room” to Mobilize Partners and Implement Solutions. *Journal of Agromedicine*, 21(2), 127-131. [doi: 10.1080/1059924x.2016.1142916](https://doi.org/10.1080/1059924x.2016.1142916)

## 2015

7. Autenrieth, D.A, Brazile, W.J., Gilkey, D.P., Reynolds, S.J., June, C., Sandfort, D. (2015). Client Perceptions of Occupational Health and Safety Management System Assistance Provided by OSHA On-Site Consultation: Results of a Survey of Colorado Small Business Consultation Clients. *J Occup Environ Hyg.*,12(11):804-17. [doi: 10.1080/15459624.2015.1049270](https://doi.org/10.1080/15459624.2015.1049270)
8. Hoffmeister, K., Gibbons, A. M., Johnson, S. K., Cigularov, K. P., Chen, P. Y., & Rosecrance, J. C. (2014). The differential effects of transformational leadership facets on employee safety. *Safety Science*, 62, 68-78. [doi: 10.1016/j.ssci.2013.07.004](https://doi.org/10.1016/j.ssci.2013.07.004)
9. Compensation Claims in Montana, 2007–2012. *Safety*, 1(1), 59. [doi: 10.3390/safety1010059](https://doi.org/10.3390/safety1010059)
10. Newman, L.S., Stinson, K.E., Metcalf, D., Fang, H., Brockbank, CV., Jinnett, K., Reynolds, S.J., Trotter, M., Witter, R., Tenney, L., Atherly, A., Goetzel, R.Z.(2015). Implementation of a Comprehensive Worksite Wellness Program Targeting Small Businesses: The Pinnacle Assurance Health Risk Management Study. *JOEM*, 57(1):14-21. [doi: 10.1097/JOM.0000000000000279](https://doi.org/10.1097/JOM.0000000000000279)

## 2014

11. Douphrate, D. I., Fethke, N. B., Nonnenmann, M. W., Rosecrance, J. C., & Reynolds, S. J. (2012). Full shift arm inclinometry among dairy parlor workers: A feasibility study in a challenging work environment. *Applied Ergonomics*, 43(3), 604-613. [doi: 10.1016/j.apergo.2011.09.007](https://doi.org/10.1016/j.apergo.2011.09.007)
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## 2013

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15. Douphrate, D. I., Stallones, L., Lunner Kolstrup, C., Nonnenmann, M. W., Pinzke, S., Hagevoort, G. R., Lower, T. (2013). Work-Related Injuries and Fatalities on Dairy Farm Operations—A Global Perspective. *J Agromedicine*, 18(3), 256-264. [doi: 10.1080/1059924x.2013.796904](https://doi.org/10.1080/1059924x.2013.796904)
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## 2011

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### Reports

1. Rautiainen, R. (2013). NIOSH Ag Centers Meeting Report. In A. DeVries (Ed.), *NIOSH Extramural Center Directors Meeting*. Anschutz Medical Campus, Aurora, CO.
2. Reynolds, S. J. (2013). Occupational Health and Biofuels Production. In R. Pool (Ed.), *The Nexus of Biofuels, Climate Change, and Human Health: Workshop Summary* (pp. 37-46): The National Academies Press.
3. Reynolds, S., Beseler, C., & Stallones, L. (2012). Preventative Search and Rescue for Rocky Mountain National Park (RMNP) Phase 1 Report: A collaboration between Mountain and Plains Education Research Center, Colorado Injury Control Research Center, High Plains Intermountain Center for Agricultural Health and Safety, and Rocky Mountain National Park.

### Trade Publications

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*This article was released during Hurricane Irma and just after Hurricane Harvey. Within one week, it was picked up by more than 80 media outlets around the world, making it the fourth most-read story coming out of Colorado State University, with a total readership of 35 million. The Associated Press tweeted it to its 11.5 million followers.*
2. Cassidy, A. (September 30, 2015). Tips for meaningful changes in dairy safety. *Progressive Dairyman*. Retrieved from <http://www.progressivedairy.com/topics/management/tips-for-meaningful-changes-in-dairy-safety>
3. Douphrate, D., & Hagevoort, R. (July 29, 2015). Using mobile devices to offer safety training to dairy workers. *Progressive Dairyman*. Retrieved from <http://www.progressivedairy.com/topics/management/using-mobile-devices-to-offer-safety-training-to-dairy-workers>
4. Douphrate, D., & Hagevoort, R. (February 26, 2015). Safety management: Employee participation and accountability. *Progressive Dairyman*. Retrieved from <http://www.progressivedairy.com/dairy-basics/management/13280-safety-management-employee-participation-and-accountability>
5. Douphrate, D., Bolsen, K., Reynolds, S., & Hagevoort, R. (February 19, 2014). Dairy worker safety and health: Silage safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11817:dairy-worker-safety-and-health-silage-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11817:dairy-worker-safety-and-health-silage-safety&catid=49:management&Itemid=75)
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- [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12216:preventing-zoonotic-disease-on-the-dairy&catid=45:herd-health&Itemid=71](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12216:preventing-zoonotic-disease-on-the-dairy&catid=45:herd-health&Itemid=71)
10. Roman-Muniz, N., & Douphrate, D. (May 21, 2014). What are zoonotic diseases? (Part 1 of 2). *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12215:what-are-zoonotic-diseases&catid=45:herd-health&Itemid=71](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12215:what-are-zoonotic-diseases&catid=45:herd-health&Itemid=71)
  11. Ayers, P., & Douphrate, D. (May 9, 2013). Dairy worker safety and health: Tractor safety on dairy farms. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10565:dairy-worker-safety-and-health-tractor-safety-on-dairy-farms&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10565:dairy-worker-safety-and-health-tractor-safety-on-dairy-farms&catid=49:management&Itemid=75)
  12. Douphrate, D., Bauer, M., Brazile, W., & Root, K. (March 8, 2013). Dairy worker safety and health: Injury and illness recordkeeping. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10306:dairy-worker-safety-and-health-injury-and-illness-recordkeeping&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10306:dairy-worker-safety-and-health-injury-and-illness-recordkeeping&catid=49:management&Itemid=75)
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  14. Murphy, D., & Douphrate, D. (September 5, 2013). Dairy worker safety and health: ATV safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11160:dairy-worker-safety-and-health-atv-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11160:dairy-worker-safety-and-health-atv-safety&catid=49:management&Itemid=75)
  15. Murphy, D., & Douphrate, D. (June 18, 2013). Dairy worker safety and health: Manure pit safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10792:dairy-worker-safety-and-health-manure-pit-safety&catid=77:manure&Itemid=121](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10792:dairy-worker-safety-and-health-manure-pit-safety&catid=77:manure&Itemid=121)
  16. Roman-Muniz, N., & Douphrate, D. (December 17, 2013). Dairy worker safety and health: Vaccination Safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75)
  17. Douphrate, D. (2011, June). Dairy Farm Safety and OSHA--Approaches for Effective Management and Worker Training. *Utah State University Dairy Extension Newsletter*, 34.
  18. Douphrate, D. (August, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/august-2011-2.pdf>
  19. Douphrate, D. (September, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/september-2011.pdf>

## Student Theses

*HICAHS researchers served on the advisory committees for the following students. The funding for conducting the student projects may or may not have been funded by HICAHS.*

### 2016

1. Escobar, M. A. (2016). *Filter Based Methods Assessment: Culturing Resistant Bacteria from Inhalable Bioaerosols*. Master of Science Thesis, Colorado State University, Fort Collins, CO.
2. Krause, L. A. (2016). *A comparative analysis between the rFC and LAL endotoxin assays for agricultural air samples*. Master of Science Thesis, Colorado State University, Fort Collins, Colorado. Retrieved from <http://hdl.handle.net/10217/173499>
3. Vawter, C.Q. (2016). *Evaluation of Sabine's Formula on the prediction and control of reverberant noise in a modern LEED Platinum certified research building*. Master of Science Thesis, Colorado State

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University. Retrieved from <https://dspace.library.colostate.edu/handle/10217/176663>

4. Walters, K. M. (2016). *Is the "grass" greener? : occupational wellness in the Colorado cannabis industry*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <https://dspace.library.colostate.edu/handle/10217/173525>

## 2015

5. Autenrieth, D. (2015) *Occupational Health and Safety Management Systems in Animal Production Agriculture*. Doctor of Philosophy Dissertation, Colorado State University.
6. Yang, X. (2015). *Investigation of the Beef Supply-Chain Microbiome and Pathogen Controls*. Doctor of Philosophy Dissertation, Colorado State University, Fort Collins, CO. Retrieved from <https://dspace.library.colostate.edu/handle/10217/170417>

## 2014

7. Hawley, B. (2014). *Development and application of an improved in vitro model for aerosol toxicology*. Doctor of Philosophy Dissertation, Colorado State University. Retrieved from <http://hdl.handle.net/10217/83775>
8. Madden, E. (2014). *An Exploration of the Role of First Aid and CPR in Improving Farm Safety and Health*. Master of Agriculture Thesis, Colorado State University, Fort Collins, CO.

## 2013

9. Modai, G. (2013). *ATV-Related Injuries in Montana 2007–2012*. Master of Science Thesis, Colorado State University, Fort Collins, Colorado.
10. Van Dyke-Gonnerman, A. L. (2013). *Comparative analysis of bacterial and fungal communities in two dairy parlors through the use of pyrosequencing, riboprinting, culture techniques, and microscopic analysis*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/81067>

## 2012

11. Robinson, D.L. (2012). *Evaluation of bacterial sampling methods for use with the bacterial tag-encoded flexible (FLX) amplicon pyrosequencing (bTEFAP) technique*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/68149>

## 2011

12. Basinas, I. (2011). *Dust and Endotoxin Exposure in Animal Farming Population. Formulating the Basis for a Model-based Exposure Assessment Approach*. PhD, Aarhus Universitet, Aarhus, Denmark.
13. Funk, S. (2011). *Evaluation of seasonal ventilation changes and their effect on ambient dust, endotoxin and bioaerosol concentrations in a dairy parlor*. Master of Science Thesis, Colorado State University, Fort Collins, CO.
14. Sorrentino, J. (2011). *A comparison of the Limulus amoebocyte lysate (LAL) and recombinant Factor C (rFC) endotoxin bioassays: Characterization of aerosols and settled dust on a sheep farm*. MS, Colorado State University, Fort Collins, CO.

## Postdoctoral Students

Joshua Schaeffer, Ph.D. (2014 – 2015 under Stephen Reynolds)

Margaret Davis, Ph.D. (2011 – 2015 under Stephen Reynolds)

## Students - Other

Graduate Students under Supervision by Paul Ayers: Farzaneh Khorsandi, PhD student (see 2016 publication) and Daniel Wade, MS student.

Undergraduate Engineering Research Students under Supervision by Paul Ayers:

2015 – Dillan Jackson

2014 – 2015 – Andrew Whitaker

2014 – Yohan John

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2012-2013 – Hunter Hill

2012-2013 – Coleman Bradley

These students work with Lorann Stallones, HICAHS Director of Outreach: Lauren Menger, PhD in psychology (Spring 2016) and Emma St Aubin, MPH student (Spring 2016).

Adrienne Keeney, Ph.D., Cortney Worrell, Ph.D. student, Rueben Addo, Ph.D. student, and other students have worked with Vicky Buchan and Louise Quijano with the HICAHS Evaluation Program.

### Audiovisual Products

1. The r2p ATV safety project with Montana Extension has led to the development of 6 high quality videos which are available on the U.S. Agricultural Safety and Health Centers YouTube channel: [www.youtube.com/usagcenters](http://www.youtube.com/usagcenters).
2. Cassidy, A. (2014). December Calendar Page: Childproof for Poison Prevention. *2015 Childhood Agricultural Safety Network Calendar*. Marshfield, WI: National Children's Center for Rural and Agricultural Health.
3. DeVries, A. (2013). June Submission on ATV Safety: Don't let your child become a statistic... *2014 Childhood Agricultural Safety Network Calendar*. Marshfield, WI: National Children's Center for Rural and Agricultural Health.
4. Tellechea, T. (2012). Photo essay of Latino dairy workers performing their daily work tasks. Fort Collins, CO: High Plains Intermountain Center for Agricultural Health and Safety at Colorado State University.
5. DeVries, A. (2011). Respiratory Illness in Farmers: Information, Diagnosis, and Prevention Tri-Fold Flyer. Fort Collins, CO: The High Plains Intermountain Center for Agricultural Health and Safety.

### Standards Development

1. ANSI/ASABE. (2011). Ventilating Manure Storages to Reduce Entry Risk (Vol. S607 OCT2010).

## Conference Papers, Presentations, Abstracts

### 2017

1. Cassidy, A., Wickman, A., & Duysen, E. (June 25-29, 2017). *Developing Agricultural Safety and Health Awareness Campaigns*. Poster presentation at the International Society for Agricultural Safety and Health Conference, Logan, UT.
2. Cassidy, A., Brooks, E., & Rodriguez, A. (June 25-29, 2017). International Society for Agricultural Safety and Health Conference, Aurora, CO.  
*We staffed a booth with informational brochures about HICAHS.*
3. Gilkey, D., Rosecrance, J., Lagerstrom, E., & Neves, H. (July 17-21, 2017). *ATV safety in agriculture: Injury, illness, analysis and interventions*. Presentation at the 8th International Conference on Applied Human Factors and Ergonomics, Los Angeles, CA.
4. Hagevoort, R. (March 8-9, 2017). *Where most dairymen go wrong*. Gibby Group Roundtable, Twin Falls, ID.
5. Hagevoort, G. R., Douphrate, D., Naerebout, B., Brose, J., White, J., & Rodriguez, A. (March 1, 2017). *Challenges Surrounding Training the Next Generation*. Presentation at the Western Dairy Management Conference, Reno, NV. <http://wdmc.org/2017/Full2017.pdf>
6. Hagevoort, R. (February 20, 2017). *Dairy safety management: current issues, challenges & solutions*. Oregon Dairy Farmers Convention, Salem, OR.
7. Menger-Ogle, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2017). *A Guide to the Design of Occupational Health and Safety Training for Immigrant, Latino/a Dairy Workers*. Panel presentation at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
8. Menger-Ogle, L. M., Pezzutti, F., Ogle, A. D., Amaya, F., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2017). *Occupational safety and health among immigrant, Latino/a dairy workers in Colorado*. Symposium presentation at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
9. Pate, M. (June 25-29, 2017). *Severe Injury and Fatality Prevention in Agriculture*. Moderator for the panel presentation at the International Society for Agricultural Safety and Health, Logan, UT.
10. Pate, M., Lawver, R. G., Smalley, S. W., Perry, D. K., Quijano, L., Buchan, V., & Miller, R. (June 25-29, 2017). *Assessing an Agricultural Safety Education Initiative Impact using Geospatial Data Mapping*. Presentation at the International Society for Agricultural Safety and Health, Logan, UT.
11. Reynolds, S. J., Schaeffer, J., Burket, T., A.VanDyke, M.Davidson, J.Mehaffy, . . . S.Magzamen. (June 21, 2017). *Dairy Bioaerosol Exposures and Inflammatory Markers in Workers: a Panel Study*. . NIOSH - Expanding Research Partnerships: State of Science, Aurora, CO.
12. Stenkamp-Strahm, C., Magzamen, S., McConnel, C., Abdo, Z., VanDyke-Gonnerman, A., Schaeffer, J., & Reynolds, S. (July 9-12, 2017). *Microbial Community Drivers of Escherichia coli O157 Colonization and Shedding in Early Lactation Dairy Cattle*. Presentation at the 2017 International Association for Food Protection Annual Meeting, Tampa, Florida.
13. VanDyke, A., Reynolds, S. J., Schaeffer, J., & S.Magzamen. (June 22, 2017). *Dairy Worker Exposure to Airborne Endotoxins and  $\beta$  Glucans*. Presentation at the NIOSH - Expanding Research Partnerships: State of Science, Aurora, CO.

### 2016

14. Douphrate, D. (November 7-8 2016). *Dairy safety management: current situation, challenges, and solutions*. Invited Presenter at the Washington State Dairy Safety Conference, Ellensburg, WA.
15. Douphrate, D. (June 20-23, 2016). *Full-shift and task-specific ergonomic exposure assessment of posture and muscle activity among dairy parlor workers in US large herd operations*. Presentation at the Ninth International Conference on Prevention of Work-Related Musculoskeletal Disorders (PREMUS), Toronto, Canada.
16. Douphrate, D. (May 25-26, 2016). *Dairy worker health and safety*. Invited Presenter at the Washington Department of Safety and Health Technical Symposium, Wenatchee, WA.

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17. Douphrate, D. (March 1-2, 2016). *On-farm risk management and safety on dairy farms: Regulatory requirements and planning*. Presentation at the High Plains Dairy Conference, Lubbock, TX.
18. Douphrate, D. (February 24, 2016). *Worker health and safety on US dairies*. Invited lecture to the Governor's Agricultural Safety Day, Wenatchee, WA.
19. Hagevoort, R., & Douphrate, D. (March 30, 2016). *Dairy safety management*. Presentation at the Western States Dairy Producers Trade Association Annual Meeting, Las Vegas, NV.
20. Reynolds, S.J, Schaeffer, J.W., Magzamen, S., VanDyke, A., Davidson, M., Mehaffy, J., Escobar, M., Anderson, K., Bradford, M., Tryon, J., Burket-Tooker, T., Brindly, B., Newman, L., & Volkens, J. (August 24-26, 2016). *Cytokine Profiles Among Dairy Workers*. Nordic Meeting on Agricultural Occupational Health & Safety, Billund, Denmark.
21. Schaeffer, J.W., Magzamen, S., Noyes, N., VanDyke, A., Davidson, M., Escobar, M., Volkens, J., Owens, S., Marcell, J., & Reynolds, S.J. (August 24-26, 2016). *Agricultural Dust in the Wind: Microbial Communities and their Resistant Genes*. Nordic Meeting on Agricultural Occupational Health & Safety, Billund, Denmark.
22. VanDyke, A., Reynolds, S., Schaeffer, J., Magzamen, S., & Krause, L. (May 25, 2016). *Task-Based Exposures to Airborne Endotoxins and  $\beta$ -Glucans Among Dairy Workers*. AIHCE, Baltimore, MD,  
*2nd Best in Session/Student Posters*  
*2nd Best Overall/In Conference*

## 2015

23. Ayers, P. (September 9, 2015). *Summary of ROPS Activities in the United States*. International Congress on Rural Health, Milan, Italy.
24. Ayers, P. (September 9, 2015). *ROPS Design and Testing for Rigid and Foldable Structures*. International Congress on Rural Health, Milan, Italy.
25. Buchan, V., & Quijano, L. M. (September 10, 2015). *Employment Policies related to Immigrant Workers in the Dairy Industry: A comparative policy analysis across 10 Countries*. International Congress on Rural Health, Milan, Italy.
26. Cassidy, A. (August 5, 2016). *Tractor Rollover Fatality Prevention*. Governor's Ag Safety Coalition of Wyoming, Douglas, WY.
27. Douphrate, D., & Hagevoort, G. R. (October 1, 2015). *Safety performance on dairy farms*. Presented at the World Dairy Expo, Madison, WI.
28. Douphrate, D., Reynolds, S. J., Hagevoort, R., Lunner Kolstrup, C., Kolb, P., & Cassidy, A. (September 27-28, 2015). *International Dairy Safety Short Course*. Invited lecture to delegations from Pakistan and China, University of Wisconsin - River Falls, WI.
29. Douphrate, D., & Reynolds, S. J. (September 18, 2015). *Successful Strides with Dairy Workers*. Presented at the Western States Occupational Network (WestON), Denver, CO.
30. Douphrate, D. (February 18-19, 2015). *Safety training using mobile learning technologies on large herd dairy operations*. Presented at the OSHA Susan Harwood Trainer Exchange Conference, Washington, D.C.
31. Gilkey, D., Rosecrance, J., & Lagerstrom, E. (June 28, 2016). *ATV Safety Research and Outreach at Colorado State University*. ANB45 (1) Rollover Subcommittee, WDC.
32. Lagerstrom, E., Rosecrance, J., & Gilkey, D. (September 9, 2015). *Community Engagement in the Prevention of Injuries and Deaths from Agricultural All-Terrain (ATV) Vehicle Use*. International Congress on Rural Health, Milan, Italy.
33. Masci, F., Mixco, A., Colosio, C., & Rosecrance, J. (September 9, 2015). *Comparison of upper limb muscle activity between US and Italian industrialized dairy operations*. International Congress on Rural Health, Milan, Italy.
34. Menger, L., Stallones, L., Pezzutti, F., Roman-Muniz, I. N., & Rosecrance, J. (September 9, 2015). *Health and Safety Challenges among Dairy Workers in the United States*. International Congress on Rural Health, Milan, Italy.
35. Menger, L. M., Pezzutti, F., Stallones, L., Rosecrance, J., & Roman-Muniz, N. (May, 2015). *Safety and productivity among immigrant dairy workers*. Poster presentation accepted at the 11th International

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Conference on Occupational Stress and Health: Work, Stress, & Health, Atlanta, GA.

36. Reynolds, S. J., & Hagevoort, R. (March 31, 2015). *Impact of Aerosols on Respiratory Health of Dairy Workers and Residents Living Near Dairies: Discussion and Implications of Recent Research*. Presentation at the Livestock and Poultry Environmental Learning Center's Waste to Worth Conference, Seattle, WA. <https://etouches.com/ehome/85805>
37. Roman-Muniz, I. N., Rosecrance, J., Menger, L., Pezzutti, F., Stallones, L., & Amaya, F. (September 9, 2015). *Dairy Worker Safety Training: Current Challenges and Opportunities for Enhanced Effectiveness*. International Congress on Rural Health, Milan, Italy.
38. Schaeffer, J. (September 9, 2015). *Large Particle Exposures and Attendant Health Effects among Dairy Workers: Progress and Future Directions*. International Congress on Rural Health, Milan, Italy.
39. VanDyke, A., Reynolds, S.J., Davidson, M., Schaeffer, J., Bisha, B., & Delton-Hanson, J. (June 3, 2015). Effect of Environmental Conditions on Bacterial and Fungal Communities in Dairy Parlors through Pyrosequencing, Riboprinting, and Microscopic Analysis Techniques. Poster presentation at the AIHCE, Salt Lake City, UT.

## 2014

40. Ayers, P. D., Hill, H., John, Y., & Whitaker, G. (July 13-16, 2014). *Implementation and evaluation of a computer-based ROPS design program*. Presented at the ASABE Conference, Montreal, Canada.
41. Buchan, V., & Quijano, L. M. (October 20, 2014). *Future Focus: What Are Our Constituencies Telling Us?* Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
42. Douphrate, D. (November 20-22, 2014). *Worker health and safety on U.S. Dairy Farms*. Presented at the 24th Annual Midwest Stream Farmworker Health Forum, San Antonio, TX.
43. Douphrate, D., Gimeno, D., Nonnenmann, M., Hagevoort, R., Rosecrance, J., & S.J., R. (October 19-22, 2014). *Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
44. Douphrate, D., Fethke, N., Hagevoort, G. R., Nonnenmann, M., Gimeno, D., Marshall, A., . . . Reynolds, S. J. (October 19-22, 2014). *Task-specific and full-shift sampling of upper extremity muscle activity among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
45. Douphrate, D.I., Gimeno, D., Nonnenmann, M., Hagevoort, R., Rosas-Goulart, C., Rosecrance, J., & Reynolds, S. (August 25-27, 2014). *Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Finnish Institute of Occupational Health (FIOH) and Farmers' Social Insurance Institution (Mela), Porvoo, Finland. [http://www.ttl.fi/partner/nmaohs/programme/Documents/Programme\\_NMAOHS%202014\\_14Aug2014\\_web.pdf](http://www.ttl.fi/partner/nmaohs/programme/Documents/Programme_NMAOHS%202014_14Aug2014_web.pdf)
46. Fisher, J., Ayers, P. D., Dobson, D., Cedarquist, S., & Green, J. (February 10-12, 2014). *ASABE tractor seatbelt and ROPS usage*. Presented at the Agricultural Equipment Technology Conference (AETC), Louisville, KY.
47. Nonnenmann, M., Gimeno, D., Levin, J., Boggaram, V., & Reynolds, S. (October 19-22, 2014). *Associations of pulmonary function and exhaled nitric oxide with measurements of exposure to inhalable dust, endotoxin and muramic acid among dairy parlor workers*. Presentation at the 7th International Symposium: Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, SK, Canada.
48. Quijano, L. M., & Buchan, V. (October 20, 2014). *A Collaborative Approach to Building Capacity for Community Response to Disaster*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)

49. Reynolds, S. J. (October 22, 2014). *Candidate TLR and NLR Innate Immunity Genes and Cross Shift Pulmonary Function Changes Among Western US Dairy Workers*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
50. Reynolds, S. J., Clark, M. L., Davidson, M. E., Keefe, T., Mehaffy, J., Bradford, M., . . . Yang, I. (August 25-27, 2014). *Candidate Innate Immunity Genes and Cross Shift Pulmonary Function Changes Among Western US Dairy Workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Porvoo, Finland. <http://www.ttl.fi/partner/nmaohs/abstracts/Documents/NMAOHS%20Abstracts%20Final%2030102014.pdf>
51. Roman-Muniz, I. N., & Wall, T. (December 10-11, 2014). *Multi-Cultural Management*. Two-day workshop hosted by the Professional Dairy Producers of Wisconsin, Chula Vista Resort, Wisconsin Dells, WI.
52. Whitaker, G., John, Y., & Ayers, P. D. (2014). *Retrofitting tractors with SAE-compliant ROPS using a computer-based ROPS design program*. Poster presented at the 2014 ASABE Conference, Montreal, Canada.

## 2013

53. Ayers, P. D. (2013). *ROPS and stability research forum: review of U.S. activity*. Presented at the OECD ROPS and Stability Research Forum, Bologna, Italy.
54. Ayers, P. D., Yantis, J., Bradley, C., & Davis, G. (2013). *Development of a computer-based ROPS design program*. Presented at the 2013 ASABE Conference, Kansas City, MO.
55. Buchan, V., & Quijano, L. (September 25-27, 2013). *An Ounce of Prevention: an Interactive Health and Safety CD for 4-H Youth*. Poster presented at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
56. DeVries, A. (2013). *Farm MAPPER for Colorado*. Presentation at the Colorado Livestock Association Safety Meeting, Embassy Suites, Loveland, CO. <http://coloradolivestock.org/>
57. Douphrate, D. (September 26, 2013). *Dairy Equipment Innovations*. Panel Presentation at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
58. Douphrate, D. (March 28, 2013). *Managing worker safety, productivity, and regulatory issues*. Presentation at the Southern Great Plains Dairy Consortium Annual Meeting, Grapevine, TX.
59. Douphrate, D. (June 17-18, 2013). *Dairy farm safety and leadership*. Southern Great Plains Dairy Consortium Teaching: Advanced Dairy Herd Management, Clovis, NM.
60. Douphrate, D., Keifer, M., Liebman, A., Carrabba, J., Hagevoort, R., Grafft, L., & Reynolds, S. J. (June 23-27, 2013). *Assisting the dairy industry to optimize worker health and safety*. Expert Panel Presentation at the International Society of Agricultural Safety and Health Annual (ISASH) Conference: Exploring the shores of safety and health, Sandusky, OH.
61. Douphrate, D., & Levin, J. (April 24-27, 2013). *Ergonomic considerations in logging operations*. Presentation at the Four-State Forestry on the Grow Conference, Texarkana, TX.
62. Gilkey, D. (June 25-26, 2013). *The ATV Epidemic: Risk Factors and Control Strategies in Agriculture*. Presentation at the Wyoming Safety Summit, Western Wyoming Community College in Rock Springs, Wyoming. <http://wyomingworkforce.org/employers-and-businesses/osha/Pages/2013-Wyoming-Safety-Workforce-Summit.aspx>
63. Modai, G., Paulsen, R., Gilkey, D., & Rosecrance, J. (April, 2013). *Increasing ATV Safety in Agriculture*. Presentation given at the 11th Annual Regional NORA Young Investigators Conference, University of Utah.
64. Newman, L. S., Reynolds, S. J., Kiefer, M., & Tenney, L. (October 3, 2013). *New Paradigms: Examples of Collaboration Across NIOSH and Centers*. Presentation at the NIOSH Extramural Center Directors Meeting, Anschutz Medical Campus, Aurora, CO.
65. Quijano, L., & Buchan, V. (Oct. 16, 2013). *Instruments to Predict Research to Practice Relevance*.

Abstract presented at the American Evaluation Association Conference, Washington, D.C.

<http://archive.eval.org/search13/session.asp?sessionid=5000&presenterid=400>

66. Reynolds, S. J., Douphrate, D., Hagevoort, R., Brazile, W., & Root, K. (March 6-8, 2013). *Managing Worker Safety, Productivity, & Regulatory Issues*. Presentation at the Western Dairy Management Conference, John Ascuaga's Nugget, Reno, NV. Paper retrieved from <http://www.wdmc.org/2013/Managing%20Worker%20Safety,%20Productivity,%20and%20Regulatory%20Issues.pdf>
67. Stallones, L. (August 7-9, 2013). *Obesity, diet and disease*. Presentation at the Ranching for Profit Summit-Wheels of Change, Laramie, Wyoming.
68. Stinson, K., Fang, H., Metcalf, D., Jinnett, K., Brockbank, C., Tenney, L., Trotter, M., Reynolds, S.J., Witter, R., Goetzel, R., & Newman, L. S. (November 6, 2013). *Evaluating the impact of a health risk management program on employee's health risks and workers compensation*. Panel presentation at the 141st APHA Annual Meeting and Exposition, Boston, MA. Abstract retrieved from <https://apha.confex.com/apha/141am/webprogram/Paper284364.html>

## 2012

69. Ayers, P., Davis, G., Yantis, J., & Kerrigan, S. (September 3-6, 2012). *Improving ROPS designs for agricultural tractors*. Presented at the International Conference RAGUSA SHWA, Ragusa, Italy. [http://www.ragusashwa.it/CD\\_2012/lavori/TOPI3/orale/topic%203\\_111\\_117.pdf](http://www.ragusashwa.it/CD_2012/lavori/TOPI3/orale/topic%203_111_117.pdf)
70. Ayers, P., & Davis, G. (June 24-28, 2012). *ROPS design program*. Presented at the International Society of Agricultural Safety and Health (ISASH) Conference, Burlington, VT.
71. DeVries, A. (March 9, 2011). *Colorado Agri-Women Presentation*. Presentation at the Colorado Agri-Women Annual Meeting, Denver, CO.
72. Douphrate, D. (September 28-30, 2012). *Upper extremity hazards and solutions in large herd parlor milking*. Presentation at the Agricultural Safety and Health: Focus on Dairy Conference, Palmerston North, New Zealand. Conference agenda retrieved from <http://www.conference.co.nz/worldsafety2012/agriculturalsafetyhealth>
73. Gilkey, D., Rosecrance, J., Paulsen, R., & Tucker, D. (April 25-27, 2012). *ATV Safety and Ergonomics in Agriculture*. Presentation given at the Brouha Work Physiology Symposium 50th Annual Meeting, Auburn, AL.
74. Nonnenmann, M. W., Choudhry, A., Mehaffy, J., Douphrate, D., Levin, J. L., Gilmore, K., & Reynolds, S. J. (August 27-29, 2012). *Evaluation of a parlor washing system to reduce exposure to inhalable aerosols during dairy parlor work--A pilot study*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Ystad, Sweden.
75. Stallones, L. (September, 2012). *Global perspectives in agricultural injury prevention*. Presentation at the American College of Epidemiology Annual Meeting, Chicago, IL.

## 2011

76. Douphrate, D. (December 7-8, 2011). *Incorporating worker safety into daily farm management activities*. refereed conference proceedings Presented at the 2011 Dairy Summit, Wisconsin Dells, WI.
77. Douphrate, D. (April 5-6, 2011). *Dairy farm safety and OSHA--Approaches for effective management and worker training*. Presented at the Dairy Calf & Heifer Association Annual Conference, Lake Geneva, Wisconsin.
78. Douphrate, D., Rosecrance, J., & Reynolds, S. J. (August 22-24, 2011). *Musculoskeletal symptoms and physical exposures among U.S. large-herd milking parlor workers*. refereed conference proceedings Presented at the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
79. Funk, S., Reynolds, S. J., Volckens, J., Dowd, S., & Nonnenmann, M. W. (May 16-19, 2011). *Evaluation of seasonal ventilation changes and their effect on ambient dust, endotoxin and bioaerosol concentrations in a dairy parlor*. Presented at the American Industrial Hygiene Conference and Exposition, Portland, OR.
80. Hussain, A., Nonnenmann, M., Levin, J., & Reynolds, S. (May 16-19, 2011). *Evaluation of Parlor Washing as an Intervention for Decreasing Occupational Exposure to Organic Dust and Endotoxin*

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*Among Dairy Parlor Workers*. American Industrial Hygiene Conference and Exposition, Portland, OR, USA.

*Best Student Poster; Occupational and Environmental Medicine Committee*

81. Reynolds, S. J., Campbell, C., Towle, M., Warner, A., Kiefer, M., Ray, B., & Comstock, N. (June, 2011). *Investigation of an Escherichia coli O111 outbreak at a state-run correctional facility dairy facility*. Presented at the National Symposium on Agriculture, Forestry and Fishing Health and Safety, Boise, ID.
82. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. (May 4, 2011). *Endotoxin exposure, TLR4 mutations, smoking and work-related behaviors: pulmonary function deficits among agricultural workers*. Presented at the NFMCC, Marshfield, WI.
83. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. A. (August 22-24, 2011). *Exposure to endotoxin, muramic acid, ergosterol and effects on pulmonary function among western dairy workers*. Presented at the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
84. Steneroden, K., Hill, A., Knight, A., Reynolds, S. J., & Salman, M. (2011). *Infectious and zoonotic disease control strategies in Western US animal shelters: An epidemiological approach and its application*. Presented at the International Symposium on Veterinary Epidemiology and Economics.

### 2010 (previous five-year cycle)

85. DeVries, A. (December 2, 2010). *Find the Hazard!* Poster presentation at the Local to Global: Perspectives on Problem Solving. The Institute for Livestock and The Environment 3rd Annual Stakeholder Summit, Fort Collins, CO.

## HICAHS SERVICE

### Conference Organizer

#### 2015

1. Magzamen, S., Schaeffer, J., & Reynolds, S. J. (April 15, 2015). *Organizer and Moderator - "Next Generation Sequencing" Workshop*. Held during The 6th Annual Public Health Symposium at Colorado State University: Microbial Ecology in a Changing World: Emerging issues in antimicrobial resistance, Fort Collins, CO.
2. Reynolds, S. J., Magzamen, S., & Schaeffer, J. (April 15, 2015). *Planning committee members*. The 6th Annual Public Health Symposium at Colorado State University: Microbial Ecology in a Changing World: Emerging issues in antimicrobial resistance, Fort Collins, Colorado.  
<http://www.publichealth.colostate.edu/public-health-symposium-2015/>
3. Roman-Muniz, I. N. (March 2-6, 2015). *Planning committee member*. Western Dairy Management Conference Planning Committee, Reno, Nevada.
4. Rosecrance, J. (September 8, 2015). *Planner of The International Dairy Research Consortium Meeting*. Held during The International Congress on Rural Health, Milan, Italy.

#### 2014

1. Cassidy, A. (September 18, 2014). *Meeting Organizer*. Wyoming-Colorado Occupational Safety and Health Coalition, Fort Collins, CO.
2. Reynolds, S. J. (October 19 - 22, 2014). *Member of scientific planning committee*. The 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Saskatchewan
3. Reynolds, S. J., Kirychuk, S., Douphrate, D., & Schaeffer, J. (October, 2014). *Organizer for the International Dairy Workshop*. Held during The 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Saskatchewan
4. Roman-Muniz, I. N. ( March 5-6, 2014). *Planning committee member*. High Plains Dairy Conference, Lubbock, TX.

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## 2013

1. Reynolds, S. J. (September 25-27, 2013). *Member of the Planning Committee*. ASHCA North American Agricultural Safety Summit, Minneapolis, MN.
2. Reynolds, S. J., DeVries, A., & Douphrate, D. (July 25-26, 2013). *Members of the Planning Committee*. HICAHS International Dairy Research Consortium, Colorado State University, Fort Collins, CO.

## 2012

1. DeVries, A. (June 20, 2012). *Colorado Agri-Women and HICAHS Booth*. Ag in the Classroom Conference, Loveland, CO.
2. DeVries, A. (November 7-11, 2011). *HICAHS Booth*. 2012 American Agri-Women Convention: Rushing West to Seek our Fortune in Agriculture, Denver, CO.
3. Reynolds, S. J. (September 29 – 30, 2012). *Pre-Conference Workshop Organizer – Agricultural Health and Safety with Emphasis on Dairy*. 11th World Conference on Injury Prevention and Safety Promotion, Wellington, New Zealand.  
<http://www.conference.co.nz/worldsafety2012/agriculturalsafetyhealth>
4. Reynolds, S. J. (August 27-29, 2012). *Workshop organizer and presenter*. Nordic Meeting on Agricultural Occupational Health & Safety, Ystad, Sweden.

## 2011

1. DeVries, A., & Douphrate, D. (February 9-10, 2011). *HICAHS Booth*. 6th Annual I-29 Dairy Conference, Sioux Falls, SD.
2. DeVries, A., & Bradford, M. (August 17, 2011). *Lung Function Testing/ HICAHS Safety Research Booth*. 2011 Irrigation Research Foundation Farm Show, Yuma, CO.
3. DeVries, A., & Bradford, M. (November 18-19, 2011). *HICAHS Booth and Lung Function Testing*. 93rd Annual Meeting of the Colorado Farm Bureau, Denver, CO.
4. Reynolds, S. J., Douphrate, D., & DeVries, A. (September 25-27, 2011). *Members of the Planning Committee for the International Dairy Research Consortium Meeting*. Held during the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
5. Reynolds, S. J., DeVries, A., & Douphrate, D. (July 11-13, 2011). *Members of the Planning Committee*. HICAHS International Dairy Research Consortium, Colorado State University, Fort Collins, CO.

## Program Organizer

86. Paul Ayers and Allison Cassidy along with personnel at NYCAMH and other organizations have participated in the National Tractor Safety Coalition (NTSC) and the National ROPS Rebate Program. Paul Ayers was part of the organizing committee for the NTSC. Allison Cassidy spoke to agricultural producers in Wyoming in August 2016 about the National ROPS Rebate Program.

## Consultations Related to Professional Expertise

1. Reynolds, S. J. (February 14, 2017). *Consultation regarding beef industry/cattle feedlots and possible exemption from EPA Clean Air Act*. AgriBeef, Boise, ID.  
*Dr. Reynolds reviewed article and email regarding legislation in Washington State. Spoke with Jayne Davis, Director Corporate and Regulatory Affairs to provide opinion and discuss. Also suggested additional contacts.*
2. Douphrate, D. (August 10-11, 2015). OSHA 10-Hour Training. Aurora Organic Dairy, Gill, CO.
3. Douphrate, D., Hagevoort, G. R., & Cassidy, A. (September 23-24, 2015). OSHA 10-Hour Training. Garden City, KS.
4. Douphrate, D., Cassidy, A., & Erickson, T. (September 11-12, 2014). OSHA 10-Hour Training. Sioux Falls, South Dakota.

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5. Roman-Muniz, N. (March, 2014). Occupational Health and Safety incorporated into a “Milker” training. Blue Sky Dairy, Mead, CO.
6. Roman-Muniz, N. (March, 2014). “Safety Training.” La Luna Dairy, Wellington, CO.
7. Roman-Muniz, N. (February, 2014). Occupational Health and Safety incorporated into a “Milker” training. Morning Fresh Dairy, Laporte, CO.
8. Roman-Muniz, N. (April, 2014). Occupational Health and Safety incorporated into a “Calf Rearing School and Sick Calf Care” educational training. Blue Sky Dairy, Mead, CO.
9. Roman-Muniz, N. (April, 2014). Occupational Health and Safety incorporated into a “Milker” training. Blue Sky Dairy, Mead, CO.
10. Reynolds, S. J. (2012). Consultation to Colorado western slope communities regarding poultry production and community health risks.
11. Reynolds, S. J. (2012). Review of and advice regarding CVMBS Vet Diagnostic Lab protocols regarding infectious agent containment (Anthrax).

### Board Service

1. Cassidy, A. (2014 – present). Agrisafe Board Member (current(=) & Vice Chair (2015-2016). <http://www.agrisafe.org/>  
Cassidy, A. (2013 – present). Member of the NORA AgFF Outreach, Communications, and Partnerships Working Group.
2. Cassidy, A. (2013 – present). Founder and Member of the NIOSH Evaluators, Coordinators, and Outreach (ECO) personnel group.
3. Reynolds, S. J. (2013 – present). NORA Agriculture, Forestry & Fishing Sector Council.
4. Reynolds, S. J. (2011 – present). External Advisory Board Member of the Upper Midwest Agricultural Safety and Health Center (Minneapolis, MN).
5. Reynolds, S. J. (2011 – present). External Advisory Board National Farm Medicine Center Dairy Initiative (Marshfield, WI).
6. Reynolds, S. J. (2010 – present). Colorado Department of Public Health and the Environment (CDPHE) Occupational Health Surveillance Program.
7. Reynolds, S. J. (2010 – present). Worksafe Colorado Advisory Board.
8. Reynolds, S. J., & Cassidy, A. (2010 – present). Wyoming Governor’s Taskforce/Wyoming-Colorado Occupational Safety and Health Coalition.
9. Reynolds, S. J. (2008 – present). International Member of the Canadian Centre for Health and Safety in Agriculture (CCHSA).

### Editors

1. Drs. Stallones and Reynolds serve as Associate Editors for the Journal of Agromedicine and the Journal of Agricultural Safety and Health (2004-present).

### Webinars

1. Reynolds, S. J. (February 20, 2014). *Employee Health Hazards in the Agricultural Industry*. Webinar through Axion Health <http://axionhealth.com/knowledge-resources/webinars>
2. Reynolds, S. J., & Douphrate, D. I. (May 13, 2013). *High Plains Intermountain Center for Agricultural Health & Safety: A Stakeholder Driven Approach to Health & Safety*. Webinar through the AgriSafe Network. [www.agrisafe.org](http://www.agrisafe.org)
3. Campbell, C., Comstock, N., Keifer, M., Ray, B., Reynolds, S. J., Towle, M., & Warner, A. (2011). Epidemiologic and occupational investigation of an Escherichia coli O111 outbreak associated with a correctional facility dairy--Colorado 2010 *Agrisafe Network*.
4. Douphrate, D., & Fry, M. (January 25, 2011). *Incorporating Lean Six Sigma into Occupational Health and Safety*. Webinar through the American Conference of Governmental Industrial Hygienists.

## OTHER

### Outcomes

1. Aurora Organic Dairy (operations in CO and TX) has worked with HICAHS on implementing an OHS Management program for a number of years. Emily Prisco, the Director of Farm Resources who implements that program, is currently pursuing an MPH in the Colorado School of Public Health. Dr. Reynolds is working with her to develop a Total Worker Health Program through an independent study, and collaborating with the new Rocky Mountain Center for Total Worker Health. To our knowledge, this would be the first TWH program for a dairy farm.
2. The emerging issues award to the University of Wyoming has helped HICAHS succeed in fostering new relationships with the logging industry.

### Research to Practice (R2P)

1. After 15 years of working with the dairy industry, we are now seeing examples of research to practice, with dairy producers implementing integrated health and safety management into their business, hiring appropriate staff, and requesting HICAHS support for their efforts. An article about the Idaho Dairymen's Association's most recent steps can be found at the following link: <http://www.capitalpress.com/Idaho/20161215/idaho-dairyman-to-add-worker-safety-emphasis>. They are now asking Drs. Douphrate and Hagevoort for assistance with training employees on 500 dairy farms, and implementing a comprehensive safety management program on each farm operation. Several other producer organizations are also exploring similar efforts.
2. The investigatory research conducted on the ROPS standards and ROPS design procedures led to the development of the Computer-based ROPS design program (CRDP). The analysis on the database of ROPS dimensions for the 14 ROPS/tractor combinations led to the development of the governing ROPS design equations. This CRDP will be useful during the National ROPS Rebate Program.
3. Allison Cassidy, Vicky Buchan, Louise Quijano continue to participate in the Evaluators, Coordinators, and Outreach (ECO) personnel group, along with the "YouTube," "Awareness," "Evaluation" and other sub-groups. Allison Cassidy founded this group with Diane Kampa and Julie Rainwater in 2012. Ms. Cassidy is the leader of the ECO calls beginning August 2017 and maintains a leadership role in the YouTube group and other *ad-hoc* projects.
4. We continue to work with the Farm and Ranch eXtension Safety and Health (FReSH) Community of Practice which operates through the Cooperative Extension eXtension program. Dr. Stallones serves as the contact person for HICAHS and serves on the Leadership Team for the Farm and Health Safety Community of Practice.
5. 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 U.S. as well as internationally.
6. 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.
7. 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. The initial OHS management system will be beta-tested and evaluated beginning in summer 2014, and further revised in 2014 - 2015. The OHS Management System is anticipated to have a significant positive impact on the industry and will serve as the basis to measure the effectiveness of future interventions.

8. Funding from the Director's Discretionary Fund was provided to Agrimetrica to assist in the development of a human resources program. Agrimetrica is a software company that provides dairy producers with a computerized system for tracking and optimizing milk production and quality; this effort will build on their existing system to manage employee health and safety risk and will include training modules.
9. In 2009 under the leadership of the NIOSH Western States Office and Alaska Pacific Office, HICAHS and the Mountain and Plains Education and Research Center (MAP ERC) partnered with Wyoming government to form a Wyoming Colorado Occupational Safety and Health Coalition (WY-CO OSH). Participants include the Wyoming Departments of Workforce Services R&P (Workers Compensation), OSHA, and Public Health, the Wyoming State Occupational Epidemiologist, Wyoming Extension, and University of Wyoming researchers. The WY-CO OSH Coalition has made important progress in organizing and fostering alliances among industry sectors in Wyoming – starting with Oil and Gas, Refinery, Transportation, Construction, and now Nursing and Agriculture. The goals of the alliances are to improve occupational health and safety, engaging more established businesses to mentor smaller businesses and share resources such as their occupational health and safety management programs. HICAHS and the MAP ERC provide expertise and additional resources to the alliances. Wyoming Extension now has representation on the HICAHS External Advisory Board. Wyoming OSHA has also established a safety improvement program. Participating businesses receive a premium discount on their Workers Compensation premiums. While rates are not available for the most recent year (2013), the WY State Occupational Epidemiologist Report documents a significant reduction in workplace fatalities in Wyoming primarily driven by a drop in transportation-related fatalities. Workers Compensation claims and hospitalizations have also decreased.

### Project Generated Resources

1. Development of an Excel version of the Computer-based ROPS Design Program (CRDP). Using 46 tractor dimension inputs, the final ROPS dimension outputs (28) required for ROPS designs are generated. ROPS construction drawings and a price list of materials is also generated by the program. Successful validation of the CRDP was conducted with 3 tractor ROPS.
2. ATV Safety Tips Sheets
3. U.S. Agricultural Health and Safety Centers YouTube Channel  
<http://www.youtube.com/user/USAgCenters>
4. Standard Operating Procedure: IESL Impactor
5. Standard Operating Procedure: Bioaerosol Sampling and Analysis
6. The Evaluation Program, led by Vicky Buchan and Louise Quijano, developed three R2P survey instruments, one for each of the HICAHS Cores (Research Core, Prevention/Intervention Core, and Education and Translation Core).
7. ANSI/ASABE. (2011). Ventilating Manure Storages to Reduce Entry Risk (Vol. S607 OCT2010). Dr. Reynolds contributed to development of this standard.

### Cumulative Enrollment Table

1. Cumulative Inclusion Enrollment Table: n/a See individual projects
2. Gender and Minority Study Subjects. n/a See individual projects
3. Inclusion of Children. n/a See individual projects

# Evaluation Program

Victoria Buchan (PI)  
Louise Quijano (Co-Investigator)  
Allison Cassidy (Coordinator)  
Adrienne Keeney (Graduate Research Assistant)

Report Prepared By: Lorann Stallones and Allison Cassidy

## Summary

### Evaluation

Evaluation efforts were comprised of multiple innovative evaluation approaches, appropriate for each project's stage of development with an emphasis on tracking, measuring, and providing feedback to PIs. In addition, there were efforts to document the collaborative and synergistic relationships between HICAHS and its regional, national and international stakeholders. The specific aims of the Evaluation Core were to: 1) evaluate leadership, guidance and management of the Administrative Core related to progress on goals, and the integration of Internal and External Center stakeholders; 2) evaluate Research Core progress on specific aims and translation potential; 3) evaluate Preventions/Intervention Core progress on specific aims and translation potential; 4) evaluate Education/Translation Core progress on specific aims and translation potential; 5) evaluate methods and impact of the Outreach program; 6) evaluate Center Pilot/Feasibility projects for capacity building, regional utility, and response to emerging issues.

### Outputs and Outcomes

Drs. Buchan and Quijano along with Allison Cassidy and Adrienne Keeney planned and hosted a two-day workshop for Evaluation, Coordinators and Outreach personnel of each of the NIOSH AFF-funded Center.

**Research to Practice:** The evaluation team developed instruments to assess utility of research to practice (R2P) for projects in the Research, Intervention/Prevention and Education/Translation Cores. The R2P instruments were used to measure stakeholder perceptions (on a yearly basis) of the utility of each project's applicability to the workplace and its relationship to regional and national priorities. The instruments were tested for both reliability and validity.

**Constituent Feedback to Center Personnel:** A number of surveys were conducted between 2011-2017 to elicit stakeholder feedback related to regional needs and the HICAHS response to those needs. The targets of the surveys included two Center advisory boards (Center and Dairy) that met regularly and the newly formed International Dairy Research Consortium (IDRC). The evaluation team played a key role in planning and evaluating the meeting and, based on member feedback, made recommendations to develop a more formal structure to promote growth and secure funding.

**Regional/National Needs Assessment:** As part of a strategic planning process, the HICAHS evaluation team conducted a constituency-based regional and national needs assessment to address the following objectives:

1) document current regional/national occupational health and safety concerns related to agriculture and forestry; 2) identify emerging trends in production agriculture and forestry; 3) document health and safety concerns related to the trends identified; and 4) provide recommendations for strategic planning to the Center.

**Results:** The top three areas of concern reported related to worker safety and included the following: machinery accidents, youth injuries, and ATVs. For the topic of health, the first items reported was adult respiratory problem, pesticide and fertilizer illnesses, and childhood respiratory problems. The primary recommendations included the need for education and training materials and collaboration with agricultural producers and organizations (for a synopsis of the needs assessment see Appendix EV-6).

**External Projects 2011-2016:** The evaluation team also participated in three external evaluation projects. First, as part of an interdisciplinary team with Extension and Veterinary Medicine, the evaluation team developed the theory base and evaluation plan for the Community Emergency Response Plans for Pets and Service Animals Project. A second grant was submitted and funded to add a video as an enhancement to the initial Community

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Response Planning Grant called “Community Capacity Building in Their Own Words: Extension Agents’ Role in Disaster Planning for Pets and Service Animals.” Third, a pilot study project funded by the HICAHS was completed in 2011 with a focus on reported Physical and Mental Health stress experienced by Latino dairy workers. This project sought to understand the lived experiences of Latino migrant dairy workers on two large Colorado dairy farms.

### Leveraged Projects

Years	Title of Proposal	Agency	Amount
2014-2015	Community Capacity Building in their own words: Extension Agent’s role in Disaster Planning for Pets & Service Animals (Frank Garry, PI, Adams, Quijano, & Buchan)	USDA	\$35,587
2012-2014	Community Emergency Response Plan for Pet and Service Animals. (F. Garry, PI, Buchan, Quijano, Adams)	USDA	\$98,484

### Conference Papers, Presentations, Abstracts

#### 2017

1. Pate, M., Lawver, R. G., Smalley, S. W., Perry, D. K., Quijano, L., Buchan, V., & Miller, R. (June 25-29, 2017). *Assessing an Agricultural Safety Education Initiative Impact using Geospatial Data Mapping*. Presentation at the International Society for Agricultural Safety and Health, Logan, UT.
2. Quijano, L. M., & Cassidy, A. (February 22, 2017). Governor’s Agricultural Forum on Colorado Agriculture, Aurora, CO.  
*Dr. Quijano and Ms. Cassidy represented HICAHS.*

#### 2015

3. Buchan, V., & Quijano, L. M. (September 10, 2015). *Employment Policies related to Immigrant Workers in the Dairy Industry: A comparative policy analysis across 10 Countries*. International Congress on Rural Health, Milan, Italy.

#### 2014

4. Buchan, V., Quijano, L., & Cassidy, A. (September 23, 2014). *HICAHS Evaluation Project*. NIOSH Site Visit, Fort Collins, CO.
5. Buchan, V., & Quijano, L. M. (October 20, 2014). *Future Focus: What Are Our Constituencies Telling Us?* Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
6. Buchan, V., & Quijano, L. M. (October 15-18, 2014). *Multilevel Evaluation of a Federally Funded Center for Occupational Health and Safety*. Presentation at the 28th Annual Conference of the American Evaluation Association: Visionary Evaluation for a Sustainable, Equitable Future, Denver, CO.
7. Keeney, A., & Quijano, L. M. (October 21, 2014). *Dairy Worker Stress: Mental and Physical Health Implications*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
8. Quijano, L. M., & Buchan, V. (October 20, 2014). *A Collaborative Approach to Building Capacity for Community Response to Disaster*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)

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[ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)

9. Quijano, L. M., & Buchan, V. (October 15-18, 2014). *Community Emergency Response Plans for Pets and Service Animals*. Presentation at the 28th Annual Conference of the American Evaluation Association: Visionary Evaluation for a Sustainable, Equitable Future, Denver, CO.

## 2013

10. Buchan, V., & Quijano, L. (September 25-27, 2013). *An Ounce of Prevention: an Interactive Health and Safety CD for 4-H Youth*. Poster presented at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
11. Quijano, L., & Buchan, V. (Oct. 16, 2013). *Instruments to Predict Research to Practice Relevance*. Abstract presented at the American Evaluation Association Conference, Washington, D.C. <http://archive.eval.org/search13/session.asp?sessionid=5000&presenterid=400>

## 2011

12. Quijano, L. (2011, April). *Seasonal and migrant farmworker stress: Mental and physical health implications*. Presented at the HICAHS Dairy Board Meeting, Fort Collins, CO.

### Conference Organizer

1. Buchan, V., Quijano, L., DeVries, A., & Keeney, A. (April 15-16, 2013). *Ag Center Evaluation Spring Workshop*. Fort Collins Marriott, CO.

### Project Generated Resources

1. The Evaluation Program, led by Vicky Buchan and Louise Quijano, developed three R2P survey instruments, one for each of the HICAHS Cores (Research Core, Prevention/Intervention Core, and Education and Translation Core).

### Research to Practice (R2P)

1. Allison Cassidy, Vicky Buchan, Louise Quijano continue to participate in the Evaluators, Coordinators, and Outreach (ECO) personnel group, along with the "YouTube," "Awareness," "Evaluation" and other sub-groups. Allison Cassidy founded this group with Diane Kampa and Julie Rainwater in 2012. Ms. Cassidy is the leader of the ECO calls beginning August 2017 and maintains a leadership role in the YouTube group and other *ad-hoc* projects.

## Inclusion Enrollment Report

**Study Title:** Evaluation Program

**Total Enrollment:** 1130

**Protocol Number:** 14-4901H

**Grant Number:** 5U54OH008085

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino	0	7	0	7 **
Not Hispanic or Latino	10	40	0	50
Unknown (individuals not reporting ethnicity)	0	0	86	86
<b>Ethnic Category: Total of All Subjects*</b>	10	47	86	143 *
<b>Racial Categories</b>				
American Indian/Alaska Native	0	0	0	0
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	0	0	0
White	10	47	0	57
More Than One Race	0	0	0	0
Unknown or Not Reported	0	0	86	86
<b>Racial Categories: Total of All Subjects*</b>	10	47	86	143 *
<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native	0	0	0	0
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	0	0	0
White	0	7	0	7
More Than One Race	0	0	0	0
Unknown or Not Reported	0	0	0	0
<b>Racial Categories: Total of Hispanics or Latinos**</b>	0	7	0	7 **

# Pilot/Feasibility Projects and Emerging Issues Program

Maggie Clark, Pilot Program Director  
Stephen J. Reynolds, Emerging Issues Program Director  
Allison Cassidy (Coordinator)

## Summary

The Pilot/Feasibility Projects Program awarded 2 to 4 new projects each year during the 2011-2017 cycle in order to generate new information and tools with which to improve human health and safety in agriculture and forestry. Historically, this program has been highly successful, leading to the generation of larger-scale federally-funded grants, the development of new educational materials and intervention techniques, the training of student and junior investigators, and conference presentations and peer-reviewed journal articles. In 2011-2017, the Pilots/Feasibility Projects and Emerging Issues Program had four aims:

- 1) To develop new and creative research, prevention, intervention, outreach, education, evaluation or translation related to agricultural safety and health within Federal Region VIII.
- 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 health and safety.
- 3) To build research capacity related to agricultural health and safety in Federal Region VIII.
- 4) To address emerging issues in agricultural health and safety through the implementation of rapid, extramurally-funded research projects.

The Emerging Issues program was managed in conjunction with the Pilot/Feasibility program, but offered more flexibility and timeliness for response to the needs of the region. All funds for emerging issues were used to address the priorities identified by HICAHS constituents including agricultural producers, Extension, HICAHS Advisory Board Members, and other agricultural and forestry partners in the High Plains Intermountain Region. Projects and use of funds varied depending on the need and availability. The Specific Aim of this program was:

- 1) To provide leadership and resources for projects addressing high priority emerging issues in Public Health Service Region VIII in a timely manner.

Program Successes. Overall programmatic success of the Pilot/Feasibility Projects Program has been demonstrated by an increased research capacity to address the health and safety needs in agriculture and forestry. Specific effectiveness of the program activities is evident in the career advancement of recipients into respected positions as well as by a high number of prestigious grants being awarded to pilot awardees since 2002 (e.g., NIOSH R21 awarded to Paul Gunderson, PI, formerly the Director of the Dakota Precision Ag Center), NIOSH R01 (Stephen Reynolds, PI; based on collaboration with two previous pilot project recipients), NIEHS ONES Outstanding New Environmental Scientist award (Jill Poole, PI, currently an Associate Professor at the University of Nebraska Medical Center), NIOSH R01 (David Douphrate, Associate Professor at the University of Texas School of Public Health, and John Rosecrance, currently a Professor at Colorado State University, PIs), and the National Cattlemen's Beef Association (Lawrence Goodridge, PI, currently an Associate Professor at McGill University). Furthermore, the program tracks awardee outputs in the form of publications, presentations, trained students, industry training curriculum, as well as the leveraged and subsequent grants awarded to the investigators (see Outputs and Outcomes below). During the 2011-2017 cycle, the HICAHS distributed 17 pilot/feasibility awards (one cancelled) totaling \$333,175 in total costs and 11 Emerging Issues Awards. Thirty-nine applications were received, with a funding success rate of approximately 44%. The 2011-2017 cycle (initial pilot funding released in 2012) recently produced its first three peer-reviewed

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journal publications (one resulting publication in each year: 2015, 2016, 2017); the two previous cycles resulted in 18 publications (published between 2007-2015). Thirteen presentations have been conducted for the 2011-2017 cycle (4 international, 6 national/regional, 3 local conferences); twenty presentations were reported from the two previous cycles (12 international, 6 national/regional, 2 local conferences). For the 2011-2017 cycle, two pilot awardees have secured institutional internal grants as PI or co-I to leverage their research programs (grants awarded total \$65,000) and one has secured an EPA Small Business Innovation Research award (grant awarded at \$99,000). Valued outputs also include industry-training curriculum; Cynthia Walker's 2013 pilot award resulted in more than 30 workshops on effective pesticide application cleanout methods to over 1,750 industry producers and pesticide applicators and (from the previous cycle) David Douphrate's 2009 pilot award resulted in six industry-training workshops as well as eight industry conference presentations on dairy farm safety and leadership.

Below, we highlight the significant contributions of three of the 2011-2017 cycle projects (2014 awardees).

Dr. Scott Noblitt (Research scientist, Colorado State University, Department of Chemistry) was awarded a pilot project entitled, "*Confirming the presence of cyanate in particulate matter from biomass burning.*" For this work, a novel analysis protocol was developed for particulate cyanate including a new filter extraction procedure and a microchip electrophoresis (MCE) assay with high cyanate specificity. The method was subsequently applied to archived biomass-burning filter samples and aerosol-phase cyanate was observed for the first time, to our knowledge. This quantitative study will provide the foundational knowledge for future studies on the health effects of occupational exposure to cyanate-containing aerosols. To date, results from this study were presented in an oral presentation at an international conference. Furthermore, the pilot project results were used by the investigators to compete successfully for a U.S. EPA Phase I Small Business Innovation Research (SBIR) award (Direct costs=\$79,231; PI: Philippe Dekleva, MicroChemica, LLC; 9/01/15-2/28/16).

Dr. Craig McConnel (Assistant professor, Colorado State University, Department of Clinical Sciences) was awarded a pilot project entitled, "*E. coli O157 Shedding and Antimicrobial Susceptibility on Colorado Dairies.*" Preliminary results indicate a much larger proportion of adult cattle (24-29%) are shedding low levels of O157 than was anticipated. Additionally, initial results indicate that there may be substantial differences related to the shiga-toxin producing capabilities and antimicrobial resistance patterns of O157 isolates in different dairies. The observed shedding in adult dairy cattle suggests endemic colonization that is potentially important not only for food safety but also worker safety and environmental contamination. Two small-scale projects were awarded to the PI to leverage the HICAHS pilot award (one from the National Institute of Food and Agriculture via Colorado State University and one through the U.S. Department of Agriculture). Furthermore, this work has resulted in two additional acknowledgments: (1) MO BIO Microbiome Award, Second Prize, Analysis of microbiome samples by the EMP consortium, 2014, \$3,000; (2) Amazon AWS in Education Grant, elastic cloud computing resources for dairy microbial sequence analysis, 2014, \$10,000. The development of a larger-scale submission to the National Science Foundation (NSF) is underway.

Dr. Bledar Bisha's (Assistant professor, University of Wyoming, Department of Animal Sciences) project "*Modified Bioaerosol Sampling for Presence of Viruses in Agricultural Environments*" evaluated how modifications to the SKC Biosampler device affected capture and subsequent molecular detection of viruses. Sampling aerosols for viruses in bioaerosols is still in its infancy, and as a result, no industry standards have been developed. The investigators previously demonstrated the ability of an anion exchange resin to capture viruses and hypothesized that incorporating the resin into the SKC Biosamplers would improve the sensitivity of the monitor. In fact, preliminary results suggest an improvement of over 8 times in the capture of bacteriophages (phenotypic surrogates of clinically relevant viruses) over SKC Biosamplers without the resin. These findings have implications for protecting agricultural workers in poultry, cattle, and swine operations where aerosol-based transmission of viral zoonotic agents is a health and safety risk. Additional funding was awarded to further refine and test the modified SKC Biosampler through the Colorado Bioscience Discovery Evaluation Grant Program (Dr. Bisha collaborated with Dr. Stephen Reynolds [HICAHS Director, PI]).

Here we highlight significant successes of the 2011-2017 cycle Emerging Issues projects.

Responding to the need for dairy management and leadership, funding was provided to assist with development and delivery of training dairy producers' management skills and OSHA compliance. As an authorized OSHA 10-Hour Trainer, Dr. Douphrate delivered training to over 100 owners and managers in Colorado, South Dakota, New Mexico, Texas and Kansas.

Utilizing a national OSHA Consultation database, HICAHS conducted research into the implementation and efficacy of the OSHA Form 33 on dairies. The form is used by OSHA Consultants to evaluate management systems. Funds were used to support a PhD student, Dan Autenrieth to conduct an evaluation of the usefulness of the Revised OSHA Form 33 from the perspective of Colorado OSHA consultation clients. The majority of respondents indicated that the Revised OSHA Form 33 accurately reflected their Occupational Health and Safety Management System (OHSMS) and that information provided on the Revised OSHA Form 33 was helpful for improving their systems. Specific outcomes reported by the respondents included increased safety awareness, reduced injuries, and improved morale. The results indicate that the OHSMS assistance provided by OSHA consultation is beneficial for clients and that the Revised OSHA Form 33 can be an effective tool for assessing and communicating OHSMS results to business management<sup>7</sup>.

Funds were also used to help develop training incorporating worker health and safety with livestock productivity, and for a joint research effort with the Southwest Center to identify novel pro-inflammatory small molecules in poultry dust.

In collaboration with the Southwest Center we also supported the production of the video series "Considering Human and Animal Safety" developed by Dr. Hagevoort. Best practices are outlined on how to safely and productively care for dairy cows while reducing risk of injury to yourself. These videos are available on the HICAHS website and the U.S. Agricultural Safety and Health Centers YouTube Channel ([www.youtube.com/usagcenters](http://www.youtube.com/usagcenters)) and have been used widely throughout the world. The 14-part video series in English and Spanish has had over 87,000 minutes watched and over 29,000 cumulative views in 139 different countries through the YouTube channel.

Developing Partnerships and Building Research Capacity. Two of the main goals of the Pilot/Feasibility Projects Program have been to develop and cultivate new partnerships and to build research capacity that serves the occupational health and safety needs of the agriculture and forestry sectors. Developing new partnerships with other academic institutions, state and federal agencies, and private industry has been a hallmark of the HICAHS. Our successful relationship with the dairy industry is an excellent example of how partnership building has enabled the HICAHS to promote agricultural health and safety through applied research. We have also pursued new partnerships by targeting a broader range of applicants for the pilot/feasibility projects. We released the request for proposals (RFP) to the sponsored programs offices at Colorado State University, University of Wyoming, University of Montana, University of Utah, North Dakota State University, University of North Dakota, South Dakota State University, and University of South Dakota; all six states in Federal Region VIII were represented. In 2016, we received eleven applications from four of the six states, a proposal from Nebraska, all of which point to an increase in dissemination and reach of the RFP. Each year shows an improvement. We have also targeted non-university audiences by releasing the RFP to several listservs and publications including the Occupational Health State Surveillance listserv, the Mountain and Plains Education and Research Center ROADMAP listserv, the Rocky Mountain Center for Occupational and Environmental Health website, and the NIOSH-maintained WestOn listserv.

The Pilot/Feasibility Projects Program has developed research capacity and encouraged new collaborations; for example, through awards administered to Drs. McConnel and Bisha (awards described below), these junior faculty awardees have formed partnerships and established themselves as valuable HICAHS investigators.

The process of awarding pilot proposals. The annual request for proposals is modeled after the application for NIH R03 grants. Each year, the RFP was revised to clarify minor ambiguities identified iteratively over time

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through communication with Pilot/Feasibility Project applicants. Eligible pilot/feasibility project investigators are individuals with research interests in agricultural and forestry health and safety including faculty up to the level of assistant professor, graduate research trainees, postdoctoral fellows, staff from health departments/state agencies and non-academic public health institutions. Faculty at the rank of associate and full professor may be eligible to apply if they are new to HICAHS and the field of agricultural and forestry safety and health (i.e., not an existing or past member of any HICAHS core or HICAHS-related project). This latter restriction was put into place to prioritize awards to junior-level investigators and to allow for the development of new research collaborations and partnerships with senior-level investigators new to the field of agricultural or forestry safety and health. Individuals from minority and underrepresented populations are strongly encouraged to apply. In distributing this RFP widely across the region we targeted academic institutions that have Latino, African-American, and Native American student and faculty populations. To date, applications have been received from every Region VIII state (Colorado, Wyoming, Utah, North Dakota, South Dakota, Montana) in addition to Nebraska. Awards for funded projects were made for a maximum one-year duration (up to \$25,000 total costs). Each proposal includes: Specific Aims (1 page) and Research Strategy (5 pages), 11-point font, 0.5 inch margins. Biographical sketches, references, IACUC and/or IRB research certifications, the proposed budget and justification, and letters of support are not included in the page limitation.

Proposals were evaluated by a review panel of HICAHS faculty and external reviewers. Each proposal was assigned a minimum of two reviewers: one primary reviewer and one secondary reviewer. Review assignments were determined by the Program Director Maggie Clark. The primary reviewer provided a brief summary of the project and his/her evaluation and the secondary reviewer, a brief evaluation. Following discussion, each panel member scored each application. The aggregate mean score was used to rank proposals. Each proposal received an overall score from 1.0 (flawless) to 9.0 (poor) by each reviewer using the NIH scoring system. To craft their overall score, reviewers were asked to consider the following evaluation criteria: 1) **Significance**, does the research address an important problem in the HICAHS region in agricultural or forestry health and safety? Does the research address an important problem or critical barrier to progress in the field of agricultural or forestry health and safety research? Does the research address an important problem in the HICAHS region in occupational and environmental safety and health? If the aims are achieved, how will scientific knowledge, technical capability and/or clinical practice be advanced? How will successful completion of the aims change the concepts, methods, technologies, treatments, services or preventive interventions that drive this field? 2) **Innovation**, does the application challenge and/or seek to shift current research or clinical practice paradigms? Does the research project involve novel concepts, approaches, methods, instrumentation or interventions? Are the concepts, approaches, methods, instrumentation and/or interventions novel to agricultural or forestry safety and health or novel in a broad sense? Does the application refine or improve existing theoretical concepts, approaches, methods, instrumentation or interventions? 3) **Approach**, are the overall strategy, conceptual framework, design (including study population), methods, and analyses adequately developed, well-integrated, well-reasoned and appropriate to the aims of the project? Does the applicant acknowledge potential problem areas and consider alternative tactics? 4) **Collaboration and Partnerships**, does the study involve multiple stakeholders? Is there interdisciplinary interaction or potential? Does the proposal include graduate students or others who will benefit from training in research methods in agricultural or forestry health and safety? 5) **Investigator(s)**, are the PIs, collaborators, and other researchers well suited to the project? If early-stage or new investigators, do they have appropriate experience and training? Do they have suitable mentors? If established investigators, are they new to the field of agricultural or forestry safety and health? If the project is collaborative or multi-PI, do the investigators have complementary and integrated expertise; is their leadership approach, governance and organizational structure appropriate for the project? 6) **Environment**, does the environment in which the work will be performed contribute to the probability of success? Are the institutional support, equipment and other physical resources available to the investigators adequate for the project proposed? Can the project be accomplished in the timeline presented? Will the project benefit from unique features of the scientific environment, subject populations or collaborative arrangements? Does the proposed project increase the institution's ability to conduct agricultural or forestry safety and health research and contribute to regional needs? 7) **Additional Criteria**, does the research project have the potential of obtaining pilot data that may increase the probability of

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developing fundable larger grants or contracts in the future? Will the research benefit under-served populations or members of minority groups? Is the budget appropriate to complete the scope of the work proposed? Does the proposal contain adequate protections for human subjects or vertebrate animals (if necessary)? Does the proposal contain adequate biohazard, radioactive hazard, or physical/chemical hazard protections for the researchers?

The process of awarding Emerging issues proposals. Emerging issues were identified by HICAHS constituents including agricultural producers, Extension Agents, HICAHS Advisory Board Members, and other agricultural and forestry partners in the High Plains Intermountain Region. We used multiple active strategies to solicit input and communication from constituents using email, regional surveys. We also discussed emerging issues at meetings with External Board members and other opportune regional producer meetings and outreach efforts. HICAHS faculty and staff served as a conduit for partners on their specific projects, and in some case potential projects were identified through the Pilot/Feasibility program. Selected emerging issues and projects were prioritized and selected by the HICAHS Leadership Team, with final selection by the HICAHS Director, Dr. Reynolds.

Program leadership. Since 2014, Dr. Maggie Clark directed (or co-directed) the Pilot/Feasibility Project Program. Dr. Clark has experience participating in both national (U.S. Environmental Protection Agency STAR grant program, USAID TRAction program) and pilot-level (NIOSH Mountain and Plains ERC Pilot ad hoc reviewer, HICAHS Pilots/Feasibility Projects) review panels and maintains an active, federally funded research program in environmental epidemiology. Dr. Clark relied on input from the Internal and External Advisory Boards when developing and modifying the RFP and soliciting membership on the review panel. Dr. Clark's primary roles were: to develop and distribute the annual RFP, to coordinate review committee development and facilitate the proposal review process, work closely with Allison Cassidy (HICAHS Coordinator) to ensure regular communication with awardees and past awardees to document and evaluate program successes, and to communicate the outcomes and solicit feedback on the annual review to both the Internal and External HICAHS Advisory Boards. All Pilot/Feasibility Project funding final decisions were made by Dr. Reynolds (Center Director). Dr. Reynolds provided ongoing guidance and mentoring to Dr. Clark to support her leadership role. Evidence of this mentoring and collaborative relationship between Drs. Clark and Reynolds has been demonstrated through the publication of seven co-authored manuscripts.

Dr. Reynolds managed the Emerging Issues program with input from the HICAHS Leadership team (Core Directors and Project PIs), with the assistance of Ms. Cassidy.

Program Documentation, Evaluation, and Outreach. Ms. Cassidy conducted documentation of the Pilots/Feasibility Program with records including: methods of dissemination, a list of all proposals submitted, reviews and scores, and funding decisions. Funded investigators submitted summaries according to Center evaluation procedures on progress, final reports, and students trained, collaborators, and results including presentations, abstracts, manuscripts, and larger scale grant submissions (e.g., R-grants). Specific records maintained for quality assurance and tracking include: 1) A copy of each proposal, maintained in a secure electronic site; 2) Review documentation from each reviewer; 3) Relative ranking of each proposal; 4) Documentation of funding decisions and copies of award letters; 5) Documentation of IRB and animal care committee approvals, including copies of human subjects research protocols on funded applications; 6) A record of results and evidence of productivity including presentations at scientific meetings, published abstracts, publications in refereed journals, theses and dissertations, and state/federal grant applications and awards obtained from Federal agencies (and any other national agencies, e.g., American Heart Association). These records are maintained for a minimum of 5 years. Each year, a notice with instructions for completion and a financial expenditures form were sent to the investigator prior to the end of the budget period. A final written report was submitted within 6 months after the end of the budget period, with results preferably presented in manuscript form or in the form of a brief white paper with executive summary. This report should have documented all presentations, publications, students/trainees supported, and extramural funds that resulted, in part, directly or indirectly from the award. Acknowledgement of funding from the HICAHS is

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required for all published work, as specified in the RFP. Follow-up with the awardee to maintain records of outputs occurs annually until the awardee notifies the HICAHS administrative staff that no further work is being pursued related to the original pilot/feasibility award.

Ms. Cassidy and Ms. Brooks documented Emerging Issues awards including the outputs and outcomes of these projects.

## Outputs and Outcomes

See individual project summaries for Pilot Program and Emerging Issues listed separately

### Emerging Issues Projects

#### **HICAHS Emerging Issues 2011 – 2017 (as of 9/11/17)-Projects fully funded or partially funded using the Emerging Issues funds.**

**1. ATV Training Program Development-2013**

PI- David Gilkey

Outputs/Outcomes

- a. Product- Helped to produce and manufacture 30 field training kits. Allowed those taking training or certified to access the information. Furthermore information was put on to a flash drive so handouts could be printed and allow for further dissemination. This was the initial impetus for further projects.

**2. Development of on-line systems OHS training program for dairy-2013**

PI-Mark Kinsel, AgriMetrica Dairy HR

Outputs/Outcomes

- a. Plan for online OHS program, initial vignettes – lead into Hagevoort's project.

**3. Modified Bioaerosol Sampler for Viruses (partner with CSU Ventures)-2014**

PI- Bledar Bisha, WY

Outputs/Outcomes

- a. Publications
  - i. J.C. Chandler, J.W. Schaeffer, M. Davidson, S.L. Magzamen, A. Pérez-Méndez, S.J. Reynolds, L.D. Goodridge, J. Volckens, A.B. Franklin, S.A. Shriner, and B. Bisha. (2017) A Method for the Improved Detection of Aerosolized Influenza Viruses and the Male-specific (F+) RNA Coliphage MS2. *J Virol Methods*. 2017 Aug;246:38-41. doi: 10.1016/j.jviromet.2017.04.004.

**4. Identification of novel pro-inflammatory small molecules in poultry dust-\$10,000 – 2014**

PI: Gregory Dooley with Rena Saito

- a. Background

Poultry workers have lower overall lung function compared to other agricultural workers (Radon et al. 2001) suggesting a need for a better understanding of the underlying cause of the respiratory impairment.

Exposure to organic dust is one component of the poultry production process that increases the risk of acute and chronic respiratory impairment (Viegas et al. 2013, Zuskin et al. 1995.) Little research has been conducted to characterize poultry dust with regard to pro-inflammatory small molecules that may be contributing to respiratory inflammation. This was a collaborative project funded by HICAHS and the Southwest Center for Agricultural Health, Injury Prevention, and Education.

#### b. Aims and Methods

The initial evaluations of poultry dust extracts for inflammatory potential was accomplished by Dr. Saito at the University of Texas Health Sciences Center at Tyler This evaluation was based on the collection aqueous extract fractions differentiated by size with molecular weight cutoff filters. Settled dust samples were collected from a poultry production facility in Tyler, TX by personnel at UTHSC and 100mg of dust extracted by sonication in 1ml of LC-MS grade water.

Aim 1: Evaluate chromatographic fractions of aqueous poultry dust extracts for inflammatory potential using a cellular based IL-8 ELISA.

Aim 2: Characterization of the chemical composition of pro-inflammatory dust extract fractions using accurate mass LC-MS.

Greg Dooley, funded by HICAHS, and Rena Saito and Vijay Boggaram, funded by the Southwest Center, isolated and characterized pro-inflammatory small molecules through mass spectrometry and biological assays. The plan was to develop a protocol to characterize small molecules in poultry dust that are pro-inflammatory using a combination of mass spectrometry and biological assays. Aqueous poultry dust extracts were fractionated with liquid chromatography and fractions applied to a human monocytic cell line, THP-1, to determine interleukin-8 induction as a marker of inflammation. Characterization of the most reactive fractions was conducted using LC-QTOF mass spectrometry with constituent molecules identified by searching against various accurate mass databases. Identified molecules associated with inflammation were investigated further with analytical standards to provide positive identification of potentially active molecules. Positively identified molecules with pro-inflammatory potential were evaluated individually in the IL-8 assay to confirm their inflammatory activity.

#### c. Findings

Results showed that inflammatory mediators from dust extracts were most prevalent between 50 and 100 kDa and this size fraction was the only one to give a significant IL-8 response compared to blank controls. This result is both unexpected and novel. Initially, they sought to investigate the small molecule (>3000 Da) contribution to inflammation since this fraction had not been previously studied, but these results indicate there may not be a significant contribution to inflammation by water-soluble small molecules. Based on these results, the focus of this project shifted from the <3000 kDa fraction to the 50-100 kDa fraction. The inflammatory response of the 50-100 kDa fractions does provide the potential for discovery of novel inflammatory mediators since nothing in this size range has been previously identified in poultry dust. The most common previously described inflammatory mediators in animal dust include lipopolysaccharides (10-20 kDa), beta glucans (50-3000 kDa), and various peptides (3-20 kDa).

#### d. Conclusions

Based on the results of these experiments, it was concluded that the protein bands present in the 50 MWCO fractions were unable to be identified conclusively with the available databases at this time. It may be that the protein present in that fraction is not in the databases available or has not been identified to date. At this point, no further experiments will be completed to investigate the identity of the proteins in the 50 MWCO fractions. Since carbohydrates were found in this fraction

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as well, it may be that the inflammatory properties of this fraction of dust extract are independent of protein.

e. Outputs/Outcomes

f. Publications

- i. Koteswara R. Gottipati , Shiva Kumar Bandari , Matthew W. Nonnenmann , Jeffrey L. Levin, Greg P. Dooley, Stephen J. Reynolds, Vijay Boggaram. Transcriptional mechanisms and protein kinase signaling mediate organic dust induction of IL-8 expression in lung epithelial and THP-1 cells. *American Journal of Physiology – Lung Cellular and Molecular Physiology* (online) 14 November 2014 Vol. no. DOI: 10.1152/ajplung.00215.2014

**5. Next Gen Sequencing and Bioinformatics for microbiome studies of environment (water), bioaerosols dairy-2014**

PI-Joshua Schaeffer and Sheryl Magzamen-ERHS, CSU

a. Outputs/Outcomes

Publications

- i. Schaeffer JW, Reynolds S, Magzamen S, VanDyke A, Gottel NR, Gilbert JA, Owens SM, Hampton-Marcell JT, Volckens J. (2017) "Size, Composition, and Source Profiles of Inhalable Bioaerosols from Colorado Dairies" *Environ Sci Technol.* 2017 Jun 6;51(11):6430-6440. doi: 10.1021/acs.est.7b00882.
- ii. Further Grants Written with Data

**6. Relationship between OSHA OHS management system (Form 33) and injury and illness rates in agriculture, poultry, dairy-2015**

PI-William Brazile and Dan Autenrieth- OSHA Consult and ERHS-CSU

a. Outputs/Outcomes

b. Publications

- i. Autenrieth DA<sup>1</sup>, Brazile WJ<sup>2</sup>, Douphrate DI<sup>3</sup>, Román-Muñiz IN<sup>4</sup>, Reynolds SJ<sup>2</sup>(2016): "Comparing OHSMS Programming with Injury Rates in Poultry Production," *J Agromedicine.* 2016;21(4):364-72. doi: 10.1080/1059924X.2016.1211575.
- ii. Autenrieth DA, Brazile WJ, Gilkey DP, Reynolds SJ, June C, Sandfort D. Client Perceptions of Occupational Health and Safety Management System Assistance Provided by OSHA On-Site Consultation: Results of a Survey of Colorado Small Business Consultation Clients. *J Occup Environ Hyg.* 2015;12(11):804-17. doi: 10.1080/15459624.2015.1049270.
- iii. Autenrieth DA, Brazile WJ, Gilkey DP, Reynolds SJ, June C, Sandfort D. Client Perceptions of Occupational Health and Safety Management System Assistance Provided by OSHA On-Site Consultation: Results of a Survey of Colorado Small Business Consultation Clients. *J Occup Environ Hyg.* 2015;12(11):804-17. doi: 10.1080/15459624.2015.1049270.

iv.

c. Students: PhD funding- Autenreith

7. **Hosted Workshop on Metagenomic/Proteomic Tools to address Occupational and Public Health in Agriculture-Partner with Colorado School of Public Health-2015**  
PI- Stephen Reynolds, Joshua Schaeffer, and Sheryl Magzamen
  - A. Outputs/Outcomes
    - a. Hosted Conference and Workshop- Report Written
  
8. **Occupational Health and Safety of U.S. Farmers in the High Plains and Beyond**  
PI-Anita Pena-Economics-CSU
  - A. Outputs/Outcomes
    - a. Publication-?
    - b. Presented in KY Workshop on economics/Ag OHS
  
9. **Antibiotic resistance genes in bacteria water looking up-wind and down-wind on Colorado Dairies-2016-2017**  
PI-Joshua Schaeffer- ERHS-CSU
  - A. Outputs/Outcomes
    - a. Undergraduate Student Research Experience
      - i. Nolan Green, Peter Seale
    - b. Project Still in Progress
  
10. **Dairy Stockman Vignettes-2016-2017**  
PI-Robert Hagevoort NMSU  
Project Still in Progress
  
11. **Assesing Worker Perceptions of Helath and Safety Risk in Beetle-Killed Forests-2017**  
PI-Trevor Durbin-WY  
Project Still in Progress

## Pilot Project Summaries

### 1. **Bioaerosol Monitoring preventing the spread of infectious diseases among farmers- \$15,000-2012**

PI's: Margaret Davidson and Lawrence Goodridge

#### **A. Abstract**

There is a need for methods that rapidly trace the source and transmission of foodborne pathogens, as well as assessing potential health risks for spread of infectious microorganisms in occupational environments. The aim of this pilot study was to investigate a rapid method for the collection and identification of viable airborne pathogenic bacteria. The method incorporated NIOSH BC-251 bioaerosol samplers loaded with a resuscitation buffer for collection of viable cells, selective and differential plating media and rapid molecular analysis by Riboprinting and matrix-assisted laser desorption ionization time-of-flight (MALDI-TOF) mass spectrometry (MS) couple with MALDI Biotyping software for microbial identification/characterization. Sampling was undertaken at four Colorado dairies and inside a cantaloupe sorting shed. Samples were plated on varying differential and selective media following isolation on TSA. The method was successful in the capture and id of the pathogenic (*Escherichia coli*) opportunistic human pathogens (*Pantoea agglomerans*, *Enterobacter cloacae* and *Pseudomonas stutzeri*). However, none of the target pathogens (*E. coli* O157, *Salmonella* spp. and *Listeria* sp.) were detected. MALDI Biotyping was the preferred analytical approach because it typically provides superior taxonomic resolution, can analyze a greater number of isolates in the same amount of time and is a fraction of the cost of Riboprinting.

#### **B. Background**

There is a need for methods that rapidly trace the source and transmission of foodborne pathogens, as well as assessing potential health risks for spread of infectious microorganisms in occupational environments.

#### **C. Aims**

The aim of this pilot study was to investigate a rapid method for the collection and identification of viable airborne pathogenic bacteria.

#### **D. Methods**

Traditional Air Sampling with differential isolation and further analysis using MALDI biotyping

#### **E. Findings**

The personal NIOSH BC-251 respirable dust sampler loaded with a liquid resuscitation buffer can be used to collect viable, and therefore potentially infectious, respirable bacteria in the workplace.

However, further particle collection efficiency studies with the liquid loaded sampler will need to be undertaken to check performance against health based sampling criteria.

#### **F. Conclusions**

The pilot project demonstrated that this method integration could provide microbial air quality assessments in agricultural facilities within 48 hours. However, further optimization of plating media and/or multi-stage isolation procedures would be needed for targeting of specific pathogens. The MALDI biotyping platform outperformed Riboprinting in taxonomic resolution, speed and cost; and provided novel data on airborne opportunistic human pathogens and phytopathogens in a cantaloupe factory, as well as further contribution of knowledge on airborne viable bacteria inside and outside of dairy milking parlors.

#### **G. Outputs/Outcomes**

##### a. Presentations

- i. Davidson, M., Bisha, B., Reynolds, S. J., & Goodridge, L. (January 26, 2013). Speciation of Airborne Bacteria Collected by Novel and Traditional Samplers in a Cantaloupe Processing Facility: A Pilot Study. Poster presented at the Colorado State University 14th Annual College of Veterinary Medicine and Biomedical Sciences Research Day, Hilton Fort Collins, CO.
- ii. Davidson, M., Goodridge, L., Bisha, B., & Reynolds, S. J. (20 May, 2013). Evaluation of the NIOSH BC-251 Personal Bioaerosol Sampler for Sampling Viable and Culturable Pathogenic Bacteria. Podium presentation at AIHce2013, Montreal, Canada.

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## 2. *In Vitro* microsystems for determining acute pesticide toxicity-\$14,976 -2012

PI: Meghan Mensack and Charles Henry

### A. Abstract

The goal of this project is to develop a microfluidic system capable of studying pesticide toxicity effects and cellular response as they directly relate to respiratory health. Microfluidic systems are powerful tools for both cellular biology and analytical chemistry and have been applied to a variety of biological studies. The device proposed here would provide a platform to study the biological mechanisms associated with acute pesticide exposure, a problem which has not been tackled previously with microfluidic devices. To better understand the biological mechanism of pesticides on human health, a representative, physiologically-based model of not only the biological system but also the aerosol deposition mechanism is needed. The outcome of this project will be a new miniaturized tool capable of real-time monitoring of extracellular biomarkers that will allow us to ultimately develop a better understanding of the toxicity associated with pesticide exposure. While we have chosen to look at vapor deposition of pesticides to non-primary bronchial cells, the next phase of this project will involve culturing primary human lung epithelial cells at the air-liquid interface in order to monitor cytotoxicity in physiologically relevant systems.

### B. Background

Farms represent a setting where a multitude of occupational exposures may occur daily with the exposures resulting in a variety of acute and chronic illness and diseases. It has also been shown that organophosphate (OP) insecticides have been associated with wheezing and increased non-atopic asthma in US farmers. Many questions remain about the specific biological mechanisms of action associated with both acute and chronic pesticide exposure. Furthermore, it is thought that the effect of co-exposure to multiple pesticides may drastically change the metabolism and elimination of pesticides as well as increase their toxicity. This fact is especially important when you consider that agricultural workers are likely exposed to multiple pesticides and other respiratory hazards simultaneously on a daily basis.

### C. Aims

- a. Develop a miniaturized device capable of culturing bronchial epithelial cells at an air-liquid interface capable of real-time sampling for biomarker analysis
- b. Develop enzymatically modified electrodes for monitoring cytotoxicity markers
- c. Monitor cellular response to acute pesticide exposure using the miniaturized cell culture device.

### D. Methods

Using previously published methods for other chemicals different biomarkers were tested, allows for flexibility for adding different enzymes.

### E. Findings

Modifications to the fluidic channels in the device have also been made to allow for on-chip mixing of the LDH containing cell supernatant with a buffer containing lactic acid. The consumption of lactic acid by LDH will be measured using the lactate oxidase modified sensor. While the pesticide aim (Aim 3) was not completed during the timeframe of this grant, we continue to work on these devices and anticipate completing the pesticide exposure in the coming months.

### F. Conclusions

Further study is needed, but this did inspire further research especially looking at the air lung interface.

### G. Outputs/Outcomes

- a. A membrane device was fabricated of polycarbonate, allowing for a chemical gradient

### **3. Acute Pesticide Poisoning Experiences of Certified Applicators in Colorado-\$15,000 -2012**

PI: Amy Warner and Meredith Towle (Project Manager)

#### **A. Abstract**

Exposure to pesticides, whether by ingestion, inhalation, ocular or dermal contact, is associated with adverse health outcomes. The Colorado Department of Public Health and Environment (CDPHE) Occupational Health and Safety Surveillance Program conducts public health surveillance for acute work-related pesticide poisoning. Currently, cases are only identified and tracked using data from the Rocky Mountain Poison and Drug Center (RMPDC) poison help-line

#### **B. Background**

Pesticides are a category of chemicals that are used to kill or control insects, weeds, fungi, rodents and microbes. If not properly applied, pesticides (including disinfectants) can pose both acute and chronic exposure risks. Exposure to pesticides, whether by ingestion, inhalation, ocular or dermal contact, has been associated with adverse health outcomes.

#### **C. Aims**

Understand the utility of existing surveillance data sources, and describe select risk factors for occupational pesticide poisoning.

#### **D. Methods**

The target population for this study was 2,000 of Colorado's currently certified restricted-use pesticide applicators. Of the 8,722 individuals currently certified in Colorado, 54.46% held a private license, 44.46% held a commercial license, and 0.85% held both types of license. Those individuals with dual certification were included in the final sample.

#### **E. Findings**

Nine hundred thirty-two (932) surveys were completed and returned (46% response rate). Most respondents were male (90.1%), white (95.7%), and age 45 and older (73.7%). Most (69.3%) reported having at least some college education, while 22.9% had high school level or less education. Only 81 (8.7%) reported that their health care provider routinely monitors them for pesticide poisoning. Thirty-one respondents (3.3%) reported at least one acute pesticide exposure event. In all, 36 acute events were reported. Most events were self-reported to have resulted in minor injury or illness (64%). The vast majority of respondents did not seek medical care for their acute exposures, nor did they report the injury to a poison center, workers' compensation claim, or emergency responders.

#### **F. Conclusions**

This finding indicates occupational pesticide surveillance using poison center data alone is likely a gross under-estimation of the true incidence of acute pesticide exposure. These results also suggest that other common data sources for occupational health surveillance may not be effective at filling this data gap. Colorado may be able to use these findings to work toward a more comprehensive and active system of pesticide surveillance. It was also noted that a large variance in age and education levels exists among respondents. This finding may be helpful to the CDA ensure development of certification training materials and education plans that are accessible and relatable to applicators of various aptitudes.

#### **G. Outputs/Outcomes**

- a. Presentations- Towle, M. (June 10, 2013). Public Health Survey to Assess Acute Pesticide Poisoning Experiences of Certified Applicators in Colorado, 2012. Presentation during the Occupational Pesticide Illness Panel at the CSTE 2013 Conference, Pasadena, CA.

#### **4 & 5. Improving pesticide tank clean-out: Analytical techniques and sample measurement-\$15,000 (PI: Delphine Farmer) with Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods-\$14,996 (PI: Thia Walker) - 2013**

##### **A. Abstract**

A number of problems arise each year from pesticide residues remaining in the pesticide application sprayer from previous applications. It may pose a safety issue for the applicator, might affect workers in the field under Worker Protection Standard, cost employers due to compensation to the injured party, or even result in the employee losing their job. Of these possible consequences, the most important are the risk to the applicator and the risk to field workers.

##### **B. Background**

The use of pesticides can pose many health problems. Finding ways to minimize those risks is always a benefit.

##### **C. Aims**

To survey and determine PPE used in pesticide application and cleaning, and to enumerate ways to better do said cleaning.

##### **D. Methods**

This project was designed as a two-part study; the first part was designed to survey licensed pesticide applicators to determine the factors that limit sprayer cleanout and procedures individual applicators use to clean the application sprayer. A paper survey was distributed to both Colorado licensed private and commercial applicators attending licensing recertification workshops.

The second part of the study was to analyze the effectiveness of individual applicator cleanout procedures by recruiting Colorado licensed pesticide applicators as volunteers, providing them with personal protective equipment for use while collecting samples during stages of their normal pesticide application equipment cleanout procedure, and analyzing the collected samples for pesticide residues.

Survey of equipment clean out and contact survey. To minimize the sampling bias, the research study was explained to applicators attending the CEC who were then asked to answer 3 demographic questions. Turning Point Audience Response System (Turning Technologies) was used to collect applicator responses.

##### **E. Findings**

Survey results show that the majority of all applicators (84%) have more than 3 years of experience making pesticide applications. This suggests that the respondents should have ample knowledge about making applications as well as maintaining and cleaning application equipment.

Samples from pesticide cleanout procedures were collected from 46 individual pesticide applicators and tested for recently used pesticides using both a standard LC-MS/MS (liquid chromatography coupled to an electrospray dual quadrupole mass spectrometer) and novel LCUV technique. We developed a multi-residue method for quantifying aqueous pesticides using LC-UV. While less sensitive than traditional LC-MS system, this approach is sensitive enough to test in the range of acceptable levels (parts per million). The LC-UV technique was demonstrated to have detection limits in the parts per million range, while LC-MS/MS has detection limits for a much wider range of pesticides in the parts per billion range. The industry standard of three repeated rinses removes the majority (typically >98%) of pesticide, although we note that there are a few individuals with much lower removal efficiencies. Perhaps unsurprisingly, final rinsate concentrations of 2,4-D typically remain above typical thresholds for drinking water; these results should be used as a reminder for applicators of the importance of wearing personal protective equipment throughout the cleaning process, and to consider placing even the third rinse back on the areas to which they were applied. The standard 'three rinses' appears to remove the bulk (i.e. >98%) of the pesticide initially placed in containers. Should thus still be treated with care using proper personal protective equipment. Applicators using 2,4-D should be particularly careful of post-cleanout usage on off-target samples. Preliminary data suggests cleaner may be unnecessary in the tank cleaning process, but further data analysis is required.

## F. Conclusions

It is important to have a proper place to clean the sprayer where rinsate will not contaminate water supplies, streams, or where puddles will not be accessible to children, pets, or other animals. If no place found, then rinsate must be collected. It may be used as a diluent for future pesticide mixtures. However, for it to be used legally as a diluent, it must meet certain conditions: if it is labeled on the site, if the amount of pesticide in the rinsate plus the amount of pesticide in the new mixture does not exceed labeled rate for the site, and if the rinsate is the same or compatible with the pesticide in the new mixture. If these conditions cannot be met, the rinsate can be collected and disposed of as hazardous waste. The best solution to rinsate disposal is to apply on a labeled site, however, it means that the applicator may have to carry additional water to the site for cleaning. The survey results show mixed results as to where spray application equipment is cleaned. Pesticide safety educators continue to emphasize that the first rinsate should be applied to the application site as it is likely to contain higher levels of residues than the subsequent rinses. As mentioned above, the best possible place to dispose of rinsate is to apply on a labeled site. Some recommendations for cleaning application equipment suggest filling the tank 1/3 full of water, spraying it out, and repeating that two additional times. That might seem reasonable with small tanks, but if that procedure is used on very large tanks, it can generate a large quantity of rinsate and complicate their disposal.

## G. Outputs/Outcomes

- a. Publications- Osborne, P. P., Xu, Z., Swanson, K. D., Walker, T., & Farmer, D. K. (2015). Dicamba and 2,4-D residues following applicator cleanout: A potential point source to the environment and worker exposure. *Journal of the Air & Waste Management Association*, 65(9), 1153-1158. doi: 10.1080/10962247.2015.1072593
- b. Presentations
  - i. Swanson, K. (2013). Quantitative analysis of pesticide tank rinses for residues. Presentation at the Southeastern Regional ACS.
  - ii. Walker, C. (March 11, 2013). Report to NIOSH: Survey & Effectiveness of Spray Equipment Cleanout Methods. Webinar.
  - iii. Swanson, K. (July 18, 2013). Quantitative analysis of pesticide tank rinses for residues. Poster presented at the Colorado State University Chemistry Research Experience for Undergraduates Program, Fort Collins, CO.
  - iv. Walker, C. (August 8, 2013). The Clean Machine - A Glimpse at 'Real-World' Sprayer Clean Out Practices. Presentation to the National Pesticide Applicator Certification and Training Workshop.
  - v. Walker, T. (February 6, 2014). Real World Pesticide Use Issues. Presentation at the 14th Annual Pesticide Stewardship Conference, San Diego, CA.
- c. Documents and Handouts
  - i. Deveau, J., & Walker, C. (2014). Effective Sprayer Cleanout Practices-Survey Results from Colorado. Handout created for Recertification Workshop. HANDOUT
  - ii. Spieser, H., & Deveau, J. (2014). Tank Cleaning Procedure Plot. Demonstration plot and handout stimulated by the results of the HICAHS cleanout survey. HANDOUT
  - iii. Cleaning Out Agricultural Sprayers and Nurse Tanks: Removing Herbicide Residues from the Tank to the Nozzle-NARRATION AND PRESENTATION-Purdue Extension

## **6. Confirming the presence of cyanate in particulate matter for biomass burning-\$20,000 - 2014-**

PI: Scott Noblitt

### **A. Abstract**

Determine a method for cyanate detection in biomass. The assumption is to determine what level due the health effects become to great and to help set a limit of detection.

### **B. Background**

Detection of Cyanate in biomass burning would be beneficial in the health of workers and farmers. Cyanate can carry negative health effects.

### **C. Aims**

The first aim of the proposed research was the development of a sensitive MCE for the analysis of cyanate from biomass-burning aerosol filters.

The second aim of the study was to analyze biomass-burning aerosol filter extracts to confirm the presence or absence of cyanate.

### **D. Methods**

Extraction using a tertiary amine base, then used background electrolytes in varying concentrations of the three electrolyte constituents permits a range of operating conditions. Once detection was achieved the signal detection in biomass was tested. Using first spiked samples, then unknowns.

### **E. Findings**

We are currently working towards making a more quantitative assessment of cyanate in particulate matter. To do this, we are working to obtain fresh biomass-burning samples for analysis. The main concern when working with archived samples is decomposition of the cyanate over long periods of time, even at  $-20^{\circ}\text{C}$ . We plan on collecting samples from a wood-burning stove in collaboration with the Volckens lab at Colorado State University. With the fresh samples, we will evaluate the range of cyanate concentrations being emitted during biomass burning. Quantifying the cyanate will permit appropriate doses to be considered in occupation exposure health studies and better concentration estimates to be used in atmospheric chemistry modeling.

### **F. Conclusions**

### **G. Outputs/Outcomes**

- a. Leveraged Grants- "Microchip Analytical System for Inexpensive, Real-Time Aerosol Chemical Speciation"-with PI-Phillippe Dekleva-EPA-SBIR Phase I-\$99,999
- b. Presentations- Henry, C. S. (October 6, 2014). Sensitive Analysis of Environmental Pollutants by Microchip Electrophoresis with Contact Conductivity Detection. Presentation at the 21st International Symposium on Electro- and Liquid Phase- Separation Techniques; 20th Latin-American Symposium on Biomedical, Biopharmaceutical, and Industrial Applications of Capillary Electrophoresis, Natal, Brazil.

## 7. *Escherichia coli* O157 Shedding and Antimicrobial Susceptibility on Colorado Dairies-\$25,000 - 2014-

PI: Craig McConnel

### Final Progress Report

**HICAHS project funded 2013-2014:** *E. coli* O157 Shedding and Antimicrobial Susceptibility on Colorado Dairies (PI—Craig McConnel; Co-I—Doreene Hyatt)

**Background:** *E. coli* is a Gram-negative rod shaped bacteria that is able to grow under aerobic and anaerobic conditions. *E. coli* O157 is the most important serotype because of its ability to cause severe clinical symptoms in humans. Available data suggest that *E. coli* O157 strains that are antibiotic resistant are most often multidrug resistant, and strains that are resistant to the highest number of antibiotics are overrepresented in cull cows and ground beef samples.

**Hypothesis & Aims from Grant:** **Hypothesis:** *E. coli* O157 shedding prevalence and antimicrobial susceptibility differ between pre-weaned dairy calves and mature dairy cattle. **Specific Aim 1:** Identify pre-weaned dairy heifer calves shedding *E. coli* O157 in conjunction with ongoing sampling of mature dairy cows. **Specific Aim 2:** Identify antimicrobial susceptibility for *E. coli* O157 isolates.

**Methods and Findings:** Fecal samples were collected from cows for a period of one year on three freestall dairies in Colorado. Results from 1,090 samples collected between July 2013 and July 2014 indicated that consistent shedding in lactating cattle is much higher than expected (24-29%, compared to 3-7% expected), and there may be a seasonal influence on average O157 and pathogen gene presence on the three dairies studied. Samples from pre-weaned calves showed that of 623 samples in total (494 pre-weaned calves and 129 environmental samples) only 2 were positive for O157 with one of those negative for the shiga-toxin genes.

Antimicrobial susceptibility testing was performed on the 237 O157 isolates obtained from adult cows and pre-weaned calves. Antimicrobials were chosen due to their potential or representative use in treating Gram-negative infections on farms or within human medicine. These spectrum antibiotics formulated to work against Gram-negative bacteria included: amoxicillin-clavulanate, ampicillin, ceftiofur, enrofloxacin, florfenicol, penicillin G, streptomycin, sulfonamides, tetracycline, trimethoprim-sulfamethoxazole, and tulathromycin. All isolates were resistant to at least one antibiotic. The most common resistance pattern seen was (erythromycin) + (PenG) +/- (tetracycline).

**New Discoveries & Implications:** Our findings related to low levels of shedding suggest endemic colonization and shedding in adult dairy cattle that is worrisome in terms of overall exposure. This broad population level of shedding impacts not only food safety but worker safety and environmental contamination. If our results related to shiga-toxin producing capabilities and antimicrobial resistance hold true, they point toward a need to identify underlying reasons affecting the pathogenicity of these organisms on a per-farm basis.

**Grants:** This pilot directly led to funding through the National Institute of Food and Agriculture via the Research Council of the College of Veterinary Medicine and Biomedical Sciences, Colorado State University. The title of the project is “Characterizing Microbial Community Impacts on the Survival and Dissemination of *E. coli* O157:H7 on Dairies.” PI: Craig McConnel, Steve Reynolds. Co-I: Sheryl Magzamen, Doreene Hyatt, Lyndsey Linke, Roberta Magnuson, Chloe Stenkamp-Strahm.

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Accession No. 1004896. Year awarded: 2014. Funding period: 2014-2015. \$20,000

In addition, the following grants were awarded:

“Describing and predicting patterns of Salmonella and E. coli O157:H7 shedding in pre-weaned dairy calves using NAHMS 2014 fecal samples”-USDA Co-Op EXT- \$24,000

“Characterizing Microbial Community Impacts on the Survival and Dissemination of *E. Coli* O157:H7 on Dairies”-NIFA- Project #-COLV201401

**Publications:**

McConnel, C. S., Stenkamp-Strahm, C. M., Rao, S., Linke, L. M., Magnuson, R. J., & Hyatt, D. R. (2016). Antimicrobial resistance profiles in Escherichia coli O157 isolates from Northern Colorado Dairies. *Journal of Food Protection*®, 79(3), 484-487.

**Students:** Numerous students have been involved with this project. Participation has included aspects of sampling, laboratory work, and analysis. Chloe Stenkamp-strahn is pursuing her PhD within the Department of Clinical Sciences at Colorado State University. She is examining bovine microbiome dynamics related to shiga toxin-producing *E. coli*. The HICAHS pilot project has served as an initial step toward the completion of her degree. Other students involved are listed below, including the time frame and area of their involvement.

Clarissa Freemyer, 2/14 – 5/14, Undergraduate student, Independent study, Comparison of VIDAS E. coli O157 (ECPT) and Immunoconcentration E. coli O157 (ICE) kits to Immunomagnetic Separation (IMS), Assessment of E. coli O157 antimicrobial susceptibilities.

Sean Montgomery, 2/14 – 5/14, Undergraduate student, Independent study, Comparison of VIDAS E. coli O157 (ECPT) and Immunoconcentration E. coli O157 (ICE) kits to Immunomagnetic Separation (IMS), Assessment of E. coli O157 antimicrobial susceptibilities.

Andi Emch, 2/14 – 5/14, Undergraduate student, Independent study, Comparison of VIDAS E. coli O157 (ECPT) and Immunoconcentration E. coli O157 (ICE) kits to Immunomagnetic Separation (IMS), Assessment of E. coli O157 antimicrobial susceptibilities.

Victoria Frank, 9/13-5/14, Undergraduate student, Laboratory work: PCR, IMS, cultures and identification.

Meagan Chriswell, 9/13-5/14, Undergraduate student, Laboratory work: PCR, IMS, cultures and identification.

Paige Tenneson, 9/13-5/14, Undergraduate student, Laboratory work: PCR, IMS, cultures and identification.

Kelly Thompson, 7/13, Undergraduate student, Laboratory work: PCR, IMS, cultures and identification. Katie

Powell, 7/13 – 5/14, DVM student, Sample collection.

Sarena Olsen, 1/14, DVM student, Sample collection.

Jessica Carie, 2/14, DVM student, Sample collection.

Ashleigh McNeil, 2/14 – 5/14, Master student, Sample collection. Danielle

Burke, 1/14, Undergraduate student, Sample collection. Sarah Kappel, 2/14

– 5/14, Undergraduate student, Sample collection.

Katherine Dirsmith, 4/15/14, Undergraduate student, Sample collection.

**Collaborators:** The project was one of three parallel pilot projects laying the foundation for further studies exploring the ecology and environmental impact of shiga toxin-producing *E. coli*. The other projects include:

2013 CSU Infectious Disease Supercluster—“E.coli O157:H7 Shedding and Super-shedding on Colorado Dairies.” PI: Craig McConnel, Doreene Hyatt Co-I: Lyndsey Linke, Roberta Magnuson, Sangeeta Rao. \$26,346

2013 Research Council of the College of Veterinary Medicine and Biomedical Sciences, Colorado State University. “E.coli O157:H7 Super-shedding on Colorado Dairies.” PI: Craig McConnel, Doreene Hyatt. Co-I: Lyndsey Linke, Roberta Magnuson, Sangeeta Rao. \$25, 000

## **8. Modified Bioaerosol Sampling for Presence of Viruses in Agricultural Environments-\$25,000 - 2014-**

PI: Bledar Bisha

### **A. Background**

Aerosol-based transmission of viral zoonotic agents to agricultural workers in poultry, cattle, and swine operations is a public and occupational health and safety risk. For example, it is well established that agricultural workers located in poultry or swine operations are more frequently exposed to influenza virus compared to other populations. Workers are likely to be infected by viral laden aerosols that are inhaled, enter the conjunctiva, or potentially skin abrasions. Thus, monitoring agricultural facilities via sampling of bioaerosols for detection of specific viruses is an important tool to protect the health and safety of agricultural workers.

### **B. Aims and Methods**

Employed methods for bioaerosol sampling of viruses typically include filtration or liquid impingement. However, these strategies suffer from drawbacks, including loss of viral infectivity and loss of sensitivity, respectively.

Therefore the studies proposed in this application will be designed to fulfill the following specific aims:

- 1. Design and development of modified bioaerosol sampling devices for viral capture compatible with subsequent molecular detection.**
- 2. Laboratory evaluation of the modified bioaerosol sampling devices: determinations of viral capture efficiency and sensitivity.**
- 3. Pilot field testing and method validation of the modified bioaerosol sampling devices in poultry operations.**

These devices will incorporate IRA-900 anionic exchange resin as a viral-capture matrix into already existing bioaerosol sampling equipment and prototype devices. Viral nucleic acids will be isolated from the entire capture matrix will then be subjected to endpoint detection via RT-PCR or analyzed by next-generation sequencing for pilot field testing. The utility of the proposed platform is not limited to sampling in agricultural settings, but it may find broad use as a public health tool for air monitoring in hospitals, schools, etc.

### **C. Findings and Conclusions**

Multiple devices that incorporate IRA-900 anion exchange resin were developed and evaluated for their ability to capture two bacteriophages (MS2 and  $\phi$ 6) from bioaerosols. HICAHS funding enabled feasibility studies with MS2-containing bioaerosols of 14 resin-containing platforms. Quantitative analyses of bacteriophage capture and qualitative evaluations of platform ease-of-use indicated that SKC Biosamplers containing resin were the best performing. Extensive studies were conducted to determine the sensitivity of the resin-modified SKC Biosampler with both MS2 and  $\phi$ 6 bacteriophages. Further, the improvement in method sensitivity was quantified between modified and unmodified SKC Biosamplers. For bacteriophage MS2, the addition of IRA-900 resin to SKC Biosamplers improved sensitivity by approximately 8.15X (about 1 log) over SKC Biosamplers alone, enabling reliable detection of 102 PFU/m<sup>3</sup> of aerosolized bacteriophages. IRA-900 adsorption of bacteriophage  $\phi$ 6 was less efficient than for MS2 in the resin-modified SKC Biosampler system, but still increased method sensitivity approximately 2.08X in comparison to unmodified SKC Biosamplers and allowed for the detection of 103 PFU/m<sup>3</sup>.

### **D. Outputs/Outcomes**

#### **Impact**

We are confident that the resin-modified SKC Biosampler developed and tested with HICAHS pilot funding will serve as an important tool for monitoring and surveillance of viruses in aerosols in agriculture settings.

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An enhanced understanding of virus capture and detection from bioaerosols with resin modified SKC biosamplers was obtained. With this knowledge in-hand, we have begun subsequent studies to further refine the platform.

- a. Publications
  - i. J.C. Chandler, J.W. Schaeffer, M. Davidson, S.L. Magzamen, A. Pérez-Méndez, S.J. Reynolds, L.D. Goodridge, J. Volckens, A.B. Franklin, S.A. Shriner, and B. Bisha. (2017) A Method for the Improved Detection of Aerosolized Influenza Viruses and the Male-specific (F+) RNA Coliphage MS2. *J Virol Methods*. 2017 Aug;246:38-41. doi: 10.1016/j.jviromet.2017.04.004.
- b. Leveraged Grants-w/ Stephen Reynolds "Modified Bioaerosol Sampling for Influenza Virus in Agricultural Environments"-CSURF-CSU Ventures # 02-07 14BGF-16- \$21,000-2015
- c. Presentations-
  - i. Bisha, B. (December 8-9, 2013). Rapid Methods/Sample Preparation/Field-based Diagnostics. Presentation at the 2013 meeting of the NC 1202 Regional Research Technical Committee "Enteric Diseases of Food Animals: Enhanced Prevention, Control and Food Safety", Chicago, IL.
  - ii. Bisha, B. (April 20-22, 2014). Food Safety: Rapid Diagnostics and Typing. Presentation at the Student American Veterinary Association (SAVMA) Annual Symposium, Loveland, CO.
  - iii. Bisha, B. (July 7-18, 2014). Food Safety: Rapid Diagnostics and Typing. Presentation at the University of Pristina International Summer University, Pristina, Kosovo.

## **9. Endotoxin exposure in the allergic lung: agriculture-related health pilot project-\$24,840 - 2015-**

PI: Sumit Ghosh

### **A. Project Summary**

Allergic asthma is an inflammatory disorder which is characterized by airway dysfunction and infiltration of inflammatory cells driven in large part by the activation of Th2 lymphocytes. However, recent studies have revealed that Th17 cells-a new T-helper cell lineage, which produce IL-17 and related cytokines may also play important roles in the development of pulmonary inflammation and AHR. Together, these observations suggest that the “Th2 theory” is probably inadequate to explain the diverse forms of asthma in humans and the various inflammatory responses seen in animal models of allergic asthma. Agricultural operators/Occupational workers are continuously exposed to a complex mix of chemical, biological, and particulate insults and are at risk for developing chronic inflammatory lung diseases. The objective of this proposal is to determine the extent to which secondary exposures to endotoxin (lipopolysaccharide [LPS]), a major contaminant of grain dust, impact the development and maintenance of allergic fungal asthma. Many studies on the effects of LPS over the years are largely descriptive, which address the question of what happens at allergen stimulation in the presence of LPS. Fewer studies in this area deal with the mechanisms by which LPS modulates allergen-induced host response. We will use an experimental model of fungal allergic asthma as the background for exposure to endotoxin. We expect to identify and characterize the effect of endotoxin on the allergy phenotype and Th17 polarization.

### **B. Background**

Airway wall remodeling is an irreversible outcome of asthma that is observed in many, if not all cases of allergic asthma. The best therapeutic methods cannot be satisfactorily implemented until the basic mechanisms that underlie the disease processes in allergic asthma are identified. This research will help to unravel the mechanism through which endotoxins impact common pulmonary states like allergy. Successful completion of this proposed research will provide evidence-based information to reduce the direct and indirect costs associated with agricultural exposures and pulmonary dysfunction, potentially helping to offset a nearly \$20-billion annual price tag and limiting the financial burden of asthma<sup>15, 20, 21</sup>. The financial benefits that are projected as a result of this research include increased productivity with a reduction in missed work days, decreased medication expenses for the treatment of chronic asthma, and a reduced number of doctor’s visits/hospitalizations for the complications of asthma. Understanding the etiology of airway exacerbation and remodeling is expected to contribute significantly to improved treatment of allergic asthma and may have applications in other pulmonary disease.

### **C. Aims**

Specific Aim 1: To determine the extent to which endotoxin exposure exacerbates fungal asthma induced by sensitization and challenge with *Aspergillus fumigatus* to recapitulate agriculture-related occupational exposures.

Specific Aim 2: To determine the extent to which endotoxin exposure exacerbates Th17 responses in allergic fungal asthma

### **D. Findings**

The Principal Investigator transferred to a different institution and had to cancel the project. No funds were transferred to the PI.

## 10. Digital Graphic Novella: Hearing Health for Spanish Speaking Agricultural Workers-\$25,000 - 2015-

PI: Mark Guiberson

### A. Abstract

This preliminary study developed a digital graphic novella targeting hearing protection beliefs of Spanish-speaking agricultural workers. Researchers used pretest–posttest interview surveys to establish if the novella had an immediate influence on the participants' beliefs about noise-induced hearing loss and usage of hearing protection devices.

### B. Method

Researchers developed a digital graphic novella directed to increase knowledge about noise-induced hearing loss and increase the proper use of hearing protection devices. The novella was tailored to meet the specific linguistic and literacy needs of Spanish-speaking agricultural workers. Thirty-one Spanish-speaking farmworkers of Mexican nationality participated. This study included an interview survey with specific questions on noise-induced hearing loss, myths, and hearing protection device usage. A pretest–posttest design was applied to measure the graphic novella's immediate influence on workers.

### C. Results

The post test scores on Hearing Protection Beliefs statements were significantly better than pretest scores, with a large effect size observed.

### D. Conclusion

Digital media may be an effective way to overcome language and literacy barriers with Spanish-speaking workers when providing health education and prevention efforts.

### E. Outputs/Outcomes

- a. Publications- Guiberson, Mark, and Emily Wakefield. "A Preliminary Study of a Spanish Graphic Novella Targeting Hearing Loss Prevention." *American Journal of Audiology* (2017): 1-9.
- b. Article on UWYO News. "UW Professor Uses Graphic Novella to Help Prevent Hearing Loss in Spanish Speaking Ag Workers."  
<http://www.uwyo.edu/uw/news/2015/06/uwprofessorusesgraphicnovellatohelppreventhearinglossinspanishspeakingagworkers.html>

## 11. Socio-ecological model for exposure to zoonotic disease among dairy farm workers-\$23,967 - 2016-

PI: Jairo E. Palomares Velosa and Multiple CO-PI's

### A. Abstract

The human-cattle-ecosystem interface is a working environment that facilitates exposure of dairy farm workers to zoonotic diseases. The behavior of the persons at risk affects the exposure to infectious diseases. Any preventive behavior(s) is affected by socio-ecological factors. The aim of this proposal is to identify the socio-ecological barriers that affect the adoption of preventive health behavior and impact exposure to important zoonotic agents utilizing a Social Ecological Model approach. We plan to conduct a cross-sectional study by administering two systematic survey instruments that will measure the intrinsic and extrinsic barriers that affect the implementation of preventive behavior of workers. Simultaneously, we will collect representative samples of personal protective equipment (clothing, gloves, and shoes) of dairy workers and environmental samples from their work areas to isolate and identify the presence of three important zoonotic pathogens. Using relevant statistical approaches, we will identify the socio-ecological barriers that are associated with preventive behaviors and zoonotic exposures. The identification of socioecological factors will serve as basis for the design and improvement of preventive programs aimed at reducing the risk of zoonoses in dairy farm workers. *Salmonella spp.*, *Campylobacter jejuni*, and *Cryptosporidium parvum*, are harmful bacteria/protozoa often found in the farm environment. They can cause serious illness in the people exposed to them. Identifying the barriers that affect the implementation of preventive behaviors would help to reduce the risk of exposure to these zoonoses.

### B. Background

Our goal is to identify social, cultural, and ecological factors that affect the implementation and maintenance of preventive measures that reduce exposure to zoonotic pathogens in dairy farm workers.

### C. Aims

Hypothesis 1: Extrinsic and intrinsic barriers affect the behavior for implementation of preventive health practices.

Specific aim 1: Assess the extrinsic and intrinsic social and ecological barriers to the prevention of zoonotic diseases in dairy cattle farm workers in Colorado.

Hypothesis 2: Dairy workers' exposure to zoonotic agents is affected by their socio-ecological environment.

Specific aim 2: Estimate the magnitude of association between socioecological factors and exposure of dairy workers to three important zoonotic pathogens (*Salmonella spp.*, *Campylobacter jejuni*, and *Cryptosporidium parvum*).

### D. Methods

A structured questionnaire will be administered to the participant dairy farm workers and managers to gather data describing the intrinsic and extrinsic socio-ecological barriers. In the same survey, specific preventive health practices will be recorded. Because of the complexity of the socio-ecological model, factor analysis will be used to examine the relationships among variables and to describe possible unobserved latent factors that underline the observed variables.

Samples will be obtained from clothes, shoes, and gloves of workers during their work shift. Workers will be instructed to change their sampling elements if changing work areas, and specific collection receptacles will be provided in each area. Environmental samples from work surfaces will be collected to determine the risk of exposure to these zoonotic agents. Microbial isolation and identification will be performed using standard laboratory procedures. Magnitudes of association between study factors and pathogen presence will be estimated using Bayesian logistic regression analyses. Intent to change, preventive practices, and pathogen presence are outcomes and the intrinsic and extrinsic barriers are the independent factors. Among other advantages, by including prior information, the Bayesian approach will provide more precise estimates without the need of a large sample size.

**E. Findings & Conclusions-** The Principal Investigator has yet to provide a final report; three requests have been made.

## 12. The application of a novel sensor for spatially and temporally resolved monitoring-\$24,000 - 2016-

PI: Kimberly Anderson and Nicholas Good

### A. Abstract

Bioaerosols are ubiquitous in many work environments, in particular the agricultural industry. The adverse health effects associated with exposure to bioaerosols include acute toxicity, allergic reaction, cancers, and infectious disease. Despite widespread recognition that harmful exposures to bioaerosol occur in many workplaces, quantitative exposure assessment remains a challenge. Bioaerosols may comprise many different components such as bacteria, viruses and fungi. Knowledge of the precise roles that specific biological agents play in causing observed adverse health outcomes is limited. The objective of this study is to evaluate a novel bioaerosol sensor's ability to quantify bioaerosol properties in the workplace. The bioaerosol sensor combines time-resolved (online) measurement of particle multichannel fluorescence, concentration, size, and shape. The sensor has been used extensively by atmospheric scientists, for example investigating the flux of biological particles from rainforests and cloud formation from ice nuclei, however its potential as an exposure assessment tool has not been explored. The sensor's ability to differentiate and quantify bioaerosol exposures associated with different locations and tasks within a workplace will be evaluated.

The study will evaluate the sensor in dairies in northern Colorado, leveraging several ongoing studies at the proposed field sites. The first aim of the project is to evaluate the sensor data against co-located filter measurements of specific bacteria and fungal agents associated with the adverse health effects of bioaerosol exposure. The second aim will quantify the spatial and temporal differences in bioaerosol properties associated with tasks in the dairy parlors. The samplers will be moved between multiple locations in the dairies representative of the environments the main works tasks are performed in, over four weeks. The proposed study will evaluate the potential for future applications of the novel bioaerosol sensor, such as personal exposure assessment, hotspot identification and ultimately in the design of strategies to mitigate harmful worker exposures.

### B. Methods

The proposed study is designed to assess the potential of an online bioaerosol detector for occupational exposure assessment. We have assembled an interdisciplinary team uniquely qualified to achieve the aims of the study. We have expertise in industrial hygiene including dairy work and exposure assessment (Dr. K. Anderson), the application of advanced aerosol instrumentation for exposure science (Dr. Good), operation and analysis of the WIBS (McMeeking and Droplet Measurement Technologies, see letter of support) and analysis of filter samples for biological particles (Dr. Schaeffer). Dr. Volckens will oversee the project and mentor the early-career investigators (see letter of support). Undergraduate researchers will also have the opportunity to work on the study and learn about exposure assessments, air sampling methods and procedures, calm air chamber testing, and agricultural health issues. Dr. B. Anderson (see letter of support) will mentor the early stage researchers on the team with the proposed statistical analyses. The facilities and expertise with Colorado State University's Departments of Mechanical Engineering and Environmental and Radiological Health Sciences and Droplet Measurement Technologies Inc. provide an ideal environment to perform the proposed study.

Data collection will take place in two parts: first, instrument optimization, comprising of both test runs in the laboratory and the field; second, 16 days of field sampling will take place in dairies in Northern Colorado. The proposed fieldwork leverages two existing studies (R01OH0129 and U01OH010840) which will be performing worker exposure assessment and acute health measurements at the same sites. Measurements will take place at La Luna and Aurora Dairies in Northern Colorado. Dr. Reynolds (see letter of support) has collaborated with these facilities for over nine years and has agreed to allow us access to the dairies in collaboration with existing field studies. Our approach leverages the expertise and interests of multiple stakeholders, combining expertise academic and technical of Colorado State University and Droplet Measurement Technologies with the needs of dairy workers in Colorado.

**C. Findings-** At least two requests made for a final report.

**D. Conclusions-** At least two requests made for a final report.

**E. Outputs/Outcomes**

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### 13. A Feasibility Study of enrolling Colorado, Wyoming, and New Mexico Farm-Families in a prospective Farm Injury Cohort-\$22,000 - 2016-

PI: Travis Sondgerath with Annette Bachand and Lorann Stallones as Mentor/Co-PI's

#### A. Project Summary, and Results

A total of 200 household surveys were sent to participants in three mailings during 2016. Five household surveys were sent to addresses that were no longer valid, additional addresses were not obtained to mail out additional surveys. A total of 61 responses were received by the end of the study period that were sent to valid household addresses. Nine of the received household surveys were not considered eligible for analysis as participants responded that they no longer lived on or operated a farm. A total of 52 eligible surveys accounting for 95 persons were received (*response rate = 28%*). Thirty eligible survey responses were received during the first mailing and 18 were received during the second and third mailings.

Respondents were allowed to categorize their farm as more than one type of operation. Most reported producing beef cattle and identified as individually family owned and operated farms. A total of eight respondents reported the occurrence of injuries on their farm during the year 2015. Injuries were most frequently reported on farms where beef cattle or dairy cattle were present. Injuries also were most commonly reported on farms that were owned and operated by the family residing on the farm.

A total of 10 injuries were suffered by 10 different people working and residing on participant farms during 2015. Although most of the reported injuries were suffered the owner/operator of the farm, two injuries were suffered by the spouse of the farm owner/operator and one injury was suffered by the child of the owner/operator (Table 2). On average, those injured worked more hours per week during all four seasons of 2015 than those not injured. On average those injured were more likely to operate tractors and all-terrain vehicles than those not injured. Those injured were more likely to engage in chores requiring interaction with large and small animals. Finally, those injured were generally older and more likely to be male than those not injured.

Detailed information of nine out of the 10 reported injury events was provided by participants. All nine injuries occurred while working on behalf of the farm. One injury occurred off the farm while the injured participant was making a delivery. Four injury events involved interactions with animals and four involved slips or falls. Two injury events required immediate treatment at an emergency room and three required treatment at a doctor's office or health clinic.

Participant's willingness to participate in follow-up was assessed at the farm level based on the response of the person filling out the household survey on behalf of all farm residents. On average participants were able to complete the household survey in 35 minutes (*range 10-60 minutes*). A minority of participants reported that they would be willing to be contacted on an annual basis during follow-up in the event that a prospective cohort of family farms were formed, (*n = 18, percent = 38, missing = 4*). Additionally, a smaller number of participants would allow linkage to medical records by providing personally identifying information such as Social Security Numbers (*n = 7, percent = 15, missing = 4*).

#### B. Discussion and Conclusions

The goal of this pilot study was to assess the feasibility of the formation of a cohort of farm families in the Rocky Mountain region. We sent household surveys to 200 farms in Colorado and received 52 eligible responses used for descriptive analysis. Five surveys were sent to addresses that were no longer valid and nine surveys were returned with a note indicating that the residents were no longer operating a farm resulting in a final participation rate of 28%. Although this participation rate is lower than would be desirable for cross-sectional studies, it is comparable to that of previous longitudinal studies of occupational injuries among farmers in North America. A previous prospective cohort of family farms in Colorado enrolled an estimated 2.6% of all farm household in Colorado, however, the participation rate of those contacted was not described (Stallones and Xiang 2003). The Saskatchewan Farm Injury Cohort reported a participation rate of 29% of eligible farms (Pickett, Day et al. 2008) and another population-based cohort in Alberta, Canada reported a

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32% participation rate among those residing on family farms (Bryant, Robson et al. 2006). The participation rate in this pilot study was similar to that of previous cohort studies involving farm families.

Feasibility of cohort formation would also be affected by follow-up of participants over time. An often cited reason for the lack of longitudinal studies of occupational injuries among farmers is the difficulty in following this population over time (Mull, Engel et al. 2001). We assessed the feasibility of cohort follow-up based on whether or not pilot participants would consent to continued participation in a cohort study through periodic interactions and linkage to health records. Of those who completed household surveys, very few would have consented to provide information on injuries occurring on the farm during follow-up and even fewer were willing to provide personally identifying information to allow for linkages to other data sources to allow tracking of health outcomes. However, it is possible that self-reported willingness to participate in follow-up may not accurately reflect participant's actual willingness to participate in follow-up. A previous longitudinal study of alcohol use and injury among Colorado farmers enrolled 746 persons using Department of Motor Vehicle records and was successfully able to follow 653 participants during two years of follow-up (Stallones and Xiang 2003). Additionally, modest financial compensation could be used to encourage participation in follow-up. Participants in a study of injuries among youth farmworkers in North Carolina were given \$20 to complete interviews (Arcury, Rodriguez et al. 2014). Participants also may have been reticent to agree to participate in follow-up as the amount of follow-up was not specified in household survey questions. Participants may have been more amenable to a follow-up duration of three years similar to the follow-up used by Stallones and Xiang in Colorado previously (Stallones and Xiang 2003). The lack of participant's willingness to consent to follow-up would be a substantial limiting factor in forming a cohort of family farms in Colorado.

The strengths of this pilot study included partnering with a multi-state farm insurance provider, a novel approach to contacting farm families. Previous agricultural cohorts have used social service intake interviews to enroll migrant workers (Mull, Engel et al. 2001), lists of trucks registered as farm vehicles in motor vehicle records (Stallones and Xiang 2003), and existing farm lists developed by rural municipalities (Pickett, Day et al. 2008). The insurance provider we partnered with has a client base is small family owned and operated farms that are unlikely to have workers compensation insurance and are unlikely to be included in national injury statistics due to the size of their operations. Only eight respondents reported hiring workers (excluding custom workers) for farm work during 2015 and of these only one respondent reported that 10 or more workers were hired. Although all of the 200 farms contacted to participate in this pilot study were actively enrolled as policy holders in Colorado enrolled as of 2015, five addresses were no longer valid and nine households were no longer operating as farms. Family owned and operated farms enrolled with this insurance provider may operate as farms on an itinerant basis or may only sporadically need insurance depending on farm activities for that year limiting our ability to identify farms using this insurance provider.

Despite the novel approach used to approach participants, the feasibility of enrolling a cohort of farmers in Colorado was likely low. Although our participation rate was similar to previous longitudinal studies of farm families, our ability to follow-up on injury status would be severely limited as the majority of those who responded to household surveys would have refused to consent to follow-up limiting our ability to ascertain injury status over time. Thus, we conclude that the approach used in this pilot would not be adequate to enroll a cohort of family farmers in the Rocky Mountain region.

## 14. Occupational Health and Safety of U.S. Farmworkers in the High Plains and Beyond-\$16,516 - 2016-

PI: Anita Pena

### HICAHS Pilot Grant

U.S. Farmworkers in the High Plains and Beyond: What Can We Learn from NAWS about Occupational Health and Safety Risk and Effects on Economic Outcomes?<sup>1</sup> We studied determinants of self-reported diagnosed health conditions and of exposure to health-related risks such as those associated with pesticides and sanitation within the population of U.S. hired farmworkers both nationally and in the High Plains area specifically. We linked these variables econometrically to individual economic outcomes within the confines of available data from the U.S. Department of Labor, Employment and Training Administration's National Agricultural Workers Survey (NAWS). This research has direct relationships to understanding agricultural health and safety as it relates to vulnerable workers in the U.S. and identifies several future research needs. Major findings and project outcomes are as follows.

#### Summary Statistical Analysis:

- the nationally-representative (weighted) proportion of the sample indicating diagnoses of at least one of the health conditions on the survey (at least one of asthma, diabetes, high blood pressure, tuberculosis, heart disease, urinary tract infections, and other conditions) has increased from around 10 percent to around 20 percent from 1999 to 2012
- those with reported health conditions have higher wages on average than those with no reported health conditions within and across the study years; this result is unconditional on the age structure of workers
- the proportion of U.S. farmworkers who indicate exposure to pesticides via loading, mixing, or applying moves from around 10 percent to more than 15 percent over the study period
- there is a sizeable gap in the raw data (not adjusting for worker compositional characteristics) between the average wages of those who are exposed to pesticides (higher) and the average wages of those who report no pesticide exposure (lower)
- access to water to wash hands and access to toilets approaches 100 percent by the end of the survey years that are available in the public use data

#### Multivariate Econometric Analysis:

- a diagnosis of diabetes has a strong negative association with wages both for piece-rate and hourly workers, and also for all workers' wages when we aggregate these payment types (and also include the smaller sample of combination pay and salaried workers)
    - o this magnitude corresponds to about four percent in the full sample and three to four percent in the hourly sample after we have controlled for observable variables
  - pesticide exposure by our definition is associated with approximately six to seven percent higher wages all else equal in both the full sample and the hourly wage subsample
    - o this is consistent with a compensating wage differential story; since we control for differences in crop, task, region, year, and a wide variety of demographic and work-
- <sup>1</sup> This research is supported by a Pilot/Feasibility Grant from the High Plains Intermountain Center for Agricultural Health and Safety (HICAHS).

<sup>2</sup> Associate Professor of Economics, PI and corresponding author, CSU Department of Economics, 1771 Campus Delivery, Fort Collins, CO 80523-1771, [anita.pena@colostate.edu](mailto:anita.pena@colostate.edu). The longer manuscript is coauthored by Edward Teather-Posadas, PhD Student in Economics and Graduate Research Assistant, Colorado State University.

## 15. Characterizing Smoke Exposure and Lung Function in Wildland Firefighters-\$11,880 - 2017-

PI: Ryan Gan

### A. Project Summary

Wildland fires present a significant challenge to public health in the Western U.S. Evolving land management practices and populations moving closer to the wildland-urban interface will increase the need for prescribed burn practices to reduce intensity of future wildfires. The firefighters who administered these prescribed burns are potentially exposed to high levels of smoke, thereby presenting an occupational health concern. Our proposal's overall aim is to address the relationship between smoke exposure and lung function in wildland firefighters who work on the prescribed burn practice known as pile burning. The three specific aims of our proposal are 1) to quantify the amount of smoke exposure firefighters are exposed to, 2) determine the association between smoke exposure and the health outcomes of lung function and inflammation in the same firefighters, and 3) compare lung function and inflammation over time in firefighters who work on pile burning to those who do not work on pile burning.

### B. Study Design and Methods

To address aims 1 and 2 we will recruit 20 wildland firefighters who plan to participate in pile burning activities over the 'shoulder season' starting in November 2016 and ending in February 2017. These firefighters will be routinely sampled throughout the shoulder season for measures of lung function, inflammation, and smoke exposure, which will include breathing zone estimates of black carbon and levoglucosan exposure, and a biomarker urinary levoglucosan. To address aim 3, we will recruit a second group of 20 wildland firefighters who do not plan to participate in pile burning activities over the shoulder season, we will collect pre-post shoulder season measures of lung function and inflammation, which we will compare to the lung function and inflammation of 20 firefighters participating in pile burning. Implications: Our proposal will address two main questions: the utility of breathing zone measures of smoke and urinary levoglucosan to assess smoke exposure, and impact of smoke exposure due to pile burn operations on lung function and inflammation of wildland firefighters.

Project will be completed in Fall 2018.

**16. A novel, Low-Cost method for assessing personal aerosol exposures in real-time-\$20,000 - 2017-**

PI: Christian L'Orange

**A. Abstract, Project Summary, Background, Aims**

Agricultural workers are often exposed to extremely high concentrations of aerosols. The adverse health effects associated with exposure to agricultural dusts is well established. Despite the known detrimental health effects these agricultural workers experience, reliably establishing when and where these workers are exposed remains challenging. One factor contributing to this challenge is a lack of reliable and economic devices for quantifying real-time aerosol concentrations.

The objective of this study is to evaluate a novel approach to measuring aerosol concentrations. The proposed Concentration via Pressure (CVP) device takes advantage of the approximately linear relationship between filter loading and differential pressure across that filter. Preliminary laboratory testing has help establish confidence in the proposed approach. The accuracy and repeatability of the proposed method as well as the efficiency of the approach in a field setting will be evaluated.

The study will evaluate the proposed method through a combination of laboratory testing and field studies at a dairy in northern Colorado. The study leverages an ongoing study at the field site. The first aim of the study is to configure proof-of-concept samplers and establish metrics of performance including accuracy, precision, and limits of detection. The second aim will evaluate the efficacy of the proposed approach by comparing the device to instruments commonly used to assess occupational exposure. A total of 40 paired samples will be collected in multiple locations in a Colorado dairy. The samplers will be placed in a range of locations representative of the main working environments found in a dairy. The proposed study will evaluate the potential for future applications and deployments of the novel sensor, such as personal exposure assessment, evaluation of sufficient sample collection prior to secondary analysis, and ultimately in reducing workers exposure to harmful pollutants by implementation of exposure mitigation steps.

Project will be completed in Fall 2018.

**17. Role of agricultural dust exposures on lung resident mesenchymal stem/stromal cell function-  
\$20,000 - 2017-**

PI: Tara Nordgren

**A. Abstract, Background, Aims, and Methods**

Agricultural organic dust exposures trigger harmful airway inflammation, and workers experiencing repetitive dust exposures are at increased risk for lung disease. Mesenchymal stem/stromal cells regulate wound repair processes in the lung, and may contribute to either pro-resolution or pro-fibrotic lung responses. It is unknown how organic dust exposures alter MSC functioning, and how dust-mediated MSC activation alters MSC-mediated wound repair programs in the lung. We hypothesize that *agricultural exposures promote pro-inflammatory responses in lung-resident mesenchymal stem/stromal cells that augments epithelial repair programs*. Using primary-isolated human lung-resident MSC, our proposed investigations will define how swine confinement facility-derived organic dust exposures polarize lung-resident MSC activation status. Specific Aim 1- Furthermore, we will determine the role of organic dust-mediated FGF10 signaling in mesenchymal-epithelial wound repair processes.

Specific Aim 2- Together, these investigations will identify how lung-resident MSC activation and wound repair activities are altered by swine CAFO dust exposures.

These pilot investigations will provide critical preliminary support for an R-series grant through the NIEHS to investigate the role of organic dust exposures on lung-resident MSC activation and function. The long-term goal of these investigations is to identify how agricultural exposures alter lung wound repair/remodeling processes to identify opportunities for improved prevention, intervention and care of CAFO workers.

# Outreach Program

Lorann Stallones (PI)

Noa Roman-Muniz (Co-Investigator)

Allison Cassidy (Coordinator)

## Summary

The High Plains Intermountain Center for Agricultural Health and Safety (HICAHS) serves Public Health Service (PHS) Region 8 (Utah, Wyoming, Montana, Colorado and the Dakotas), whose agriculture is largely defined by its unique western climate and geography. It is also important to understand the unique combination of characteristics that PHS Region 8 represents including agricultural characteristics of both the Midwest and the West, including differences in production agriculture ranging from the field crops, beef and dairy cattle of the great plains to the orchards and truck farming of the far west. Outreach within HICAHS involves providing technical assistance, consultation, educational materials, and training activities that engage external constituencies. The HICAHS outreach program has played a crucial role in providing information and tools to promote a safer and healthier work environment in agriculture and expanded its role to include forestry during the past six years.

## A. Specific Aims

- 1) To engage with the network of state, regional, local and community partners who can expand use of educational materials, training programs and evidence based interventions including developing a regional directory of resources;
- 2) To establish a regional Dairy Health and Safety Network for dissemination of knowledge and a Dairy Advisory Board to identify and prioritize dairy farm workers health needs, and to identify resources, expertise, and strategies to address these needs;
- 3) To continue to use culturally appropriate educational and training materials related to agricultural and forestry safety and health issues;
- 4) To provide information to the Farm & Ranch eXtension in Safety & Health (FReSH) website and review blogs on topics reflecting HICAHS expertise as requested (this Aim has been modified);
- 5) To continue to participate in conferences/workshops and to develop conferences/workshops related to agricultural and forestry safety and health issues.

## Outputs and Outcomes

### 2011-2016 Outreach Specific Aims

**Specific Aim 1: Expanding connections:** A list of regional resources was developed and made available on the HICAHS website.

At the **Colorado Farm Bureau's** 2011 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. 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,

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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. Ms. Allison Cassidy has actively participated in the Colorado American Agri-Women conference calls.

**ECO Group Activities**

HICAHS has greatly increased the quality and frequency of collaboration with the other NIOSH-Sponsored Agricultural Safety and Health Centers through the Evaluators, Coordinators, and Outreach (ECO) personnel group, which is a cross-center forum to share program methods and expertise and peer mentoring to new personnel and all ten U.S. Agricultural Safety and Health (AFF) centers. In November 2012, Allison Cassidy founded this group with Diane Kampa, Coordinator of the Upper Midwest Center for Agricultural Safety and Health, and Julie Rainwater, Evaluation Director at the Western Center for Agricultural Safety and Health. These three woman organized the first ECO meeting in Minneapolis in October 2012 to discuss common evaluation metrics across the centers. Ms. Cassidy created an email listserv ([nioshagcenters-eco@lists.colostate.edu](mailto:nioshagcenters-eco@lists.colostate.edu)) and corresponding conference calls through which information is shared. Best practices for Ag Center Evaluation became one of the first topics. The listserv now has 62 members as of September 2017. Through ECO, AFF Centers share approaches to evaluation and outreach; and collaborate on priorities, challenges and opportunities. Recent training sessions included Altmetrics (Feb 2017), Social Media Analytics (May 2017), Contribution Analysis (June 2017), and Cost Analysis for Evaluation (August 2017). The ECO group operates under rotating leadership; Allison Cassidy is leading the calls beginning August 2017.

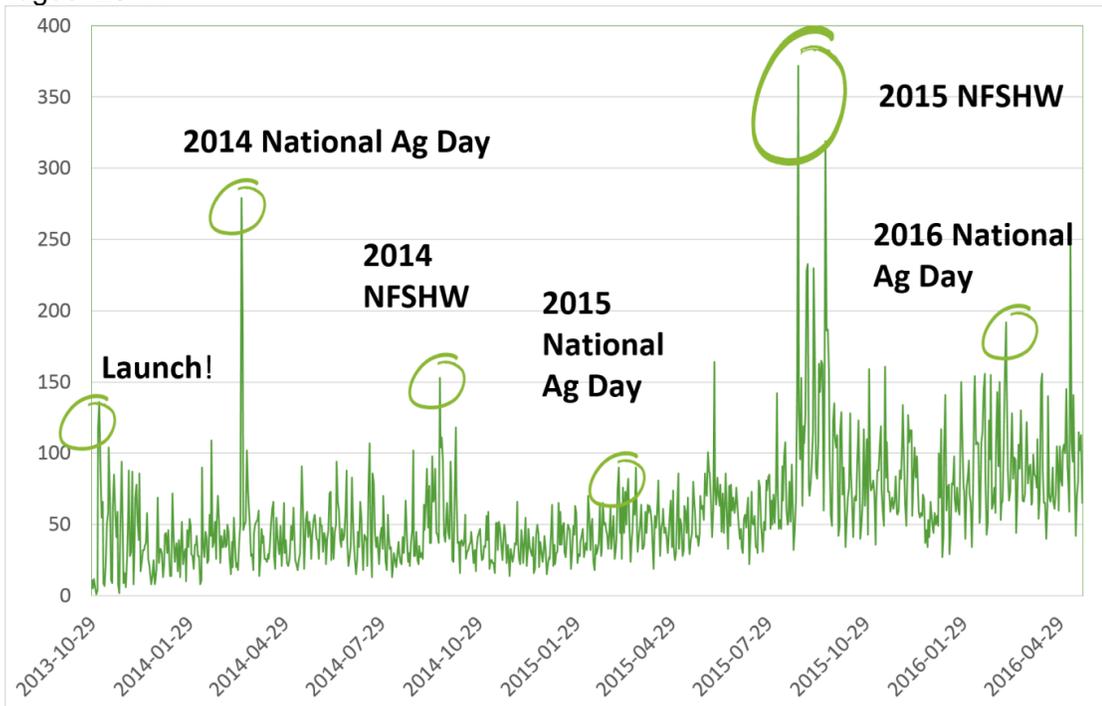


Figure 1. YouTube Video Views. Each Awareness Event has resulted in a spike in video viewership. Average views have doubled from 44 views per day in 2013 to **88 views per day** in 2016.

On November 4, 2013, the Ag Centers ECO group launched a joint YouTube channel to promote their videos on agricultural health and safety ([www.youtube.com/usagcenters](http://www.youtube.com/usagcenters)). Artwork was created for the channel, which subsequently became the official logo to represent the Ag Centers nationwide. The development of the YouTube channel was led by Allison Cassidy and Amanda Wickman, with many creative ideas and assistance provided from personnel in all the Ag Centers. The YouTube channel surpassed 100 videos in August 2017. The videos on the channel have had over 120,000 views, 265,000 minutes watched, and 597 subscribers.

Diane Kampa initiated “Awareness Campaigns” for the Ag Centers beginning in 2014. Each awareness campaign drives more viewers to the YouTube videos. In addition, AFF and non-AFF resources for agricultural health and safety are promoted. The awareness campaigns are centered around national events that coincide with our messages. The following events have been promoted: National Farm Safety and Health Week in 2014, 2015, 2016, and 2017, National Ag Day in 2015 and 2016, and Ag Safety Awareness Program Week in 2017. Figure 1 above illustrates the effect that these campaigns have on viewership of the Ag Center videos. This graph is part of a poster presentation that Ms. Cassidy presented at the 2016 International Society for Agricultural Safety and Health Meeting.

**Specific Aim 2: Networking activities:** We communicated with the Dairy Advisory Board and Network members frequently by email and phone since September 2011. A number of action items were developed at the initial meeting and refined in subsequent communications. The International Dairy Research Consortium (IDRC), led by Dr. Stephen Reynolds, increased membership and continued meeting at International Agricultural/Dairy Conferences. The Consortium completed a series of articles related to international dairy health and safety issues and published in a dedicated issue of the Journal of Agromedicine. Ms. Cassidy actively participated in a group that includes the evaluation and outreach professionals from the NIOSH funded Agricultural Safety and Health Centers that has been actively engaged in collecting materials that have been developed and provide them on a YouTube channel for wide dissemination ([www.youtube.com/usagcenters](http://www.youtube.com/usagcenters)).

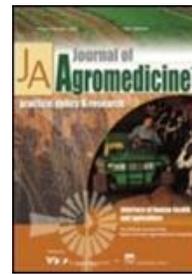
**Specific Aim 3: Use culturally appropriate educational and training materials related to agricultural and forestry safety and health issues:**

In order to enhance the communication and outreach program of HICAHS we have developed a formal HICAHS Strategic Communication Plan which details specific messages and target audiences as well as identifying the themes and communication channels we can use to reach target audiences. In April 2015,

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## Journal of Agromedicine

Volume 18, Issue 3,  
2013

**Special Issue: A Global Perspective on Modern Dairy: Occupational Health and Safety Challenges and Opportunities**

- 1) [International Dairy Health and Safety](#)
- 2) [Occupational Health in the Dairy Industry Needs to Focus on Immigrant Workers, the New Normal](#)
- 3) [The Dairy Industry: A Brief Description of Production Practices, Trends, and Farm Characteristics Around the World](#)
- 4) [Ergonomics in Modern Dairy Practice: A Review of Current Issues and Research Needs](#)
- 5) [Occupational Health and Safety Regulations in the Dairy Industry](#)
- 6) [Systematic Review of Respiratory Health Among Dairy Workers](#)
- 7) [International Perspectives on Psychosocial Working Conditions, Mental Health, and Stress of Dairy Farm Operators](#)
- 8) [Work-Related Injuries and Fatalities on Dairy Farm Operations—A Global Perspective](#)
- 9) [A Review of Health and Safety Leadership and Managerial Practices on Modern Dairy Farms](#)
- 10) [Occupational Health and Safety Aspects of Animal Handling in Dairy Production](#)

Download the entire issue at

<http://www.tandfonline.com/toc/wagr20/18/3>

Dr. David Douphrate with the assistance from other HICAHS researchers, has written a regular column on health and safety issues in the *Progressive Dairyman*, one of the leading publications on the dairy industry with a circulation on 27,789.

HICAHS began a newsletter on agricultural safety and health topics. The first newsletter highlighted the work on the emergence and transmission of antimicrobial resistance, which was emailed to over 240 people. The contact list that Ms. Cassidy developed over the previous four years was used as the contact list for the newsletter. Through additional promotional campaigns led by Ms. Cassidy, including an invitation to ISASH members, the list has grown to 355 subscribers. As of September 2017, the average open rate of a newsletter is 28%. Visit [www.hicahs.colostate.edu/outreach.html](http://www.hicahs.colostate.edu/outreach.html) to read and subscribe to the newsletter.

**Table 1. List of HICAHS newsletter topics**

03/28/2017 - Livestock Handling Safety
03/08/2017 - participate in Ag Safety Awareness Week
05/03/2016 - Do YOU have a plan for your pets when disaster strikes?
04/13/2016 - REVISION: SAY What? New Ag Resources!
03/21/2016 - SAY What? New Ag Resources!
02/15/2016 - HICAHS Collaborations Provide Avenues for Partnership
12/15/2015 - A FReSH Look at Ag Research
11/12/2015 - Do you know how to handle pesticides this winter?
10/15/2015 - Make Your Tractor Safer With ROPS!
09/15/2015 - Do you know ATV safety rules in your state?
04/30/2015 - Emerging Issues in Antimicrobial Resistance

# PROGRESSIVE DAIRYMAN

**Progressive Dairyman Series by David Douphrate and HICAHS Researchers**

[www.progressivedairy.com](http://www.progressivedairy.com)

**January 2013:** [Dairy worker safety and health: A new column from David Douphrate](#)

**February 2013:** [OSHA inspections, citations and penalties](#)

**March 2013:** [Injury and illness recordkeeping](#)

**April 2013:** [Chemical hazard communication](#)

**May 2013:** [Tractor safety on dairy farms](#)

**June 2013:** [Manure pit safety](#)

**July 2013:** [Respiratory protections](#)

**August 2013:** [Heat stress 2013: Bad for dairy cows and the people who care for them](#)

**September 2013:** [ATV safety](#)

**October 2013:** [Dairy worker safety training](#)

**November 2013:** [Dairy worker safety in cold environments](#)

**December 2013:** [Vaccination Safety](#)

**January 2014:** [Shiftwork on dairy farms: Worker health and safety considerations](#)

**February 2014:** [Silage safety](#)

**March 2014:** [Open-air manure storage safety](#)

**April 2014:** [Workplace violence on dairy farms](#)

**May 2014:** [What are zoonotic diseases? \(Part 1 of 2\)](#)

**May 2014:** [Preventing zoonotic disease on the dairy \(Part 2 of 2\)](#)

**August 2014:** [Emergency preparedness on dairy farms](#)

**December 2014:** [HICAHS requests feedback for safety management training programs](#)

**December 2014:** [Safety management on dairy farms: Owner and manager commitment](#)

**February 2015:** [Safety management: Employee participation and accountability](#)

**July 2015:** [Using mobile devices to offer safety training to dairy workers](#)

John Rosecrance was a leader in the development of a special issue in the Journal *Frontiers in Public Health*, an open access journal. There were 10 manuscripts developed with 32 authors (Table 3).

**Table 3. Frontier in Public Health Special Issue: “International Perspectives on Health and Safety among Dairy Workers: Challenges, Solutions and the Future”**

<http://journal.frontiersin.org/researchtopic/4224/>

1. A Guide to the Design of Occupational Safety and Health Training for Immigrant, Latino/a Dairy Workers
2. Dairy Tool Box Talks: A Comprehensive Worker Training in Dairy Farming
3. Occupational Health and Safety of Finnish Dairy Farmers Using Automatic Milking Systems
4. Comparison of Upper Limb Muscle Activity among Workers in Large-Herd U.S. and Small-Herd Italian Dairies
5. Awareness and Need for Knowledge of Health and Safety among Dairy Farmers Interviewed in Uganda
6. Upper Limb Muscle Activity among Workers in Large-Herd Industrialized Dairy Operations
7. The Roles of Financial Threat, Social Support, Work Stress, and Mental Distress in Dairy Farmers' Expectations of Injury
8. Perceptions of Health and Safety among Immigrant Latino/a Dairy Workers in the U.S.
9. Online Design Aid for Evaluating Manure Pit Ventilation Systems to Reduce Entry Risk
10. Comparison of Working Conditions and Prevalence of Musculoskeletal Symptoms among Dairy Farmers in Southern Sweden over a 25-Year Period

#### **Specific Aim 4: Farm & Ranch eXtension in Safety & Health (FReSH):**

We have begun to work with the Farm and Health Safety Community of Practice which operates through the Cooperative Extension eXtension program. Dr. Stallones serves as the contact person for HICAHS and has been invited to serve on the Leadership Team for the Farm and Health Safety Community of Practice. She is also contacting all other Ag Centers to identify a point of contact for those interested in participating to work together regarding eXtension opportunities such as Ask an Expert, article reviews, and article writing.

Initially, this aim was to provide information about the National Agricultural Safety Database (NASD) to all Partners. However, there were difficulties moving forward due to limited funding available for the support of the NASD nationally.

**Update HICAHS Website:** Ms. Cassidy regularly updates the HICAHS website, which can be viewed at [www.hicahs.colostate.edu](http://www.hicahs.colostate.edu).

#### **Specific Aim 5: Conferences/workshops**

A Workshop on *Research Translation with Vulnerable Worker Populations* with HICAHS support along with MAPERC, CICRC, CPWR and the NIOSH Regional office in Denver took place in 2012. More than 50 people attended from around the world. The Emergence of Antimicrobial Resistance was the topic of the 2014, 6<sup>th</sup> Annual Public Health Symposium at Colorado State University which involved 130 participants representing researchers, students, academics, and agriculturalists with HICAHS as a major supporter for the conference.

## OSHA 10-Hour Training for Dairy Farmers

According to the USDA, the number of dairies with at least 2,000 milk cows doubled between 2000 and 2006. A 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. Dr. Douphrate, with assistance from Ms. Cassidy, provided OSHA 10-Hour training to dairy farmers in Kansas, Texas, New Mexico and Colorado between 2009-2016. Course participants improved their knowledge of OSHA regulations following the trainings. For example, at a training of 12 dairy industry professional in Brookings, South Dakota, participants' test scores improved 28% after the course.

See the outcomes below for a comprehensive list of conferences and workshops attended.

## Publications

### 2016

37. Masci, F., Mixco, A., Brents, C. A., Murgia, L., Colosio, C., & Rosecrance, J. (2016). comparison of Upper limb Muscle activity among Workers in large-herd Us and small-herd italian Dairies. *Frontiers in public health*, 4. [doi: 10.3389/fpubh.2016.00141](https://doi.org/10.3389/fpubh.2016.00141)
38. Masci, F., Tassoni, M., Bossi, M., Magenta Biasina, A., Serrao, G., Rosecrance, J., & Colosio, C. (2016). Assessing the effects of biomechanical overload on dairy parlor workers' wrist: Definition of a study approach and preliminary results. *Work*, 55(4), 747-756. [doi: 10.3233/WOR-162462](https://doi.org/10.3233/WOR-162462)
39. Menger, L. M., Pezzutti, F., Tellechea, T., Stallones, L., Rosecrance, J., & Roman-Muniz, I. N. (2016). Perceptions of Health and Safety among Immigrant Latino/a Dairy Workers in the U.S. *Frontiers in Public Health*, 4, 106. [doi: 10.3389/fpubh.2016.00106](https://doi.org/10.3389/fpubh.2016.00106)
40. Menger, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2016). A Guide to the Design of Occupational Safety and Health Training for Immigrant, Latino/a Dairy Workers. *Frontiers in Public Health*, 4, 282. [doi: 10.3389/fpubh.2016.00282](https://doi.org/10.3389/fpubh.2016.00282)
41. Mixco, A., Masci, F., Brents, C. A., & Rosecrance, J. (2016). Upper limb muscle activity among workers in large-herd industrialized dairy operations. *Frontiers in public health*, 4(134). [doi: 10.3389/fpubh.2016.00134](https://doi.org/10.3389/fpubh.2016.00134)

### 2013

42. Beseler, C. L., & Stallones, L. (2013). Structural equation modeling of pesticide poisoning, depression, safety, and injury. *J Agromedicine*, 18(4), 340-349. [doi: 10.1080/1059924x.2013.826117](https://doi.org/10.1080/1059924x.2013.826117)
43. Douphrate, D. I., Hagevoort, G. R., Nonnenmann, M. W., Lunner Kolstrup, C., Reynolds, S. J., Jakob, M., & Kinsel, M. (2013). The Dairy Industry: A Brief Description of Production Practices, Trends, and Farm Characteristics Around the World. *J Agromedicine*, 18(3), 187-197. [doi: 10.1080/1059924x.2013.796901](https://doi.org/10.1080/1059924x.2013.796901)
44. Douphrate, D. I., Lunner Kolstrup, C., Nonnenmann, M. W., Jakob, M., & Pinzke, S. (2013). Ergonomics in Modern Dairy Practice: A Review of Current Issues and Research Needs. *J Agromedicine*, 18(3), 198-209. [doi: 10.1080/1059924x.2013.796900](https://doi.org/10.1080/1059924x.2013.796900)
45. Douphrate, D. I., Stallones, L., Lunner Kolstrup, C., Nonnenmann, M. W., Pinzke, S., Hagevoort, G. R., Lower, T. (2013). Work-Related Injuries and Fatalities on Dairy Farm Operations—A Global Perspective. *J Agromedicine*, 18(3), 256-264. [doi: 10.1080/1059924x.2013.796904](https://doi.org/10.1080/1059924x.2013.796904)
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### Trade Publications

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35. Douphrate, D., & Bauer, M. (April 9, 2013). Dairy worker safety and health: Chemical hazard communication. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10443:dairy-worker-safety-and-health-chemical-hazard-communication&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10443:dairy-worker-safety-and-health-chemical-hazard-communication&catid=49:management&Itemid=75)
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37. Douphrate, D., Bauer, M., Brazile, W., & Root, K. (February 11, 2013). Dairy worker safety and health: OSHA inspections, citations and penalties. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10210:dairy-worker-safety-and-health-osha-inspections-citations-and-penalties&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10210:dairy-worker-safety-and-health-osha-inspections-citations-and-penalties&catid=49:management&Itemid=75)
38. Douphrate, D., & Hagevoort, R. (January 11, 2013). Dairy worker safety and health: A new column from David Douphrate. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10037:dairy-worker-safety-and-health-a-new-column-from-david-douphrate&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10037:dairy-worker-safety-and-health-a-new-column-from-david-douphrate&catid=49:management&Itemid=75)
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41. Murphy, D., & Douphrate, D. (September 5, 2013). Dairy worker safety and health: ATV safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11160:dairy-worker-safety-and-health-atv-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11160:dairy-worker-safety-and-health-atv-safety&catid=49:management&Itemid=75)
42. Murphy, D., & Douphrate, D. (June 18, 2013). Dairy worker safety and health: Manure pit safety.

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43. Reynolds, S., & Douphrate, D. (July 10, 2013). Dairy worker safety and health: Respiratory protections. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10895:dairy-worker-safety-and-health-respiratory-protections&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10895:dairy-worker-safety-and-health-respiratory-protections&catid=49:management&Itemid=75)
  44. Roman-Muniz, N., & Douphrate, D. (December 17, 2013). Dairy worker safety and health: Vaccination Safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75)
  45. Douphrate, D. (2011, June). Dairy Farm Safety and OSHA--Approaches for Effective Management and Worker Training. *Utah State University Dairy Extension Newsletter*, 34.
  46. Douphrate, D. (August, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/august-2011-2.pdf>
  47. Douphrate, D. (September, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/september-2011.pdf>

### Audiovisual Products

6. The r2p ATV safety project with Montana Extension has led to the development of 6 high quality videos which are available on the U.S. Agricultural Safety and Health Centers YouTube channel: [www.youtube.com/usagcenters](http://www.youtube.com/usagcenters).
7. Cassidy, A. (2014). December Calendar Page: Childproof for Poison Prevention. *2015 Childhood Agricultural Safety Network Calendar*. Marshfield, WI: National Children's Center for Rural and Agricultural Health.
8. DeVries, A. (2013). June Submission on ATV Safety: Don't let your child become a statistic... *2014 Childhood Agricultural Safety Network Calendar*. Marshfield, WI: National Children's Center for Rural and Agricultural Health.
9. DeVries, A. (2011). Respiratory Illness in Farmers: Information, Diagnosis, and Prevention Tri-Fold Flyer. Fort Collins, CO: The High Plains Intermountain Center for Agricultural Health and Safety.

### Conference Papers, Presentations, Abstracts

#### 2017

87. Cassidy, A., Wickman, A., & Duysen, E. (June 25-29, 2017). *Developing Agricultural Safety and Health Awareness Campaigns*. Poster presentation at the International Society for Agricultural Safety and Health Conference, Logan, UT.
88. Cassidy, A., Brooks, E., & Rodriguez, A. (June 25-29, 2017). International Society for Agricultural Safety and Health Conference, Aurora, CO.  
*We staffed a booth with informational brochures about HICAHS.*
89. Quijano, L. M., & Cassidy, A. (February 22, 2017). Governor's Agricultural Forum on Colorado Agriculture, Aurora, CO.  
*Dr. Quijano and Ms. Cassidy represented HICAHS.*

#### 2016

90. Douphrate, D. (November 7-8 2016). *Dairy safety management: current situation, challenges, and solutions*. Invited Presenter at the Washington State Dairy Safety Conference, Ellensburg, WA.
91. Douphrate, D. (June 20-23, 2016). *Full-shift and task-specific ergonomic exposure assessment of posture and muscle activity among dairy parlor workers in US large herd operations*. Presentation at

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the Ninth International Conference on Prevention of Work-Related Musculoskeletal Disorders (PREMUS), Toronto, Canada.

92. Douphrate, D. (May 25-26, 2016). *Dairy worker health and safety*. Invited Presenter at the Washington Department of Safety and Health Technical Symposium, Wenatchee, WA.
93. Douphrate, D. (March 1-2, 2016). *On-farm risk management and safety on dairy farms: Regulatory requirements and planning*. Presentation at the High Plains Dairy Conference, Lubbock, TX.
94. Douphrate, D. (February 24, 2016). *Worker health and safety on US dairies*. Invited lecture to the Governor's Agricultural Safety Day, Wenatchee, WA.

## 2015

95. Cassidy, A. (August 5, 2016). *Tractor Rollover Fatality Prevention*. Governor's Ag Safety Coalition of Wyoming, Douglas, WY.
96. Cassidy, A. (June 24, 2015). *Collaboration to create a joint YouTube channel*. Presentation at the International Society for Agricultural Safety and Health (ISASH) Conference, Omaha, NE.
97. Douphrate, D. (October 29-30, 2015). *Musculoskeletal diseases and ergonomics in agriculture*. Texas Rural Health Association, Agromedicine Workshop, Fort Worth, TX.
98. Douphrate, D. (October 29-30, 2015). *Acute agricultural injuries*. Texas Rural Health Association, Agromedicine Workshop, Fort Worth, TX.
99. Douphrate, D. (May 30-June 4, 2015). Interventions to reduce exposure to physical risk factors for musculoskeletal disorders among dairy parlor workers. American Industrial Hygiene Conference and Exposition (AIHce), Salt Lake City, UT.
100. Douphrate, D., & Hagevoort, G. R. (October 1, 2015). *Safety performance on dairy farms*. Presented at the World Dairy Expo, Madison, WI.
101. Douphrate, D., Reynolds, S. J., Hagevoort, R., Lunner Kolstrup, C., Kolb, P., & Cassidy, A. (September 27-28, 2015). *International Dairy Safety Short Course*. Invited lecture to delegations from Pakistan and China, University of Wisconsin - River Falls, WI.
102. Douphrate, D., & Reynolds, S. J. (September 18, 2015). *Successful Strides with Dairy Workers*. Presented at the Western States Occupational Network (WestON), Denver, CO.
103. Douphrate, D. (March 1-2, 2015). *On-farm risk management and safety on dairy farms: Regulatory requirements and planning*. Presented at the High Plains Dairy Conference, Lubbock, TX.
104. Douphrate, D. (February 18-19, 2015). *Safety training using mobile learning technologies on large herd dairy operations*. Presented at the OSHA Susan Harwood Trainer Exchange Conference, Washington, D.C.
105. Noa Roman-Muniz. (December, 2015). "Multicultural Management Workshop." Two-day workshop presented for Professional Dairy Producers of Wisconsin. Green Bay, WI.
106. Noa Roman-Muniz. (October, 2015). *Cultural and Language Barriers to Effective Communication in CO Livestock Operations*. Presentation and panel discussion Immigration and Agriculture: A One Health Approach, Fort Collins, CO.
107. Murgia, L., Rosecrance, J., & Paulsen, R. (September 9, 2015). *Ergonomic issues and musculoskeletal disorders among ewe dairy workers involved in mechanical milking*. International Congress on Rural Health, Milan, Italy.
108. Reynolds, S. J., & Hagevoort, R. (March 31, 2015). *Impact of Aerosols on Respiratory Health of Dairy Workers and Residents Living Near Dairies: Discussion and Implications of Recent Research*. Presentation at the Livestock and Poultry Environmental Learning Center's Waste to Worth Conference, Seattle, WA. <https://etouches.com/ehome/85805>
109. Roman-Muniz, I. N., Rosecrance, J., Menger, L., Pezzutti, F., Stallones, L., & Amaya, F. (September 9, 2015). *Dairy Worker Safety Training: Current Challenges and Opportunities for Enhanced Effectiveness*. International Congress on Rural Health, Milan, Italy.
110. Roman-Muniz, I.N. (2015). Dairy Issues: Welfare and Dairy Beef Quality. Presentation at the North American Meat Institute Animal Care and Handling Conference, Kansas City, MO.
111. Rosecrance, J., & Brumby, S. (September 9, 2015). *Dairy Symposium Chairs: International Perspectives on Health and Safety among Dairy Workers: Challenges, Solutions & the Future*.

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International Congress on Rural Health, Milan, Italy.

112. Rosecrance, J., & Murgia, L. (September 9, 2015). *Manually milking ewes and the risk of carpal tunnel syndrome*. International Congress on Rural Health, Milan, Italy.
113. Rosecrance, J. (September 9, 2015). *Symposium Chair: WMSDs and Occupational Health*. International Congress on Rural Health, Milan, Italy.
114. Schaeffer, J. (September 9, 2015). *Large Particle Exposures and Attendant Health Effects among Dairy Workers: Progress and Future Directions*. International Congress on Rural Health, Milan, Italy.
115. VanDyke, A., Reynolds, S.J., Davidson, M., Schaeffer, J., Bisha, B., & Delton-Hanson, J. (June 3, 2015). *Effect of Environmental Conditions on Bacterial and Fungal Communities in Dairy Parlors through Pyrosequencing, Riboprinting, and Microscopic Analysis Techniques*. Poster presentation at the AIHCE, Salt Lake City, UT.

## 2014

116. Buchan, V., Quijano, L., & Cassidy, A. (September 23, 2014). *HICAHS Evaluation Project*. NIOSH Site Visit, Fort Collins, CO.
117. Buchan, V., & Quijano, L. M. (October 20, 2014). *Future Focus: What Are Our Constituencies Telling Us?* Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
118. Buchan, V., & Quijano, L. M. (October 15-18, 2014). *Multilevel Evaluation of a Federally Funded Center for Occupational Health and Safety*. Presentation at the 28th Annual Conference of the American Evaluation Association: Visionary Evaluation for a Sustainable, Equitable Future, Denver, CO.
119. Cassidy, A. (June 26, 2014). *Professional Improvement Workshop - Information Technology: YouTube and Other Google Products*. Presentation at the International Society for Agricultural Safety and Health (ISASH) Conference, Omaha, NE.
120. Cassidy, A., & Cheyney, M. (November 19, 2014). *U.S. Agricultural Safety and Health Centers YouTube Channel*. Presentation at the Transforming Safety and Health in the Heartland: 13th Annual Midwest Rural Agricultural Safety & Health Conference in conjunction with the Iowa Rural Health Association's Fall Meeting, Ankeny, IA. <http://cph.uiowa.edu/icash/events/MRASH-IRHA/2014/>
121. Douphrate, D. (November 20-22, 2014). *Worker health and safety on U.S. Dairy Farms*. Presented at the 24th Annual Midwest Stream Farmworker Health Forum, San Antonio, TX.
122. Douphrate, D., Gimeno, D., Nonnenmann, M., Hagevoort, R., Rosecrance, J., & S.J., R. (October 19-22, 2014). *Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
123. Douphrate, D., Fethke, N., Hagevoort, G. R., Nonnenmann, M., Gimeno, D., Marshall, A., . . . Reynolds, S. J. (October 19-22, 2014). *Task-specific and full-shift sampling of upper extremity muscle activity among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
124. Douphrate, D.I., Gimeno, D., Nonnenmann, M., Hagevoort, R., Rosas-Goulart, C., Rosecrance, J., & Reynolds, S. (August 25-27, 2014). *Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Finnish Institute of Occupational Health (FIOH) and Farmers' Social Insurance Institution (Mela), Porvoo, Finland. [http://www.ttl.fi/partner/nmaohs/programme/Documents/Programme\\_NMAOHS%202014\\_14Aug2014\\_web.pdf](http://www.ttl.fi/partner/nmaohs/programme/Documents/Programme_NMAOHS%202014_14Aug2014_web.pdf).

## 2013

125. DeVries, A. (October 4, 2013). *Outreach update from ASHCA*. Presentation at the NIOSH Extramural Center Directors Meeting, Anschutz Medical Campus, Aurora, CO.

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126. DeVries, A. (2013). *Farm MAPPER for Colorado*. Presentation at the Colorado Livestock Association Safety Meeting, Embassy Suites, Loveland, CO. <http://coloradolivestock.org/>
127. Douphrate, D. (September 25-27, 2013). *Milking parlor ergonomics on US large herd dairies*. North American Agricultural Safety Summit, Minneapolis, MN.
128. Douphrate, D. (September 26, 2013). *Dairy Equipment Innovations*. Panel Presentation at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
129. Douphrate, D. (March 28, 2013). *Managing worker safety, productivity, and regulatory issues*. Presentation at the Southern Great Plains Dairy Consortium Annual Meeting, Grapevine, TX.
130. Douphrate, D. (June 17-18, 2013). *Dairy farm safety and leadership*. Southern Great Plains Dairy Consortium Teaching: Advanced Dairy Herd Management, Clovis, NM.
131. Douphrate, D., Keifer, M., Liebman, A., Carrabba, J., Hagevoort, R., Grafft, L., & Reynolds, S. J. (June 23-27, 2013). *Assisting the dairy industry to optimize worker health and safety*. Expert Panel Presentation at the International Society of Agricultural Safety and Health Annual (ISASH) Conference: Exploring the shores of safety and health, Sandusky, OH.
132. Douphrate, D., & Levin, J. (April 24-27, 2013). *Ergonomic considerations in logging operations*. Presentation at the Four-State Forestry on the Grow Conference, Texarkana, TX.
133. Stallones, L. (August 7-9, 2013). *Consumer attitudes*. Presentation at the Ranching for Profit Summit-Wheels of Change, Laramie, Wyoming.
134. Stallones, L. (August 7-9, 2013). *Obesity, diet and disease*. Presentation at the Ranching for Profit Summit-Wheels of Change, Laramie, Wyoming.

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135. Douphrate, D. (September 28-30, 2012). *Upper extremity hazards and solutions in large herd parlor milking*. Presentation at the Agricultural Safety and Health: Focus on Dairy Conference, Palmerston North, New Zealand. Conference agenda retrieved from <http://www.conference.co.nz/worldsafety2012/agriculturalsafetyhealth>
136. Douphrate, D., & Rosecrance, J. (September 3-6, 2012). *Ergonomic exposure assessment of posture and muscle activity among dairy parlor workers in U.S. large herd operations*. Paper presented at the International Conference on Safety, Health and Welfare in Agriculture and Agro-food Systems--Ragusa SHWA, Ragusa Ibla Campus- Italy.
137. Douphrate, D., Rosecrance, J., & Reynolds, S. J. (August 27-29, 2012). *Ergonomic exposures of posture and muscle activity among U.S. large herd dairy parlor workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Ystad, Sweden.
138. Stallones, L. (September, 2012). *Global perspectives in agricultural injury prevention*. Presentation at the American College of Epidemiology Annual Meeting, Chicago, IL.

## 2011

139. DeVries, A. (March 9, 2011). *Colorado Agri-Women Presentation*. Presentation at the Colorado Agri-Women Annual Meeting, Denver, CO.
140. Ayers, P., Bozdech, G., Freeman, J., Reid, A., & O'kins, J. (2011). *Development of a dynamic visco-elastic vehicle-soil interaction model for rut depth, energy and power determinations*. Presentation at the 17th International Conference of the International Society for Terrain-Vehicle Systems, Blacksburg, VA.
141. Clark, M. L., Bachand, A., Heiderscheidt, J. M., Diaz-Sanchez, D., Luna, B., Volckens, J., . . . Neas, L. (September 13-16, 2011). *Impact of an indoor cook stove intervention on measures of systemic inflammation*. Presented at the ISEE, Barcelona, Spain.
142. Clark, M. L., Reynolds, S. J., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. A. (September, 2011). *Endotoxin exposure, TLR4 mutations, smoking and work-related behaviors: pulmonary function deficits among potentially susceptible subgroups of agricultural workers in Colorado and Nebraska*. Presented at the ISEE.
143. DeVries, A. (April 5, 2011). *Colorado Dairy Women Presentation*. Presentation at the Colorado Dairy Women Meeting, Eaton, CO.

144. DeVries, A. (August 17, 2011). *Respiratory Illness and Farming*. Presentation at the 2011 Irrigation Research Foundation Farm Show, Yuma, CO.
145. DeVries, A. (November 19, 2011). *About HICAHS*. Presentation at the 93rd Annual Meeting of the Colorado Farm Bureau, Denver, CO.
146. Douphrate, D. (December 7-8, 2011). *Incorporating worker safety into daily farm management activities*. refereed conference proceedings Presented at the 2011 Dairy Summit, Wisconsin Dells, WI.
147. Douphrate, D. (April 5-6, 2011). *Dairy farm safety and OSHA--Approaches for effective management and worker training*. Presented at the Dairy Calf & Heifer Association Annual Conference, Lake Geneva, Wisconsin.
148. Douphrate, D., Rosecrance, J., & Reynolds, S. J. (August 22-24, 2011). *Musculoskeletal symptoms and physical exposures among U.S. large-herd milking parlor workers*. refereed conference proceedings Presented at the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.

### Cumulative Enrollment Table

No human research was conducted as part of the Outreach Program, therefore there are no enrollment tables to provide.

# Research Core

Stephen J. Reynolds (Core Director)

Bioaerosol Exposures and Models of Human Response in Dairies and Cattle Feedlots (R01)

Stephen J. Reynolds (PI)

Exploring Shed Antimicrobial Exposures within High Plains Livestock Operations (R21)

Paul Gunderson (PI)

# Bioaerosol Exposures and Models of Human Response in Dairies

Stephen J. Reynolds (PI), John Volckens (Co-I), Jill Poole (Co-I), Bledar Bisha (Co-I), Joshua Schaefer (Co-I), Sheryl Magzamen (Co-I), Thomas Keefe (Co-I)

## Summary

### A. Abstract

Respiratory diseases, including chronic bronchitis and occupational asthma, are a significant problem among dairy workers, contributing to high employee turnover, decreased productivity, and higher worker compensation costs. The objectives of this research were to apply powerful new tools to better understand bioaerosols in dairies 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. Particulate matter emissions from agricultural livestock operations contain both chemical and biological constituents that represent a potential human health hazard. The size and composition of these dusts, however, have not been well described. For Aim 1 we evaluated the full size distribution (from 0 to 100  $\mu\text{m}$  in aerodynamic diameter) and chemical/biological composition of inhalable dusts inside five western US dairy parlors using a novel hi-volume impactor and next generation sequencing for relevant microorganisms. Bacterial genera comprised by the next-generation analyses included *Staphylococcus* spp., *Pseudomonas* spp, and *Streptococcus* spp., all of which contain species with pro-inflammatory potential and can be manifested as pathogenic or opportunistic pathogenic. Our results demonstrated that the size-distribution of bioaerosols emitted by dairy operations extends well above 10  $\mu\text{m}$  in diameter and contains a diverse mixture of potentially hazardous constituents and opportunistic pathogens. One paper was published. For Aim 2 we exposed well-differentiated normal human bronchial epithelial cells and normal human nasal epithelial cells to two different size fractions ( $\text{PM}_{10}$  and  $\text{PM}_{>10}$ ) of re-aerosolized dairy parlor dust using a novel aerosol-to-cell exposure system. Our results suggest that both  $\text{PM}_{10}$  and  $\text{PM}_{>10}$  size fractions elicit a pro-inflammatory response in airway epithelial cells and that the entire inhalable size fraction should be considered when assessing potential risks from exposure to agricultural dusts. Further, our results suggest that human bronchial cells respond differently to these dusts than human nasal cells and, therefore, the two cell types should be considered separately in airway cell models of agricultural dust toxicity. To our knowledge, this is the first study to evaluate the effects of distinct size fractions of agricultural dust on human airway epithelial cells. For Aim 3 lung function testing (pre and post shift work), blood, tissue and dust exposure sampling were undertaken on repeated personal sampling sessions with 21 dairy workers. All but one participant were Hispanic males ranging from 20 – 50 years in age. The mild mean decreases in cross-shift FVC and FEV1 are consistent with our prior findings among dairy workers, and there is a wide variation among individuals. Evaluation of nasal markers of inflammation using Rhinoprobes was not well received by subjects and not successful (not quantifiable). Further cell studies are in progress to evaluate the physiological relevance of direct particle-to-cell deposition of re-aerosolized dairy parlor  $\text{PM}_{10}$  (using an air-liquid interface model) as compared to a traditional *in vitro* model (i.e. submerged in medium). We aim to improve our understanding of inflammatory mechanisms involved in bioaerosol exposure-response outcomes. Overall, This project has been instrumental in developing better tools for understanding agricultural lung disease and has provided data to help develop and evaluate effective interventions. This study has also provided a first step in understanding upper respiratory injury from exposure to larger particles in the agricultural workplace. Potentially this project could help improve the respiratory health of 100,000 workers in U.S. dairies, reducing medical and workers' compensation costs, reducing employee turnover, and improving productivity. The project has broad implications for reducing exposures to inflammatory aerosols in a wide range of agricultural and other industries. Results of this project have led to the development and deployment of an intervention study evaluating the effectiveness of strategies to reduce bioaerosol exposures (bedding material additive) and health effects (nasal rinse).

## B. Background

Exposure to organic dusts is associated with increased respiratory morbidity and mortality in agricultural workers. Dairy workers, in particular, have elevated risks for negative respiratory outcomes. Organic dusts in dairy farm environments are complex, polydispersed mixtures of toxic and immunogenic compounds. Previous toxicological studies have focused primarily on exposures to the respirable size fraction however, organic dusts in dairy farm environments are known to contain larger particles above 10  $\mu\text{m}$  in diameter. Such larger particles tend to deposit in the upper airways; thus, the nasal and bronchial epithelia represent targets of agricultural dust exposures. This work is novel because standard particle sizing equipment has an upper limit of 10-20  $\mu\text{m}$ ; very few instruments exist to collect or size-segregate aerosols in the inhalable range (1-100  $\mu\text{m}$ ). In addition, while it is clear that exposure to dusts containing endotoxins from the cell walls of gram-negative bacteria plays an important role in respiratory disease among workers in dairy and other agricultural settings, recent studies using new genetic techniques has shown that bioaerosols in dairies, swine, and poultry environments are dominated by an incredibly diverse population of Gram-positive bacteria. In laboratory studies, we have demonstrated that agricultural dusts containing these Gram-positive bacteria also contribute to inflammation of human lung cells. These types of cell studies have traditionally used settled dusts and dust extracts, not aerosols which are more relevant for human exposures. 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.

## C. Aims

Aim 1: Characterize the biologically active constituents of agricultural aerosols in four dairies over four seasons, focusing on Gram-positive bacteria and muramic acid.

Aim 2: Evaluate the performance of a novel aerosol sampler (incorporating normal human bronchial epithelial cells) in comparison to a traditional in vitro model of bioaerosol toxicity in the lung (incorporating the same cells grown in a submerged culture).

Aim 3: Evaluate the relevance of the aerosol sampler and submerged cell culture model to human health (immune response and cross-shift pulmonary function).

## D. Methods

Aim 1: *Sampling* Four Colorado dairies representative of large-herd operations (i.e., at least 1,000 lactating cows) were recruited to participate. Two operations employed a parallel milking parlor design while the third operation used a rotary configuration. Samples were collected over four different campaigns at each dairy (n=12 days) to represent fall, winter, spring, and summer seasons. The IESL v2 cascade impactor was modified from its original design for atmospheric sampling to segregate airborne dust into four aerodynamic size fractions: >30, 10-30, 3-10, and <3  $\mu\text{m}$  that could potentially deposit in the pulmonary, tracheo-bronchial, and upper regions of the respiratory system. The three largest size fractions were collected onto PTFE impaction substrates, while particles smaller than 3  $\mu\text{m}$  were collected on a PTFE final filter (20 x 20 cm, Zefluor™, 3 $\mu\text{m}$  pore size). A rotary vane blower maintained a flow of 1500 L/min.

*Sample Analysis* Dust collected on each stage of the IESL v2 sampler were analyzed for gravimetric weight, microbial community, and chemical markers including endotoxin, 3-hydroxy fatty acids; 3-OHFA), and muramic acid. High-throughput DNA sequencing was conducted on a subset of six IESL v2 samples (i.e., 24 size-fractionated samples) representing each dairy. Bacterial genomic DNA was extracted and the V4 region of the 16S rRNA gene (515F-806R) was amplified with region-specific primers according to protocols published by the Earth Microbiome Project ([www.earthmicrobiome.org](http://www.earthmicrobiome.org)). Amplification was completed utilizing a barcoded primer set adapted for MiSeq by adding nine extra bases in the adapter region of the forward amplification

primer that support paired-end sequencing. Following PCR, amplicons were quantified using PicoGreen (Invitrogen) and a plate reader. Bacteria were identified using an Illumina MiSeq sequencer.

During a selected sampling day, the top three stages of the IESL v2 were loaded with 200-mesh transmission electron microscopy grids (Ted Pella, Inc., Redding, CA) and operated for 30 min. Each grid was analyzed using Scanning electron microscopy (SEM) coupled with energy dispersive spectroscopy (EDS). Elemental identification, relative abundances, and X-ray mapping were performed.

#### Aim 2

Normal human bronchial epithelial (NHBE) cells were obtained by brush biopsy from two healthy, non-smoking human volunteers (EPA, Research Triangle Park, NC, USA) in accordance with a human studies protocol approved by the Institutional Review Board at the University of North Carolina. Human nasal epithelial (HNE) cells from two different human donors were obtained from Celprogen Inc. Cell populations were expanded through two passages in Petri dishes before being plated onto collagen-coated, porous, polycarbonate membranes at a seeding density of approximately 150,000 cells per cm<sup>2</sup>. All air-liquid interface (ALI) cultures were carried for a minimum of 21 days (prior to exposure) to allow progressive differentiation into basal, ciliated, and mucin-producing cell types within a pseudo-stratified columnar epithelium. Well-differentiated NHBE or HNE cells were exposed to re-suspended dust samples in a gravity settling chamber (n = 10 per treatment group). We exposed well-differentiated normal human bronchial epithelial cells and normal human nasal epithelial cells to two different size fractions (PM<sub>10</sub> and PM<sub>>10</sub>) of re-aerosolized dairy parlor dust using a novel aerosol-to-cell exposure system. Levels of pro-inflammatory transcripts (IL-8, IL-6, and TNF- $\alpha$ ) were measured two hours after exposure. Lactate dehydrogenase release was also measured as an indicator of cytotoxicity. We characterized cell exposure to dairy dust in each size fraction as a function of mass, endotoxin, and muramic acid levels.

#### Aim 3

For worker studies, four dairies (with 5 different milking parlors) participated in measurements during four seasons. Twenty three workers, almost all in the milking parlor, participated in measurements of exposure and lung function over one work shift during four seasons. Lung function was measured before and after the workshift, and the percent change in cross-shift lung function was determined. Each worker wore a sampling device that collected the inhalable-sized aerosol they experienced during their work shift (typically 8 – 10 hours). Samples of nasal tissue were collected after the workshift for measurement of inflammatory markers using Rhinoprobes as used successfully in clinical settings.

### E. Findings

**Aim 1:** One paper has been published on this aim based on findings from three dairies; sampling was not completed in the fourth dairy at this time (Schaeffer 2017). Inhalable PM in each dairy parlor exhibited a bimodal size distribution with one mode under 3  $\mu\text{m}$  and a second mode above 30  $\mu\text{m}$ ; the larger size mode persisted across different dairies, days and seasons. The distribution of mass in this larger mode often rivaled, or exceeded that of the smaller mode. A higher mass concentration was observed in the 10-30  $\mu\text{m}$  size range at Dairies 1 and 3 and in the 30-100  $\mu\text{m}$  size range at Dairy 2. This work is novel because standard particle sizing equipment has an upper limit of 10-20  $\mu\text{m}$ ; very few instruments exist to collect or size-segregate aerosols in the inhalable range (1-100  $\mu\text{m}$ ). As a result, previous studies have typically reported unimodal distributions in agricultural aerosols. Re-suspension events, such as flushing the parlor and moving animals, may account for this bimodal distribution. A wide spectrum of particle morphologies ranging from round to amorphous was observed in each size-resolved sample using the SEM. Particle topographies were heterogeneous, including surfaces that were flat and smooth as well as folded and rough. The concentration of bacterial chemical markers varied by particle size. Endotoxin and muramic acid were present in varying

concentrations in both smaller and larger size fractions. The distribution of muramic acid and 3-OHFA was also bimodal; however, the mass contribution of 3-OHFA was at least an order of magnitude greater than muramic acid. On the contrary, biologically active endotoxin by size-fraction largely varied and followed a unimodal distribution. Based on the 16S-rRNA gene sequences from these aerosols, a microbiome derived predominantly from animal sources was revealed. Bacterial genera included *Staphylococcus* spp., *Pseudomonas* spp., and *Streptococcus* spp., all of which contain species with pro-inflammatory and pathogenic or opportunistic pathogenic potential. Our results suggest that the size-distribution of bioaerosols emitted by dairy operations extends well above 10  $\mu\text{m}$  in diameter and contains a diverse mixture of potentially hazardous constituents and opportunistic pathogens.

**Aim 2:** One paper has been published on this aim (Hawley 2015).

To our knowledge, this is the first study to evaluate the effects of distinct size fractions of agricultural dust on human airway epithelial cells. We observed significant differences in the accumulation of pro-inflammatory transcripts within NHBE and HNE cells following exposure to dairy dust. The responses of each cell type were significantly different and varied with particle size and by transcript type. For example, in  $\text{PM}_{>10}$  exposed cells, IL-8 was increased in HNE cells but not in NHBE cells, whereas, TNF- $\alpha$  was increased in NHBE cells, but not in HNE cells. These results suggest that IL-8 transcript production in NHBE and HNE cells may not be driven via the same stimuli and/or pathways, and moreover, if IL-8 is a chemokine of interest, HNE cells may not be a good surrogate for NHBE cellular response. Further, TNF- $\alpha$  transcript production was different between NHBE and HNE cells. NHBE cells produced significantly greater levels of TNF- $\alpha$  than HNE cells after exposure to  $\text{PM}_{10}$  and  $\text{PM}_{>10}$  mass loadings of 0.4  $\mu\text{g}$  per  $\text{cm}^2$  ( $p = 0.007$  and  $p = 0.01$ , respectively). Our results suggest that HNE and NHBE cells have distinctly different responses to dairy parlor dust.

Because muramic acid levels did not vary significantly between each particle size fraction, we do not believe muramic acid was responsible for the observed differences between  $\text{PM}_{10}$  and  $\text{PM}_{<10}$  exposed cells. The higher endotoxin content in  $\text{PM}_{10}$  could suggest that the higher endotoxin content in  $\text{PM}_{10}$  played a role in the increased NHBE IL-8 response to  $\text{PM}_{10}$ . However, previous work by Poole et al. (2010) showed that endotoxin removal did not eliminate NHBE production of IL-8. ( Because we did not explicitly control for endotoxin exposure levels, we cannot conclude that the higher endotoxin content in  $\text{PM}_{10}$  was responsible for the NHBE IL-8 response to  $\text{PM}_{10}$ . Further, because HNE cells responded significantly to the  $\text{PM}_{>10}$  but not to  $\text{PM}_{10}$ , the higher endotoxin content in  $\text{PM}_{10}$  had no observable effect on HNE cell response ([Parsanejad et al., 2008](#)).

Our results suggest that both  $\text{PM}_{10}$  and  $\text{PM}_{>10}$  size fractions elicit a pro-inflammatory response in airway epithelial cells and that the entire inhalable size fraction should be considered when assessing potential risks from exposure to agricultural dusts. Further, our results suggest that human bronchial cells respond differently to these dusts than human nasal cells, and therefore, the two cell types should be considered separately in airway cell models of agricultural dust toxicity.

Strengths of this study include the use of a direct, air-to-cell exposure system, the use of primary cells, and the application of distinct (and previously unstudied in airway cells) particle sizes at environmentally-relevant exposure levels. Many traditional *in vitro* studies rely on the use of particle extracts (or suspensions) with unrealistic doses ([Frampton et al., 1999](#), [Veranth et al., 2004](#), [Romberger et al., 2002](#), [Wyatt et al., 2007](#)). Our work here reports, for the first time, differences in the pro-inflammatory (1) response of human airway cells to two different particle size fractions across the inhalable size range of agricultural dusts and (2) response of two airway cell populations after exposure to agricultural dust.

**Aim 3:**

Lung function testing (pre and post shift work), blood, tissue and dust exposure sampling were undertaken on repeated personal sampling sessions with 21 dairy workers. All but one participant were Hispanic males

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ranging from 20 – 50 years in age. The mean FVC and FEV1 measured in the worker population both mildly decreased over the workshift – consistent with other recent studies of modern dairies. There was a significant variability among individuals. Eight individuals had cross-shift reductions greater than 5% in FVC and/or FEV1. We are evaluating these data to determine if there is an association between exposure and lung function changes, and whether other factors may play a role. In agreement with results from other modern dairies, almost all of the dairy workers' exposure measurements, including endotoxin, were much lower than suggested in occupational exposure guidelines. We found that the Rhino-probe nasal sampling method may not be a significant improvement over nasal lavage for field studies. The Rhino probe is easy to use in the field but is not well accepted by participants and yields low amounts of RNA, preventing us from quantitatively measuring pro-inflammatory cytokines.

The bimodal mass concentrations used for the cell exposures in Aim 2 are similar to the inhalable mass concentrations observed in dairy farming environments, including in Aim 1 (J. Schaeffer, 2013, Reynolds et al., 2013, Garcia et al., 2013a, Reynolds et al., 2012). The particle size fractions used here appear to play a role in eliciting differential responses among HNE and NHBE cells. Overall, NHBE cells responded more strongly to PM<sub>10</sub>, whereas HNE cells responded more strongly to the PM<sub>>10</sub> size fraction. *In vivo*, PM<sub>>10</sub> deposits primarily in the extrathoracic region (20-40% of inhaled PM<sub>>10</sub> is deposited in the human nasal, mouth, larynx, and pharynx, versus 0-1% deposition in the bronchial region of the lungs, (ICRP, 1994)). To that end, primary nasal cells from human donors may be more sensitized to PM<sub>>10</sub> size fractions (as opposed to PM<sub>10</sub> size fractions). Similarly, NHBE cells may be more sensitive to PM<sub>10</sub> due to increased deposition of these particles in the conducting airways. Anywhere from 1-20% of inhaled PM<sub>10</sub> is deposited in the human bronchial airways, whereas 5% or less of PM<sub>>10</sub> is deposited in this same region (James et al., 1991). The mechanism for sensitizing HNE and NHBE cells to specific particle sizes is unclear but may involve epigenetic or immunogenic factors. Previous studies have found that exposure to PM<sub>10</sub> air pollutants induces gene-specific and global methylation in the lungs (Holloway et al., 2012). Building on this work, additional cell studies using air-liquid interface and a traditional submersed model are continuing.

## **F. Conclusions**

Results of this project will help develop better tools for understanding agricultural lung disease and have provided data to help develop effective interventions. The relatively low exposure to dust and endotoxins plus a mild reduction in cross-shift lung function are typical of modern dairies and represent an improvement from traditional dairies. We found that the Rhino-probe nasal sampling method may not be a significant improvement over nasal lavage for field studies. It is easy to use in the field but is not well accepted by participants and yields low amounts of RNA. 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. We have demonstrated that large aerosols with a cut point of 30µm are an important component of the aerosols inhaled by workers in dairy milking parlors. Importantly, our current studies are also demonstrating an increased prevalence of gram positive bacteria (>21-fold increase). The differences in inflammatory response between human lung cell type and dust size fraction are also an important novel finding.

These results suggest that the air microbiome may impact or deposit along the entire respiratory tract. In addition to inflammatory reactions, infections in the nasal passage and gut are possible. Potentially this project could help improve the respiratory health of 100,000 workers in U.S. dairies, reducing medical and workers' compensation costs, reducing employee turnover, and improving productivity. The project has broad implications for reducing exposures to inflammatory aerosols in a wide range of agricultural and other industries. We are currently building on this work in a related project to identify and evaluate cost effective

interventions to further reduce bioaerosol exposures and inflammatory respiratory responses among dairy workers.

## Outputs and Outcomes

### Publications

#### 2017

1. Schaeffer, J. W., Reynolds, S., Magzamen, S., VanDyke, A., Gottel, N. R., Gilbert, J. A., Owens, S.M., Hampton-Marcell, J.T., Volckens, J. (2017). Size, Composition, and Source Profiles of Inhalable Bioaerosols from Colorado Dairies. *Environmental Science & Technology*, 51(11), 6430-6440. doi: 10.1021/acs.est.7b00882
2. Nonnenmann, M. W., Gimeno Ruiz de Porras, D., Levin, J., Douphrate, D., Boggaram, V., Schaffer, J., Gallagher, M., Hornick, M. & Reynolds, S. (2017). Pulmonary function and airway inflammation among dairy parlor workers after exposure to inhalable aerosols. *Am J Ind Med*, 60(3), 255-263. doi: 10.1002/ajim.22680

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4. Dusad, A., Thiele, G.M., Klassen, L.W., Wang, D., Duryee, M.J., Mikuls, T.R., Staab, E.B., Wyatt, T.A., West, W.W., Reynolds, S.J., Romberger, D.J., Poole, J.A. (2015). Vitamin D Supplementation Protects Against Bone Loss Following Inhalant Organic Dust and Lipopolysaccharide Exposures in Mice. *Immunol Res*, 62(1):46-59. doi: [10.1007/s12026-015-8634-4](https://doi.org/10.1007/s12026-015-8634-4)
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8. Poole, J. A., Wyatt, T. A., Romberger, D. J., Staab, E., Simet, S., Reynolds, S. J., . . . Kielian, T. (2015). MyD88 in lung resident cells governs airway inflammatory and pulmonary function responses to organic dust treatment. [journal article]. *Respiratory Research*, 16(1), 111. doi: 10.1186/s12931-015-0272-9

#### 2014

9. Clark, M. L., Reynolds, S. J., Hendrikson, E., & Peel, J. L. (2014). Asthma Prevalence and Risk Factor Assessment of an Underserved and Primarily Latino Child Population in Colorado. *JEH*, 76(6), 8-16. PMID: 24645408

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## 2012

14. Poole J.A., Gleason, A.M., Bauer, C., West, W.W., Alexis, N., Rooijen, N., Reynolds, S.J, Romberger, D.J., Kielian, T. (2012). CD11c+/CD11b+ Cells are Critical for Organic Dust-Elicited Murine Lung Inflammation. *Am J Respir Cell Mol Biol*. 2012;47(5):652-9. PMID: 22822029
15. Reynolds, S. J., Clark, M. L., Koehncke, N., von Essen, S., Prinz, L., Keefe, T. J., Burch, J. B. (2012). Pulmonary function reductions among potentially susceptible subgroups of agricultural workers in Colorado and Nebraska. *J Occup Environ Med*, 54(5), 632-641. doi: [10.1097/JOM.0b013e31824d2e1c](https://doi.org/10.1097/JOM.0b013e31824d2e1c)
16. Outbreak of shiga toxin—producing Escherichia Coli O111 infections associated with a correctional facility dairy—Colorado, 2010. (2012). *JAMA*, 308(5), 447-449.
17. Choudhry, A. H., Reynolds, S. J., Mehaffy, J., Douphrate, D. I., Gilmore, K., Levin, J. L., & Nonnenmann, M. W. (2012). Evaluation of parlor cleaning as an intervention for decreased occupational exposure to dust and endotoxin among dairy parlor workers--a pilot study. *J Occup Environ Hyg*, 9(7), D136-140. doi: 10.1080/15459624.2012.691410
18. Comstock, N., Towle, M., Warner, A., Reynolds, S. J., Durso, L., Campbell, C., Bosch, S. A. (2012). Outbreak of Shiga toxin-producing Escherichia coli O111 infections associated with a correctional facility dairy - Colorado, 2010. *MMWR*, 61(9), 149-152.
19. Garcia, J., Bennett, D. H., Tancredi, D. J., Schenker, M. B., Mitchell, D. C., Reynolds, S. J., Silva, R., Dooley, G. P., Mehaffy, J., Mitloehner, F. M., & Mitloehner, F. M. (2012). Characterization of endotoxin collected on California dairies using personal and area-based sampling methods. *J Occup Environ Hyg*, 9(10), 580-591. doi: 10.1080/15459624.2012.713301
20. Koehler, K. A., Anthony, T. R., Van Dyke, M., & Volckens, J. (2012). Solid versus Liquid Particle Sampling Efficiency of Three Personal Aerosol Samplers when Facing the Wind. *Ann Occup Hyg*, 56(2), 194-206. doi: 10.1093/annhyg/mer077
21. Koehler, K. A., Anthony, T. R., van Dyke, M., & Volckens, J. (2011). A Rotating Bluff-Body Disc for Reduced Variability in Wind Tunnel Aerosol Studies. *Ann Occup Hyg*, 55(1), 86-96. doi: 10.1093/annhyg/meq078

22. Thayer, D., Koehler, K. A., Marchese, A., & Volckens, J. (2011). A Personal, Thermophoretic Sampler for Airborne Nanoparticles. *AEROSOL SCI TECH*, 45(6), 744-750. doi: 10.1080/02786826.2011.558943

### Book Sections

1. Davidson, M. E., & Thornton, S. (2013). Biological Hazards. In S. Reed, D. Pisaniello, G. Benke & K. Burton (Eds.), *Principles of occupational health and hygiene: An introduction* (2 ed.). Crows Nest, Australia: Allen & Unwin.

### Reports

1. Reynolds, S. J. (2013). Occupational Health and Biofuels Production. In R. Pool (Ed.), *The Nexus of Biofuels, Climate Change, and Human Health: Workshop Summary* (pp. 37-46): The National Academies Press.

### Trade Publications

1. Douphrate, D., Bolsen, K., Reynolds, S., & Hagevoort, R. (February 19, 2014). *Dairy worker safety and health: Silage safety*. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11817:dairy-worker-safety-and-health-silage-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11817:dairy-worker-safety-and-health-silage-safety&catid=49:management&Itemid=75)
2. Reynolds, S., & Douphrate, D. (July 10, 2013). *Dairy worker safety and health: Respiratory protections*. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10895:dairy-worker-safety-and-health-respiratory-protections&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10895:dairy-worker-safety-and-health-respiratory-protections&catid=49:management&Itemid=75)

### Conferences Organized

1. Reynolds, S. J., Stallones, L. (2014 – 2015). Planning committee members for The 6th Annual Public Health Symposium at Colorado State University: Microbial Ecology in a Changing World: Emerging issues in antimicrobial resistance (April 15, 2015). Fort Collins, Colorado. <http://www.publichealth.colostate.edu/public-health-symposium-2015/>
2. Reynolds, S. J. (2013 – 2014). Member of scientific planning committee for 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives (October 19 - 22, 2014). Saskatoon, Saskatchewan
3. Reynolds, S. J., Kirychuk, S., Douphrate, D., & Schaeffer, J. (2013 – 2014). Organizer for the International Dairy Workshop (October 19, 2014) during the 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives. Saskatoon, Saskatchewan

### Conference Papers, Presentations, Abstracts

#### 2017

1. Escobar, M., Schaeffer, J., Magzamen, S., Bisha, B., & Reynolds, S. (March, 2016). *Filter-Based Methods Assessment: Culturing Resistant Bacteria from Inhalable Bioaerosols*. MAP ERC Research Day, Denver, CO.
2. Korchevskiy, A. (March, 2017). *Risk assessment course*. Ternopol State Medical University, Ternopol, Ukraine.  
*Dr. Stephen J. Reynolds provided PPT presentations on organic dusts and agriculture for his use. Will follow up to explore collaborations.*

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3. Reynolds, S. J. (February 15, 2017). MAP ERC and HICAHS overview. Edith Cowen University, Joondalup, Western Australia. Dr. Stephen J. Reynolds presentation and discussion to ~ 20 OHS faculty and students. Dr. Reynolds is Adjunct Professor at ECU.
4. Reynolds, S. J., Schaeffer, J., Burket, T., A.VanDyke, M.Davidson, J.Mehaffy, S.Magzamen. (June 21, 2017). Dairy Bioaerosol Exposures and Inflammatory Markers in Workers: a Panel Study. . NIOSH - Expanding Research Partnerships: State of Science, Aurora, CO.
5. Stenkamp-Strahm, C., Magzamen, S., Abdo, Z., Reynolds, S., & McConnel, C. (June 12, 2017). E. coli O157 shedding is associated with low diversity and changes of specific taxa within the dairy cow microbiome. Gaussi Symposium, Colorado State University, Fort Collins, CO.
6. Stenkamp-Strahm, C., Magzamen, S., McConnel, C., Abdo, Z., VanDyke-Gonnerman, A., Schaeffer, J., & Reynolds, S. (July 9-12, 2017). Microbial Community Drivers of Escherichia coli O157 Colonization and Shedding in Early Lactation Dairy Cattle. Presentation at the 2017 International Association for Food Protection Annual Meeting, Tampa, Florida.
7. VanDyke, A., Reynolds, S. J., Schaeffer, J., & S.Magzamen. (June 22, 2017). Dairy Worker Exposure to Airborne Endotoxins and  $\beta$  Glucans. Presentation at the NIOSH – Expanding Research Partnerships: State of Science, Aurora, CO.

## 2016

8. L. Krause, S. Reynolds, A. VanDyke, J. Schaeffer A COMPARATIVE ANALYSIS BETWEEN rFC AND LAL ENDOTOXIN ASSAYS FOR AGRICULTURAL AIR SAMPLES. MAP ERC Research Day, Denver, CO March 2016
9. Reynolds, S.J. Schaeffer, JW, Magzamen S, VanDyke A, Davidson M, Mehaffy J, Escobar M, Anderson K, Bradford M, Tryon J, Burket-Tooker T, Brindly B, Newman L, Volkens J. Cytokine Profiles Among Dairy Workers. Nordic Meeting on Agricultural Occupational Health & Safety. August 24-26, 2016 Billund, Denmark
10. Schaeffer, JW, Magzamen S, Noyes N, VanDyke A, Davidson M, Escobar M, Volkens J, Owens, S, Marcell, J., Reynolds, S.J. Agricultural Dust in the Wind: Microbial Communities and their Resistant Genes. Nordic Meeting on Agricultural Occupational Health & Safety. August 24-26, 2016 Billund, Denmark.
11. A VanDyke, S Reynolds, J Schaeffer, S Magzamen, L Krause, Task-Based Exposures to Airborne Endotoxins and  $\beta$ -Glucans Among Dairy Workers. AIHCE 2016, Baltimore, MD, May 25, 2016 \*\*2nd Best in Session/Student Posters\*\*2nd Best Overall/In Conference\*\*

## 2015

12. Douphrate, D., Reynolds, S. J., Hagevoort, R., Lunner Kolstrup, C., Kolb, P., & Cassidy, A. (September 27-28, 2015). *International Dairy Safety Short Course*. Invited lecture to delegations from Pakistan and China, University of Wisconsin - River Falls, WI.
13. Douphrate, D., & Reynolds, S. J. (September 18, 2015). *Successful Strides with Dairy Workers*. Presented at the Western States Occupational Network (WestON), Denver, CO.
14. L. Krause, S. Reynolds, J. Schaeffer, A. VanDyke, M. Davidson, B. Bisha. Evaluation of Collection Effectiveness during Air Sampling of Culturable Bioaerosols using SKC BioSamplers. AIHCE 2015 Student Poster Session. Best Poster Award. June 3, 2015. Salt Lake City, UT.
15. Reynolds, S. J., & Hagevoort, R. (March 31, 2015). Impact of Aerosols on Respiratory Health of Dairy Workers and Residents Living Near Dairies: Discussion and Implications of Recent Research. Presentation at the Livestock and Poultry Environmental Learning Center's Waste to Worth Conference, Seattle, WA. <https://etouches.com/ehome/85805>

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16. Schaeffer, J. (September 9, 2015). Large Particle Exposures and Attendant Health Effects among Dairy Workers: Progress and Future Directions. International Congress on Rural Health, Milan, Italy.
17. A. VanDyke, S. Reynolds, M. Davidson, J. Schaeffer, B. Bisha, J. Delton Hanson. Effect of Environmental Conditions on Bacterial and Fungal Communities in Dairy Parlors through Pyrosequencing, Riboprinting, and Microscopic Analysis Techniques. AIHCE 2015 Student Poster Session. June 3, 2015. Salt Lake City, UT.

## 2014

18. Davidson, M. (October 22, 2014). *Extraction of RNA from Rhino-Probe™ Samples: The Good, the Bad and the Ugly*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
19. Davidson, M., Schaeffer, J., Reynolds, S., & Reed, S. (December 2, 2014). *Bioaerosol sampling in the 21st Century: is there still a place for culture-based assessments?* Presentation at the Australian Institute of Occupational Hygienists (AIOH) 32nd Annual Conference & Exhibition, Melbourne, Australia. <https://event.crowdcompass.com/aioh2014>
20. Davidson, M. E., Hawley, B., Schaeffer, J., Bradford, M., Volckens, J., & Reynolds, S. J. (August 25-27, 2014). *Use of Rhino-Probe™ Sampling for Analyzing Cross-shift Variation in the Expression of IL8, IL6 and TNF alpha in Nasal Epithelial Cells from Colorado Dairy Workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Porvoo, Finland. <http://www.ttl.fi/partner/nmaohs/abstracts/Documents/NMAOHS%20Abstracts%20Final%2030102014.pdf>
21. Krause, L., Reynolds, S. J., Schaeffer, J., Van Dyke, A., Davidson, M., & Bisha, B. (April 15, 2014). Evaluation of Bacterial Preservation during Air Sampling of Culturable Bioaerosols \*Awarded High Honors\*. Celebrate Undergraduate Research and Creativity (CURC 2014) Showcase, Colorado State University, Fort Collins, CO.
22. Nonnenmann M, Gimeno D, Levin J, Boggaram V, Reynolds S. Associations of pulmonary function and exhaled nitric oxide with measurements of exposure to inhalable dust, endotoxin and muramic acid among dairy parlor workers. Conference: 7th International Symposium: Safety & Health in Agricultural & Rural Populations: Global Perspectives (SHARP). Organization: Canadian Association for Research on Work and Health & Canadian Rural Health Research Society. Place: Saskatoon, SK, Canada. Date: 19-22 October, 2014.
23. Reed, S., Davidson, M., Schaeffer, J., & Reynolds, S. (November 6, 2014). Bioaerosols: What IHS need to know about biological hazards in the future. Presentation at the AIHA/MIHA 2014: Asia Pacific OH + EH Conference + Exhibition, Kuala Lumpur, Malaysia. <https://www.aiha.org/events/asia-pacific/programme/Pages/Main-Program-Thursday.aspx>
24. Reynolds, S. J. (October 22, 2014). Candidate TLR and NLR Innate Immunity Genes and Cross Shift Pulmonary Function Changes Among Western US Dairy Workers. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
25. Reynolds, S. J., Clark, M. L., Davidson, M. E., Keefe, T., Mehaffy, J., Bradford, M., Yang, I. (August 25-27, 2014). Candidate Innate Immunity Genes and Cross Shift Pulmonary Function Changes Among Western US Dairy Workers. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Porvoo, Finland.

<http://www.ttl.fi/partner/nmaohs/abstracts/Documents/NMAOHS%20Abstracts%20Final%2030102014.pdf>

26. Schaeffer, J. (October 22, 2014). *Microbial Communities of Inhalable Bioaerosols at Colorado Dairies*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
27. Schaeffer, J., Volckens, J., Davidson, M. E., Van Dyke, A., Krause, L., Tryon, J., . . . Reynolds, S. (August 25-27, 2014). *Size Characterization and Composition of Inhalable Bioaerosols at Colorado Dairies*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Porvoo, Finland. <http://www.ttl.fi/partner/nmaohs/abstracts/Documents/NMAOHS%20Abstracts%20Final%2030102014.pdf>
28. Van Dyke, A., & Reynolds, S. (October 19-22, 2014). *Comparative Analysis of Bacterial and Fungal Communities in Three Dairy Parlors Through the Use of Pyrosequencing, Riboprinting, Culture Techniques, and Microscopy*. Poster presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
29. Van Dyke, A., Reynolds, S. J., Davidson, M. E., Schaeffer, J., Bisha, B., & Hanson, J. D. (June 3, 2014). *Effect of Environmental Factors on Isolation and Identification of Potential Pathogenic Species of Bacteria and Fungi from Bioaerosols in Three Dairy Parlors*. Poster presentation at AIHCE 2014, San Antonio, TX. <http://aihce2014.org/>

## 2013

30. Davidson, M., Reynolds, S., Clark, M., Keefe, T., Mehaffy, J., Bradford, M., . . . Schenker, M. (May 21, 2013). *Tasked Based Assessment of Dairy Worker Exposure to Bioaerosols*. Podium presentation at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
31. Douphrate, D., Keifer, M., Liebman, A., Carrabba, J., Hagevoort, R., Grafft, L., & Reynolds, S. J. (June 23-27, 2013). Assisting the dairy industry to optimize worker health and safety. Expert Panel Presentation at the International Society of Agricultural Safety and Health Annual (ISASH) Conference: Exploring the shores of safety and health, Sandusky, OH.
32. Gallagher, M., Nonnenmann, M., Hornick, M., Reynolds, S., Levin, J., & Boggaram, V. (May, 2013). Evaluation of Pulmonary Function Cross-Shift Changes in Dairy Parlor Workers using Spirometry and Exhaled Nitric Oxide. Student abstract presented at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
33. Reynolds, S., Clark, M., Davidson, M., Keefe, T., Mehaffy, J., Bradford, M., . . . Schenker, M. (23 May, 2013). Exposures to Organic Aerosols and Effects on Pulmonary Function among Western U.S. Dairy Workers. Podium presentation at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
34. \*Awarded Best Presentation AIHA Occupational and Environmental Epidemiology Committee\*
35. Reynolds, S. J. (October 4, 2013). Follow up & next steps facilitated discussion. NIOSH Extramural Center Directors Meeting, Anschutz Medical Campus, Aurora, CO.

36. Reynolds, S. J., Douphrate, D., Hagevoort, R., Brazile, W., & Root, K. (March 6-8, 2013). Managing Worker Safety, Productivity, & Regulatory Issues. Presentation at the Western Dairy Management Conference, John Ascuaga's Nugget, Reno, NV. Paper retrieved from <http://www.wdmc.org/2013/Managing%20Worker%20Safety,%20Productivity,%20and%20Regulatory%20Issues.pdf>
37. Rickabaugh, K., Casuccio, G., Lersch, T., Zock, M., Volckens, J., & Leith, D. (May 22, 2013). Evaluation of the Thermophoretic Personal Air Sampler (TPS) for Collection of Nanoparticles. Podium presentation at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
38. Schaeffer, J. W., Volckens, J., Van Dyke-Gonnerman, A., Davidson, M., & Reynolds, S. J. (May, 2013). Particle Size Characterization of Agricultural Aerosols in Two Colorado Dairies using a High-Volume Cloud Impactor. Student abstract presented at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
39. Stallones, L. (August 7-9, 2013). Consumer attitudes. Presentation at the Ranching for Profit Summit-Wheels of Change, Laramie, Wyoming.
40. Stallones, L. (August 7-9, 2013). Obesity, diet and disease. Presentation at the Ranching for Profit Summit-Wheels of Change, Laramie, Wyoming.
41. Stinson, K., Fang, H., Metcalf, D., Jinnett, K., Brockbank, C., Tenney, L., Trotter, M., Reynolds, S.J., Witter, R., Goetzl, R., & Newman, L. S. (November 6, 2013). Evaluating the impact of a health risk management program on employee's health risks and workers compensation. Panel presentation at the 141st APHA Annual Meeting and Exposition, Boston, MA. Abstract retrieved from <https://apha.confex.com/apha/141am/webprogram/Paper284364.html>
42. Van Dyke-Gonnerman, A., Reynolds, S., Davidson, M., Schaeffer, J., Bisha, B., Goodridge, L., & Hanson, J. D. (May, 2013). Comparative Analysis of Bacteria and Fungi Communities Through the Use of Pyrosequencing, Riboprinting, Culture Techniques, and Microscopic Analysis in Two Dairy Parlors. Student abstract presented at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>

## 2012

43. Davidson, M., Clark, M. L., Keefe, T., Mehaffy, J., Bradford, M., Roman-Muniz, N., Reynolds, S. J. (August 27-29, 2012). Similar exposure group (task) based analysis of bioaerosol exposures in dairies. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Ystad, Sweden.
44. Nonnenmann, M. W., Choudhry, A., Mehaffy, J., Douphrate, D., Levin, J. L., Gilmore, K., & Reynolds, S. J. (August 27-29, 2012). *Evaluation of a parlor washing system to reduce exposure to inhalable aerosols during dairy parlor work--A pilot study*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Ystad, Sweden.
45. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, M., Reynolds, S. J. (August 27-29, 2012). *Exposures to organic aerosols and effects on pulmonary function among western U.S. dairy workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Ystad, Sweden.

## 2011

46. Funk, S., Reynolds, S. J., Volckens, J., Dowd, S., & Nonnenmann, M. W. (May 16-19, 2011). Evaluation of seasonal ventilation changes and their effect on ambient dust, endotoxin and bioaerosol

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concentrations in a dairy parlor. Presented at the American Industrial Hygiene Conference and Exposition, Portland, OR.

47. Hussain, A., Nonnenmann, M., Levin, J., Reynolds, S. Evaluation of Parlor Washing as an Intervention for Decreasing Occupational Exposure to Organic Dust and Endotoxin Among Dairy Parlor Workers. American Industrial Hygiene Conference and Exposition, Portland, OR, USA. May 16th - 19th, 2011.\* Best Student Poster - Occupational and Environmental Medicine Committee.
48. Mitchell, D., Schenker, M. B., Armitage, T., Bennett, D., Tancredi, D., Eastman, C., Mitloehner, F. (September 7-9, 2011). Are respiratory decrements associated with exposure to particles including endotoxins on large California dairies? Presented at the EPICOH International Conference on Epidemiology in Occupational Health, Oxford, UK.
49. Reynolds, S. J. (May 4, 2011). What's hanging in dairy; avoiding udder disaster: High Plains Intermountain Dairy Health and Safety Initiatives-Projects and Partnerships. Presented at the NFMC, Marshfield, WI.
50. Reynolds, S. J., Campbell, C., Towle, M., Warner, A., Kiefer, M., Ray, B., & Comstock, N. (June, 2011). Investigation of an Escherichia coli O111 outbreak at a state-run correctional facility dairy facility. Presented at the National Symposium on Agriculture, Forestry and Fishing Health and Safety, Boise, ID.
51. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. (May 4, 2011). Endotoxin exposure, TLR4 mutations, smoking and work-related behaviors: pulmonary function deficits among agricultural workers. Presented at the NFMC, Marshfield, WI.
52. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. A. (June, 2011). Agricultural dust exposures and pulmonary function among grain elevator, cattle feedlot, dairy, and corn farm workers in Colorado and Nebraska. Presented at the National Symposium on Agriculture, Forestry and Fishing Health and Safety, Boise, ID.
53. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. A. (August 22-24, 2011). Exposure to endotoxin, muramic acid, ergosterol and effects on pulmonary function among western dairy workers. Presented at the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
54. Steneroden, K., Hill, A., Knight, A., Reynolds, S. J., & Salman, M. (2011). Infectious and zoonotic disease control strategies in Western US animal shelters: An epidemiological approach and its application. Presented at the International Symposium on Veterinary Epidemiology and Economics.

## Student Theses

HICAHS researchers served on the advisory committees for the following students. The funding for conducting the student projects may or may not have been funded by HICAHS.

### 2016

1. Escobar, M. A. (2016). *Filter Based Methods Assessment: Culturing Resistant Bacteria from Inhalable Bioaerosols*. Master of Science Thesis, Colorado State University, Fort Collins, CO.
2. Krause, L. A. (2016). *A comparative analysis between the rFC and LAL endotoxin assays for agricultural air samples*. Master of Science Thesis, Colorado State University, Fort Collins, Colorado. Retrieved from <http://hdl.handle.net/10217/173499>

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3. Walters, K. M. (2016). *Is the "grass" greener?: occupational wellness in the Colorado cannabis industry*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <https://dspace.library.colostate.edu/handle/10217/173525>

## 2015

4. Autenrieth, D. (2015) *Occupational Health and Safety Management Systems in Animal Production Agriculture*. Doctor of Philosophy Dissertation, Colorado State University.
5. Ndonga, M. (2015). *Design of An Inhalable Aerosol Size Spectrometer*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/166860>
6. Yang, X. (2015). *Investigation of the Beef Supply-Chain Microbiome and Pathogen Controls*. Doctor of Philosophy Dissertation, Colorado State University, Fort Collins, CO. Retrieved from <https://dspace.library.colostate.edu/handle/10217/170417>

## 2014

7. Hawley, B. (2014). *Development and application of an improved in vitro model for aerosol toxicology*. Doctor of Philosophy Dissertation, Colorado State University. Retrieved from <http://hdl.handle.net/10217/83775>

## 2013

8. Krause, L. (2013). *Bacterial Preservation during Air Sampling*. Undergraduate Student Honors Thesis, Colorado State University, Fort Collins, CO.
9. Schaeffer, J.W. (2013). Evaluation and resolution of two sampling methods for airborne aromatic diisocyanate monomers. Doctor of Philosophy Dissertation, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/80195>
10. Van Dyke-Gonnerman, A. L. (2013). *Comparative analysis of bacterial and fungal communities in two dairy parlors through the use of pyrosequencing, riboprinting, culture techniques, and microscopic analysis*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/81067>

## 2012

11. Frazey, J.S. (2012). *Decontamination of bioaerosols within engineering tolerances of aircraft materials*. Doctor of Philosophy Dissertation, Colorado State University. Retrieved from <http://hdl.handle.net/10217/71558>
12. Robinson, D.L. (2012). *Evaluation of bacterial sampling methods for use with the bacterial tag-encoded flexible (FLX) amplicon pyrosequencing (bTEFAP) technique*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/68149>

## 2011

13. Basinas, I. (2011). *Dust and Endotoxin Exposure in Animal Farming Population. Formulating the Basis for a Model-based Exposure Assessment Approach*. PhD, Aarhus Universitet, Aarhus, Denmark.
14. Funk, S. (2011). *Evaluation of seasonal ventilation changes and their effect on ambient dust, endotoxin and bioaerosol concentrations in a dairy parlor*. Master of Science Thesis, Colorado State University, Fort Collins, CO.

15. Sorrentino, J. (2011). *A comparison of the Limulus amoebocyte lysate (LAL) and recombinant Factor C (rFC) endotoxin bioassays: Characterization of aerosols and settled dust on a sheep farm*. MS, Colorado State University, Fort Collins, CO.

## HICAHS SERVICE

### Conference Organizer

#### 2015

5. Magzamen, S., Schaeffer, J., & Reynolds, S. J. (April 15, 2015). *Organizer and Moderator - "Next Generation Sequencing" Workshop*. Held during The 6th Annual Public Health Symposium at Colorado State University: Microbial Ecology in a Changing World: Emerging issues in antimicrobial resistance, Fort Collins, CO.
6. Reynolds, S. J., Magzamen, S., & Schaeffer, J. (April 15, 2015). *Planning committee members*. The 6th Annual Public Health Symposium at Colorado State University: Microbial Ecology in a Changing World: Emerging issues in antimicrobial resistance, Fort Collins, Colorado.  
<http://www.publichealth.colostate.edu/public-health-symposium-2015/>

#### 2014

5. Cassidy, A., Reynolds, S. J., & Douphrate, D. (September 10, 2014). *Planning Committee Members*. HICAHS Dairy Board Meeting, Sioux Falls Regional Center.
6. Reynolds, S. J. (October 19 - 22, 2014). *Member of scientific planning committee*. The 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Saskatchewan
7. Reynolds, S. J., Kirychuk, S., Douphrate, D., & Schaeffer, J. (October, 2014). *Organizer for the International Dairy Workshop*. Held during The 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Saskatchewan

#### 2013

3. Reynolds, S. J. (September 25-27, 2013). *Member of the Planning Committee*. ASHCA North American Agricultural Safety Summit, Minneapolis, MN.
4. Reynolds, S. J., DeVries, A., & Douphrate, D. (July 25-26, 2013). *Members of the Planning Committee*. HICAHS International Dairy Research Consortium, Colorado State University, Fort Collins, CO.

#### 2012

5. DeVries, A., & Reynolds, S. J. (July 24-25, 2012). *Planning committee members*. HICAHS Dairy Board Meeting, Colorado State University, Fort Collins, Colorado.
6. Reynolds, S. J. (September 29 – 30, 2012). *Pre-Conference Workshop Organizer – Agricultural Health and Safety with Emphasis on Dairy*. 11th World Conference on Injury Prevention and Safety Promotion, Wellington, New Zealand. <http://www.conference.co.nz/worldsafety2012/agriculturalsafetyhealth>
7. Reynolds, S. J. (August 27-29, 2012). *Workshop organizer and presenter*. Nordic Meeting on Agricultural Occupational Health & Safety, Ystad, Sweden.

## 2011

6. DeVries, A., & Bradford, M. (August 17, 2011). *Lung Function Testing/ HICAHS Safety Research Booth*. 2011 Irrigation Research Foundation Farm Show, Yuma, CO.
7. DeVries, A., & Bradford, M. (November 18-19, 2011). *HICAHS Booth and Lung Function Testing*. 93rd Annual Meeting of the Colorado Farm Bureau, Denver, CO.
8. Reynolds, S. J., Douphrate, D., & DeVries, A. (September 25-27, 2011). *Members of the Planning Committee for the International Dairy Research Consortium Meeting*. Held during the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
9. Reynolds, S. J., DeVries, A., & Douphrate, D. (July 11-13, 2011). *Members of the Planning Committee*. HICAHS International Dairy Research Consortium, Colorado State University, Fort Collins, CO.

### Consultations Related to Professional Expertise

1. Reynolds, S. J. (February 17, 2017). *Consultation regarding guidelines and standards for organic dust exposures, sample interpretation, and exposure profiles for agricultural workers*. LDS Church, Risk Management, Salt Lake City, UT. *Dr. Reynolds consulted with Clark Evans*.
2. Reynolds, S. J. (February 14, 2017). *Consultation regarding beef industry/cattle feedlots and possible exemption from EPA Clean Air Act*. AgriBeef, Boise, ID. *Dr. Reynolds reviewed article and email regarding legislation in Washington State. Spoke with Jayne Davis, Director Corporate and Regulatory Affairs to provide opinion and discuss. Also suggested additional contacts*.
3. Reynolds, S. J. (2012). Consultation to Colorado western slope communities regarding poultry production and community health risks.
4. Reynolds, S. J. (2012). Review of and advice regarding CVMBS Vet Diagnostic Lab protocols regarding infectious agent containment (Anthrax).

### Board Service

1. Reynolds, S. J. (2013 – present). NORA Agriculture, Forestry & Fishing Sector Council.
2. Reynolds, S. J. (2011 – present). External Advisory Board Member of the Upper Midwest Agricultural Safety and Health Center (Minneapolis, MN).
3. Reynolds, S. J. (2011 – present). External Advisory Board National Farm Medicine Center Dairy Initiative (Marshfield, WI).
4. Reynolds, S. J. (2010 – present). Colorado Department of Public Health and the Environment (CDPHE) Occupational Health Surveillance Program.
5. Reynolds, S. J. (2010 – present). Worksafe Colorado Advisory Board.
6. Reynolds, S. J., & Cassidy, A. (2010 – present). Wyoming Governor's Taskforce/Wyoming-Colorado Occupational Safety and Health Coalition.
7. Reynolds, S. J. (2008 – present). International Member of the Canadian Centre for Health and Safety in Agriculture (CCHSA).

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## Editors

1. Drs. Stallones and Reynolds serve as Associate Editors for the Journal of Agromedicine and the Journal of Agricultural Safety and Health (2004-present).

## Webinars

1. Reynolds, S. J. (February 20, 2014). *Employee Health Hazards in the Agricultural Industry*. Webinar through Axion Health <http://axionhealth.com/knowledge-resources/webinars>
2. Reynolds, S. J., & Douphrate, D. I. (May 13, 2013). *High Plains Intermountain Center for Agricultural Health & Safety: A Stakeholder Driven Approach to Health & Safety*. Webinar through the AgriSafe Network. [www.agrisafe.org](http://www.agrisafe.org)
3. Campbell, C., Comstock, N., Keifer, M., Ray, B., Reynolds, S. J., Towle, M., & Warner, A. (2011). Epidemiologic and occupational investigation of an Escherichia coli O111 outbreak associated with a correctional facility dairy--Colorado 2010 *AgriSafe Network*.

## OTHER

### Outcomes

Aurora Organic Dairy (operations in CO and TX) has worked with HICAHS on implementing an OHS Management program for a number of years. Emily Prisco, the Director of Farm Resources who implements that program, is currently pursuing an MPH in the Colorado School of Public Health. Dr. Reynolds is working with her to develop a Total Worker Health Program through an independent study, and collaborating with the new Rocky Mountain Center for Total Worker Health. To our knowledge, this would be the first TWH program for a dairy farm.

### Research to Practice (R2P)

After 15 years of working with the dairy industry, we are now seeing examples of research to practice, with dairy producers implementing integrated health and safety management into their business, hiring appropriate staff, and requesting HICAHS support for their efforts. An article about the Idaho Dairymen's Association's most recent steps can be found at the following link: <http://www.capitalpress.com/Idaho/20161215/idaho-dairymen-to-add-worker-safety-emphasis>. They are now asking Drs. Douphrate and Hagevoort for assistance with training employees on 500 dairy farms, and implementing a comprehensive safety management program on each farm operation. Several other producer organizations are also exploring similar efforts.

### Project Generated Resources

Standard Operating Procedure: IESL Impactor

Standard Operating Procedure: Bioaerosol Sampling and Analysis

## Inclusion Enrollment Report

**Study Title:** Bioaerosol Exposures and Models of Human Responses in Dairies  
**Total Enrollment:** Up to 128 **Protocol Number:** 11-2847H  
**Grant Number:** 5U54OH008085

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino	1	23	0	24 **
Not Hispanic or Latino	1	2	0	3
Unknown (individuals not reporting ethnicity)	0	0	0	0
<b>Ethnic Category: Total of All Subjects*</b>	2	25	0	27 *
<b>Racial Categories</b>				
American Indian/Alaska Native	0	2	0	2
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	0	0	0
White	1	8	0	9
More Than One Race	0	0	0	0
Unknown or Not Reported	1	15	0	16
<b>Racial Categories: Total of All Subjects*</b>	2	25	0	27 *
<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native	0	2	0	2
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	0	0	0
White	0	0	0	8
More Than One Race	0	0	0	0
Unknown or Not Reported	1	21	0	22
<b>Racial Categories: Total of Hispanics or Latinos**</b>	1	23	0	24 **

# Exploring Shed Antimicrobial Exposures within High Plains Livestock Operations

Paul Gunderson (PI), Sanjay Shukla (Co-PI)

## Summary

### A. Abstract

For more than five decades agricultural producers within the United States have administered sub-therapeutic doses of antibiotics, including macrolides, penicillins, tetracyclines and sulfonamides to poultry, feedlot beef cattle, fish, swine, and avian pheasant, duck, and geese populations. And, producers of bio-oil products have also used low doses for control of arthropod infestations. The antibiotics are given through feed or water as a prophylactic measure to enhance growth and retard communal transmission of disease, and in the case of crop farmers applied via aerosolized spray to control levels of infestation. The quantity of non-therapeutic product used within agricultural production environments has been estimated to account for 35 to 70 percent of all antibiotic use across the United States placing it at the top of the world's industrialized nations. Mechanisms of antimicrobial resistance have been reported for virtually all known antibiotics, including those in use by agricultural producers. It is important to assess whether feeding antimicrobials to healthy food livestock and poultry or applying across large crop areas promotes development of resistant bacteria that can spread to humans involved in livestock operations. This study is the first phase in that exploration and involved 14 dairy farms in which fresh manure, fecal material from on-farm manure storage structures, and soil amended by manure were sampled across three growing seasons. Total genomic DNA was extracted for assessment of the total microbiota of manure and soil, *tet* (*tetK*, *tetL*, *tetM*, *tetO*, *tetT*, and *tetW*) genes were determined by gene-specific PCR in order to determine the prevalence of tetracycline (*tet*) in both types of samples, and to determine the concentration of selected physical properties (N, P, K, S, Ca, Mg, Na, Zn, Fe, Mn, Cu, and B) of soil so that initial assessment of capability to yield bacterium known to colonize and possibly infect humans could be conducted. Our data showed that the soil microbiome is rich in microbial density and species diversity with as many as ~ 60% of taxa not yet fully classified at the genus level, though Proteobacteria, Firmicutes, and Actinobacteria were dominant. Fresh manure reflected mostly uncharacterized microbiota, a large relative abundance of rare genera, and an abundance of *Ruminococcus* and *Rikinella* that reflect microbiome environments of the bovine gut. Manure stored in on-farm storage structures typically reflected lower levels, probably due to different nutrient and oxygen levels within such structures when compared to ambient barn atmospheres and use of manure digesters. High rates of tetracycline resistant genes were present in both manure and soil samples, while considerable variation of concentration was detected in soil samples, and the identified *tet* genes were identical to those present in common human pathogens. These results raise a number of important scientific, clinical and agricultural production management issues that deserve further exploration. For example, the majority (four of seven) of factors affecting ultimate fate of resistant genes are thought to be under human control...factors perpetrated by agricultural owners/managers and may be subject to design of management/policy recommendations capable of reducing or eliminating agricultural worker exposure to slurry manure borne antimicrobials..

### B. Background

In 2006, the PI was attending a European agricultural health and safety conference that highlighted, among other topics, the European Union's move toward combating antibiotic resistance within human medicine. In addition to announcing new training activities for medical providers in most EU countries, all countries had begun proceeding toward banning antibiotic use as growth promoters in food animal production. Upon his

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return home, this PI initiated a random exploration of antibiotic use within food production agricultural settings located in the Northern high plains region of the U.S.; this activity continued an informal inquiry of non-therapeutic use of antimicrobials within food animal agricultural enterprises initiated by both Paul Gunderson, Ph.D., and Dean Stueland, M.D. (former co-directors of the NIOSH-funded Midwest Center for Agricultural Research, Education, and Disease and Injury Prevention – 1991-1999) in the mid-1990's in central Wisconsin's dairy country. Little formal research activity unfolded until the end of 2006 when a small project team located at the Marshfield Medical Research & Education Foundation that included both Co-PI's identified above informally begun to explore potential research initiatives, due in part to heightened awareness of the potential for development of antibiotic resistance traits within the U.S. itself.

Antibiotics have been in use within human medicine across the U.S. for over 70 years and have saved millions of lives. And, not surprisingly, antibiotic use within production agriculture settings has closely paralleled use within human medicine. Such use, particularly in hospitals and food animal production facilities, results in intense pressure upon targeted bacteria, some of which survive and embark upon a journey of resistance development. It is estimated that at least two million people a year currently become infected with antibiotic-resistant bacteria, resulting in the death of 23,000 people annually (CDC, 2013).

Within U.S. food animal production settings, antibiotic use has followed two paths: (1) therapeutic use when combatting specific bacterial threat(s) such as treatment of foot rot in adult dairy cattle or emerging respiratory disease in young dairy and beef calves, or (2) as a growth promoter. Therapeutic use has evolved across time as agricultural producers discovered the contribution to their fiscal bottom line of timely food animal treatment, thereby altering disease progression and reducing or eliminating premature death. And, agricultural producers discovered early in the 1950's that adding antibiotics in low doses to feed, primarily in poultry (boiler chicken, turkey), selected avian species such as domesticated pheasant, duck, and geese, farmed fish, and swine finishing diets, resulted in faster growth and quicker attainment of desirable market weight. Some agricultural enterprises, such as dairy cow and goat milking enterprises never adopted the non-therapeutic practice given the potential for carry-through of antibiotic residue into milk, and when antibiotics were (and still are) used therapeutically within such enterprises, specific milk withdrawal periods are adhered to by producers.

These practices, ultimately mandated by the U.S. Food and Drug Administration (FDA), prevented entry of antibiotic-tainted milk into the nation's food chain. When used for growth promotion, antibiotics are given through feed or water as a prophylactic measure to encourage growth (reduction in disease impact) and retard communal transmission of disease. This practice grew in popularity given the nation's shift toward large food animal enterprises typically housed within concentrated spatial areas for efficiency and watchfulness. The quantity of non-therapeutic product used within such agricultural food production environments across the United States remains unknown as no surveillance system exists to address the practice, however advocates for reducing or eliminating non-therapeutic use suggest such use accounts for 35 to 70 percent of all antibiotic (hereafter referred to as antimicrobials) use within the United States (Mellon & Benbrook, 2001) and places the United States at the top of industrialized countries in employ of such products (DANMAP, 2008; Aarestrup, 2009; Kupferschmidt, 2016). Not unexpectedly, clinical attention to these matters has intensified and calls for change in agricultural use and accepted practice have emerged (The Economist, 2016; Association of Public Land-grant Universities & Association of American Veterinary Medical Colleges, 2016; Farm Foundation, 2016).

In an overall response to antimicrobial resistance, on January 1, 2017, new restrictions were instituted within the U.S. that required all agricultural food producing enterprises to implement a process employing Veterinary Feed Directives (VFD's). Mandated by the U.S. Food and Drug Administration, this requirement places dual-use antimicrobials (used within both human and veterinary medical practice) under veterinary supervision when used within agricultural food enterprises. This action was taken to ensure judicious use of shared-use

antimicrobials in livestock feed. Normally, this action requires establishment of a Veterinary Client Patient Relationship (VCPR) with agricultural food animal/poultry/arthropod/fish producers.

Antimicrobials currently in use among U.S. agricultural food producers include macrolides, penicillin's, tetracyclines, and sulfonamides (GAO, 1999 & 20190), as evidenced in Table 1 below.

**Table 1. Major Antimicrobial Agent Classes Approved for Use in Agricultural Livestock and Fowl Enterprises**

<b>Antimicrobial Class</b>	<b>Species</b>	<b>Prophylaxis</b>	<b>Growth</b>
<b>Promotion</b>			
Aminoglycoside	Feed cattle, goats, poultry, sheep, swine	Yes	No
β-Lactam (penicillin)	Beef cattle, dairy beef (culled heifers, steers, bull calves), fowl, poultry, sheep	Yes	Yes
β-Lactam (cephalosporin)	Beef cattle, dairy, fowl, poultry, sheep swine	Yes	No
Ionophore	Beef cattle, fowl, goats, poultry, rabbits,	Yes	Yes
Lincosamide	Poultry, swine	Yes	Yes
Macrolide	Beef cattle, poultry, swine	Yes	Yes
Polypeptide	Fowl, Poultry, swine	Yes	Yes
Streptogramin	Beef cattle, poultry, swine	Yes	Yes
Sulfonamide	Beef cattle, poultry, swine	Yes	Yes
Tetracycline	Beef cattle, dairy cows, fowl, honey bees, Poultry, sheep, swine	Yes	Yes
Bambermycin	Beef cattle, poultry, swine	Yes	Yes
Carbadox	Swine	Yes	Yes
Novobiocin	Poultry, swine	Yes	No
Spectinomycin	Poultry, swine	Yes	No

Adapted from GAO, 1999 & 2010.

Antimicrobials enter the agricultural environment in several ways. Within North America, these pathways include (1) discharges from urban-based wastewater treatment plants, (2) fecal voiding by pastured livestock, swine, and poultry, (3) land application of livestock manure by agricultural producers, (4) aerial and ground-based application of fungicides to oilseed and dryland cereal grain crops, (5) use of antimicrobials when farming bees, crustaceans, and fish, and (6) antimicrobial use in farm and rural household pets (for example, placing the farm dog on tetracycline which he/she sheds via licking, or rubbing the anus on soil, livestock bedding, or even household carpet with subsequent transfer via footwear to the external environment). Other potential vectors of transfer include migrating wild bird populations that nest or rest within food livestock production settings, house and horse flies, and German cockroaches. Central to this research was farm site management and storage of fecal material and urine, and land application of fecal material and urine.

The process that unfolds is dynamic. Antimicrobials are given both therapeutically and non-therapeutically (prophylactic or growth promoting) to food livestock (excepting lactating dairy cows), poultry, and fish whereupon the active ingredient is processed commensally within the gut. That process may generate, prior to excretion, antibiotic resistance gene organisms (ARG's) as a direct result of gene selection, horizontal gene transfer, or vertical gene inheritance, and the antimicrobial itself (AB's) as a moving product since most of the

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injected/ingested dose is excreted unchanged or as active metabolites (Courvalin, 2010). It has been estimated that 60% to 80% of commercial agricultural livestock raised on U.S. agricultural premises receive such compounds across their working lives (EPA, 2000).

Once secreted as fecal waste, the initial fate of antimicrobials depends on (1) characteristics of the livestock waste holding structure such as single or multi-cell storage, use of liquid-solid separation technologies, anaerobic digestion, one or more aerated cells for enhancing ammonia removal, or any physicochemical treatment of collected slurry such as employ of chlorine oxidation, chlorine dioxide, or ozone or ultraviolet oxidation, (2) thermal weather conditions during initial storage, and (3) sorption or hydrolysis, which in turn is dependent on innate characteristics of the antimicrobial itself. Fecal slurry manure carrying antimicrobials (AB residues), as well as other bacteria and antimicrobial resistant genes (ARG's) are agitated within the storage structure to integrate solids and aqueous solution, thereby achieving slurry homogenization prior to removal from storage structures. Its removal typically involves pumping into a 150 mm – 304 mm (6" – 8") diameter continuous hose for delivery to field transport vehicles that traverse agricultural field injection sites, whereupon it is injected into the top 20 cm (6") of the soil profile.

High plains soil profiles are structurally complex, and offer a milieu of subsequent fates within their profiles, including sorption, degradation, and transport to runoff or groundwater movement. As environmental matrices, Midwest and high plains soils contain but are not limited to organic matter and aqueous dissolved organic carbon (DOC), clays, sands, gravel, calcareous rock, metal oxides, and oxyhydroxides, and fates of antimicrobials are dependent on (1) soil pH levels, (2) clay content, (3) cation exchange or cation-bridging (for those antimicrobials and other products possessing positive charges, such as the tetracyclines), (4) electron donor-acceptor interactions for those products possessing neutral interactions, (5) complexation for zwitterion products containing both a positive and a negative charge (as in fluoroquinolone antibiotics), (6) hydrophobic partitioning whereby mobility is reduced through lowering net electrical charges, and (7) metal oxides such as manganese being present (Carmonsini & Lee, 2008; Kumar, et al., 2005). Although these dynamics are not presently well understood relative to the fate of antimicrobials, antimicrobial communities do affect the soil biome, and telegraph effect to contiguous watershed areas, field buffers, global cycling of CO<sub>2</sub>, and other soil-borne off-gassing activity.

These interactions are complex, and the ultimate fate of shed antimicrobials, aside from initial fate factors, high plains soil characteristics (see above), and residual antimicrobial concentrations within liquid livestock slurry, is thought to be affected by (1), manure management systems at the farm/ranch/feedlot site (long vs. short storage times with land application once or more per year, moisture content of the slurry, temperature control within the storage structure, oxygen availability, pH levels, covers permitting methane capture, or use of amendments promoting odor control or organic matter breakdown), (2) technological features of field application equipment, (3) choice of field crop capable of up-taking applied/injected slurry nutrient, (4) structural characteristics of the receiving soil profile, (5) presence/absence of field drainage, including sub-surface drain tile, (6) the relative contribution of thermal events (degree growing days, UV exposure, surface wind velocities, and rain runoff), and (7) soil surface weathering/leaching.

### **C. Aims**

The overall objective of this R21 project was to identify and quantify shed antimicrobials (tetracyclines functioned as surrogate) within agricultural environments where workers handle, manage, and apply liquid manure slurry, given their persistent and pervasive use within livestock operations, whereupon specific management and policy recommendations for agricultural enterprises will be developed. Specifically, this

project sought to collect samples of fecal pats (fresh manure), stored dairy and swine manure slurry, and soil cores from fecal-amended crop fields, and...

- (1) quantitate shed tetracyclines, their metabolites, and other structurally related transformation products found within livestock feces, amended soil, and
- (2) characterize dissipation half-lives of identified tetracyclines, their metabolites, and other identified structurally related transformation products, and
- (3-a & 3-b) explore the interactions and processes resident within manure slurry, field soil, and airborne field dust microbiomes by (a) assessing the presence of tetracycline resistance determinants conferring ribosomal protection through extracting DNA, and (b) testing for encoding of the following genes – [*tet(K)*, *tet(L)*, *tet(M)*, *tet(O)*, *tet(T)*, and *tet(W)*], and
- (4) document short-term movement of compounds of interest within soil zones and/or into groundwater, and
- 5) provide management and policy recommendations capable of controlling, reducing (or eliminating) agricultural worker exposure to shed antimicrobials.

#### D. Methods

**Sample Collection.** The samples were collected in three different seasons from 14 unique farms. The samples collected were as follows. In the fall of 2015 (14 farms), the spring of 2016 (13 farms), and the fall of 2016 (13 farms). We collected a total of 230 samples. Typically from each farm, we collected one fresh manure sample, three samples from manure holding lagoons at 6", 12", and 24" depths, and two soil samples at 6" and 12" depths respectively.

**Microbiome Analysis Methodology.** Total genomic DNA was extracted individually from these samples with appropriate DNA extraction kits. DNA quality and quantity were determined. Extracted DNA was stored at -80°C. The microbiota from these samples was determined by amplifying the V4 region of the 16S rRNA bacterial gene with barcoded (along with Illumina adapter) primers using 515F and 806R primer pairs (Illumina, Inc., San Diego, CA). The amplicons were sequenced using the MiSeq Reagent Kit V2 Sequencing Primers (Illumina, Inc.). Microbiome sequence analysis was performed utilizing the modules of the Mothur software (version 1.34, [www.mothur.org](http://www.mothur.org)). Sequences were screened for ambiguity and homopolymers. Chimeras were detected using the Uchime algorithm. The sequences were clustered as operational taxonomic units (OTUs) using the threshold of 3% divergence (97% pairwise identity cutoff). All taxonomic classifications were assigned using the naïve Bayesian algorithm developed for the RDP classifier, as in Mothur 1.3.4 (47); OTU representative sequences were classified at the taxonomic level by comparing them with sequences from the SILVA database with the threshold limit of sequence homology set to 80%. Sequence abundance for each sample was calculated to build an OTU table. OTU data were analyzed at the phylum, family, and genus levels by implementing appropriate % relative abundance cut off across the three taxonomic levels. The OTU table was used to calculate descriptive indices for microbial diversity (alpha-diversity, non-parametric Shannon index), richness (Chao1 richness estimate), and phylogenetic evenness of the microbiome species (Shannon index-based measure of evenness). Beta-diversity measures were performed using AMOVA to compare the species composition among the sampled microbiota from soil and manure samples. Principal coordinate analysis (PCoA) was performed directly on the OTU table to analyze within-group relationships. Distance

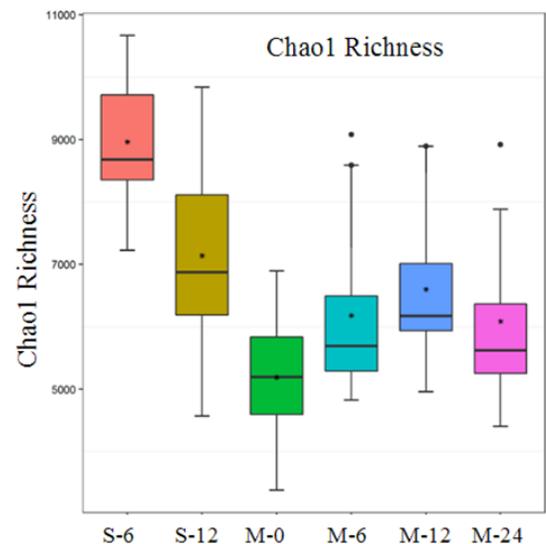


Figure 1. Chao 1 richness of the soil and manure denote soil and manure and the number after the letters denotes the sample. The letters S and M are depth at which the samples were collected. M-0 = fresh manure.

matrices were constructed based on the index of similarity of community composition with distances and structure estimated with the Bray-Curtis indices, respectively. These changes were visualized by PCoA plot with the first PCo 1 on the x-axis and second PCo 2 on the y-axis. Descriptive statistics of sequences and relative abundance were calculated and visualized in boxplots using ggplot2 package in R. A T-test was performed to determine the significant differences of relative abundance at the phylum, family, and genus level of data from the four groups. All statistical analyses were performed with MOTHUR 1.34.0 and R 3.1.0 (47) (<http://www.R-project.org/>).

**Determining Prevalence of (*tet*).** Identified genes were determined by gene specific PCR.

**Determining Concentration of Soil Compounds of Interest.** Soil samples for submitted to a certified laboratory (AGVISE LABORATORIES , Northwood, North Dakota 58267) for analysis of overall soil chemistry and identified levels.

**Developing Agricultural Enterprise Management Recommendations.** The PI is developing these recommendations whereupon they will be submitted for empirical review.

### E. Brief Summary of Findings

The data were analyzed for three seasons at the phyla, family, and genus level. The Chao indices of soil samples were higher than manure samples but within manure samples, the Chao index measure of species richness) was higher for samples from holding lagoons (Figure 1). However, the Shannon diversity index (measures how many different types of species) of the fresh manure samples was higher than the samples from the holding lagoons. The Shannon index was higher for soil samples (Figure 2). This observation was consistent across all three seasons. At the phyla level manure samples (both fresh and from holding lagoons) were dominated by Firmicutes followed by Bacteroidetes, an unclassified bacterial group and Actinobacteria. The soil samples, on the other hand, had relatively higher abundance of Proteobacteria, Bacteroidetes, an unclassified bacterial group, and Actinobacteria. All sample groups had a rare group which consisted of bacteria represented by relative abundance less than 1 %. The rare group constituted ~58% of relative abundance in soil samples compared ~20% in manures from holding lagoons and ~9% in fresh manure. The soil samples had ~3 fold

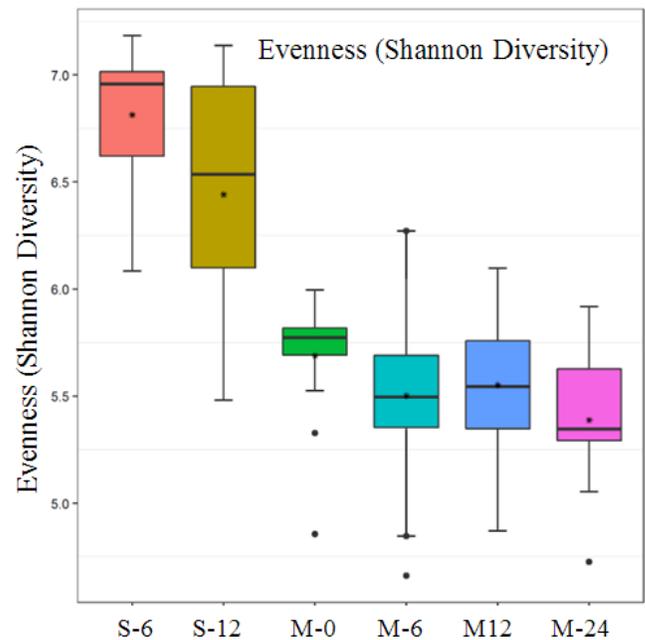


Figure 2. Shannon diversity index (evenness) of the soil and manure samples. The letters S and M denote soil and manure and the number after the letters denotes the depth at which the samples were collected. M-0 = fresh manure.

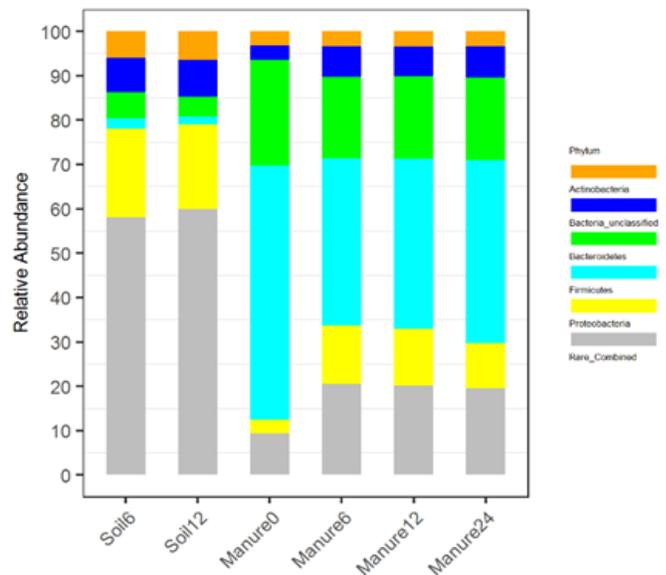


Figure 3. A representative profile of microbiota at the phyla level

higher 'rare phyla group' compared to the manure sample group suggesting soil had more rare species than other samples. Firmicutes and Bacteroidetes were the dominant phyla in fresh manures (Figure 3).

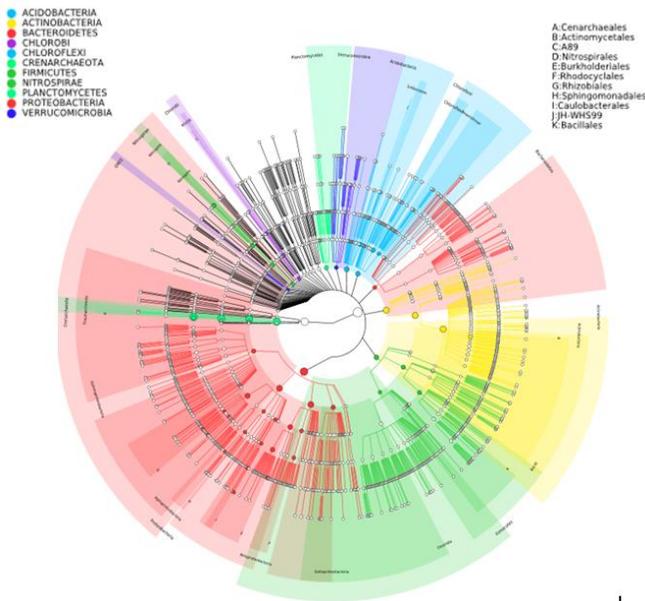


Figure 4. A representative phylogenetic tree of microbiota of soil samples.

At the family level, manure samples were dominated by bacterial members belonging to Ruminococcaceae (the dominant gut microbes that digests complex carbohydrates), Rikenellaceae, Porphyromonadaceae, and Planctomycetaceae. Again, the soil sample had more rare families than the manure samples.

At the genus level, both soil and manure samples were dominated by rare genera (represented by less 0.025% relative abundances) and an unclassified genera. This suggests not much is known about the rich diversity of bacteria present in soil and manure (Figure 4). Fresh manure had significantly higher relative abundance of members of Ruminococcaceae and Rikenellaceae\_RC0\_gut\_group and Prevotellaceae\_UCG-003 compared to bacteria present in other manure and soil samples. The Principal component analysis showed soil, fresh manure, and the manure in holding tanks clustered away from each other. Not surprisingly, the holding tank samples at all three depths had a similar microbiome.

Specific agricultural enterprise management recommendations are currently under development given that the first empirical laboratory results are emerging from our project. Several recommendations have been developed, and are under review by our project veterinarian and a small team of agricultural entrepreneurs. This activity will consume much of the summer, fall and winter of 2017 - 2018, together with development of the first three scientific manuscripts, as clinical and managerial review of each recommendation is imperative before release to the general agricultural industry.

## F. Conclusions

These project results are novel as the project investigated the complexity of the microbiome of dairy enterprise environments which spanned fresh cow manure pats, manure stored in on-farm holding structures over 6 – 12 month periods, and crop fields amended by stored manure via injection or surface application technologies. **This study was very difficult to implement as its timing occurred within the outbreaks of both the Swine Flu and Bird Flu epidemics that spanned 2013 to date.** Most agricultural enterprises resisted placement of project staff within their enterprises to extract manure samples and soil cores. Some were also suspicious of the project's outcome given that the FDA was also addressing the antimicrobial issue via implementation of the Veterinary Food Animal Directive beginning in January, 2017. Our data showed that the soil microbiome is quite rich in microbial density and species diversity with as many as ~60% of taxa not yet fully classified at the genus level. Among the known phyla, Proteobacteria, Firmicutes, and Actinobacteria were dominant. Fresh manure also reflected mostly uncharacterized microbiota and a large relative abundance of rare genera. As expected, the manure harbored significant abundance of *Ruminococcus* and *Rikinella* species reflecting the microbiome environment of the bovine gut. There was a change in microbiome composition from fresh manure to the manures stored in on-farm holding structures. This was likely due to different levels of nutrient and oxygen available in holding structures compared to the typical bovine gut. Further, use of manure digester technologies by some farms may have contributed to this difference as well.

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There was a high rate of tetracycline resistant genes present in both manure and soil samples although the latter group had comparatively lower rates. Based on DNA sequencing, these *tet* genes were found to be identical to those present in common human pathogens. And, the concentration of major chemical elements varied considerably in soil samples.

### Outputs and Outcomes

Not applicable at this juncture given that overall analysis of laboratory results is still underway

### Cumulative Enrollment Table

Not Applicable

# Prevention/Intervention Core

David Douphrate (Core Director)

Exposure Assessment and Intervention Analysis in Industrialized Dairy Parlors (R01)

David Douphrate (PI)

Development and Evaluation of a Computer-based ROPS Design Program (CRDP) (R01)

Paul Ayers (PI)

# Exposure Assessment and Intervention Analysis in Large-Herd Dairy Parlors

David Douphrate (PI), David Gimeno, Matthew Nonnenmann, Nathan Fethke,  
Robert Hagevoort, John Rosecrance, Stephen Reynolds.

## Summary

### A. Abstract

Over the past three decades the U.S. dairy industry has moved to a mass production model with larger herd sizes. With the goal of increased milk production at lower cost, dairy capacity will continue to grow leading to increases in task specialization for workers. The 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 for milking parlor workers. This 5-year project addressed the health and safety of large-herd dairy parlor workers through physical exposure assessment and intervention analysis. Physical exposures were compared across parlor configurations, and intervention strategies were evaluated for their effectiveness in reducing physical exposures. 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.

### B. Background

Large-herd dairy workers remain a vastly understudied population, and limited research has addressed intervention efforts leading to the reduction of unintentional injuries and work-related musculoskeletal disorders in this vulnerable working group. Dairy production in the U.S. is steadily moving toward large-herd operations due to associated economies of scale. The relatively recent shift towards large-herd production has led to an increased need for intervention research. The long-term goal of this multi-year project was to contribute to the general body of knowledge which may lead to the reduction or elimination of injuries among vulnerable workers in large-herd milking facilities. This innovative and novel work was the first to quantify and compare physical exposures in U.S. large-herd parlors.

### C. Aims

Aim 1: Quantify and compare full shift physical workloads (motion, posture, and muscle force) of the upper extremity and cardiovascular workloads among workers performing milking tasks in three industrial parlor configurations. Status: Completed.

Aim 2: Determine an optimum parlor pit height which minimizes physical exposures (postures and muscle activity) of the upper extremity and trunk among workers performing milking tasks in large herd parlors. Status: Completed.

Aim 3: Evaluate the effect of an ergonomic intervention (lightweight milking cluster) on muscle activity of selected upper extremity muscle groups. Status: Completed.

Aim 4: Evaluate the effect on an ergonomic intervention (teat stripping and sanitization tool) on muscle activity of selected upper extremity muscle groups. Status: Completed.

Aim 5: Based on findings from Specific Aims 1-4, develop recommendations and strategies for dairy producers which address parlor design, milking tools and worker productivity. Status: Based on findings, recommendations will continue to be presented in publications and presentations.

### D. Methods

To compare full-shift physical exposures (i.e. motion, posture, muscle activity) we utilized direct measurement technology and novel exposure metrics. Direct-measurement methods included surface electromyography (EMG) to estimate muscle activity, and wireless inertial measurement units or IMUs to estimate limb motion and postures. Custom software written in Labview enabled the efficient processing of large data files and the

generation of novel exposure metrics. This project was the first study to use this direct-measure, motion capture technology in challenging work environments of milking parlors.

## **E. Findings**

A number of findings from this project will contribute to the body of knowledge regarding large-herd milking parlor exposures, and will enable the development of targeted intervention strategies to reduce work-related musculoskeletal disorders among parlor workers. Findings from Aim 1 revealed lower muscle activity levels and higher muscular rest among rotary parlor workers as compared to herringbone and parallel parlor workers. These findings suggest rotary parlors may offer workstation designs or organizational dynamics which may be more beneficial to the health and performance of the worker, as compared to parallel or herringbone parlors. Additionally, differences in limb motion and posture exist between parlor configurations. A third finding from this Aim includes evidence of the onset of localized muscle fatigue and subjective fatigue during the course of a milking shift. This is in addition to the gradual demise of worker performance (teat wipe effectiveness) during the milking shift. Milking tasks in large-herd dairy parlors have significant effects on the upper limb muscle activity of workers. Specifically, the muscle activity of biceps brachii during normal work tasks exceeded the recommended safe limits. Wrist flexors and upper trapezius approached the recommended limit. The study findings suggest that milking tasks in large-herd dairies may increase the worker's risk for developing musculoskeletal symptoms and possibly musculoskeletal disorders. (Findings published.)

Data from Aim 2 are still being analyzed, but preliminary findings suggest differences in parlor pit height contribute to differences in muscle forces in the upper extremity. These findings will contribute to the identification of an optimal pit height for a predominantly Latino workforce (shorter in stature). (Manuscript in development.) Findings from Aim 3 revealed differences in upper extremity muscle activity levels across milking unit designs. Milking unit weight, milk tube spread, and teat cup shape may explain differences in muscle activity levels. Milking unit design may influence muscle activity levels among Latino parlor workers. Small reductions muscle activity associated with milking unit design have the potential to delay the onset of fatigue or development of musculoskeletal health outcomes among parlor workers. (Findings published.)

Findings from Aim 4 revealed conventional manual milking tasks of dip, strip and wipe were associated higher muscle activity levels of the upper trapezius and anterior deltoid. Results also suggest that the novel teat scrubber (TS) system is effective in reducing anterior deltoid muscle activation levels. The TS system also appears to result in increased biceps, forearm flexor and extensor muscle activation levels. However, increases in muscle activation levels could be offset by reduced repetitiveness resulting from three conventional manual milking tasks being replaced with one TS task. If parlor production requirements (e.g., quality and consistency) are maintained while simultaneously reducing cumulative muscle loading and worker fatigue, then TS use should be considered in milking parlor operations. (Findings published.)

## **F. Conclusions and Plans**

Our findings suggest organizational factors associated with parlor design may have an influence on muscle activity and potentially the development of worker fatigue. In turn, worker fatigue could result in compromised worker health, parlor productivity or cow health. Engineering controls such as parlor configuration and workstation design, milking cluster design and udder preparation tools may contribute to the reduction of physical exposures among workers. In addition to parlor configuration and milking routine, dairy producers should consider engineering and administrative controls and their influence on worker health and performance.

Dr. Douphrate and his research team plan to apply the One Health model to investigate the interactions between the worker, cow and working environment. A new study proposal will be developed using findings from this project, newly developed metrics to assess worker fatigue, as well as a novel method to assess worker performance. Dr. Douphrate and his research team will propose a new study to evaluate worker fatigue and its association with worker health and performance, as well as cow health. We plan to solicit both USDA and

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CDC/NIOSH funding. Findings from this study will facilitate the identification of effective within-shift and weekly work-rest strategies.

## Outputs and Outcomes

### Journal Articles

#### 2017

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26. Douphrate, D. (2011, June). Dairy Farm Safety and OSHA--Approaches for Effective Management and Worker Training. *Utah State University Dairy Extension Newsletter*, 34.
27. Douphrate, D. (August, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/august-2011-2.pdf>
28. Douphrate, D. (September, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/september-2011.pdf>

## Conference Papers, Presentations, Abstracts

### 2016

1. Douphrate, D. (November 7-8 2016). *Dairy safety management: current situation, challenges, and solutions*. Invited Presenter at the Washington State Dairy Safety Conference, Ellensburg, WA.
2. Douphrate, D. (June 20-23, 2016). *Full-shift and task-specific ergonomic exposure assessment of posture and muscle activity among dairy parlor workers in US large herd operations*. Presentation at the Ninth International Conference on Prevention of Work-Related Musculoskeletal Disorders (PREMUS), Toronto, Canada.
3. Douphrate, D. (May 25-26, 2016). *Dairy worker health and safety*. Invited Presenter at the Washington Department of Safety and Health Technical Symposium, Wenatchee, WA.
4. Douphrate, D. (March 1-2, 2016). *On-farm risk management and safety on dairy farms: Regulatory requirements and planning*. Presentation at the High Plains Dairy Conference, Lubbock, TX.
5. Douphrate, D. (February 24, 2016). *Worker health and safety on US dairies*. Invited lecture to the Governor's Agricultural Safety Day, Wenatchee, WA.
6. Hagevoort, R., Douphrate, D., Garcia, B. A., & Rodriguez, A. (August 24-26, 2016). *Delivery of animal handling training to U.S. workers using novel mobile technologies*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Billund, Denmark.
7. Hagevoort, R., & Douphrate, D. (March 30, 2016). *Dairy safety management*. Presentation at the Western States Dairy Producers Trade Association Annual Meeting, Las Vegas, NV.

### 2015

29. Douphrate, D. (October 29-30, 2015). *Acute agricultural injuries*. Texas Rural Health Association, Agromedicine Workshop, Fort Worth, TX.
30. Douphrate, D., & Reynolds, S. J. (September 18, 2015). *Successful Strides with Dairy Workers*. Presented at the Western States Occupational Network (WestON), Denver, CO.
31. Douphrate, D. (May 30-June 4, 2015). *Interventions to reduce exposure to physical risk factors for musculoskeletal disorders among dairy parlor workers*. Presentation at the American Industrial Hygiene Conference and Exposition (AIHce), Salt Lake City, UT.
32. Hagevoort, R., Douphrate, D., DeWitt, H., & DeJong, D. (March 5, 2015). *Training Employees under Higher Standards*. Panel presentation at the Western Dairy Management Conference, John Ascuaga's Nugget, Reno, NV.

### 2014

33. Douphrate, D. (November 20-22, 2014). *Worker health and safety on U.S. Dairy Farms*. Presented at

the 24th Annual Midwest Stream Farmworker Health Forum, San Antonio, TX.

34. Douphrate, D., Gimeno, D., Nonnenmann, M., Hagevoort, R., Rosecrance, J., & S.J., R. (October 19-22, 2014). *Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
35. Douphrate, D., Fethke, N., Hagevoort, G. R., Nonnenmann, M., Gimeno, D., Marshall, A., . . . Reynolds, S. J. (October 19-22, 2014). *Task-specific and full-shift sampling of upper extremity muscle activity among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)

## 2013

36. Douphrate, D. (September 26, 2013). *Dairy Equipment Innovations*. Panel Presentation at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
37. Douphrate, D., Keifer, M., Liebman, A., Carrabba, J., Hagevoort, R., Grafft, L., & Reynolds, S. J. (June 23-27, 2013). *Assisting the dairy industry to optimize worker health and safety*. Expert Panel Presentation at the International Society of Agricultural Safety and Health Annual (ISASH) Conference: Exploring the shores of safety and health, Sandusky, OH.

## 2012

38. Douphrate, D. (September 28-30, 2012). *Upper extremity hazards and solutions in large herd parlor milking*. Presentation at the Agricultural Safety and Health: Focus on Dairy Conference, Palmerston North, New Zealand. Conference agenda retrieved from <http://www.conference.co.nz/worldsafety2012/agriculturalsafetyhealth>
39. Douphrate, D., & Rosecrance, J. (September 3-6, 2012). *Ergonomic exposure assessment of posture and muscle activity among dairy parlor workers in U.S. large herd operations*. Paper presented at the International Conference on Safety, Health and Welfare in Agriculture and Agro-food Systems--Ragusa SHWA, Ragusa Ibla Campus- Italy.
40. Douphrate, D., Rosecrance, J., & Reynolds, S. J. (August 27-29, 2012). *Ergonomic exposures of posture and muscle activity among U.S. large herd dairy parlor workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Ystad, Sweden.

## Outcomes

We have adopted and utilized novel ergonomic exposure metrics for full-shift exposures including Amplitude Probability Distribution Function (APDF), Exposure Variation Analysis (EVA), Median Power Frequency, and Gap Analysis. These metrics will enable comparison of ergonomic exposures to other studies, as well as enable the quantification of intervention effectiveness. In addition, we have developed a novel methodology using image pixel analysis to assess worker performance (teat cleaning effectiveness and consistency). This new methodology will enable future research investigations of the associations between worker fatigue and performance. Additionally, findings from the teat-preparation evaluation facilitated the re-design of the milking tool to reduce the forearm muscle loads on the worker. The manufacturer has made modifications to the tool by moving the location of the drive shaft. By doing so, the center of mass of the tool has been altered thus potentially reducing the load of the forearm muscle activity.

## Inclusion Enrollment Report

**Study Title:** Exposure Assessment and Intervention Analysis in Dairy Parlors - UTHSCH  
**Total Enrollment:** \_\_\_\_\_ **Protocol Number:** HSC-SPH-11-0361  
**Grant Number:** 5U54OH008085

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino	0	146	0	146 **
Not Hispanic or Latino	0	2	0	3
Unknown (individuals not reporting ethnicity)	0	0	0	0
<b>Ethnic Category: Total of All Subjects*</b>	0	146	0	146 *
<b>Racial Categories</b>				
American Indian/Alaska Native	0	0	0	0
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	0	0	0
White	0	146	0	146
More Than One Race	0	0	0	0
Unknown or Not Reported	0	0	0	0
<b>Racial Categories: Total of All Subjects*</b>	0	146	0	146 *
<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native	0	0	0	0
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	0	0	0
White	0	146	0	146
More Than One Race	0	0	0	0
Unknown or Not Reported	0	0	0	0
<b>Racial Categories: Total of Hispanics or Latinos**</b>	0	146	0	146 **

## Inclusion Enrollment Report

**Study Title:** Exposure Assessment and Intervention Analysis in Industrialized Dairy Parlors - CSU  
**Total Enrollment:** 29 **Protocol Number:** 13-4448H  
**Grant Number:** 5U54OH008085

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino	1	28		29 **
Not Hispanic or Latino				
Unknown (individuals not reporting ethnicity)				
<b>Ethnic Category: Total of All Subjects*</b>	1	28		29 *
<b>Racial Categories</b>				
American Indian/Alaska Native				
Asian				
Native Hawaiian or Other Pacific Islander				
Black or African American				
White	1	28		29
More Than One Race				
Unknown or Not Reported				
<b>Racial Categories: Total of All Subjects*</b>	1	28		29 *
<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native				
Asian				
Native Hawaiian or Other Pacific Islander				
Black or African American				
White	1	28		29
More Than One Race				
Unknown or Not Reported				
<b>Racial Categories: Total of Hispanics or Latinos**</b>	1	28		29 **

# Development and Evaluation of a Computer-based ROPS Design Program (CRDP)

Paul Ayers (PI)

## A. Abstract

Tractor rollover is the leading cause of agricultural fatalities in the United State. These fatalities can be eliminated using a Rollover Protective Structure (ROPS) and a seatbelt. Unfortunately, not all agricultural tractors, designed to support ROPS, have ROPS designs. A computer-based ROPS design program (CRDP) was developed and successfully tested to provide a quick and simple tractor 2-post, rear axle-mounted ROPS design based on the SAE J2194 standard. The program utilizes tractor dimensions and weight to calculate the dimensions needed for ROPS components. Excel was used as the framework which provides the input, calculation, and ROPS drawing worksheets. Three ROPS (for Massey Ferguson 265, Long 460 and Allis Chalmers 5040 tractors) were designed and constructed using the CRDP. Static rear, side and vertical tests were conducted based on SAE J2194 on two of the ROPS. All ROPS performance deflections (RPD) tests were less than the ROPS allowable deflections (RAD), indicating the ROPS passed the static tests. The third ROPS was successfully mounted on the tractor axle housing within one hour, demonstrating the ease of installation using the CROPS bolted corner bracket design. Although the CRDP provided a quick and simple design for ROPS this program does not eliminate the requirement to conduct and pass the ROPS performance tests specified in OSHA and SAE standards.

## B. Background

Tractor overturn is the leading cause of occupational fatalities on farms in the US. Roll-over protective structures (ROPS) have been proven effective to reduce fatalities during tractor overturns. A ROPS, as described in SAE J2194, is a protective structure designed to minimize the frequency and severity of operator injury resulting from accidental tractor upset. ROPS are designed to absorb energy resulting from the impact of the tractor with the ground surface during a tractor overturn, protecting the operator zone from intrusion of outside objects and exposure to the ground plane.

While ROPS are prevalent on agricultural tractors in the United States, an estimated 1.6 million tractors are still not equipped with ROPS. Many tractors originally designed to support a ROPS, do not have current ROPS designs, and thus have no ROPS availability. Many of these tractors can be retrofitted with a two-post ROPS. CROPS (cost effective ROPS) can be made quickly, using mostly Off –The-Shelf (OTS) materials, but still need a technically valid design for a specific tractor. CROPS research with NIOSH has shown that ROPS designs can be simple and easy to manufacture, but must be specific for each tractor model series.

Although some ROPS designs are simple, the process of designing the ROPS is not. ROPS designs require a balance of 1) ROPS material strengths and allowable deflections to meet energy criteria, 2) elasto-plastic material behavior to reduce peak moments at the mounting brackets, and 3) ROPS positioning and alignment to meet appropriate operator protection. The ROPS design process is not a straight-forward procedure and requires experience and engineering analysis to develop a feasible ROPS design. Once an appropriate ROPS design is developed, the construction of the ROPS, while requiring skill, is an easy process. Testing of the ROPS design is required to assure the design meets appropriate OSHA regulations and SAE ROPS performance standards.

To assist retrofitting ROPS on tractors within the US, a current need is to develop and demonstrate a computer-based ROPS design program to assure ROPS availability for all post-ROPS tractors. The program would provide two-post ROPS retrofit designs for tractors that were originally designed to receive a ROPS, but for which ROPS designs are lacking. The tractor ROPS design process includes parameters such as the tractor weight and dimensions, and ROPS mounting points. The designs must to be based on appropriate

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OSHA 1928.52 regulations and/or SAE J2194 standards. The computer-based ROPS design program should not require specialized/expensive software, and provide a design (and associated mechanical drawings) that is easy to implement and construct by ROPS manufacturers and/or local custom fabricators (machine shops). An inventory parts list and associated material costs would provide support to ease material acquisition and feasibility. This program does not eliminate the requirement to conduct and pass the ROPS performance tests specified in OSHA and SAE standards.

### C. Aims

The objectives of this study are to develop and evaluate a computer-based Excel program to assist in the design of tractor 2-post, rear axle-mounted ROPS.

### D. Methods

A computer-based ROPS design program (CRDP) was developed to quickly and effectively develop ROPS designs based on a tractor's weight and dimensions. Based on the previous ROPS design experience the model input parameters consists of 46 tractor dimensions and tractor mass. ROPS designs are based on 28 ROPS dimensions. An empirical approach was used to generate the relationship between the ROPS and tractor dimensions. The model was derived by examining existing ROPS designs based on SAE J2194 and developing relationships with the tractor dimensions. The model parameter inputs were determined for 15 tractor/ROPS combinations with 2-post rear axle housing mounts, and have been included into the tractor/ROPS dimension database. Relationships between the ROPS and tractor dimensions were developed. The CRDP uses the tractor dimensions and weight inputs (input example shown in figure 1) and the derived relationships between tractor and ROPS dimensions to define the final ROPS design dimensions. The final framework for the computer-based ROPS design program (CRDP) utilizes Microsoft Excel. The program requires tractor dimension inputs and provides ROPS design outputs. The 28 required ROPS design dimensions were incorporated into the ROPS output CAD drawing (within Excel), which are used for ROPS construction. The final ROPS design construction drawings have been included in the computer-based ROPS design program (CRDP). This includes drawing of the posts, crossbeam, baseplates, corner braces and strapping (fig. 2). The CRDP utilizes a bolted corner bracket design based on the NIOSH CROPS design (McKenzie and Harris, 2010; Keane and McKenzie, 2013). To assist in the ROPS construction an Excel worksheet provides a material list and expected pricing (fig. 3). Steel grades are not specified, however ASTM A500 Grades B and C, ASTM A513 Grade A and ASTM A36 are common for ROPS construction. The steel must be either Charpy-approved or the ROPS must be cold tested.

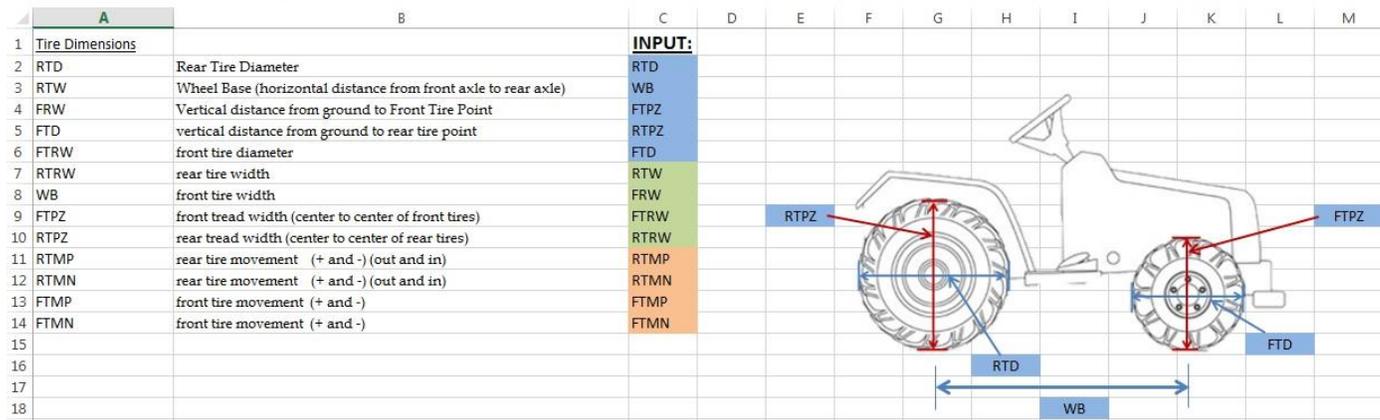


Figure 1. Example of tractor dimension input requirements.

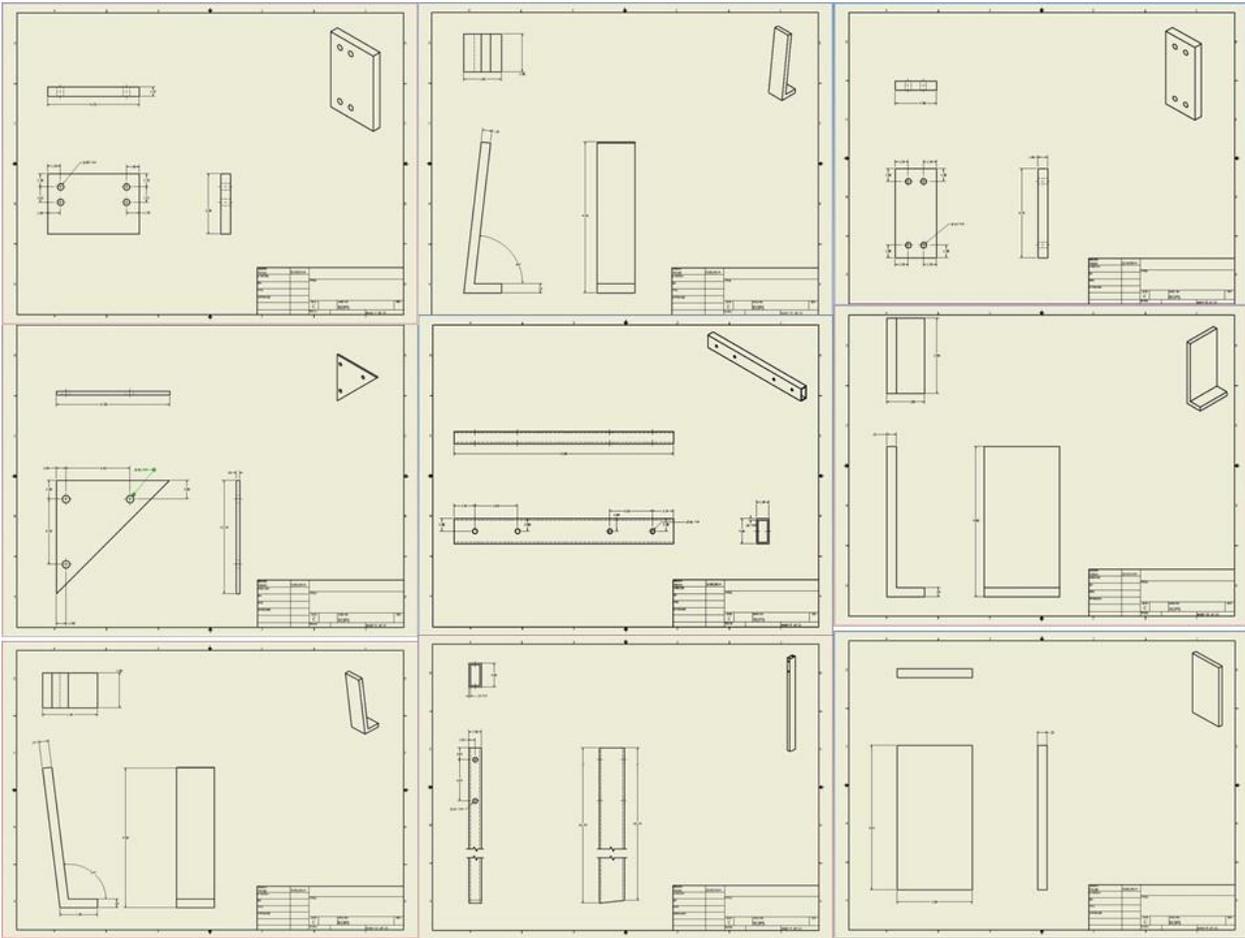


Figure 2. Set of drawings for ROPS parts.

	A	B	C	D	E	F	G
1	<b>Summary of Materials and Cost</b>						
2	Length in inches						
3	<b>ROPS Tubing</b>						
4	Quantity	Thickness	Width	Depth	Length	Part	Price
5	2	0.1875		2	3	69.8 posts	\$153.48
6	1	0.1875		3	2	38.8 crossbeam	\$62.28
7							
8	<b>Baseplates</b>						
9	Quantity	Thickness	Length	Width		Part	Price
10	2	0.75		8.875	6.28125	Top Baseplate	\$60.69
11	2	0.75		8.875	5.8125	Bottom Baseplate	\$56.16
12							
13	<b>Corner Braces</b>						
14	Quantity	Thickness	Length	Width			Price
15	1	0.375		12	12		\$40.32
16							
17	<b>Strapping</b>						
18	Quantity	Thickness	Length	Width		Part	Price
19	1	0.25		20		1 Baseplate Strapping	\$3.45
20	1	0.25		20		1 Baseplate Strapping	\$3.45
21							
22	<b>Fasteners</b>						
23	Quantity	Diameter	Grade	Length		Part	Price
24	14	0.5		8	10	Baseplate Bolt	\$86.59
25							
26	Total:						\$466.42
27							
28							
29							

Figure 3. Excel worksheet with ROPS material lengths, quantities and approximate costs.

## E. Findings

Using the CRDP and acquired tractor dimensions, ROPS for 3 tractors (Massey Ferguson 265, Allis Chalmers 5040 and Long 460) were designed and successfully constructed using a local fabricator. The Allis Chalmers 5040 and Long 460 tractors were chosen as they were identified as a common ROPS request for NYCAMH ROPS retrofit program, and a current ROPS design was not commercially available. The Massey Ferguson 265 design was selected as this tractor is currently available in-house, and the assembly and ROPS mounting could be evaluated. Using the CRDP, the ROPS materials were determined and acquired. The material and construction costs for each ROPS were documented and ranged from \$500 to \$600.

The bolted corner bracket design and the detailed axle housing bolt groove measurements provided an easily assembled ROPS without the need for mounted modifications or construction. The Massey Ferguson 265 ROPS design was validated by successful mounting on the axle housing of the tractor. ROPS mounting was conducted in less than one hour, without modification.

According to SAE J2194 standard, ROPS must pass sequences of static tests, including of the rear, side, and vertical load tests. The ROPS must absorb predefined levels of energy during the rear and side load tests and tolerate a specific force under vertical loads, before the driver's clearance zone is infringed by the ROPS or the ground surface.

The ROPS performance criteria for the Long 460 and Allis Chalmers 5040 tractors are shown in table 1. The required energy for a ROPS designed for the Long 460 tractor is equal to 2844.8 J and 3556.0 J under rear and side load, respectively. The Allis Chalmers 5040 absorbed energy must be equal to 2578.8 J and 3223.5 J for rear and side load, respectively. The vertical load to withstand was 40,640 N for Long 460, and 36,840 N for Allis Chalmers 5040.

Table 1. Tractor mass, required ROPS performance criteria, and performance and allowable deflections.

	Long 460	Allis Chalmers 5040
Tractor reference mass (kg)	2032	1842
Rear load test, absorbed energy (J)	2844.8	2578.8
Rear load test, RPD (cm)	22.9	17.6
Rear load test, RAD (cm)	40.0	42.0
Vertical load test, load (N)	40,640	36,840
Vertical load test, RPD (cm)	2.4	0.7
Vertical load test, RAD (cm)	7.2	6.8
Side load test, absorbed energy (J)	3556.0	3223.5
Side load test, RPD (cm)	22.1	16.8
Side load test, RAD (cm)	36.0	29.5

The ROPS Allowable Deflection (RAD) is defined as the maximum deflection of the ROPS without violating the intrusion or exposure criteria. The ROPS Performance Deflection (RPD) is determined during the static tests. The RPD is the ROPS deflection at the point that the ROPS absorbs the predefined level of energy in rear or side tests, or the ROPS deflection under the vertical load. To pass the SAE J2194 Standard the RPD must be smaller than the RAD.

The ROPS for the Long 460 and Allis Chalmers 5040 tractors were sent to the FEMCO Inc. in McPherson, KS for experimental tests. The standard static load tests were conducted on the ROPS using the SAE J2194 standard test procedure. In static side load test for the Long 460 the RAD is 36.0 cm and the RPD is 22.1 cm indicating the ROPS passes the test. In the static rear load tests for the Long 460 the RAD of 40.0 cm is greater than the RPD of 22.9 cm indicating the ROPS passes the rear load test. Similar results were found in the side and rear load tests for the Allis Chalmers 5040. For the vertical tests the Long 460 ROPS and Allis Chalmers 5040 ROPS produced deflections of 2.4 and 0.7 cm, respectively. The RAD for the two tractors were 7.2 and 6.8 cm, indicating the actual ROPS deflection was lower, and the operator was protected. In all tests, the RAD is greater than the RPD, indicating both ROPS pass the SAE J2194 side, rear and vertical tests.

## F. Conclusions

A computer-based ROPS design program (CRDP) was developed and successfully tested to provide a quick and simple tractor 2-post, rear axle-mounted ROPS design based on the SAE J2194 standard. Relationships between tractor and ROPS dimensions were established. The program utilizes tractor dimensions and weight to determine the dimensions needed for ROPS components to be used for construction. The program uses Excel as the framework which provides the input, calculation, and ROPS drawing worksheets. Three ROPS were designed and constructed using the CRDP. Based on SAE J2194, static rear, side and vertical tests were conducted on two of the ROPS. All ROPS deflections during the performance tests were less than the ROPS deflections that expose the operator zone to the ground plane or intrude into the operator zone, indicating the ROPS passed the static tests. The third ROPS was successfully mounted on the tractor axle housing within one hour, demonstrating the ease of installation using the CROPS bolted corner bracket design. The CRDP provided a quick and simple design for ROPS for tractors originally designed to support ROPS

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(post-ROPS tractors). This program does not eliminate the requirement to conduct and pass the ROPS performance tests specified in OSHA and SAE standards.

## Outputs and Outcomes

### Products

1. ROPS designs for 3 tractors (Allis Chalmers 5040, Massey Ferguson 285, Long 460).
2. Computer-based ROPS design program and manual.

### Journal Articles

#### 2017

1. Ayers, P., F. Khorsandi, X. Wang, and G. Araujo. 2017. ROPS designs to protect operators during tractor rollovers. In press for Journal of Terramechanics, Special Issue.
2. Khorsandi, F., P. Ayers, and T. Truster. 2017. Developing and evaluating a finite element model for predicting the Roll-Over Protective Structure (ROPS) nonlinear behavior under SAE J2194 Static Test. Biosystems Engineering 156(2017) 96-107.

#### 2016

3. Ayers, P., F. Khorsandi, Y. John, and G. Whitaker. 2016. Development and evaluation of a computer-based ROPS design program. Journal for Agricultural Safety and Health 22(4): 247-260.

### Conference Papers, Presentations, Abstracts

#### 2015

1. Ayers, P. and F. Khorsandi. 2015. ROPS design and testing for rigid and foldable structures: Computer-based ROPS Design Program (CRDP) and foldable ROPS force analysis and lift assist design. Proceeding of the International Conference on Rural Health, Lodi, Italy.

# Education and Translation Core

Victoria Buchan (Core Director)

Enhancing Safety Training Effectiveness in Industrialized Dairy Production (R01)

Noa Roman-Muniz and John Rosecrance (Co-PIs)

Enhancing Translation and Dissemination through Agricultural Partnerships (R18)

John Rosecrance and David Gilkey (Co-PIs)

# Enhancing Safety Training Effectiveness in Large-Herd Dairy Production

Noa Roman-Muniz (PI)  
John Rosecrance (Co-PI)

## Summary

### A. Abstract

This study builds upon our extensive research and outreach activities in the dairy industry and addresses important issues related to safety training for workers in large-herd dairy operations. The long-term goal of the proposed research is to eliminate injuries among a vulnerable (primarily Latino) workforce in industrialized dairy operations. The purpose of the proposed project was to develop a training program that addresses critical training issues not often considered in traditional safety education. The training program developed from the proposed project is not intended to replace but rather to enhance existing safety curriculums. The investigators pursued an innovative approach that addresses facilitators and barriers of safe work practices as well as the facilitators and barriers involved in the transfer of training knowledge to actual work environments. The specific aims included 1) Develop, implement, and evaluate safety workshops that enhance the effectiveness of safety training for dairy workers and managers; and 2) Develop, implement, and evaluate an empirically-based dairy communication campaign designed around the strategies tested and refined in the dairy safety workshops. The first major contribution to agricultural safety research of this study was the consideration of human-related systems in the development of effective dairy safety training. The second major contribution to agricultural safety research was the development of an empirically-driven safety communication campaign that incorporates both audience segmentation and end-user collaboration.

### B. Background

Dairy farming is among the most dangerous occupations and accounts for a disproportionately large percentage of all injuries in livestock-related agriculture. The relatively recent shift towards industrialized dairy production has led to greater work demands, task specialization, and higher rates of injuries and illnesses. The industrialization of dairy work has resulted in a critical need for effective safety training specific to owners / supervisors and to Latino/a dairy workers. Although data pertaining to injury and illness rates for Latino (a) dairy workers is scarce, individual, cultural and environmental factors suggest that this population of workers is at higher risk of occupational injuries and illnesses. Previous work has shown that current occupational safety and health training programs are offered inconsistently and might not have the intended impact of protecting workers against occupational risks. Given the direct and indirect costs associated with workplace injuries and illnesses, it is essential to provide culturally congruent and relevant occupational safety and health training opportunities for immigrant, Latino/a workers in the dairy industry.

### C. Aims

The original Specific Aims of the Dairy Safety Training Project were consistent during the grant period and included:

Aim 1: Develop, implement, and evaluate safety workshops that enhance the effectiveness of safety training for dairy workers and managers.

Aim 2: Develop, implement, and evaluate a dairy communication campaign designed around the strategies tested and refined in the dairy safety workshops in Specific Aim 1.

## **D. Methods**

Focus groups were conducted to determine the barriers to / facilitators of effective safety training programs in the dairy industry. A total of 68 dairy workers and managers participated in 7 focus groups. Data were collected regarding dairy occupational history, job related knowledge and job characteristics, physical and socio-psychological work environment, as well as management factors. The data was used to develop an open-ended survey to validate identified themes and assess the prevalence of the safety barriers / facilitators perceived by workers and management. A total of 61 workers in Colorado completed the survey. Results from the focus groups and surveys guided the creation of a video training program. The training program was developed by interviewing 9 dairy workers and management on best practices to minimize the risk of exposure to zoonoses on the dairy farm. To assess the effectiveness of this training program, 105 workers from local dairy operations were recruited to complete pre and post training surveys. A treatment group and 2 control groups (from dairies where some coworkers watched the video and dairies where no worker watched the video) were compared for changes in knowledge, attitudes and self-reported behaviors prior to the training session and 3 months following the training session.

## **E. Findings**

Although most dairy workers who participated in this study were immigrant Latino(a), reported backgrounds and dairy industry experiences were varied. Regardless of their tenure in dairy production, participants demonstrated serious knowledge gaps in animal health, behavior, and handling topics. Work demands and psychosocial conditions negatively affected productivity and occupational safety and health. Animal handling hazards, equipment maintenance issues and ineffective communication were identified as contributing to unsafe working environments.

Managers considered effective by workers were described as accessible, fair, knowledgeable and good communicators. Workers who reported greater quality of communication with managers also reported decreased job stress and a greater work-life balance. Additionally, dairy workers who perceived their supervisors as being concerned with occupational health and safety, reported greater job satisfaction.

Workers saw training programs as motivators and valuable, especially when specific to their job-related tasks. Workers who had received safety training were more likely to have communicated with their physician about their dairy work. Workers who completed the video training on best practices to decrease the risk of exposure to zoonoses on the dairy perceived the training as valuable and beneficial and showed positive changes in knowledge, attitudes and preventive behaviors.

## **F. Conclusions**

Dairy operations are perceived as risky environments by workers. Management can significantly influence worker's perceptions and the culture of health and safety on the dairy operation. Psychosocial conditions, especially the quality of communication between management and workers may have greater effects on worker health and sense of wellbeing than demographics or training experiences. In addition to developing culturally congruent training programs, dairy operations should invest on the developing of middle and top management human resource management and leadership skills. Training programs created with the input and participation of the target audience could prove effective in increasing knowledge and changing attitudes and behaviors for immigrant Latino(a) workers in US dairy operations. Findings from these research activities could inform policies, procedures and programs aiming to enhance dairy worker health and safety.

## Outputs and Outcomes

### Journal Articles and Book Chapters

#### 2017

1. Autenrieth, D., & Román-Muñiz, N. (2017). Needs and Opportunities for Applying Voluntary Occupational Health and Safety Management Systems in the High-Hazard US Dairy Production Industry. In Arezes, P. (Ed.), *Advances in Safety Management and Human Factors: Proceedings of the AHFE 2017 International Conference on Safety Management and Human Factors*, July 17-21, Los Angeles, CA (pp. 55-66), Cham, Switzerland: Springer.

#### 2016

2. Menger-Ogle, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2017). *A Guide to the Design of Occupational Health and Safety Training for Immigrant, Latino/a Dairy Workers*. Panel presentation at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
3. Menger, L. M., Pezzutti, F., Tellechea, T., Stallones, L., Rosecrance, J., & Roman-Muniz, I. N. (2016). Perceptions of Health and Safety among Immigrant Latino/a Dairy Workers in the U.S. *Front Public Health*, 4, 106. [doi: 10.3389/fpubh.2016.00106](https://doi.org/10.3389/fpubh.2016.00106)

#### 2013

4. Rosecrance, J., Tellechea, T., Menger, L., Gilkey, D., & Roman-Muniz, N. (2013). Health and safety challenges associated with immigrant dairy workers. [Conference Proceedings]. *J of Agricultural Engineering*, XLIV(s1):e129, 645-648. [doi: 10.4081/jae.2013.\(s1\):e129](https://doi.org/10.4081/jae.2013.(s1):e129)

### Conference Papers, Presentations, Abstracts

#### 2017

1. Menger-Ogle, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2017). *A Guide to the Design of Occupational Health and Safety Training for Immigrant, Latino/a Dairy Workers*. Panel presentation at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
2. Menger-Ogle, L. M., Pezzutti, F., Ogle, A. D., Amaya, F., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2017). *Occupational safety and health among immigrant, Latino/a dairy workers in Colorado*. Symposium presentation at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
3. Noa Roman-Muniz. (February, 2017). *Dairies and Communication: What you haven't been told*. AABP and VOICE's dinner lecture. CSU's Veterinary Teaching Hospital, Fort Collins, CO.

#### 2016

4. Menger, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2016). A Review of Best Practice Recommendations for Training Immigrant, Latino/a Dairy Workers in the U.S. Poster presentation at the National Occupational Research Agenda Conference, Salt Lake City, UT.
5. Flor Amaya-Soto, MV, Lauren Menger, PhD, Lorann Stallones, PhD, MPH, Pablo Pinedo, DVM, PhD, Noa Roman-Muniz, DVM, MS. (November, 2016) *Occupational Health and Safety (OHS) Knowledge Assessment: Audiovisual Training Program for Latino Workers in Colorado Dairies*. Poster presentation. Graduate Student Showcase, Colorado State University, Fort Collins, CO.
6. Dietz MA, Ryan EP, & Stallons L. (May, 2016). "Joint Indicators of Animal Welfare and Worker Safety Risks in the Dairy Industry." Oral Presentation and Poster Presentation. Colorado School of Public Health Forum, Colorado State University, Fort Collins, CO.

7. Noa Roman-Muniz. Immigration Challenges. (March, 2016). Panel presentation, Food & Ag Summit, Loveland, CO. 2016
8. Noa Roman-Muniz. "Perspectives on Labor Across Agricultural Industry Sectors." (February, 2016). Panel presentation, Governor's Forum on Colorado Agriculture, Denver, CO.

## 2015

9. Jairo E. Palomares Velosa, DVM, MS; Gwenith Fisher, BA, MA, PhD; Noa Roman-Muniz, DVM, MS; Craig McConnel DVM, MA, PhD; Lyndsey Linke, BS, ME, PhD; Roberta Magnuson BS; Sangeeta Rao, BVSc, MVSc, PhD; and Mo D. Salman, BVMS, MPVM, PhD. (2015). Socio-ecological model for zoonotic diseases exposure of dairy farm communities: a proposed approach. Poster. 2015 SNOCAP Convocation and CCTSI Community Engagement Research Exchange, Denver, CO.
10. Roman-Muniz, I. N., Rosecrance, J., Menger, L., Pezzutti, F., Stallones, L., & Amaya, F. (September 9, 2015). *Dairy Worker Safety Training: Current Challenges and Opportunities for Enhanced Effectiveness*. International Congress on Rural Health, Lodi, Italy.
11. Menger, L., Stallones, L., Pezzutti, F., Roman-Muniz, I. N., & Rosecrance, J. (September 9, 2015). *Health and Safety Challenges among Dairy Workers in the United States*. International Congress on Rural Health, Lodi, Italy.
12. Menger, L. M., Pezzutti, F., Stallones, L., Rosecrance, J., & Roman-Muniz, N. (May, 2015). *Safety and productivity among immigrant dairy workers*. Poster presentation accepted at the 11th International Conference on Occupational Stress and Health: Work, Stress, & Health, Atlanta, GA.
13. Noa Roman-Muniz. (December, 2015). "Multicultural Management Workshop." Two-day workshop presented for Professional Dairy Producers of Wisconsin. Green Bay, WI.
14. Noa Roman-Muniz. (October, 2015). *Cultural and Language Barriers to Effective Communication in CO Livestock Operations*. Presentation and panel discussion Immigration and Agriculture: A One Health Approach, Fort Collins, CO.

## 2014

15. Roman-Muniz, I. N. (December 10-11, 2014). *Worker Training and Protocol Development*. Presentation for Midwest PMS Nutrition, Denver, CO and Firestone, CO.
16. Roman-Muniz, I. N., & Wall, T. (December 10-11, 2014). *Multi-Cultural Management*. Two-day workshop hosted by the Professional Dairy Producers of Wisconsin, Chula Vista Resort, Wisconsin Dells, WI.

## 2013

17. Rosecrance, J., Tellechea, T., Menger, L., Gilkey, D., & Roman-Muniz, I.N. (2013). *Health and Safety Challenges Associated with Immigrant Dairy Workers*. Published abstract in the Journal of Agricultural Engineering. Volume XLIV(s2):e129, 645-648

## 2012

18. Noa Roman-Muniz. (December, 2012). *Hispanic Supervisor Workshop*, Presented for Professional Dairy Producers of Wisconsin, Chilton, WI and Madison, WI.
19. Noa Roman-Muniz. (December, 2012). *Bridging Cultures on Dairy Operations*, Presented for Professional Dairy Producers of Wisconsin, Oshkosh, WI.
20. Noa Roman-Muniz. (2012). *Bridging the Culture Divide*, Colorado Agriculture Big and Small Conference, Brighton, CO.
21. Noa Roman-Muniz. (2012). *Dairy Labor Management*, Great Lakes Regional Dairy Conference, Mt. Pleasant, MI.

### Trade Publications

1. Roman-Muniz, N., & Douphrate, D. (May 21, 2014). Preventing zoonotic disease on the dairy (Part 2 of 2). *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12216:preventing-zoonotic-disease-on-the-dairy&catid=45:herd-health&Itemid=71](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12216:preventing-zoonotic-disease-on-the-dairy&catid=45:herd-health&Itemid=71)
2. Roman-Muniz, N., & Douphrate, D. (May 21, 2014). What are zoonotic diseases? (Part 1 of 2). *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12215:what-are-zoonotic-diseases&catid=45:herd-health&Itemid=71](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12215:what-are-zoonotic-diseases&catid=45:herd-health&Itemid=71)
3. Roman-Muniz, N., & Douphrate, D. (December 17, 2013). Dairy worker safety and health: Vaccination Safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75)
4. Noa Roman-Muniz. 2012. "Training the Trainers: how to facilitate the development of the middle manager's training skills." *Rocky Mountain Milk Peak*, Fall Issue.

### Audiovisual Products

1. (2016) Best Practices to Stay Healthy at the Dairy Farm. Bilingual video training Program. <https://vimeo.com/161500888> (English), <https://vimeo.com/145893176> (Spanish).
2. Tellechea, T. (2012). Photo essay of Latino dairy workers performing their daily work tasks. Fort Collins, CO: High Plains Intermountain Center for Agricultural Health and Safety at Colorado State University.

## Inclusion Enrollment Report

**Study Title:** Enhancing Safety Training Effectiveness in Industrialized Dairy Production  
**Total Enrollment:** 107 **Protocol Number:** 12-3246H  
**Grant Number:** 5U54OH008085

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino	40	170	1	211 **
Not Hispanic or Latino	6	18		24
Unknown (individuals not reporting ethnicity)	1	2	5	8
<b>Ethnic Category: Total of All Subjects*</b>	47	190	6	243 *
<b>Racial Categories</b>				
American Indian/Alaska Native				
Asian				
Native Hawaiian or Other Pacific Islander				
Black or African American				
White	2	4		6
More Than One Race				
Unknown or Not Reported	45	184	8	237
<b>Racial Categories: Total of All Subjects*</b>	47	188	8	243 *
<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native				
Asian				
Native Hawaiian or Other Pacific Islander				
Black or African American				
White				
More Than One Race				
Unknown or Not Reported	40	170	1	211
<b>Racial Categories: Total of Hispanics or Latinos**</b>	40	170	1	211 **

# Enhancing Translation and Dissemination through Agricultural Partnership

John Rosecrance (PI)  
David Gilkey (Co-Investigator)  
Allison Cassidy (Program Manager)  
Gus Arroyo (Graduate Research Assistant)

## Summary

Agricultural organizations representing producers and workers as well as State Extension Programs have very limited the resources to adequately provide health and safety training to their membership and their agricultural-related populations. Through community-initiated small grants, community organizations and HICAHS researchers have been engaged together in developing and conducting agricultural health and safety education and training programs to agricultural end-users. During the grant period, HICAHS assisted a variety of community partners with small grants in augmenting their occupational safety efforts. The occupational groups that we targeted during the grant period included dairy and livestock workers (livestock handling focus), ranchers and farmers (all terrain vehicle safety focus) small land foresters (chainsaw safety focus) and professional loggers in Montana (focus on heavy equipment safety and emergency first aid). These projects involve partnerships with South Dakota State University Dairy Extension and surrounding dairy farms, Colorado Livestock and Dairy Association, New Mexico State University Dairy Extension, Montana State University Extension, Montana State University Forestry Extension and the Montana Logging Association. Additionally, we have engaged other organizations that have added context and valuable data to this work including the Consumer Product Safety Commission, ATV Institute of America, Workers' Compensation Boards in Colorado, Montana and Idaho.

## A. Abstract

This project built on the foundation of twenty years of agricultural partnership development as well as our previous translation-dissemination initiative at the High Plains Intermountain Center for Agricultural Health and Safety (HICAHS). The project focused on the opportunities to strengthen the effectiveness of the translation and dissemination activities of our network of community partners involved in agricultural safety and health. The goal of this project was to enhance the translation, dissemination, and evaluation of the safety and health activities of agricultural community organizations. Key facets of this project included financial support to organizations involved in agricultural health and safety activities through community-initiated small grants and methodological assistance to grant recipients in the evaluation of their translation and dissemination activities. Knowledge generated from community-initiated small grants were translated into user-specific media and disseminated to the targeted agricultural community. Investigators utilized a participatory approach where university personnel and agricultural stakeholders were engaged in a process focused on the needs of the targeted agricultural community.

## B. Background

The diversity of agriculture and the vast distances between communities in the HICAHS region presents a major challenge to dissemination of agricultural health and safety information. Through our extensive partnership base with a variety of agricultural stakeholders, HICAHS was well positioned to assist community organizations in their conduct and evaluation of translation and dissemination activities relevant to agricultural health and safety. Effective dissemination not only required the translation of research results into user-friendly and culturally sensitive material, but also required a system of community trusted change agents who communicate with farmers, workers, and the agricultural community. This type of innovation/dissemination model involving researchers, agricultural specialists and farmers/workers is often referred to as the "Agricultural Extension Model." Agricultural organizations representing producers and workers as well as State Extension Programs have very limited the resources to adequately provide health and safety training to their membership and their agricultural-related populations. Through community-initiated small grants, community organizations and HICAHS researchers were engaged together in developing and conducting agricultural health and safety education and training programs to agricultural end-users.

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### **C. Aims**

The original Specific Aims of the Translation Project were consistent throughout the grant period and included the following:

Aim 1: Augment regional agricultural health and safety education programs by providing community-initiated small grants to regional agricultural partners involved in the prevention of occupational injuries and illnesses.

Aim 2: Enhance and refine the translation and dissemination activities of organizations receiving community-initiated small grants through formative evaluation and impact assessment processes.

### **D. Methods**

This project provided innovative communication, education, and social marketing techniques to influence knowledge, attitudes and practices of agricultural workers. Through the community-initiated small grants program, community organizational and HICAHS researchers were engaged together in developing and conducting agricultural health and safety education and training programs for our stakeholders. Based on our network of agricultural stakeholders and safety and health needs assessment of the agricultural community, we targeted our efforts in dairy / livestock, logging and among ranchers and farmers that used ATVs in their work. The agricultural community-initiated small grants program involved organizations in 5 states (Colorado, Wyoming, Montana, South Dakota, North Dakota) of the HICAHS Region. Neighboring New Mexico was also included as it shares common agricultural health and safety issues in the dairy industry. Agricultural partners in each state were contacted and notified of the availability of grant money from HICAHS to award for community-initiated projects aimed at improving agricultural health and safety specific in their community. The HICAHS personnel informed agricultural groups about the agricultural community-initiated small grants program through networking activities in the region (direct phone calls, announcements at meetings, organization newsletters, and the HICAHS website).

For the agricultural community-initiated small grants program, we originally budgeted \$34,000 that funded approximately three to four awards each year ranging from \$7,000 to \$15,000 each. The award levels were based on the scope of the projects submitted. Awards were made on an annual basis and scheduled (announcement of program, proposal evaluation, award made) per the Center's funding cycle. High priority for funding was given to the proposals that were considered to be targeted occupational groups (dairy/livestock, logging and forestry, and ATV use in agriculture). Each community-initiated proposal that met an acceptable score received an award.

### **E. Findings**

Occupational groups that we targeted during the grant period did include dairy and livestock workers, ranchers and farmers using ATVs, and forestry workers (both small landowners as well as professional loggers. The projects that were the most successful based on the evaluation of products and outputs were those that were directly involved with personnel at HICAHS during the entire project period. Successful partners included South Dakota State University Dairy Extension and their surrounding dairy farms, New Mexico State University Dairy Extension, Montana State University Extension, Montana State University Forestry Extension and the Montana Logging Association. Addition engagement with other organizations (Consumer Product Safety Commission, Workers' Compensation Boards) added considerable value in the success of the community-initiated projects.

### **F. Conclusions**

The most successful occupational safety programs in the agricultural community are those that involve end-users and key stakeholders such as extension agents or agricultural community change agents. Working together with university personnel as in the Agricultural Extension Model, is very effective for developing a safety culture and safer community.

## Outputs and Outcomes

### Book Section

1. Gilkey D, Rosecrance J, Neves H, Lagerstrom E. (2017) ATV Safety in Agriculture: Injury, Illness, Analysis and Interventions. In: Stanton N. (eds) *Advances in Human Aspects of Transportation*. AHFE 2017. *Advances in Intelligent Systems and Computing*, vol 597, 227-233.

### Publications

#### 2017

1. Rosecrance J, Lagerstrom E, Murgia L. (2017) Job factors associated with occupational injuries and deaths in the United States forestry industry. *Chemical Engineering Transactions*, 58, 115-120 DOI: 10.3303/CET1758020.
2. Lagerstrom E, Magzamen S, Rosecrance J. (2017) A mixed-methods analysis of logging injuries in Montana and Idaho. *American Journal of Industrial Medicine*

#### 2016

3. Masci F, Tassoni M, Bossi M, Magenta Biasina A, Serrao G, Rosecrance JC, Colosio, C. (2016). Assessing the effects of biomechanical overload on dairy parlor workers' wrist: Definition of a study approach and preliminary results. *WORK: A Journal of Prevention, Assessment & Rehabilitation*, 55, 747-756.
4. Menger LM, Rosecrance JC, Stallones L, Roman-Muniz IN. (2016). A Guide to the Design of Occupational Safety and Health Training for Immigrant, Latino/a Dairy Workers. *Frontiers in Public Health*, 4:282.
5. Lagerstrom, E. A., Magzamen, S. L., Stallones, L., Gilkey, D. P., Rosecrance, J. C. (2016). Understanding risk factor patterns in ATV fatalities: A recursive partitioning approach. *Journal of Safety Research*, 59, 23-31.
6. Masci, F., Mixco, A., Brents, C. A., Murgia, L., Colosio, C., Rosecrance, J. C. (2016). Comparison of Upper Limb Muscle Activity among Workers in Large-Herd U.S. and Small-Herd Italian Dairies. *Frontiers in Public Health*, 4, 141.
7. Mixco, A., Masci, F., Brents, C. A., Rosecrance, J. C. (2016). Upper Limb Muscle Activity among Workers in Large-Herd Industrialized Dairy Operations. *Frontiers in Public Health*, 4, 134.
8. Menger, L. M., Pezzutti, F. L., Tellechea, T., Stallones, L., Rosecrance, J. C., Roman-Muniz, I. N. (2016). Perceptions of Health and Safety among Immigrant Latino/a Dairy Workers in the U.S. *Frontiers in Public Health*, 4, 106.

#### 2015

9. Lagerstrom E, Hibiske S, Gilkey D, Rosecrance J. (2015). Case Study: The Development of Safety Tip Sheets for ATV Use in Ranching. *Safety*, 1, 84-93. doi:10.3390/safety1010084
10. Lagerstrom E, Gilkey D, Elenbaas D, Rosecrance J. (2015). ATV-Related Workers' Compensation Claims in Montana, 2007–2012. *Safety*, 1, 59-70. doi:10.3390/safety1010059

### Conference Papers, Presentations, Abstracts

#### 2017

1. Gilkey D, Rosecrance J, Neves H, Lagerstrom E. (July, 2017). ATV Safety in Agriculture: Injury, Illness, Analysis and Interventions. 8th International Conference on Applied Ergonomics and Human Factors. Los Angeles, CA
2. Rosecrance J., Lagerstrom E. Murgia L. (June, 2017). Job factors associated with occupational injuries and deaths in the US forestry industry. XXXVII CIOSTA & CIGR International Conference: Research

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and Innovation for the Sustainable and Safe Management of Agricultural and Forestry Systems. Palermo, Italy

3. Rosecrance J., Symposium Chair, WMSDs and Occupational Health, International Congress on Safety Health and Welfare in Agriculture Agrofood and Forestry Systems, Lodi, Italy September 8-11, 2015.
4. Rosecrance J., Symposium Chair, Dairy Consortium International Perspectives on Health and Safety among Dairy Workers: Challenges, Solutions and the Future, International Congress on Rural Health, Lodi, Italy September 8-11, 2015.
5. Sdfdsf

## 2015

6. Rosecrance, J, Lagerstrom, E., Gilkey D., Community engagement in the prevention of injuries and deaths from agricultural All-Terrain Vehicle Use. Platform Presentation. International Congress on Safety Health and Welfare in Agriculture Agrofood and Forestry Systems, Lodi, Italy September 8-11, 2015.
7. Menger L, Stallones L, Pazzuti F., Roman-Muntz N, Rosecrance J. Health and safety challenges among dairy workers in the United States. Platform Presentation. International Congress on Safety Health and Welfare in Agriculture Agrofood and Forestry Systems, Lodi, Italy September 8-11, 2015.
8. Murgia L, Rosecrance J, Malall, Paulsen R. Ergonomic issues and musculoskeletal disorders among ewe dairy workers involved in mechanical milking. International Congress on Safety Health and Welfare in Agriculture Agrofood and Forestry Systems, Lodi, Italy September 8-11, 2015.
9. Rosecrance J, Murgia L. Manually milking ewes and the risk of carpal tunnel syndrome. Platform Presentation. International Congress on Safety Health and Welfare in Agriculture Agrofood and Forestry Systems, Lodi, Italy September 8-11, 2015.
10. Rosecrance J, Murgia L, Paulsen R. Comparison of the Strain Index and OCRA Checklist for Risk Analysis Occupational MSDs. Platform Presentation, International Congress on Rural Health, Lodi, Italy September 8-11, 2015.
11. Gilkey, D. and Rosecrance, L. (2015). Developing Innovative Partnerships to Reduce Deaths from All-Terrain Vehicle use in Agricultural Operations. International Ergonomics Association, Melbourne, Australia. August 9th – 15th. (Platform presentation)

## 2013

12. Douphrate D, Gimeno D, Nonnenmann M, Hagevoort R, Rosas-Goulart C, Rosecrance J. (2013) Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers. American Journal of Industrial Medicine.

## 2012

13. Douphrate D, Fethke N, Nonnenmann M, Rosecrance J, Reynolds S. (2012) Full shift arm inclinometry among dairy parlor workers: A feasibility study in a challenging work environment, Applied Ergonomics, 43(3) 604–613
14. Patil A, Rosecrance J, Douphrate D, Gilkey D. (2012) Prevalence of carpal tunnel syndrome among dairy workers. American Journal of Industrial Medicine, Vol 55(2), 127–135.

## Research to Practice (R2P) Outcomes

In collaboration with the Montana Logging Association, Dr. Rosecrance and his graduate students developed a 3-hour video-based OSHA compliant emergency first aid training program for professional loggers. In the spring of 2017, 1200 professional loggers in Montana were trained with the program. The course will be used annually as part of the Association's safety training. In collaboration with Extension Specialists and ranchers in Montana ATV Safety Tip Sheets were developed and disseminated throughout the HICAHS region and the US via websites hosted by Montana State University and HICAHS. Additionally, an ATV safety training videotape and training curriculum were developed and are available through HICAHS and the US Agricultural Center's YouTube Channel. Other videotapes that were developed for end-users in the dairy industry were finished and funded in part by HICAHS include those developed by the New Mexico State University Dairy Extension Specialist on dairy worker safety. In fact, that video series was the 2<sup>nd</sup> most popular (out of videos 100 on the Ag Center's YouTube channel) with over 5000 viewers.

## Inclusion Enrollment Report

**Study Title:** Enhancing Translation and Dissemination through Agricultural Partnership (EP2) -  
ATV Use and Animal Handling Safety - ATV Safety Training  
**Total Enrollment:** 75 **Protocol Number:** 11-2744H  
**Grant Number:** 5U54OH008085

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino				**
Not Hispanic or Latino	30	45		75
Unknown (individuals not reporting ethnicity)				
<b>Ethnic Category: Total of All Subjects*</b>	30	45		75 *
<b>Racial Categories</b>				
American Indian/Alaska Native				
Asian				
Native Hawaiian or Other Pacific Islander				
Black or African American				
White				
More Than One Race	30	45		75
Unknown or Not Reported				
<b>Racial Categories: Total of All Subjects*</b>	30	45		75 *
<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native				
Asian				
Native Hawaiian or Other Pacific Islander				
Black or African American				
White				
More Than One Race				
Unknown or Not Reported				
<b>Racial Categories: Total of Hispanics or Latinos**</b>				**

# Colorado State University

HIGH PLAINS INTERMOUNTAIN CENTER  
FOR AGRICULTURAL HEALTH & SAFETY



## 2011-2017 HICAHS Publications & Products

CDC/NIOSH Cooperative Agreement No. 2 U54 OH008085

September 2017

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## Leveraged Projects (and Pending Grants)

<b>Years</b>	<b>Title of Proposal</b>	<b>Agency</b>	<b>Amount</b>
2015 – 2020	Mountain and Plains ERC (Reynolds PI at CSU and Director IH Program, Rosecrance, Stallones, Gilkey, Schaeffer, Brazile, Volckens)	CDC/NIOSH	\$8,100,000
2016-2017	Safety Training Among Dairy Workers Using Mobile Learning Technologies [SH-29638-16-60-F-48] (PI: Douphrate)	DOL/OSHA Susan Harwood	\$116,248 Total Costs
2015-2016	Safety Training Among Dairy Workers Using Mobile Learning Technologies [SH-27689-15-60-F-48] (PI: Douphrate)	DOL/OSHA Susan Harwood	\$126,000 Total Costs
2015 – 2018	R21. Mechanisms of bone loss following inhalant bioaerosol- induced lung inflammation. (Poole at UNMC PI, Reynolds consultant)	NIEHS	\$5,000 Reynolds Portion
2014-2015	Safety Training Among Dairy Workers Using Mobile Learning Technologies [SH-26326-14-60-F-48] (PI: Douphrate)	DOL/OSHA Susan Harwood	\$140,000 Total Costs
2014 – 2017	Design and Evaluation of Interventions to Improve Dairy Worker Health (Reynolds, Schaeffer, Magzamen PI's)	NIOSH	\$823,800
2014 – 2015	Modified Bioaerosol Sampling for Influenza Virus in Agricultural Environments (Reynolds PI)	CSURF	\$21,000
2014 – 2015	HICAHS Administrative Supplement (Reynolds PI)	CDC/NIOSH	\$90,000
2013 – 2014	Pilot Study Bioaerosols in an Australian Dairy (Reed PI at ECU, Reynolds, Schaeffer, Davidson at CSU)	Aust. Gov.	\$4500
2013 – 2015	The Impact of Pesticides on Cancer Morbidity and Reproductive Health of Rural Population, and Development of Risk Reduction Strategy (Reynolds PI at CSU, Tadevosyan PI Armenia)	State Committee of Science Armenia	\$17,700
2011 – 2012	Pinnacol Research Advisory Council	Pinnacol Assurance	\$14,448
2012 – 2013	Pinnacol Research Advisory Council	Pinnacol Assurance	\$14,448
2011 – 2012	Preventive Search and Rescue	DOI-NPS- National Park Service	\$20,000

<b>Years</b>	<b>Title of Proposal</b>	<b>Agency</b>	<b>Amount</b>
2011 – 2012	Reassessment of Indoor Air Quality in Swine Confinement Barns – Reynolds -Consultant/rFC Assay	Natl Pork Board	\$1,400
2010	TLR4 and NOD2 Sensors of Gram Positive Breakdown Products (Poole PI at UNMC) Reynolds Role –Consultant	NIEHS	\$5,000 (CSU)
2010 – 2013	Endotoxin Exposure in Texas Dairies Reynolds Mentor for KO1 Award Dr. Matt Nonnenmann, University of Texas Tyler/ University of Iowa 2011	CDC/NIOSH	\$37,631
2011 – 2016	Mountain and Plains ERC	CDC/NIOSH	\$4,000,000
	<ul style="list-style-type: none"> <li>Administrative Core (PI Reynolds)</li> </ul>		\$2,055,000
	<ul style="list-style-type: none"> <li>Industrial Hygiene Program (PI Reynolds)</li> </ul>		\$1,114,500
2010-2015	Mountain and Plains ERC <ul style="list-style-type: none"> <li>Director, Occupational Health Psychology Training (PI Stallones)</li> </ul>	CDC/NIOSH	\$1,553,000 /year,
2014	Carry-forward of unspent funds High Plains Intermountain Center for Agricultural Health and Safety (HICAHS) grant for 2012 – 2013. \$466,197 unobligated balance for the HICAHS Center grant U54OH008085-09 and the HICAHS Administrative Supplement grant 3U54OH08085-09S1.		
2015 – 2020	Mountain and Plains ERC Reynolds PI at CSU and Director IH Program	CDC/NIOSH	\$8,100,000
2015	Partnership for Air Quality, Climate and Health (PACH) (Kreidenweis PI, Reynolds Co-I, Volckens Co-I)	CSU/VPR	\$200,000
2015	A New Paradigm for Workplace Air Sampling and Cost Effective Exposure Assessment (Volckens PI, Reynolds CO-PI	CDC/NIOSH	\$2,250,000
2014 - 2015	Multidisciplinary approaches to agricultural antimicrobial resistance and human health impacts (PI - Sheryl Magzamen, Col Reynolds, Schaeffer)	CSPH	\$20,000
2014 – 2017	Paradigm Shift: Revolutionizing our Understanding of Antimicrobial Resistance Ecology through Whole Genome	USDA	\$2,500,000

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<b>Years</b>	<b>Title of Proposal</b>	<b>Agency</b>	<b>Amount</b>
	Analysis of Microbial Communities (Morley PI, Reynolds Co-I)		
2014 – 2015	Characterizing Microbial Community Impacts on the Survival and Dissemination of E. coli O157:H7 on Dairies (McConnel PI, Reynolds Co-I, Schaeffer, Magzamen)	USDA CVMBS/CRC	\$20,000
2013 – 2014	“Characterizing Biological Pollutants in Agricultural Runoff at Colorado Dairies” (Magzamen PI, Reynolds, Schaeffer Co-Is)	CSU Water Center	\$25,000
2013 – 2015	Woodsmoke Exposure and Novel Health Indicators: A feasibility Field Study (Peel – PI, Reynolds Co-I) – application of methods developed for HICAHS projects	NIH	\$414,161
2013 – 2014	Modeling and Predicting Microbiomes in Dairies: a Metagenetic Assessment of Bioaerosols (Schaeffer PI, Reynolds Co-I)	MAP ERC	\$17,500
2012 – 2016	Cookstove Intervention: Barriers to Adoption and Impact on Cardiovascular Health (Peel – PI)	HHS-NIH	\$3,523,408
2013 – 2017	Community-Based Participatory Research: A Tool to Advance Cookstove Interventions (Clark PI, Reynolds, Stallones)	NIH-NIEHS	\$978,877
2011 – 2013	A Portable Spectrometer for Inhalable Aerosol Size Distributions (Volckens PI, Reynolds)	CDC/NIOSH	\$392,000
2012 - 2016	Design, Evaluation & Validation of a Next-Generation Inhalable Aerosol Sampler (Volckens PI, Reynolds)	CDC/NIOSH	\$2,094,000
2014 – 2017	Assessment of Joint Effects of Pesticides and Air Pollution in Pediatric Asthma (Magzamen PI, Reynolds Co-I)	NIH	\$459,446
2014 – 2018	Sustainable Places, Health and Educational Research in Schools (Cross – PI, Reynolds, Magzamen, Schaeffer)	US EPA	\$999,387
2013 – 2018	1 T32 OD012201-01 Veterinary Pre-Doctoral Research Scholars Program (PI: VandeWoude, Reynolds Mentor)	NIH-NCRR (Now NIH-OD)	\$522,028
2014-2015	Community Capacity Building in their own words: Extension Agent’s role in Disaster Planning for Pets & Service Animals	USDA	\$35,587

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<b>Years</b>	<b>Title of Proposal</b>	<b>Agency</b>	<b>Amount</b>
	(Frank Garry, PI, Adams, Quijano, & Buchan)		
2012-2014	Community Emergency Response Plan for Pet and Service Animals. (F. Garry, PI, Buchan, Quijano, Adams)	USDA	\$98,484
<b>PENDING PROPOSALS</b>			
2015 - 2016	Occupational Exposures and Transmission Pathways of Antibiotic-Resistant Bacteria in Beef Cattle Production (Reynolds PI)	National Cattlemans Beef Association	\$115,200

# PUBLISHED WORKS

## Journal Articles

2017

1. Chandler, J. C., Schaeffer, J. W., Davidson, M., Magzamen, S. L., Pérez-Méndez, A., Reynolds, S. J., . . . Bisha, B. (2017). A method for the improved detection of aerosolized influenza viruses and the male-specific (F+) RNA coliphage MS2. *Journal of Virological Methods*, 246(Supplement C), 38-41. doi: [doi: 10.1016/j.jviromet.2017.04.004](https://doi.org/10.1016/j.jviromet.2017.04.004)
2. Ayers, P., Khorsandi, F., Wang, X., & Araujo, G. (2017). ROPS designs to protect operators during agricultural tractor rollovers. *Journal of Terramechanics*. doi: [10.1016/j.iterra.2017.05.003](https://doi.org/10.1016/j.iterra.2017.05.003)
3. Campos-Fumero, A., Delclos, G. L., Douphrate, D. I., Felknor, S. A., Vargas-Prada, S., Serra, C., . . . Gimeno Ruiz de Porras, D. (2017). Low back pain among office workers in three Spanish-speaking countries: findings from the CUPID study. *Injury Prevention*, 23(3), 158-164. doi: [10.1136/injuryprev-2016-042091](https://doi.org/10.1136/injuryprev-2016-042091)
4. Conway, S. H., Pompeii, L. A., Casanova, V., & Douphrate, D. I. (2017). A qualitative assessment of safe work practices in logging in the southern United States. *American Journal of Industrial Medicine*, 60(1), 58-68. doi: [10.1002/ajim.22656](https://doi.org/10.1002/ajim.22656)
5. Douphrate, D. I., Fethke, N. B., Nonnenmann, M. W., Rodriguez, A., Hagevoort, R., & Gimeno Ruiz de Porras, D. (2017). Full-shift and task-specific upper extremity muscle activity among US large-herd dairy parlour workers. *Ergonomics*, 60(8), 1042-1054. doi: [10.1080/00140139.2016.1262464](https://doi.org/10.1080/00140139.2016.1262464)
6. Douphrate, D. I., Gimeno Ruiz de Porras, D., Nonnenmann, M. W., Hagevoort, R., Reynolds, S. J., Rodriguez, A., & Fethke, N. B. (2017). Effects of milking unit design on upper extremity muscle activity during attachment among U.S. large-herd parlor workers. *Appl Ergon*, 58, 482-490. doi: [10.1016/j.apergo.2016.08.008](https://doi.org/10.1016/j.apergo.2016.08.008)
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8. Lagerstrom, E., Magzamen, S., & Rosecrance, J. (2017). A mixed-methods analysis of logging injuries in Montana and Idaho. *American Journal of Industrial Medicine*, 1-11. doi: [10.1002/ajim.22759](https://doi.org/10.1002/ajim.22759)
9. Martin, L., & Ayers, P. (2017). Evaluation of Foldable Tractor Roll-Over Protective Structures (ROPS) Clearance. *Pursuit - The Journal of Undergraduate Research at the University of Tennessee*, 8(1). <http://trace.tennessee.edu/pursuit/vol8/iss1/9/>
10. Mokarami, H., Mortazavi, S. B., Asgari, A., Choobineh, A., & Stallones, L. (2017). Multiple dimensions of work-related risk factors and their relationship to work ability among industrial workers in Iran. *International journal of occupational safety and ergonomics*, 23(3), 374-379. doi: [10.1080/10803548.2016.1262602](https://doi.org/10.1080/10803548.2016.1262602)
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12. Oyama, S., Sosa, A., Campbell, R., Ortega, C., & Douphrate, D. I. (2017). Evaluation of upper body kinematics and muscle activity during milking attachment task. *International Journal of Industrial Ergonomics*, 61, 101-106. doi: [10.1016/j.ergon.2017.05.012](https://doi.org/10.1016/j.ergon.2017.05.012)
13. Pinion, C., Brewer, S., Douphrate, D., Whitehead, L., DelliFraine, J., Taylor, W. C., & Klyza, J. (2017). The impact of job control on employee perception of management commitment to safety. *Safety Science*, 93, 70-75. doi: [10.1016/j.ssci.2016.11.015](https://doi.org/10.1016/j.ssci.2016.11.015)
14. Rosecrance, J., Paulsen, R., & Murgia, L. (2017). Risk assessment of cheese processing tasks using the Strain Index and OCRA Checklist. *International Journal of Industrial Ergonomics*, 61, 142-148. doi: [10.1016/j.ergon.2017.05.009](https://doi.org/10.1016/j.ergon.2017.05.009)

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15. Rosecrance J, Lagerstrom E, Murgia L. (2017) Job factors associated with occupational injuries and deaths in the United States forestry industry. *Chemical Engineering Transactions*, 58, 115-120 [doi: 10.3303/CET1758020](https://doi.org/10.3303/CET1758020).
16. Schaeffer, J. W., Reynolds, S., Magzamen, S., VanDyke, A., Gottel, N. R., Gilbert, J. A., Owens, S.M., Hampton-Marcell, J.T., Volckens, J. (2017). Size, Composition, and Source Profiles of Inhalable Bioaerosols from Colorado Dairies. *Environmental Science & Technology*, 51(11), 6430-6440. [doi: 10.1021/acs.est.7b00882](https://doi.org/10.1021/acs.est.7b00882)
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18. Taghavi, S. M., Mokarami, H., Ahmadi, O., Stallones, L., Abbaspour, A., & Marioryad, H. (2017). Risk Factors for Developing Work-Related Musculoskeletal Disorders during Dairy Farming. *Int J Occup Environ Med*, 8(1), 39-45. [doi: 10.15171/ijoem.2017.861](https://doi.org/10.15171/ijoem.2017.861)
19. Zhang, X., Yang, Y., Chen, Y., Yao, H., Wu, M., Cui, M, Li, Y., Hu, J., Zhang, C., Li, Z., Stallones, L., Xiang, H. (2017). Road traffic crashes among farm vehicle drivers in southern China: A cross-sectional survey. *Traffic Injury Prevention*, 18(1), 83-87. [doi: 10.1080/15389588.2016.1190840](https://doi.org/10.1080/15389588.2016.1190840)

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21. Adams, A. E., Ahola, J. K., Chahine, M., Ohlheiser, A. L., & Roman-Muniz, I. N. (2016). Case Study: Effect of on-farm dairy Beef Quality Assurance training on selected welfare-related and Beef Quality Assurance-related traits in lactating dairy cows. *The Professional Animal Scientist*, 32(3), 368-374. [doi: 10.15232/pas.2015-01443](https://doi.org/10.15232/pas.2015-01443)
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23. Autenrieth, D. A., Brazile, W. J., Douphrate, D. I., Román-Muñiz, I. N., & Reynolds, S. J. (2016). Comparing Occupational Health and Safety Management System Programming with Injury Rates in Poultry Production. *Journal of Agromedicine*, 21(4), 364-372. [doi: 10.1080/1059924x.2016.1211575](https://doi.org/10.1080/1059924x.2016.1211575)
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26. Douphrate, D. I., Fethke, N. B., Nonnenmann, M. W., Rodriguez, A., Hagevoort, G. R., & de Porras, D. G. R. (2016). Effect of a novel teat preparation system on upper extremity muscle activity among US large-herd dairy parlor workers. *International Journal of Industrial Ergonomics*, 56, 161-169. [doi: 10.1016/j.ergon.2016.10.003](https://doi.org/10.1016/j.ergon.2016.10.003)
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28. Khorsandi, F., Ayers, P., Jackson, D., & Wilkerson, J. (2016). The Effect of Speed on Foldable ROPS Actuation Forces. *Journal of Agricultural Safety and Health*, 22(4), 285-298. [doi: 10.13031/jash.22.11752](https://doi.org/10.13031/jash.22.11752)
29. Lagerstrom, E., Magzamen, S., Stallones, L., Gilkey, D., & Rosecrance, J. (2016). Understanding risk factor patterns in ATV fatalities: A recursive partitioning approach. *J Safety Res*, 59, 23-31. [doi: 10.1016/j.jsr.2016.10.004](https://doi.org/10.1016/j.jsr.2016.10.004)
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Development Needs Associated with SAE Programming and Safety. *Journal of Agricultural Education*, 57(1). [doi: 10.5032/jae.2016.01150](https://doi.org/10.5032/jae.2016.01150)

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  10. Murphy, D., Hill, D., & Douphrate, D. (March, 2014). Open-air manure storage safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12012:open-air-manure-storage-safety&catid=77:manure&Itemid=121](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12012:open-air-manure-storage-safety&catid=77:manure&Itemid=121)
  11. Pompeii, L., & Douphrate, D. (April, 2014). Workplace violence on dairy farms. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12094:workplace-violence-on-dairy-farms&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12094:workplace-violence-on-dairy-farms&catid=49:management&Itemid=75)
  12. Roman-Muniz, N., & Douphrate, D. (May 21, 2014). Preventing zoonotic disease on the dairy (Part 2 of 2). *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12216:preventing-zoonotic-disease-on-the-dairy&catid=45:herd-health&Itemid=71](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12216:preventing-zoonotic-disease-on-the-dairy&catid=45:herd-health&Itemid=71)
  13. Roman-Muniz, N., & Douphrate, D. (May 21, 2014). What are zoonotic diseases? (Part 1 of 2). *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=12215:what-are-zoonotic-diseases&catid=45:herd-health&Itemid=71](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=12215:what-are-zoonotic-diseases&catid=45:herd-health&Itemid=71)
  14. Ayers, P., & Douphrate, D. (May 9, 2013). Dairy worker safety and health: Tractor safety on dairy farms. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10565:dairy-worker-safety-and-health-tractor-safety-on-dairy-farms&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10565:dairy-worker-safety-and-health-tractor-safety-on-dairy-farms&catid=49:management&Itemid=75)
  15. Douphrate, D. (November 15, 2013). Dairy worker safety in cold environments. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11452:dairy-worker-safety-in-cold-environments&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11452:dairy-worker-safety-in-cold-environments&catid=49:management&Itemid=75)
  16. Douphrate, D., & Bauer, M. (April 9, 2013). Dairy worker safety and health: Chemical hazard communication. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10443:dairy-worker-safety-and-health-chemical-hazard-communication&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10443:dairy-worker-safety-and-health-chemical-hazard-communication&catid=49:management&Itemid=75)
  17. Douphrate, D., Bauer, M., Brazile, W., & Root, K. (March 8, 2013). Dairy worker safety and health: Injury and illness recordkeeping. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10306:dairy-worker-safety-and-health-injury-and-illness-recordkeeping&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10306:dairy-worker-safety-and-health-injury-and-illness-recordkeeping&catid=49:management&Itemid=75)
  18. Douphrate, D., Bauer, M., Brazile, W., & Root, K. (February 11, 2013). Dairy worker safety and health: OSHA inspections, citations and penalties. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10210:dairy-](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10210:dairy-)

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- [worker-safety-and-health-osh-inspections-citations-and-penalties&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10037:dairy-worker-safety-and-health-osh-inspections-citations-and-penalties&catid=49:management&Itemid=75)
19. Douphrate, D., & Hagevoort, R. (January 11, 2013). Dairy worker safety and health: A new column from David Douphrate. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10037:dairy-worker-safety-and-health-a-new-column-from-david-douphrate&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10037:dairy-worker-safety-and-health-a-new-column-from-david-douphrate&catid=49:management&Itemid=75)
  20. Douphrate, D., & Hagevoort, R. (October 22, 2013). Dairy worker safety training. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11348:dairy-worker-safety-training&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11348:dairy-worker-safety-training&catid=49:management&Itemid=75)
  21. Douphrate, D., Nonnenmann, M., & Hagevoort, R. (August 10, 2013). Heat stress: Bad for dairy cows and the people who care for them. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11019:heat-stress-bad-for-both-dairy-cows-and-the-people-who-care-for-them&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11019:heat-stress-bad-for-both-dairy-cows-and-the-people-who-care-for-them&catid=49:management&Itemid=75)
  22. Murphy, D., & Douphrate, D. (September 5, 2013). Dairy worker safety and health: ATV safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11160:dairy-worker-safety-and-health-atv-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11160:dairy-worker-safety-and-health-atv-safety&catid=49:management&Itemid=75)
  23. Murphy, D., & Douphrate, D. (June 18, 2013). Dairy worker safety and health: Manure pit safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10792:dairy-worker-safety-and-health-manure-pit-safety&catid=77:manure&Itemid=121](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10792:dairy-worker-safety-and-health-manure-pit-safety&catid=77:manure&Itemid=121)
  24. Reynolds, S., & Douphrate, D. (July 10, 2013). Dairy worker safety and health: Respiratory protections. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=10895:dairy-worker-safety-and-health-respiratory-protections&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=10895:dairy-worker-safety-and-health-respiratory-protections&catid=49:management&Itemid=75)
  25. Roman-Muniz, N., & Douphrate, D. (December 17, 2013). Dairy worker safety and health: Vaccination Safety. *Progressive Dairyman*. Retrieved from [http://www.progressivedairy.com/index.php?option=com\\_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75](http://www.progressivedairy.com/index.php?option=com_content&view=article&id=11590:dairy-worker-safety-and-health-vaccination-safety&catid=49:management&Itemid=75)
  26. Douphrate, D. (2011, June). Dairy Farm Safety and OSHA--Approaches for Effective Management and Worker Training. *Utah State University Dairy Extension Newsletter*, 34.
  27. Douphrate, D. (August, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/august-2011-2.pdf>
  28. Douphrate, D. (September, 2011). Special Issue: Dairy Farm Safety & OSHA--Approaches for Effective Management and Worker Training. *New Mexico State University Dairy Extension Newsletter*, 2. Retrieved from <http://aces.nmsu.edu/ces/dairy/documents/september-2011.pdf>

## Student Theses

*HICAHS researchers served on the advisory committees for the following students. The funding for conducting the student projects may or may not have been funded by HICAHS.*

### 2016

1. Escobar, M. A. (2016). *Filter Based Methods Assessment: Culturing Resistant Bacteria from Inhalable Bioaerosols*. Master of Science Thesis, Colorado State University, Fort Collins, CO.
2. Krause, L. A. (2016). *A comparative analysis between the rFC and LAL endotoxin assays for agricultural air samples*. Master of Science Thesis, Colorado State University, Fort Collins, Colorado. Retrieved from <http://hdl.handle.net/10217/173499>
3. Vawter, C.Q. (2016). *Evaluation of Sabine's Formula on the prediction and control of reverberant noise in a modern LEED Platinum certified research building*. Master of Science Thesis, Colorado State University. Retrieved from <https://dspace.library.colostate.edu/handle/10217/176663>

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4. Menger, L. (2016). *Promoting psychosocial health and empowerment among female sex workers in Nepal: A pilot peer education intervention*. Doctor of Philosophy Dissertation, Colorado State University.
5. St. Aubin, E. (2016). Master of Public Health, Colorado State University.
6. Walters, K. M. (2016). *Is the "grass" greener? : occupational wellness in the Colorado cannabis industry*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <https://dspace.library.colostate.edu/handle/10217/173525>

## 2015

7. Autenrieth, D. (2015) *Occupational Health and Safety Management Systems in Animal Production Agriculture*. Doctor of Philosophy Dissertation, Colorado State University.
8. Ndonga, M. (2015). *Design of An Inhalable Aerosol Size Spectrometer*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/166860>
9. Yang, X. (2015). *Investigation of the Beef Supply-Chain Microbiome and Pathogen Controls*. Doctor of Philosophy Dissertation, Colorado State University, Fort Collins, CO. Retrieved from <https://dspace.library.colostate.edu/handle/10217/170417>

## 2014

10. Hawley, B. (2014). *Development and application of an improved in vitro model for aerosol toxicology*. Doctor of Philosophy Dissertation, Colorado State University. Retrieved from <http://hdl.handle.net/10217/83775>
11. Madden, E. (2014). *An Exploration of the Role of First Aid and CPR in Improving Farm Safety and Health*. Master of Agriculture Thesis, Colorado State University, Fort Collins, CO.

## 2013

12. Krause, L. (2013). *Bacterial Preservation during Air Sampling*. Undergraduate Student Honors Thesis, Colorado State University, Fort Collins, CO.
13. Modai, G. (2013). *ATV-Related Injuries in Montana 2007–2012*. Master of Science Thesis, Colorado State University, Fort Collins, Colorado.
14. Paulsen, R. J. (2013). *Reliability of Ergonomic Exposure Assessment: Comparing the strain index and the OCRA checklist*. Master of Science Thesis, Colorado State University, Fort Collins, Colorado. Retrieved from <http://hdl.handle.net/10217/79129>
15. Schaeffer, J.W. (2013). Evaluation and resolution of two sampling methods for airborne aromatic diisocyanate monomers. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/80195>
16. Van Dyke-Gonnerman, A. L. (2013). *Comparative analysis of bacterial and fungal communities in two dairy parlors through the use of pyrosequencing, ribotyping, culture techniques, and microscopic analysis*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/81067>

## 2012

17. Danhoff, K. L. (2012). *A Survey of Graduate Social Work Educators: Teaching Perspectives and Classroom Environments*. Doctor of Philosophy Dissertation, Colorado State University. Retrieved from <http://hdl.handle.net/10217/67428>
18. Frazey, J.S. (2012). *Decontamination of bioaerosols within engineering tolerances of aircraft materials*. Doctor of Philosophy Dissertation, Colorado State University. Retrieved from <http://hdl.handle.net/10217/71558>
19. Robinson, D.L. (2012). *Evaluation of bacterial sampling methods for use with the bacterial tag-encoded flexible (FLX) amplicon pyrosequencing (bTEFAP) technique*. Master of Science Thesis, Colorado State University, Fort Collins, CO. Retrieved from <http://hdl.handle.net/10217/68149>

## 2011

20. Basinas, I. (2011). *Dust and Endotoxin Exposure in Animal Farming Population. Formulating the Basis for a Model-based Exposure Assessment Approach*. PhD, Aarhus Universitet, Aarhus, Denmark.

21. Basinas, I. (2011). *Dust and endotoxin exposure in animal farming populations: formulating the basis for a model-based exposure assessment approach*. Doctor of Philosophy Dissertation, Department of Environmental & Occupational Medicine, Institute of Public Health, Aarhus University, Denmark.
22. Funk, S. (2011). *Evaluation of seasonal ventilation changes and their effect on ambient dust, endotoxin and bioaerosol concentrations in a dairy parlor*. Master of Science Thesis, Colorado State University, Fort Collins, CO.
23. Shen, X. (2011). *Aqueous Phase Sulfate Production in Clouds at Mt. Tai in Eastern China*. Doctor of Philosophy Dissertation, Colorado State University Department of Atmospheric Science.
24. Sorrentino, J. (2011). *A comparison of the Limulus amoebocyte lysate (LAL) and recombinant Factor C (rFC) endotoxin bioassays: Characterization of aerosols and settled dust on a sheep farm*. MS, Colorado State University, Fort Collins, CO.

### Postdoctoral Students

Joshua Schaeffer, Ph.D. (2014 – 2015 under Stephen Reynolds)  
 Margaret Davis, Ph.D. (2011 – 2015 under Stephen Reynolds)

### Students - Other

Graduate Students under Supervision by Paul Ayers: Farzaneh Khorsandi, PhD student (see 2016 publication) and Daniel Wade, MS student.

Undergraduate Engineering Research Students under Supervision by Paul Ayers:

2015 – Dillan Jackson  
 2014 – 2015 – Andrew Whitaker  
 2014 – Yohan John  
 2012-2013 – Hunter Hill  
 2012-2013 – Coleman Bradley

These students work(ed) with Lorann Stallones, HICAHS Director of Outreach: Lauren Menger, PhD in psychology (Spring 2016) and Emma St Aubin, MPH student (Spring 2016).

Adrienne Keeney, Ph.D., Cortney Worrell, Ph.D. student, Rueben Addo, Ph.D. student, and other students have worked with Vicky Buchan and Louise Quijano with the HICAHS Evaluation Program.

### Audiovisual Products

1. (2016) Best Practices to Stay Healthy at the Dairy Farm. Bilingual video training Program. <https://vimeo.com/161500888> (English), <https://vimeo.com/145893176> (Spanish).
2. The r2p ATV safety project with Montana Extension has led to the development of 6 high quality videos which are available on the U.S. Agricultural Safety and Health Centers YouTube channel: [www.youtube.com/usagcenters](http://www.youtube.com/usagcenters).
3. Cassidy, A. (2014). December Calendar Page: Childproof for Poison Prevention. *2015 Childhood Agricultural Safety Network Calendar*. Marshfield, WI: National Children's Center for Rural and Agricultural Health.
4. DeVries, A. (2013). June Submission on ATV Safety: Don't let your child become a statistic... *2014 Childhood Agricultural Safety Network Calendar*. Marshfield, WI: National Children's Center for Rural and Agricultural Health.
5. Tellechea, T. (2012). Photo essay of Latino dairy workers performing their daily work tasks. Fort Collins, CO: High Plains Intermountain Center for Agricultural Health and Safety at Colorado State University.
6. DeVries, A. (2011). Respiratory Illness in Farmers: Information, Diagnosis, and Prevention Tri-Fold Flyer. Fort Collins, CO: The High Plains Intermountain Center for Agricultural Health and Safety.

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## Standards Development

1. ANSI/ASABE. (2011). Ventilating Manure Storages to Reduce Entry Risk (Vol. S607 OCT2010).

## Conference Papers, Presentations, Abstracts

2017

1. Autenrieth, D., & Román-Muñiz, N. (2018). *Needs and Opportunities for Applying Voluntary Occupational Health and Safety Management Systems in the High-Hazard U.S. Dairy Production Industry*. Paper presented at the Advances in Safety Management and Human Factors. AHFE 2017. Advances in Intelligent Systems and Computing. doi: [10.1007/978-3-319-60525-8\\_7](https://doi.org/10.1007/978-3-319-60525-8_7)
2. Cassidy, A., Wickman, A., & Duysen, E. (June 25-29, 2017). *Developing Agricultural Safety and Health Awareness Campaigns*. Poster presentation at the International Society for Agricultural Safety and Health Conference, Logan, UT.
3. Cassidy, A., Brooks, E., & Rodriguez, A. (June 25-29, 2017). International Society for Agricultural Safety and Health Conference, Aurora, CO.  
*We staffed a booth with informational brochures about HICAHS.*
4. Erlandson, G., Root, K. S., Magzamen, S. L., Reynolds, S. J., & Schaeffer, J. W. (June 5-7, 2017). *Indoor Air Quality Across Three Different Higher Education Building Types*. Presentation at the American Industrial Hygiene Conference and Exposition (AIHce), Seattle, WA.
5. Erlandson, G., Root, K. S., Schaeffer, J. W., Reynolds, S. J., & Magzamen, S. L. (June 5-7, 2017). *Pilot Indoor Air Quality Study in Three Higher Education Buildings*. Presentation at the CVMBS Research Day, Colorado State University, Fort Collins, CO.
6. Erlandson, G., Root, K. S., Schaeffer, J. W., Reynolds, S. J., & Magzamen, S. L. (March 9, 2017). *Pilot Indoor Air Quality Study in Three Higher Education Buildings*. Presentation at the MAP ERC Research Day, Westminster, CO.
7. Escobar, M., Schaeffer, J., Magzamen, S., Bisha, B., & Reynolds, S. (March, 2016). *Filter-Based Methods Assessment: Culturing Resistant Bacteria from Inhalable Bioaerosols*. MAP ERC Research Day, Denver, CO.
8. Gilkey, D., Rosecrance, J., Lagerstrom, E., & Neves, H. (July 17-21, 2017). *ATV safety in agriculture: Injury, illness, analysis and interventions*. Presentation at the 8th International Conference on Applied Human Factors and Ergonomics, Los Angeles, CA.
9. Hagevoort, R. (March 8-9, 2017). *Where most dairymen go wrong*. Gibby Group Roundtable, Twin Falls, ID.
10. Hagevoort, G. R., Douphrate, D., Naerebout, B., Brose, J., White, J., & Rodriguez, A. (March 1, 2017). *Challenges Surrounding Training the Next Generation*. Presentation at the Western Dairy Management Conference, Reno, NV. <http://wdmc.org/2017/Full2017.pdf>
11. Hagevoort, R. (February 20, 2017). *Dairy safety management: current issues, challenges & solutions*. Oregon Dairy Farmers Convention, Salem, OR.
12. Korchevskiy, A. (March, 2017). *Risk assessment course*. Ternopol State Medical University, Ternopol, Ukraine.  
*Dr. Stephen J. Reynolds provided PPT presentations on organic dusts and agriculture for his use. Will follow up to explore collaborations.*
13. Lagerstrom, E., Magzamen, S., Rosecrance, J. (June 2017). *Injury Analysis and Prevention in the Logging Industry of Montana and Idaho*. Poster Presentation at the American Industrial Hygiene Conference and Expo, Seattle, WA.  
*Best Student Safety Poster*
14. Lagerstrom, E., Magzamen, S., & Rosecrance, J. (March 2017). *A mixed-methods analysis of logging injuries in Montana and Idaho*. Poster Presentation at the 8th Annual Mountain and Plains Research Day. Denver, CO.  
*Best Ergonomics Poster*
15. Menger-Ogle, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2017). *A Guide to the Design of Occupational Health and Safety Training for Immigrant, Latino/a Dairy Workers*. Panel presentation at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
16. Noa Roman-Muniz. (February, 2017). *Dairies and Communication: What you haven't been told*. AABP and VOICE's dinner lecture. CSU's Veterinary Teaching Hospital, Fort Collins, CO.

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17. Menger-Ogle, L. M., Pezzutti, F., Ogle, A. D., Amaya, F., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2017). *Occupational safety and health among immigrant, Latino/a dairy workers in Colorado*. Symposium presentation at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
18. Pate, M. (June 25-29, 2017). *Severe Injury and Fatality Prevention in Agriculture*. Moderator for the panel presentation at the International Society for Agricultural Safety and Health, Logan, UT.
19. Pate, M., Lawver, R. G., Smalley, S. W., Perry, D. K., Quijano, L., Buchan, V., & Miller, R. (June 25-29, 2017). *Assessing an Agricultural Safety Education Initiative Impact using Geospatial Data Mapping*. Presentation at the International Society for Agricultural Safety and Health, Logan, UT.
20. Quijano, L. M., & Cassidy, A. (February 22, 2017). Governor's Agricultural Forum on Colorado Agriculture, Aurora, CO.  
*Dr. Quijano and Ms. Cassidy represented HICAHS.*
21. Rank, B.D. & Smalley, S.W. (May, 2017). Students' Perceptions of School-Based Agricultural Education Through an Initial Early Field Experience. Proceedings of the American Association of Agricultural Educators. San Luis Obispo, CA.
22. Reynolds, S. J. (February 15, 2017). *MAP ERC and HICAHS overview*. Edith Cowen University, Joondalup, Western Australia.  
*Dr. Stephen J. Reynolds presentation and discussion to ~ 20 OHS faculty and students. Dr. Reynolds is Adjunct Professor at ECU.*
23. Reynolds, S. J., Schaeffer, J., Burket, T., A.VanDyke, M.Davidson, J.Mehaffy, . . . S.Magzamen. (June 21, 2017). *Dairy Bioaerosol Exposures and Inflammatory Markers in Workers: a Panel Study*. . NIOSH - Expanding Research Partnerships: State of Science, Aurora, CO.
24. Sorensen, T.J., Dutton, C., Lawver, R. G. & Jensen, B. (2017). Examining the development and concerns of preservice agriculture teachers during student teaching. Proceedings of the National American Association for Agricultural Education Research Conference. San Luis Obispo, CA
25. Stenkamp-Strahm, C., Magzamen, S., Abdo, Z., Reynolds, S., & McConnel, C. (June 12, 2017). *E. coli O157 shedding is associated with low diversity and changes of specific taxa within the dairy cow microbiome*. Gaussi Symposium, Colorado State University, Fort Collins, CO.
26. Stenkamp-Strahm, C., Magzamen, S., McConnel, C., Abdo, Z., VanDyke-Gonnerman, A., Schaeffer, J., & Reynolds, S. (July 9-12, 2017). *Microbial Community Drivers of Escherichia coli O157 Colonization and Shedding in Early Lactation Dairy Cattle*. Presentation at the 2017 International Association for Food Protection Annual Meeting, Tampa, Florida.
27. VanDyke, A., Reynolds, S. J., Schaeffer, J., & Magzamen, S. (June 22, 2017). *Dairy Worker Exposure to Airborne Endotoxins and  $\beta$  Glucans*. Presentation at the NIOSH - Expanding Research Partnerships: State of Science, Aurora, CO.

## 2016

28. Noa Roman-Muniz. "Immigration Challenges." (March, 2016). Panel presentation, Food & Ag Summit, Loveland, CO. 2016
29. Noa Roman-Muniz. "Perspectives on Labor Across Agricultural Industry Sectors." (February, 2016). Panel presentation, Governor's Forum on Colorado Agriculture, Denver, CO.
30. Dietz MA, Ryan EP, & Stallons L. (May, 2016). "Joint Indicators of Animal Welfare and Worker Safety Risks in the Dairy Industry." Oral Presentation and Poster Presentation. Colorado School of Public Health Forum, Colorado State University, Fort Collins, CO.
31. Ayers, P., Khorsandi, F., Wang, X., & Araujo, G. (2016). ROPS designs to protect operators during tractor rollovers. International Society for Terrain-Vehicle Systems, Detroit, MI.
32. Flor Amaya-Soto, MV, Lauren Menger, PhD, Lorann Stallones, PhD, MPH, Pablo Pinedo, DVM, PhD, Noa Roman-Muniz, DVM, MS. (November, 2016) *Occupational Health and Safety (OHS) Knowledge Assessment: Audiovisual Training Program for Latino Workers in Colorado Dairies*. Poster presentation. Graduate Student Showcase, Colorado State University, Fort Collins, CO.
33. Ayers, P., & Khorsandi, F. (2016). Tractor rollover injury prevention. Presentation at the Emergency and Trauma Services Symposium, Knoxville, TN.

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34. Douphrate, D. (November 7-8 2016). *Dairy safety management: current situation, challenges, and solutions*. Invited Presenter at the Washington State Dairy Safety Conference, Ellensburg, WA.
35. Douphrate, D. (June 20-23, 2016). *Full-shift and task-specific ergonomic exposure assessment of posture and muscle activity among dairy parlor workers in US large herd operations*. Presentation at the Ninth International Conference on Prevention of Work-Related Musculoskeletal Disorders (PREMUS), Toronto, Canada.
36. Douphrate, D. (May 25-26, 2016). *Dairy worker health and safety*. Invited Presenter at the Washington Department of Safety and Health Technical Symposium, Wenatchee, WA.
37. Douphrate, D. (March 1-2, 2016). *On-farm risk management and safety on dairy farms: Regulatory requirements and planning*. Presentation at the High Plains Dairy Conference, Lubbock, TX.
38. Douphrate, D. (February 24, 2016). *Worker health and safety on US dairies*. Invited lecture to the Governor's Agricultural Safety Day, Wenatchee, WA.
39. Gilkey, D., Rosecrance, J., & Lagerstrom, E. (June 2016). *ATV Safety Research and Outreach at Colorado State University*. Presentation at the ANB45 (1) Rollover Subcommittee, Washington, D.C.
40. Gilkey, D., Rosecrance, J., & Lagerstrom, E. (August 2016). *ATV Safety Research and Outreach at Colorado State University*. Presentation at the Governor's Ag Safety Coalition, Douglas, WY.
41. Hagevoort, R., Douphrate, D., Garcia, B. A., & Rodriguez, A. (August 24-26, 2016). *Delivery of animal handling training to U.S. workers using novel mobile technologies*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Billund, Denmark.
42. Hagevoort, R., & Douphrate, D. (March 30, 2016). *Dairy safety management*. Presentation at the Western States Dairy Producers Trade Association Annual Meeting, Las Vegas, NV.
43. Khorsandi, F. & Ayers, P. (2016). *Simulating SAE J2194 static test to predict the Roll-Over Protective Structure (ROPS) behavior using finite element model*. Presentation at the ASABE Conference, Orlando, FL.
44. Krause, L., Reynolds, S., VanDyke, A., & Schaeffer, J. (May 25, 2016). *A comparative analysis between rFC and LAL endotoxin assays for agricultural air samples*. AIHCE Baltimore, MD.
45. Krause, L., Reynolds, S.J., VanDyke, A., & Schaeffer, J. (March 2016). *A comparative analysis between rFC and LAL endotoxin assays for agricultural air samples*. MAP ERC Research Day, Denver, CO
46. Lagerstrom, E., Magzamen S., Stallones L., Gilkey D., Rosecrance J. (November, 2016). *Modeling the United States' ATV Epidemic*. Poster presentation at the American Public Health Association (APHA) Annual Conference. Denver, CO.
47. Lagerstrom, E. (May 2016). *Logging Injuries- Analysis and Prevention*. Platform presentation at the MLA Annual Membership Meeting. Missoula, MT.
48. Lagerstrom, E., & Rosecrance, J. (April 2016). *Logging Injuries- Analysis and Prevention*. Platform presentation at the Intermountain Logging Conference. Spokane, WA.
49. Lagerstrom, E. (March 2016). *Logging on the Western Slope of Montana*. Poster presentation at the 8th Annual Mountain and Plains Research Day. Denver, CO.
50. Menger, L. M., Rosecrance, J., Stallones, L., & Roman-Muniz, I. N. (2016). *A Review of Best Practice Recommendations for Training Immigrant, Latino/a Dairy Workers in the U.S.* Poster presentation at the National Occupational Research Agenda Conference, Salt Lake City, UT.
51. Reynolds, S.J, Schaeffer, J.W., Magzamen, S., VanDyke, A., Davidson, M., Mehaffy, J., Escobar, M., Anderson, K., Bradford, M., Tryon, J., Burket-Tooker, T., Brindly, B., Newman, L., & Volkens, J. (August 24-26, 2016). *Cytokine Profiles Among Dairy Workers*. Nordic Meeting on Agricultural Occupational Health & Safety, Billund, Denmark.
52. Schaeffer, J.W., Magzamen, S., Noyes, N., VanDyke, A., Davidson, M., Escobar, M., Volkens, J., Owens, S., Marcell, J., & Reynolds, S.J. (August 24-26, 2016). *Agricultural Dust in the Wind: Microbial Communities and their Resistant Genes*. Nordic Meeting on Agricultural Occupational Health & Safety, Billund, Denmark.
53. VanDyke, A., Reynolds, S., Schaeffer, J., Magzamen, S., & Krause, L. (May 25, 2016). *Task-Based Exposures to Airborne Endotoxins and  $\beta$ -Glucans Among Dairy Workers*. AIHCE, Baltimore, MD, *2nd Best in Session/Student Posters*

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2015

54. Jairo E. Palomares Velosa, DVM, MS; Gwenith Fisher, BA, MA, PhD; Noa Roman-Muniz, DVM, MS; Craig McConnel DVM, MA, PhD; Lyndsey Linke, BS, ME, PhD; Roberta Magnuson BS; Sangeeta Rao, BVSc, MVSc, PhD; and Mo D. Salman, BVMS, MPVM, PhD. (2015). Socio-ecological model for zoonotic diseases exposure of dairy farm communities: a proposed approach. Poster. 2015 SNOCAP Convocation and CCTSI Community Engagement Research Exchange, Denver, CO.
55. Anderson, K., Schaeffer, J., Mehaffy, J., Tryon, J., VanDyke, A., Bradford, M., Reynolds, S., Anthony, R., Sleeth, D., & Volckens, J. (October 12-16, 2015). Inhalable Particle Exposures in Northern Colorado Dairies. AAAR, Minneapolis, MN.
56. Ayers, P. (2015). Computer-based ROPS design program and the National Tractor Safety Partnership. Presentation at the High Plains Intermountain Center for Agricultural Safety and Health Advisory Conference, Fort Collins, CO.
57. Ayers, P., Khorsandi, F., John, Y., Whitaker, G. & Dixon, J. (2015). Protecting operators during tractor overturns – Foldable ROPS lift assist and Computer-based ROPS Design Program (CRDP). Presentation at ISASH Conference. Normal, IL.
58. Ayers, P., Khorsandi, F., John, Y., Whitaker, G. & Dixon, J. (2015). Computer-based ROPS Design Program (CRDP): Evaluation of initial validation testing and implementation process. Presentation at the ASABE Conference, New Orleans, LA.
59. Ayers, P. (September 9, 2015). *Summary of ROPS Activities in the United States*. International Congress on Rural Health, Lodi, Italy.
60. Ayers, P. & Khorsandi, F. (September 9, 2015). *ROPS Design and Testing for Rigid and Foldable Structures*. International Congress on Rural Health, Lodi, Italy.
61. Buchan, V., & Quijano, L. M. (September 10, 2015). *Employment Policies related to Immigrant Workers in the Dairy Industry: A comparative policy analysis across 10 Countries*. International Congress on Rural Health, Lodi, Italy.
62. Cassidy, A. (August 5, 2016). *Tractor Rollover Fatality Prevention*. Governor's Ag Safety Coalition of Wyoming, Douglas, WY.
63. Cassidy, A. (June 24, 2015). *Collaboration to create a joint YouTube channel*. Presentation at the International Society for Agricultural Safety and Health (ISASH) Conference, Omaha, NE.
64. Chandler, J., Bisha, B., Schaeffer, J., Davidson, M., Reynolds, S.J. & Goodridge, L.D. (July 26, 2015). *Development of an Improved Sampling Method for Concentrating Viruses from Bioaerosols*. Presentation at the IAFP Conference, Portland, Oregon.
65. Douphrate, D. (October 29-30, 2015). *Musculoskeletal diseases and ergonomics in agriculture*. Texas Rural Health Association, Agromedicine Workshop, Fort Worth, TX.
66. Douphrate, D. (October 29-30, 2015). *Acute agricultural injuries*. Texas Rural Health Association, Agromedicine Workshop, Fort Worth, TX.
67. Douphrate, D. (May 30-June 4, 2015). Interventions to reduce exposure to physical risk factors for musculoskeletal disorders among dairy parlor workers. American Industrial Hygiene Conference and Exposition (AIHce), Salt Lake City, UT.
68. Douphrate, D., & Hagevoort, G. R. (October 1, 2015). *Safety performance on dairy farms*. Presented at the World Dairy Expo, Madison, WI.
69. Douphrate, D., Reynolds, S. J., Hagevoort, R., Lunner Kolstrup, C., Kolb, P., & Cassidy, A. (September 27-28, 2015). *International Dairy Safety Short Course*. Invited lecture to delegations from Pakistan and China, University of Wisconsin - River Falls, WI.
70. Douphrate, D., & Reynolds, S. J. (September 18, 2015). *Successful Strides with Dairy Workers*. Presented at the Western States Occupational Network (WestON), Denver, CO.
71. Douphrate, D. (March 1-2, 2015). *On-farm risk management and safety on dairy farms: Regulatory requirements and planning*. Presented at the High Plains Dairy Conference, Lubbock, TX.
72. Douphrate, D. (February 18-19, 2015). *Safety training using mobile learning technologies on large herd dairy operations*. Presented at the OSHA Susan Harwood Trainer Exchange Conference, Washington,

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D.C.

73. Douphrate D. (May 25-26, 2016). *Safety training on dairy farms*. Invited Presenter to the Washington Department of Safety and Health Technical Symposium, Wenatchee, WA.
74. Douphrate D. (April 1, 2016). *Dairy worker health and safety: current situation, research challenges and lessons learned*. Keynote presenter at the 1st Annual Occupational Health and Safety Research Conference. University of Iowa, Iowa City, IA.
75. Garcia Buitrago, J.A., Hagevoort, G.R., Gimeno, D., & Douphrate, D. (2015). *Ergonomic assessment of the milking routine in large dairy operations of southwest United States*. J. Anim. Sci. Vol. 93, Suppl. s3/J. Dairy Sci. Vol. 98, Suppl. 2015 JAM Meeting.  
[www.itmtg.org/JAM/2015/docs/JAM2015\\_Program\\_FINAL.pdf](http://www.itmtg.org/JAM/2015/docs/JAM2015_Program_FINAL.pdf)
76. Gilkey, D. (August 5, 2016). *ATV Safety Research and Outreach at Colorado State University*. Governor's Ag Safety Coalition of Wyoming, Douglas, WY.
77. Gilkey, D., Rosecrance, J., & Lagerstrom, E. (June 28, 2016). *ATV Safety Research and Outreach at Colorado State University*. ANB45 (1) Rollover Subcommittee, WDC.
78. Gilkey, D. & Rosecrance, J. (August 9-15, 2015). *Developing Innovative Partnerships to Reduce Deaths from All-Terrain Vehicle use in Agricultural Operations*. Presentation at the International Ergonomics Association, Melbourne, Australia.
79. Hagevoort, R., Douphrate, D., DeWitt, H., & DeJong, D. (March 5, 2015). *Training Employees under Higher Standards*. Panel presentation at the Western Dairy Management Conference, John Ascuaga's Nugget, Reno, NV.
80. Khorsandi, F. & Ayers, P. (2015). *Developing a Finite Element (FE) model to predict the Roll-Over Protective Structure (ROPS) behavior under SAE J2194 Standard test*. Presentation at the ASABE Conference, New Orleans, LA.
81. Krause, L., Reynolds, S., Schaeffer, J., VanDyke, A., Davidson, M., & Bisha, B. (June 3, 2015). *Evaluation of Collection Effectiveness during Air Sampling of Culturable Bioaerosols using SKC BioSamplers*. Poster presentation at the AIHCE, Salt Lake City, UT.  
*Best Poster Award*
82. Lagerstrom, E., Rosecrance, J., & Gilkey, D. (September 9, 2015). *Community Engagement in the Prevention of Injuries and Deaths from Agricultural All-Terrain (ATV) Vehicle Use*. International Congress on Rural Health, Lodi, Italy.
83. Lagerstrom, E., Gilkey, D., Rosecrance, J. & Paulsen, R. (April 16-17, 2015). *A Case Study on the Effectiveness of Two ATV Injury Prevention Strategies*. NORA Young Investigators Conference, Salt Lake City, UT.
84. Lagerstrom, E., Gilkey, D., Elenbaas, D., & Rosecrance, J. (May 28-29, 2015). *Occupational ATV Injury and Fatality Claims in Montana, 2007-2012*. Platform presentation at the XXVIIth Annual International Occupational Ergonomics and Safety Conference, Nashville, TN.
85. Lagerstrom, E., Gilkey, D., Magzamen, S., Stallones, L., & Rosecrance, J. (June 7-10, 2015). *ATV Fatality Risk Categorization & Mapping*. Poster presentation at the ASSE Annual Education Conference, Dallas, TX.
86. Lagerstrom, E., Gilkey, D., Magzamen, S., Stallones, L. & Rosecrance, J. (April, 2015). *ATV Mortality in the United States, 2011-2013*. Presentation at the 13th Annual National Occupational Research Agenda Young Investigators Conference, Salt Lake City, UT.
87. Lagerstrom, E., Gilkey, D., Magzamen, S., Stallones, L., & Rosecrance, J. (March, 2015). *ATV Mortality in the United States, 2011-2013*. Presentation at the 7th Annual Mountain and Plains Research Day, Denver, CO.
88. Masci, F., Mixco, A., Colosio, C., & Rosecrance, J. (September 9, 2015). *Comparison of upper limb muscle activity between US and Italian industrialized dairy operations*. International Congress on Rural Health, Lodi, Italy.
89. Menger, L., Stallones, L., Pezzutti, F., Roman-Muniz, I. N., & Rosecrance, J. (September 9, 2015). *Health and Safety Challenges among Dairy Workers in the United States*. International Congress on Rural Health, Lodi, Italy.

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90. Menger, L. M., Pezzutti, F., Stallones, L., Rosecrance, J., & Roman-Muniz, N. (May, 2015). *Safety and productivity among immigrant dairy workers*. Poster presentation accepted at the 11th International Conference on Occupational Stress and Health: Work, Stress, & Health, Atlanta, GA.
91. Noa Roman-Muniz. (December, 2015). "Multicultural Management Workshop." Two-day workshop presented for Professional Dairy Producers of Wisconsin. Green Bay, WI.
92. Noa Roman-Muniz. (October, 2015). *Cultural and Language Barriers to Effective Communication in CO Livestock Operations*. Presentation and panel discussion Immigration and Agriculture: A One Health Approach, Fort Collins, CO.
93. Murgia, L., Rosecrance, J., & Paulsen, R. (September 9, 2015). *Ergonomic issues and musculoskeletal disorders among ewe dairy workers involved in mechanical milking*. International Congress on Rural Health, Lodi, Italy.
94. Reynolds, S. J., & Hagevoort, R. (March 31, 2015). *Impact of Aerosols on Respiratory Health of Dairy Workers and Residents Living Near Dairies: Discussion and Implications of Recent Research*. Presentation at the Livestock and Poultry Environmental Learning Center's Waste to Worth Conference, Seattle, WA. <https://etouches.com/ehome/85805>
95. Roman-Muniz, I. N., Rosecrance, J., Menger, L., Pezzutti, F., Stallones, L., & Amaya, F. (September 9, 2015). *Dairy Worker Safety Training: Current Challenges and Opportunities for Enhanced Effectiveness*. International Congress on Rural Health, Lodi, Italy.
96. Roman-Muniz, I.N. (2015). Dairy Issues: Welfare and Dairy Beef Quality. Presentation at the North American Meat Institute Animal Care and Handling Conference, Kansas City, MO.
97. Rosecrance, J., & Brumby, S. (September 9, 2015). *Dairy Symposium Chairs: International Perspectives on Health and Safety among Dairy Workers: Challenges, Solutions & the Future*. International Congress on Rural Health, Lodi, Italy.
98. Rosecrance, J., & Murgia, L. (September 9, 2015). *Manually milking ewes and the risk of carpal tunnel syndrome*. International Congress on Rural Health, Lodi, Italy.
99. Rosecrance, J. (September 9, 2015). *Symposium Chair: WMSDs and Occupational Health*. International Congress on Rural Health, Lodi, Italy.
100. Schaeffer, J. (September 9, 2015). *Large Particle Exposures and Attendant Health Effects among Dairy Workers: Progress and Future Directions*. International Congress on Rural Health, Lodi, Italy.
101. VanDyke, A., Reynolds, S.J., Davidson, M., Schaeffer, J., Bisha, B., & Delton-Hanson, J. (June 3, 2015). Effect of Environmental Conditions on Bacterial and Fungal Communities in Dairy Parlors through Pyrosequencing, Riboprinting, and Microscopic Analysis Techniques. Poster presentation at the AIHCE, Salt Lake City, UT.

## 2014

102. Ayers, P. D., Hill, H., John, Y., & Whitaker, G. (July 13-16, 2014). *Implementation and evaluation of a computer-based ROPS design program*. Presented at the ASABE Conference, Montreal, Canada.
103. Ayers, P. (2014). Tractor rollover protection. Presentation at the Tennessee Department of Health Violence and Injury Prevention Program Commissioners Council, Nashville, TN.
104. Ayers, P. (2014). *Computer-based ROPS design program*. Presentation at the NIOSH Office of Agricultural Safety and Health Meeting, Fort Collins, CO.
105. Ayers, P. (2014). *Development of computer-based ROPS design program*. Presentation at the High Plains Intermountain Center for Agricultural Safety and Health Advisory Conference, Fort Collins, CO.
106. Ayers, P. D., & Wang, X. (2014). *Review of new developments and issues related to ROPS, center of gravity, vehicle stability and continuous roll standards and regulations for tractors and ZTR mowers*. Presentation at the ASABE Conference, Montreal, Canada.
107. Buchan, V., Quijano, L., & Cassidy, A. (September 23, 2014). *HICAHS Evaluation Project*. NIOSH Site Visit, Fort Collins, CO.
108. Buchan, V., & Quijano, L. M. (October 20, 2014). *Future Focus: What Are Our Constituencies*

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*Telling Us?* Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)

109. Buchan, V., & Quijano, L. M. (October 15-18, 2014). *Multilevel Evaluation of a Federally Funded Center for Occupational Health and Safety*. Presentation at the 28th Annual Conference of the American Evaluation Association: Visionary Evaluation for a Sustainable, Equitable Future, Denver, CO.
110. Cassidy, A. (June 26, 2014). *Professional Improvement Workshop - Information Technology: YouTube and Other Google Products*. Presentation at the International Society for Agricultural Safety and Health (ISASH) Conference, Omaha, NE.
111. Cassidy, A., & Cheyney, M. (November 19, 2014). *U.S. Agricultural Safety and Health Centers YouTube Channel*. Presentation at the Transforming Safety and Health in the Heartland: 13th Annual Midwest Rural Agricultural Safety & Health Conference in conjunction with the Iowa Rural Health Association's Fall Meeting, Ankeny, IA. <http://cph.uiowa.edu/icash/events/MRASH-IRHA/2014/>
112. Davidson, M. (October 22, 2014). *Extraction of RNA from Rhino-Probe™ Samples: The Good, the Bad and the Ugly*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
113. Davidson, M., Schaeffer, J., Reynolds, S., & Reed, S. (December 2, 2014). *Bioaerosol sampling in the 21st Century: is there still a place for culture-based assessments?* Presentation at the Australian Institute of Occupational Hygienists (AIOH) 32nd Annual Conference & Exhibition, Melbourne, Australia. <https://event.crowdcompass.com/aioh2014>
114. Davidson, M. E., Hawley, B., Schaeffer, J., Bradford, M., Volckens, J., & Reynolds, S. J. (August 25-27, 2014). *Use of Rhino-Probe™ Sampling for Analyzing Cross-shift Variation in the Expression of IL8, IL6 and TNF alpha in Nasal Epithelial Cells from Colorado Dairy Workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Porvoo, Finland. <http://www.ttl.fi/partner/nmaohs/abstracts/Documents/NMAOHS%20Abstracts%20Final%2030102014.pdf>
115. Douphrate, D. (November 20-22, 2014). *Worker health and safety on U.S. Dairy Farms*. Presented at the 24th Annual Midwest Stream Farmworker Health Forum, San Antonio, TX.
116. Douphrate, D., Gimeno, D., Nonnenmann, M., Hagevoort, R., Rosecrance, J., & S.J., R. (October 19-22, 2014). *Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
117. Douphrate, D., Fethke, N., Hagevoort, G. R., Nonnenmann, M., Gimeno, D., Marshall, A., . . . Reynolds, S. J. (October 19-22, 2014). *Task-specific and full-shift sampling of upper extremity muscle activity among US large-herd dairy parlor workers*. Presented at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
118. Douphrate, D.I., Gimeno, D., Nonnenmann, M., Hagevoort, R., Rosas-Goulart, C., Rosecrance, J., & Reynolds, S. (August 25-27, 2014). *Prevalence of work-related musculoskeletal symptoms among US large-herd dairy parlor workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Finnish Institute of Occupational Health (FIOH) and Farmers' Social Insurance Institution (Mela), Porvoo, Finland. [http://www.ttl.fi/partner/nmaohs/programme/Documents/Programme\\_NMAOHS%202014\\_14Aug2014\\_web.pdf](http://www.ttl.fi/partner/nmaohs/programme/Documents/Programme_NMAOHS%202014_14Aug2014_web.pdf)
119. Fisher, J., Ayers, P. D., Dobson, D., Cedarquist, S., & Green, J. (February 10-12, 2014). *ASABE tractor seatbelt and ROPS usage*. Presented at the Agricultural Equipment Technology Conference (AETC), Louisville, KY.
120. Keeney, A., & Quijano, L.M., (2014). *Dairy Worker Stress: Mental and Physical Health Implications*. Presentation at the 7th International Symposium of Safety & Health in Agricultural and Rural Populations: Global Perspectives, Saskatoon, SK, Canada.

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121. Krause, L., Reynolds, S. J., Schaeffer, J., Van Dyke, A., Davidson, M., & Bisha, B. (April 15, 2014). *Evaluation of Bacterial Preservation during Air Sampling of Culturable Bioaerosols \*Awarded High Honors\**. Celebrate Undergraduate Research and Creativity (CURC 2014) Showcase, Colorado State University, Fort Collins, CO.
122. Lagerstrom, E., Gilkey, D., Rosecrance, J. & Paulsen R. (April, 2014). *A Case Study on the Effectiveness of Two ATV Injury Prevention Strategies*. Presentation at the 12th Annual National Occupational Research Agenda Young Investigators Conference, Salt Lake City, UT.
123. Nonnenmann, M., Gimeno, D., Levin, J., Boggaram, V., & Reynolds, S. (October 19-22, 2014). *Associations of pulmonary function and exhaled nitric oxide with measurements of exposure to inhalable dust, endotoxin and muramic acid among dairy parlor workers*. Presentation at the 7th International Symposium: Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, SK, Canada.
124. Pate, M. (February 21, 2014). *Respirator Training Program and Fit Assessment for Agricultural Producers*. Presentation at the 2014 HICAHS Advisory Board Meeting, Fort Collins, CO.
125. Quijano, L. M., & Buchan, V. (October 20, 2014). *A Collaborative Approach to Building Capacity for Community Response to Disaster*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
126. Quijano, L. M., & Buchan, V. (October 15-18, 2014). *Community Emergency Response Plans for Pets and Service Animals*. Presentation at the 28th Annual Conference of the American Evaluation Association: Visionary Evaluation for a Sustainable, Equitable Future, Denver, CO.
127. Reed, S., Davidson, M., Schaeffer, J., & Reynolds, S. (November 6, 2014). *Bioaerosols: What IHs need to know about biological hazards in the future*. Presentation at the AIHA/MIHA 2014: Asia Pacific OH + EH Conference + Exhibition, Kuala Lumpur, Malaysia. <https://www.aiha.org/events/asia-pacific/programme/Pages/Main-Program-Thursday.aspx>
128. Reynolds, S. J. (October 22, 2014). *Candidate TLR and NLR Innate Immunity Genes and Cross Shift Pulmonary Function Changes Among Western US Dairy Workers*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
129. Reynolds, S. J., Clark, M. L., Davidson, M. E., Keefe, T., Mehaffy, J., Bradford, M., . . . Yang, I. (August 25-27, 2014). *Candidate Innate Immunity Genes and Cross Shift Pulmonary Function Changes Among Western US Dairy Workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Porvoo, Finland. <http://www.ttl.fi/partner/nmaohs/abstracts/Documents/NMAOHS%20Abstracts%20Final%2030102014.pdf>
130. Roman-Muniz, I. N. (December 10-11, 2014). *Worker Training and Protocol Development*. Presentation for Midwest PMS Nutrition, Denver, CO and Firestone, CO.
131. Roman-Muniz, I.N. (2014). *Effect of on-farm dairy Beef Quality Assurance (BQA) training on dairy worker knowledge of BQA and welfare related practices*. Poster presentation at the ADSA-ASAA Joint Annual Meeting, Kansas City, MO.
132. Roman-Muniz, I. N., & Wall, T. (December 10-11, 2014). *Multi-Cultural Management*. Two-day workshop hosted by the Professional Dairy Producers of Wisconsin, Chula Vista Resort, Wisconsin Dells, WI.
133. Schaeffer, J. (October 22, 2014). *Microbial Communities of Inhalable Bioaerosols at Colorado Dairies*. Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
134. Schaeffer, J., Volckens, J., Davidson, M. E., Van Dyke, A., Krause, L., Tryon, J., . . . Reynolds, S. (August 25-27, 2014). *Size Characterization and Composition of Inhalable Bioaerosols at Colorado Dairies*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Porvoo, Finland. <http://www.ttl.fi/partner/nmaohs/abstracts/Documents/NMAOHS%20Abstracts%20Final%2030102014.pdf>

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135. Van Dyke, A., & Reynolds, S. (October 19-22, 2014). *Comparative Analysis of Bacterial and Fungal Communities in Three Dairy Parlors Through the Use of Pyrosequencing, Riboprinting, Culture Techniques, and Microscopy*. Poster presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. [http://cchsa-ccssma.usask.ca/sharp2014/docs/Full\\_Program-Final.pdf](http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf)
136. Van Dyke, A., Reynolds, S. J., Davidson, M. E., Schaeffer, J., Bisha, B., & Hanson, J. D. (June 3, 2014). *Effect of Environmental Factors on Isolation and Identification of Potential Pathogenic Species of Bacteria and Fungi from Bioaerosols in Three Dairy Parlors*. Poster presentation at AIHCE 2014, San Antonio, TX. <http://aihce2014.org/>
137. Whitaker, G., John, Y., & Ayers, P. D. (2014). *Retrofitting tractors with SAE-compliant ROPS using a computer-based ROPS design program*. Poster presented at the 2014 ASABE Conference, Montreal, Canada.

## 2013

138. Ayers, P. D. (2013). *ROPS and stability research forum: review of U.S. activity*. Presented at the OECD ROPS and Stability Research Forum, Bologna, Italy.
139. Ayers, P. D., Yantis, J., Bradley, C., & Davis, G. (2013). *Development of a computer-based ROPS design program*. Presented at the 2013 ASABE Conference, Kansas City, MO.
140. Ayers, P. D., Wade, D., Yantis, J., & Freeman, J. (2013). *Modeling vehicle power requirements with tire compression and terrain interaction*. Presentation at the ASABE Conference, Kansas City, MO.
141. Buchan, V., & Quijano, L. (September 25-27, 2013). *An Ounce of Prevention: an Interactive Health and Safety CD for 4-H Youth*. Poster presented at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
142. Davidson, M., Reynolds, S., Clark, M., Keefe, T., Mehaffy, J., Bradford, M., . . . Schenker, M. (May 21, 2013). *Tasked Based Assessment of Dairy Worker Exposure to Bioaerosols*. Podium presentation at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
143. DeVries, A. (October 4, 2013). *Outreach update from ASHCA*. Presentation at the NIOSH Extramural Center Directors Meeting, Anschutz Medical Campus, Aurora, CO.
144. DeVries, A. (2013). *Farm MAPPER for Colorado*. Presentation at the Colorado Livestock Association Safety Meeting, Embassy Suites, Loveland, CO. <http://coloradolivestock.org/>
145. Douphrate, D. (September 25-27, 2013). *Milking parlor ergonomics on US large herd dairies*. North American Agricultural Safety Summit, Minneapolis, MN.
146. Douphrate, D. (September 26, 2013). *Dairy Equipment Innovations*. Panel Presentation at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
147. Douphrate, D. (March 28, 2013). *Managing worker safety, productivity, and regulatory issues*. Presentation at the Southern Great Plains Dairy Consortium Annual Meeting, Grapevine, TX.
148. Douphrate, D. (June 17-18, 2013). *Dairy farm safety and leadership*. Southern Great Plains Dairy Consortium Teaching: Advanced Dairy Herd Management, Clovis, NM.
149. Douphrate, D., Keifer, M., Liebman, A., Carrabba, J., Hagevoort, R., Grafft, L., & Reynolds, S. J. (June 23-27, 2013). *Assisting the dairy industry to optimize worker health and safety*. Expert Panel Presentation at the International Society of Agricultural Safety and Health Annual (ISASH) Conference: Exploring the shores of safety and health, Sandusky, OH.
150. Douphrate, D., & Levin, J. (April 24-27, 2013). *Ergonomic considerations in logging operations*. Presentation at the Four-State Forestry on the Grow Conference, Texarkana, TX.
151. Gallagher, M., Nonnenmann, M., Hornick, M., Reynolds, S., Levin, J., & Boggaram, V. (May, 2013). *Evaluation of Pulmonary Function Cross-Shift Changes in Dairy Parlor Workers using Spirometry and Exhaled Nitric Oxide*. Student abstract presented at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>

\*Awarded Best Poster AIHA\*

152. Gilkey, D. (June 25-26, 2013). *The ATV Epidemic: Risk Factors and Control Strategies in Agriculture*. Presentation at the Wyoming Safety Summit, Western Wyoming Community College in Rock Springs, Wyoming. <http://wyomingworkforce.org/employers-and-businesses/osha/Pages/2013-Wyoming-Safety--Workforce-Summit.aspx>
  153. Modai, G., Paulsen, R., Gilkey, D., & Rosecrance, J. (April, 2013). *Increasing ATV Safety in Agriculture*. Presentation given at the 11th Annual Regional NORA Young Investigators Conference, University of Utah.
  154. Newman, L. S., Reynolds, S. J., Kiefer, M., & Tenney, L. (October 3, 2013). *New Paradigms: Examples of Collaboration Across NIOSH and Centers*. Presentation at the NIOSH Extramural Center Directors Meeting, Anschutz Medical Campus, Aurora, CO.
  155. Pfister, J. (January 28, 2013). *ATV Safety in Montana*. Presentation at the 2013 HICAHS Advisory Board Meeting, Fort Collins, CO.
  156. Quijano, L., & Buchan, V. (Oct. 16, 2013). *Instruments to Predict Research to Practice Relevance*. Abstract presented at the American Evaluation Association Conference, Washington, D.C. <http://archive.eval.org/search13/session.asp?sessionid=5000&presenterid=400>
  157. Reynolds, S., Clark, M., Davidson, M., Keefe, T., Mehaffy, J., Bradford, M., . . . Schenker, M. (23 May, 2013). *Exposures to Organic Aerosols and Effects on Pulmonary Function among Western U.S. Dairy Workers*. Podium presentation at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
- \*Awarded Best Presentation AIHA Occupational and Environmental Epidemiology Committee\*
158. Reynolds, S. J. (October 4, 2013). *Follow up & next steps facilitated discussion*. NIOSH Extramural Center Directors Meeting, Anschutz Medical Campus, Aurora, CO.
  159. Reynolds, S. J., Douphrate, D., Hagevoort, R., Brazile, W., & Root, K. (March 6-8, 2013). *Managing Worker Safety, Productivity, & Regulatory Issues*. Presentation at the Western Dairy Management Conference, John Ascuaga's Nugget, Reno, NV. Paper retrieved from <http://www.wdmc.org/2013/Managing%20Worker%20Safety,%20Productivity,%20and%20Regulatory%20Issues.pdf>
  160. Rickabaugh, K., Casuccio, G., Lersch, T., Zock, M., Volckens, J., & Leith, D. (May 22, 2013). *Evaluation of the Thermophoretic Personal Air Sampler (TPS) for Collection of Nanoparticles*. Podium presentation at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
  161. Rosecrance, J., Tellechea, T., Menger, L., Gilkey, D., & Roman-Muniz, I.N. (2013). *Health and Safety Challenges Associated with Immigrant Dairy Workers*. Published abstract in the Journal of Agricultural Engineering. Volume XLIV(s2):e129, 645-648
  162. Schaeffer, J. W., Volckens, J., Van Dyke-Gonnerman, A., Davidson, M., & Reynolds, S. J. (May, 2013). *Particle Size Characterization of Agricultural Aerosols in Two Colorado Dairies using a High-Volume Cloud Impactor*. Student abstract presented at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
  163. Stallones, L. (August 7-9, 2013). *Consumer attitudes*. Presentation at the Ranching for Profit Summit-Wheels of Change, Laramie, Wyoming.
  164. Stallones, L. (August 7-9, 2013). *Obesity, diet and disease*. Presentation at the Ranching for Profit Summit-Wheels of Change, Laramie, Wyoming.
  165. Stinson, K., Fang, H., Metcalf, D., Jinnett, K., Brockbank, C., Tenney, L., Trotter, M., Reynolds, S.J., Witter, R., Goetzel, R., & Newman, L. S. (November 6, 2013). *Evaluating the impact of a health risk management program on employee's health risks and workers compensation*. Panel presentation at the 141st APHA Annual Meeting and Exposition, Boston, MA. Abstract retrieved from <https://apha.confex.com/apha/141am/webprogram/Paper284364.html>
  166. Van Dyke-Gonnerman, A., Reynolds, S., Davidson, M., Schaeffer, J., Bisha, B., Goodridge, L., & Hanson, J. D. (May, 2013). *Comparative Analysis of Bacteria and Fungi Communities Through the Use of Pyrosequencing, Riboprinting, Culture Techniques, and Microscopic Analysis in Two Dairy Parlors*. Student abstract presented at AIHce2013, Montreal, Canada. Abstract retrieved from

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2012

167. Noa Roman-Muniz. (December, 2012). *Hispanic Supervisor Workshop*, Presented for Professional Dairy Producers of Wisconsin, Chilton, WI and Madison, WI.
168. Noa Roman-Muniz. (December, 2012). *Bridging Cultures on Dairy Operations*, Presented for Professional Dairy Producers of Wisconsin, Oshkosh, WI.
169. Noa Roman-Muniz. (2012). *Bridging the Culture Divide*, Colorado Agriculture Big and Small Conference, Brighton, CO.
170. Noa Roman-Muniz. (2012). *Dairy Labor Management*, Great Lakes Regional Dairy Conference, Mt. Pleasant, MI.
171. Ayers, P., Davis, G., Yantis, J., & Kerrigan, S. (September 3-6, 2012). *Improving ROPS designs for agricultural tractors*. Presented at the International Conference RAGUSA SHWA, Ragusa, Italy. [http://www.ragusashwa.it/CD\\_2012/lavori/TOPIC3/orale/topic%203\\_111\\_117.pdf](http://www.ragusashwa.it/CD_2012/lavori/TOPIC3/orale/topic%203_111_117.pdf)
172. Ayers, P., & Davis, G. (June 24-28, 2012). *ROPS design program*. Presented at the International Society of Agricultural Safety and Health (ISASH) Conference, Burlington, VT.
173. Ayers, P., & Davis, G. (July 29 - August 1, 2012). *Computer modeling for ROPS design*. Presentation at the ASABE Conference, Dallas, TX.
174. Ayers, P., Groothuis, M., Kruckeberg, J., Nichols, W., Samba, A., Shaver, C., & Bradley, C. (July 29 - August 1, 2012). *Design of a powered foldable ROPS*. Presentation at the ASABE Conference, Dallas, TX.
175. Davidson, M., Clark, M. L., Keefe, T., Mehaffy, J., Bradford, M., Roman-Muniz, N., . . . Reynolds, S. J. (August 27-29, 2012). *Similar exposure group (task) based analysis of bioaerosol exposures in dairies*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Ystad, Sweden.
176. DeVries, A. (March 9, 2011). *Colorado Agri-Women Presentation*. Presentation at the Colorado Agri-Women Annual Meeting, Denver, CO.
177. Douphrate, D. (September 28-30, 2012). *Upper extremity hazards and solutions in large herd parlor milking*. Presentation at the Agricultural Safety and Health: Focus on Dairy Conference, Palmerston North, New Zealand. Conference agenda retrieved from <http://www.conference.co.nz/worldsafety2012/agriculturalsafetyhealth>
178. Douphrate, D., & Rosecrance, J. (September 3-6, 2012). *Ergonomic exposure assessment of posture and muscle activity among dairy parlor workers in U.S. large herd operations*. Paper presented at the International Conference on Safety, Health and Welfare in Agriculture and Agro-food Systems--Ragusa SHWA, Ragusa Ibla Campus- Italy.
179. Douphrate, D., Rosecrance, J., & Reynolds, S. J. (August 27-29, 2012). *Ergonomic exposures of posture and muscle activity among U.S. large herd dairy parlor workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health & Safety, Ystad, Sweden.
180. Gilkey, D., Rosecrance, J., Paulsen, R., & Tucker, D. (April 25-27, 2012). *ATV Safety and Ergonomics in Agriculture*. Presentation given at the Brouha Work Physiology Symposium 50th Annual Meeting, Auburn, AL.
181. Nonnenmann, M. W., Choudhry, A., Mehaffy, J., Douphrate, D., Levin, J. L., Gilmore, K., & Reynolds, S. J. (August 27-29, 2012). *Evaluation of a parlor washing system to reduce exposure to inhalable aerosols during dairy parlor work--A pilot study*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Ystad, Sweden.
182. Paulsen, R., Tucker, D., Gilkey, D., & Rosecrance, J. (April 19, 2012). *Investigating All-Terrain Vehicle Use in Agriculture: The initial phase of a multi-year project aimed at increasing the safety and health of agricultural ATV users*. Presentation given at the 10th Annual Regional NORA Young Investigators Conference, University of Utah.
183. Read, T., Amick, B., & Douphrate, D. (April 26-27, 2012). *Head injury risk assessment in a large oilfield services company*. Poster presented at the 53rd Annual National Student Researcher Forum,

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Galveston, TX.

184. Reynolds, S. J. (December, 2012). *HICAHS Programs and Services*. Presentation at the Colorado Livestock Association Meeting, Embassy Suites, Loveland, CO. <http://coloradolivestock.org/>
185. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, M., . . . Reynolds, S. J. (August 27-29, 2012). *Exposures to organic aerosols and effects on pulmonary function among western U.S. dairy workers*. Presentation at the Nordic Meeting on Agricultural Occupational Health and Safety, Ystad, Sweden.
186. Stallones, L. (September, 2012). *Global perspectives in agricultural injury prevention*. Presentation at the American College of Epidemiology Annual Meeting, Chicago, IL.

## 2011

187. Ayers, P., Bozdech, G., Freeman, J., Reid, A., & O'kins, J. (2011). *Development of a dynamic visco-elastic vehicle-soil interaction model for rut depth, energy and power determinations*. Presentation at the 17th International Conference of the International Society for Terrain-Vehicle Systems, Blacksburg, VA.
188. Clark, M. L., Bachand, A., Heiderscheidt, J. M., Diaz-Sanchez, D., Luna, B., Volckens, J., . . . Neas, L. (September 13-16, 2011). *Impact of an indoor cook stove intervention on measures of systemic inflammation*. Presented at the ISEE, Barcelona, Spain.
189. Clark, M. L., Reynolds, S. J., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. A. (September, 2011). *Endotoxin exposure, TLR4 mutations, smoking and work-related behaviors: pulmonary function deficits among potentially susceptible subgroups of agricultural workers in Colorado and Nebraska*. Presented at the ISEE.
190. DeVries, A. (April 5, 2011). *Colorado Dairy Women Presentation*. Presentation at the Colorado Dairy Women Meeting, Eaton, CO.
191. DeVries, A. (August 17, 2011). *Respiratory Illness and Farming*. Presentation at the 2011 Irrigation Research Foundation Farm Show, Yuma, CO.
192. DeVries, A. (November 19, 2011). *About HICAHS*. Presentation at the 93rd Annual Meeting of the Colorado Farm Bureau, Denver, CO.
193. Douphrate, D. (December 7-8, 2011). *Incorporating worker safety into daily farm management activities*. refereed conference proceedings Presented at the 2011 Dairy Summit, Wisconsin Dells, WI.
194. Douphrate, D. (April 5-6, 2011). *Dairy farm safety and OSHA--Approaches for effective management and worker training*. Presented at the Dairy Calf & Heifer Association Annual Conference, Lake Geneva, Wisconsin.
195. Douphrate, D., Rosecrance, J., & Reynolds, S. J. (August 22-24, 2011). *Musculoskeletal symptoms and physical exposures among U.S. large-herd milking parlor workers*. refereed conference proceedings Presented at the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
196. Funk, S., Reynolds, S. J., Volckens, J., Dowd, S., & Nonnenmann, M. W. (May 16-19, 2011). *Evaluation of seasonal ventilation changes and their effect on ambient dust, endotoxin and bioaerosol concentrations in a dairy parlor*. Presented at the American Industrial Hygiene Conference and Exposition, Portland, OR.
197. Gilkey, D., Randall, E., Hansen, C., Patil, A., Rosecrance, J., & Douphrate, D. (September 1, 2011). *Musculoskeletal Symptoms And Ergonomic Risk Factors Among Veterinary Ultrasonographers*. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. <http://pro.sagepub.com/content/55/1/720.abstract>
198. Hussain, A., Nonnenmann, M., Levin, J., & Reynolds, S. (May 16-19, 2011). *Evaluation of Parlor Washing as an Intervention for Decreasing Occupational Exposure to Organic Dust and Endotoxin Among Dairy Parlor Workers*. American Industrial Hygiene Conference and Exposition, Portland, OR, USA.  
*Best Student Poster; Occupational and Environmental Medicine Committee*
199. Mitchell, D., Schenker, M. B., Armitage, T., Bennett, D., Tancredi, D., Eastman, C., . . . Mitloehner, F. (September 7-9, 2011). *Are respiratory decrements associated with exposure to particles*

- including endotoxins on large California dairies?* Presented at the EPICOH International Conference on Epidemiology in Occupational Health, Oxford, UK.
200. Quijano, L. M., Becerra, D. & Amell, J. (April 27, 2011). *Dairy Farmworker Stress: Mental and Physical Implications*. HICAHS Dairy Board Meeting, Fort Collins, CO.
  201. Reynolds, S. J. (May 4, 2011). *What's hanging in dairy; avoiding udder disaster: High Plains Intermountain Dairy Health and Safety Initiatives-Projects and Partnerships*. Presented at the NFMC, Marshfield, WI.
  202. Reynolds, S. J., Campbell, C., Towle, M., Warner, A., Kiefer, M., Ray, B., & Comstock, N. (June, 2011). *Investigation of an Escherichia coli O111 outbreak at a state-run correctional facility dairy facility*. Presented at the National Symposium on Agriculture, Forestry and Fishing Health and Safety, Boise, ID.
  203. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. (May 4, 2011). *Endotoxin exposure, TLR4 mutations, smoking and work-related behaviors: pulmonary function deficits among agricultural workers*. Presented at the NFMC, Marshfield, WI.
  204. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. A. (June, 2011). *Agricultural dust exposures and pulmonary function among grain elevator, cattle feedlot, dairy, and corn farm workers in Colorado and Nebraska*. Presented at the National Symposium on Agriculture, Forestry and Fishing Health and Safety, Boise, ID.
  205. Reynolds, S. J., Clark, M. L., Davidson, M., Keefe, T., Mehaffy, J., Bradford, J., . . . Poole, J. A. (August 22-24, 2011). *Exposure to endotoxin, muramic acid, ergosterol and effects on pulmonary function among western dairy workers*. Presented at the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
  206. Roman-Muniz, I.N. (2011). Dairy Worker Training Experiences. Danish Bovine Veterinarian Annual Meeting, Vejle, Denmark.
  207. Roman-Muniz, I.N. (2011). Labor Management and Dairy Worker Safety. Danish Bovine Veterinarian Annual Meeting, Vejle, Denmark.
  208. Smith, M.A., Hagevoort, G.R., & Rivera, F.A. (2011). A Dairy Safety Program: Considering Human and Animal Safety. Abstract in the J. Dairy Sci. 94 Suppl. 1: 504.
  209. Steneroden, K., Hill, A., Knight, A., Reynolds, S. J., & Salman, M. (2011). *Infectious and zoonotic disease control strategies in Western US animal shelters: An epidemiological approach and its application*. Presented at the International Symposium on Veterinary Epidemiology and Economics.

# HICAHS PILOT PRODUCTS

## Outputs – Leveraged Projects from Pilot Grants

Note: The pilot product section list includes products that were developed during this cycle (2011-2016), for which the grantee was awarded funds from the last cycle (2006-2011).

<b>HICAHS Pilot Grant Awardee</b> (Year Awarded & PI Last Name)	<b>Leveraged Project</b> (PI of new award & Title)	<b>Funding Agency</b>	<b>Funding Period</b>	
2014 Noblitt	Philippe Dekleva: Microchip Analytical System for Inexpensive, Real-Time Aerosol Chemical Speciation	EPA	n/a	
2014 Noblitt	Charles Henry: Integrated Microfluidic Analyzer for Real-Time Aerosol Chemical Monitoring	NSF	n/a	
2014 McConnel	Craig McConnel: Characterizing Microbial Community Impacts on the Survival and Dissemination of E. Coli O157:H7 on Dairies	NIFA	10/1/14	9/30/17
2013 Bisha	Stephen J. Reynolds: Modified Bioaerosol Sampling for Influenza Virus in Agricultural Environments	CSURF-CSU Ventures	1/4/14	1/4/15
2010 Gunderson	Paul Gunderson: Exploring Shed Antimicrobials within High Plains Livestock Operations	NIOSH	9/15/13	9/14/16
2008 Poole & 2009 Saito	Stephen Reynolds: Bioaerosols Exposures and Models of Human Response in Dairies	NIOSH	9/15/01	9/14/16
2008 Poole	Jill Poole: Role of pattern recognition receptors in organic dust-induced airway inflammation	NIEHS	9/1/10	9/1/15

## Outputs – Journal Articles

<b>HICAHS Pilot Grant Awardee (Year Awarded &amp; PI Last Name)</b>	<b>Article</b>
2015 Guiberson	Guiberson, Mark, and Emily Wakefield. "A Preliminary Study of a Spanish Graphic Novella Targeting Hearing Loss Prevention." <i>American Journal of Audiology</i> (2017): 1-9.
2014 McConnel	McConnel, C. S., Stenkamp-Strahm, C. M., Rao, S., Linke, L. M., Magnuson, R. J., & Hyatt, D. R. (2016). Antimicrobial resistance profiles in <i>Escherichia coli</i> O157 isolates from Northern Colorado Dairies. <i>Journal of Food Protection</i> ®, 79(3), 484-487.
2013 Walker + 2013 Farmer	Osborne, P. P., Xu, Z., Swanson, K. D., Walker, T., & Farmer, D. K. (2015). Dicamba and 2,4-D residues following applicator cleanout: A potential point source to the environment and worker exposure. <i>Journal of the Air &amp; Waste Management Association</i> , 65(9), 1153-1158. doi: 10.1080/10962247.2015.1072593
2010 Pate	Pate, M., & Merryweather, A. (2012). Utah farm owner/operators' safety practices and risk awareness regarding confined space work in agriculture. <i>Journal of Agricultural Safety and Health</i> , 18(4), 273-284.
2009 Douphrate	Douphrate, D. I., Fethke, N. B., Nonnenmann, M. W., Rosecrance, J. C., & Reynolds, S. J. (2012). Full shift arm inclinometry among dairy parlor workers: A feasibility study in a challenging work environment. <i>Applied Ergonomics</i> , 43(3), 604-613. doi: 10.1016/j.apergo.2011.09.007

**HICAHS Pilot Grant****Awardee**

(Year Awarded & PI Last  
Name)

**Article**

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2008 Poole	Poole, J. A., & Romberger, D. J. (2012). Immunological and inflammatory responses to organic dust in agriculture. <i>Curr Opin Allergy Clin Immunol</i> , 12(2), 126-132. doi: 10.1097/ACI.0b013e3283511d0e
2008 Poole	Poole, J. A., Wyatt, T. A., Kielian, T., Oldenburg, P., Gleason, A. M., Bauer, A., . . . Romberger, D. J. (2011). Toll-like receptor 2 regulates organic dust-induced airway inflammation. <i>Am J Respir Cell Mol Biol</i> , 45(4), 711-719. doi: 10.1165/rcmb.2010-0427OC
2008 Poole	Poole, J. A., Kielian, T., Wyatt, T. A., Gleason, A. M., Stone, J., Palm, K., . . . Romberger, D. J. (2011). Organic dust augments nucleotide-binding oligomerization domain expression via an NF- $\kappa$ B pathway to negatively regulate inflammatory responses. <i>Am J Physiol Lung Cell Mol Physiol</i> , 301(3), L296-306. doi: 10.1152/ajplung.00086.2011
2005 Hanneman	Dooley, G. P., Tjalkens, R. B., & Hanneman, W. H. (2013). The atrazine metabolite diaminochlorotriazine suppresses LH release from murine LbetaT2 cells by suppressing GnRH-induced intracellular calcium transients. <i>Toxicol Res (Camb)</i> , 2(3), 180-186. doi: 10.1039/c3tx20088d
2005 Cragin	Cragin, L. A., Kessner, J., Bachand, A., Boyd Barr, D., Meadows, J., Krieg, E., & Reif, J. S. (2011). Menstrual cycle characteristics and reproductive hormone levels in women exposed to atrazine in drinking water. <i>Environmental Research</i> , 111(8), 1293-1301.

## Outputs –Conference Presentations

<b>HICAHS Pilot Grant Awardee</b> (Year Awarded & PI Last Name)	<b>Presentation</b>
2014 Noblitt	Henry, C. S. (October 6, 2014). <i>Sensitive Analysis of Environmental Pollutants by Microchip Electrophoresis with Contact Conductivity Detection</i> . Presentation at the 21st International Symposium on Electro- and Liquid Phase- Separation Techniques; 20th Latin-American Symposium on Biomedical, Biopharmaceutical, and Industrial Applications of Capillary Electrophoresis, Natal, Brazil.
2009 Quijano	Keeney, A., & Quijano, L. M. (October 21, 2014). <i>Dairy Worker Stress: Mental and Physical Health Implications</i> . Presentation at the 7th International Symposium: Safety and Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Canada. <a href="http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf">http://cchsa-ccssma.usask.ca/sharp2014/docs/Full_Program-Final.pdf</a>
2014 Bisha	Bisha, B. (July 7-18, 2014). <i>Food Safety: Rapid Diagnostics and Typing</i> . Presentation at the University of Pristina International Summer University, Pristina, Kosovo.
2014 Bisha	Bisha, B. (April 20-22, 2014). <i>Food Safety: Rapid Diagnostics and Typing</i> . Presentation at the Student American Veterinary Association (SAVMA) Annual Symposium, Loveland, CO.
2013 Walker + 2013 Farmer	Walker, T. (February 6, 2014). <i>Real World Pesticide Use Issues</i> . Presentation at the 14th Annual Pesticide Stewardship Conference, San Diego, CA.
2014 Bisha	Bisha, B. (December 8-9, 2013). <i>Rapid Methods/Sample Preparation/Field-based Diagnostics</i> . Presentation at the 2013 meeting of the NC 1202 Regional Research Technical Committee "Enteric Diseases of Food Animals: Enhanced Prevention, Control and Food Safety", Chicago, IL.
2013 Walker + 2013 Farmer	Walker, C. (August 8, 2013). <i>The Clean Machine - A Glimpse at 'Real-World' Sprayer Clean Out Practices</i> . Presentation to the National Pesticide Applicator Certification and Training Workshop.
2013 Walker + 2013 Farmer	Swanson, K. (July 18, 2013). <i>Quantitative analysis of pesticide tank rinses for residues</i> . Poster presented at the Colorado State University Chemistry Research Experience for Undergraduates Program, Fort Collins, CO.
2013 Walker + 2013 Farmer	Walker, C. (March 11, 2013). <i>Report to NIOSH: Survey &amp; Effectiveness of Spray Equipment Cleanout Methods</i> . Webinar.
2013 Walker + 2013 Farmer	Swanson, K. (2013). <i>Quantitative analysis of pesticide tank rinses for residues</i> . Presentation at the Southeastern Regional ACS.

- 2012 Warner                      Towle, M. (June 10, 2013). *Public Health Survey to Assess Acute Pesticide Poisoning Experiences of Certified Applicators in Colorado, 2012*. Presentation during the Occupational Pesticide Illness Panel at the CSTE 2013 Conference, Pasadena, CA.
- 2012 Davidson                    Davidson, M., Goodridge, L., Bisha, B., & Reynolds, S. J. (20 May, 2013). *Evaluation of the NIOSH BC-251 Personal Bioaerosol Sampler for Sampling Viable and Culturable Pathogenic Bacteria*. Podium presentation at AIHce2013, Montreal, Canada. Abstract retrieved from <http://aihce2013.org/wp-content/uploads/2013/06/2013AbstractBook.pdf>
- 2012 Davidson                    Davidson, M., Bisha, B., Reynolds, S. J., & Goodridge, L. (January 26, 2013). *Speciation of Airborne Bacteria Collected by Novel and Traditional Samplers in a Cantaloupe Processing Facility: A Pilot Study*. Poster presented at the Colorado State University 14th Annual College of Veterinary Medicine and Biomedical Sciences Research Day, Hilton Fort Collins, CO. Schedule retrieved from <http://csu-cvmb.colostate.edu/Documents/cvmb-research-day-schedule-2013.pdf>
- 2010 Pate                            Pate, M. L. (November 14, 2012). *Estimating the Effect of Selected Predictors on Agricultural Confined Space Hazard Perceptions of Utah Farm Owner Operators*. Presentation at the 2012 Midwest Rural Agricultural Safety and Health Conference: Reaping the Rewards, Cedar Rapids, IA.
- 2010 Pate                            Pate, M. (2012, March). *Increasing risk awareness of confined spaces in production agriculture*. Presented at the Utah State University Extension Annual Conference, Logan, UT.
- 2011 Pate                            Pate, M. (June 26-30, 2011). *Developing a Research and Extension Agenda for Agricultural Confined Spaces*. Panel discussant for the white paper presented at the International Society of Agricultural Safety and Health (ISASH) Conference, Boise, Idaho.
- 2010 Pate                            Pate, M. (June 26-30, 2011). *Estimation of the Frequency, Severity and Primary Causative Factors Associated with Injuries and Fatalities involving Confined Spaces in Agriculture*. Poster presented at International Society of Agricultural Safety and Health (ISASH) Conference, Boise, Idaho. Agenda retrieved from [http://www.isash.org/ckfinder/userfiles/files/prelim\\_agenda323.pdf](http://www.isash.org/ckfinder/userfiles/files/prelim_agenda323.pdf)
- 2010 Pate                            Pate, M. L., Young, C., & Merryweather, A. (August 7-10, 2011). *Farm Owner/Operators' Perceptions of Risk Associated with Confined Spaces in Agriculture*. Paper presented at the ASABE Annual International Meeting, Louisville, KY. Paper retrieved from <http://elibrary.asabe.org/azdez.asp?JID=5&AID=37369&CID=loui2011&T=2>

2010 Pate Pate, M. (2011, August). Farm owner/operators' perceptions of risk associated with confined spaces in agriculture. Paper presented at the ASABE Annual International Meeting, Louisville, KY.

2009 Douphrate Douphrate, D., Rosecrance, J., & Reynolds, S. J. (2011, August 22-24). *Musculoskeletal symptoms and physical exposures among U.S. large-herd milking parlor workers*. Paper presented at the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland

2008 Merryweather Merryweather, A., & Pate, M. (August 7-11, 2011). Tractor mounting/dismounting biomechanics related to falls. Paper presented at ASABE Annual International Meeting, Louisville, KY.  
<http://elibrary.asabe.org/azdez.asp?JID=5&AID=37421&CID=loui2011&T=2>

2008 Merryweather Merryweather, A., & Pate, M. (August 7-11, 2011). Self-reported tractor operator falls, ergonomics, and musculoskeletal pain. Paper presented at ASABE Annual International Meeting, Louisville, KY.  
<http://elibrary.asabe.org/azdez.asp?JID=5&AID=37790&CID=loui2011&T=2>

2008 Poole Poole, J. A., Wyatt, T. A., Kielian, T., Oldenburg, P., Gleason, A., Bauer, A., . . . Romberger, D. J. (2011). Toll-like receptor (TLR2) Regulates Organic Dust-Induced Airway Inflammation. *The Journal of allergy and clinical immunology*, 127(2), AB137.

2004 Goodridge + 2008 Goodridge Goodridge, L. D. (2011). *Rapid Detection of Bacteria Isolated from Agricultural Dust Samples: A Comparison of Methods*. Presentation at the American Society for Microbiology 111th General Meeting, New Orleans, Louisiana.

## Outputs –Non-Conference Presentations

<b>HICAHS Pilot Grant Awardee (Year Awarded &amp; PI Last Name)</b>	<b>Presentation</b>
2012 Davidson	Davidson, M. (February 21, 2014). <i>Bioaerosol Monitoring: preventing the spread of infectious diseases among farmers</i> . Presentation at the 2014 HICAHS Advisory Board Meeting, Fort Collins, CO.
2013 Walker + 2013 Farmer	Walker, C. (March 14, 2014). Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant). Presentation at the CWMA Spring Training.

- 2013 Walker +  
2013 Farmer Walker, C. (March 14, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Lamar CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (March 13, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Eads CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (March 11, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Weld County CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (March 5, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Colorado Association of Lawn Care Professionals.
- 2013 Walker +  
2013 Farmer Walker, C. (February 28, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Burlington CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (February 27, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Akron CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (February 26, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Irrigation Research Farm CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (February 25, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Sterling CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (February 24, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Fort Morgan CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (February 21, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Adams County CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (February 18, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Tri River Area Pest Management Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (February 13, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the ProGreen Expo.
- 2013 Walker +  
2013 Farmer Walker, C. (January 29, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation to the Greeley Farm Show.
- 2013 Walker +  
2013 Farmer Walker, C. (January 16, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation to the Rocky Mountain Agribusiness Association.

- 2013 Walker +  
2013 Farmer Walker, C. (March 14, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Cheyenne Wells CEC Workshop.
- 2013 Walker +  
2013 Farmer Walker, C. (March 14, 2014). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Las Animas CEC Workshop.
- 2010 Pate Pate, M. (January 28, 2013). *Agricultural Confined Space Hazard Perceptions of Utah Farm Owner Operators*. Presentation at the 2013 HICAHS Advisory Board Meeting, Fort Collins, CO.
- 2012 Warner Towle, M. (2013). *Public Health Survey of Certified Pesticide Applicators in Colorado, 2012*. Presentation at the Colorado Department of Public Health and Environment Internal Meeting, Denver, CO.
- 2012 Warner Towle, M. (2013). *Public Health Survey of Certified Pesticide Applicators in Colorado, 2012*. Presentation at the Colorado Pesticide Applicator Association.
- 2012 Warner Towle, M. (January 28, 2013). *Public Health Survey of Certified Pesticide Applicators in Colorado, 2012*. Presentation at the 2013 HICAHS Advisory Board Meeting, Fort Collins, CO.
- 2013 Walker +  
2013 Farmer Walker, T. (November 21, 2013). *A Glimpse at Real-World Sprayer Cleanout: Results from Aerial Spray Equipment*. Presentation to the Colorado Agricultural Aviation Association, Loveland, CO.
- 2013 Walker +  
2013 Farmer Walker, C. (April 14, 2013). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at a Private Applicator Recertification Workshop, Akron, CO.
- 2013 Walker +  
2013 Farmer Walker, C. (February 19, 2013). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at the Tri-River Area Pest Management Workshop, Grand Junction, CO.
- 2013 Walker +  
2013 Farmer Walker, C. (February 13, 2013). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at a Private Applicator Recertification Workshop, Holyoke, CO.
- 2013 Walker +  
2013 Farmer Walker, C. (February 12, 2013). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at a Private Applicator Recertification Workshop, Sterling, CO.
- 2013 Walker +  
2013 Farmer Walker, C. (February 11, 2013). *Survey & Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)*. Presentation at a Private Applicator Recertification Workshop, Fort Morgan, CO.

2013 Walker + 2013 Farmer	Walker, C. (January 30, 2013). <i>Survey &amp; Effectiveness of Pesticide Application Equipment Cleanout Methods (2012-2013 HICAHS Pilot Grant)</i> . Presentation, Fort Morgan, CO.
2013 Walker + 2013 Farmer	Walker, C. (January 28, 2013). <i>Survey &amp; Effectiveness of Pesticide Spray Equipment Cleanout</i> . Presentation at the 2013 HICAHS Advisory Board Meeting.
2013 Walker + 2013 Farmer	Swanson, K. (2013). <i>Quantitative analysis of pesticide tank rinses for residues</i> . Presentation at the Southeastern Regional ACS.
2009 Quijano	Quijano, L. (2011, April). <i>Seasonal and migrant farmworker stress: Mental and physical health implications</i> . Presented at the HICAHS Dairy Board Meeting, Fort Collins, CO.

### Outputs – Trained Students

23. Bisha, Bledar. (FY 2014 awardee). Trained one postdoctoral student (Jeff Chandler) through a HICAHS pilot grant.
24. Craig McConnel (FY 2014 awardee). One doctoral student (Chloe Stenkamp-strahm) was supported to initiate her PhD project examining bovine microbiome dynamics related to *E. coli* O157 shedding. Additionally, 3 undergraduate students conducted independent studies and 4 undergraduate students received training in laboratory work related to the project. Six students (DVM students, MS student, undergraduate students) participated in sample collection.

### Leveraged Grants

25. Bledar Bisha (FY 2014 awardee) is part of the research team led by Stephen Reynolds for a \$21,000 Colorado Bioscience Discovery Evaluation Grant Program titled “Modified Bioaerosol Sampling for Influenza Virus in Agricultural Environments.”
26. Scott Noblitt (FY 2014 awardee) is part of a research team led by Philippe Dekleva for a \$100K grant from the EPA titled, “SBIR Phase I Microchip Analytical System for Inexpensive, Real-Time Aerosol Chemical Speciation” Project Period: 9/1/15-2/28/16.
27. Craig McConnel (FY 2014 awardee) received a grant from the National Institute of Food and Agriculture titled, “Characterizing Microbial Community Impacts on the Survival and Dissemination of *E. Coli* O157:H7 on Dairies.” Project Period: 10/1/14 to 9/30/17.
28. Craig McConnel (FY 2014 awardee) received a grant from USDA Cooperative Extension titled “Describing and predicting patterns of Salmonella and *E. coli* O157:H7 shedding in preweaned dairy calves using NAHMS 2014 fecal sample” for \$24,000 in 2015.

# HICAHS SERVICE

## Conference Organizer

### 2015

1. DeVries, A., & Reynolds, S. J. (February 27, 2015). *Planning committee members*. HICAHS Advisory Board Meeting, Colorado State University, Fort Collins, CO.
2. Magzamen, S., Schaeffer, J., & Reynolds, S. J. (April 15, 2015). *Organizer and Moderator - "Next Generation Sequencing" Workshop*. Held during The 6th Annual Public Health Symposium at Colorado State University: Microbial Ecology in a Changing World: Emerging issues in antimicrobial resistance, Fort Collins, CO.
3. Reynolds, S. J., Magzamen, S., & Schaeffer, J. (April 15, 2015). *Planning committee members*. The 6th Annual Public Health Symposium at Colorado State University: Microbial Ecology in a Changing World: Emerging issues in antimicrobial resistance, Fort Collins, Colorado.  
<http://www.publichealth.colostate.edu/public-health-symposium-2015/>
4. Roman-Muniz, I. N. (March 2-6, 2015). *Planning committee member*. Western Dairy Management Conference Planning Committee, Reno, Nevada.
5. Rosecrance, J. (September 8, 2015). *Planner of The International Dairy Research Consortium Meeting*. Held during The International Congress on Rural Health, Milan, Italy.

### 2014

6. Cassidy, A., Reynolds, S. J., & Douphrate, D. (September 10, 2014). *Planning Committee Members*. HICAHS Dairy Board Meeting, Sioux Falls Regional Center.
7. Cassidy, A. (September 18, 2014). *Meeting Organizer*. Wyoming-Colorado Occupational Safety and Health Coalition, Fort Collins, CO.
8. Cassidy, A., & Reynolds, S. J. (September 23, 2014). *Planning committee members*. NIOSH Site Visit, Fort Collins, CO.
9. DeVries, A., & Reynolds, S. J. (February 21, 2014). *Planning committee members*. HICAHS Advisory Board Meeting, Colorado State University, Fort Collins, CO.
10. Reynolds, S. J. (October 19 - 22, 2014). *Member of scientific planning committee*. The 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Saskatchewan
11. Reynolds, S. J., Kirychuk, S., Douphrate, D., & Schaeffer, J. (October, 2014). *Organizer for the International Dairy Workshop*. Held during The 7th International Symposium Safety & Health in Agricultural & Rural Populations: Global Perspectives, Saskatoon, Saskatchewan
12. Roman-Muniz, I. N. (March 5-6, 2014). *Planning committee member*. High Plains Dairy Conference, Lubbock, TX.

### 2013

13. Buchan, V., Quijano, L., DeVries, A., & Keeney, A. (April 15-16, 2013). *Ag Center Evaluation Spring Workshop*. Fort Collins Marriott, CO.
14. DeVries, A. (September 25-27, 2013). *Summit Exhibitor: High Plains Intermountain Center for Agricultural Health and Safety*. Booth at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
15. DeVries, A. (September 25-27, 2013). *Summit Exhibitor: NIOSH Ag Centers*. Booth at the North American Agricultural Safety Summit hosted by ASHCA, Minneapolis, MN. Program retrieved from [http://ashca.org/wp-content/uploads/2013/10/ASHCA\\_Summit\\_Finalweb.pdf](http://ashca.org/wp-content/uploads/2013/10/ASHCA_Summit_Finalweb.pdf)
16. DeVries, A. (October 2, 2013). *"Agricultural Safety and Health at the National Centre for Farmer Health in Australia" Guest Lecture by Sue Brumby*. High Plains Intermountain Center for Agricultural Health and Safety Seminar, Colorado State University, Fort Collins, CO.
17. Scott, K., Gibson, H., Mulloy, K., DeVries, A., & Chiu, J. (April 1-2, 2013). *Workers Compensation Training*. Occupational Health and Safety Outreach by HICAHS, MAP-ERC, and the James Chiu Law Office with the Global Refugee Center, Greeley, CO.

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18. DeVries, A., & Reynolds, S. J. (January 28, 2013). *Planning committee members*. HICAHS Advisory Board Meeting, Colorado State University, Fort Collins, CO.
19. Gunderson, P. (2013). *Workshop organizer and presenter*. Ag Center Evaluation Workshop.
20. Reynolds, S. J. (September 25-27, 2013). *Member of the Planning Committee*. ASHCA North American Agricultural Safety Summit, Minneapolis, MN.
21. Reynolds, S. J., DeVries, A., & Douphrate, D. (July 25-26, 2013). *Members of the Planning Committee*. HICAHS International Dairy Research Consortium, Colorado State University, Fort Collins, CO.

## 2012

22. DeVries, A., & Reynolds, S. J. (January 24 2012). *Planning committee members*. HICAHS Advisory Board Meeting, Colorado State University, Fort Collins, CO.
23. DeVries, A. (June 20, 2012). *Colorado Agri-Women and HICAHS Booth*. Ag in the Classroom Conference, Loveland, CO.
24. DeVries, A., & Reynolds, S. J. (July 24-25, 2012). *Planning committee members*. HICAHS Dairy Board Meeting, Colorado State University, Fort Collins, Colorado.
25. DeVries, A. (November 7-11, 2011). *HICAHS Booth*. 2012 American Agri-Women Convention: Rushing West to Seek our Fortune in Agriculture, Denver, CO.
26. Reynolds, S. J. (September 29 – 30, 2012). *Pre-Conference Workshop Organizer – Agricultural Health and Safety with Emphasis on Dairy*. 11th World Conference on Injury Prevention and Safety Promotion, Wellington, New Zealand. <http://www.conference.co.nz/worldsafety2012/agriculturalsafetyhealth>
27. Reynolds, S. J. (August 27-29, 2012). *Workshop organizer and presenter*. Nordic Meeting on Agricultural Occupational Health & Safety, Ystad, Sweden.

## 2011

28. DeVries, A., & Douphrate, D. (February 9-10, 2011). *HICAHS Booth*. 6th Annual I-29 Dairy Conference, Sioux Falls, SD.
29. DeVries, A., Reynolds, S. J., & Douphrate, D. (April 27-28, 2011). *Planning Committee Members*. HICAHS Dairy Board Meeting, Colorado State University, Fort Collins, Colorado.
30. DeVries, A., & Bradford, M. (August 17, 2011). *Lung Function Testing/ HICAHS Safety Research Booth*. 2011 Irrigation Research Foundation Farm Show, Yuma, CO.
31. DeVries, A., & Bradford, M. (November 18-19, 2011). *HICAHS Booth and Lung Function Testing*. 93rd Annual Meeting of the Colorado Farm Bureau, Denver, CO.
32. Reynolds, S. J., Douphrate, D., & DeVries, A. (September 25-27, 2011). *Members of the Planning Committee for the International Dairy Research Consortium Meeting*. Held during the Irish Meeting on Agricultural Occupational Safety and Health, Dublin, Ireland.
33. Reynolds, S. J., DeVries, A., & Douphrate, D. (July 11-13, 2011). *Members of the Planning Committee*. HICAHS International Dairy Research Consortium, Colorado State University, Fort Collins, CO.

## Program Organizer

1. Paul Ayers and Allison Cassidy along with personnel at NYCAMH and other organizations have participated in the National Tractor Safety Coalition (NTSC) and the National ROPS Rebate Program. Paul Ayers was part of the organizing committee for the NTSC. Allison Cassidy spoke to agricultural producers in Wyoming in August 2016 about the National ROPS Rebate Program.

## Consultations Related to Professional Expertise

1. Reynolds, S. J. (February 17, 2017). *Consultation regarding guidelines and standards for organic dust exposures, sample interpretation, and exposure profiles for agricultural workers*. LDS Church, Risk Management, Salt Lake City, UT. *Dr. Reynolds consulted with Clark Evans*.
2. Reynolds, S. J. (February 14, 2017). *Consultation regarding beef industry/cattle feedlots and possible exemption from EPA Clean Air Act*. AgriBeef, Boise, ID. *Dr. Reynolds reviewed article and email regarding legislation in Washington State. Spoke with Jayne*

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*Davis, Director Corporate and Regulatory Affairs to provide opinion and discuss. Also suggested additional contacts.*

3. Rodriguez, A., Spears, S., & Cassidy, A. (April 11-14, 2016). *Dairy Training via iPads*. Gill, CO.
4. DeVries, A. (December 3, 2012). *Outreach Consultation with the Western Dairy Association and the Colorado Dairywomen*. WDA Headquarters, Thornton, CO.
5. Douphrate, D. (August 10-11, 2015). OSHA 10-Hour Training. Aurora Organic Dairy, Gill, CO.
6. Douphrate, D., Hagevoort, G. R., & Cassidy, A. (September 23-24, 2015). OSHA 10-Hour Training. Garden City, KS.
7. Douphrate, D., Cassidy, A., & Erickson, T. (September 11-12, 2014). OSHA 10-Hour Training. Sioux Falls, South Dakota.
8. Roman-Muniz, N. (March, 2014). Occupational Health and Safety incorporated into a “Milker” training. Blue Sky Dairy, Mead, CO.
9. Roman-Muniz, N. (March, 2014). “Safety Training.” La Luna Dairy, Wellington, CO.
10. Roman-Muniz, N. (February, 2014). Occupational Health and Safety incorporated into a “Milker” training. Morning Fresh Dairy, Laporte, CO.
11. Roman-Muniz, N. (April, 2014). Occupational Health and Safety incorporated into a “Calf Rearing School and Sick Calf Care” educational training. Blue Sky Dairy, Mead, CO.
12. Roman-Muniz, N. (April, 2014). Occupational Health and Safety incorporated into a “Milker” training. Blue Sky Dairy, Mead, CO.
13. Reynolds, S. J. (2013). RC1N IAQ Review for University of Colorado Denver, Center for Worker Health and Environment
14. Reynolds, S. J. (2013). RC1N IAQ Review for University of Colorado Denver, Center for Worker Health and Environment
15. Reynolds, S. J. (2012). Consultation to Colorado western slope communities regarding poultry production and community health risks.
16. Reynolds, S. J. (2012). Review of and advice regarding CVMBS Vet Diagnostic Lab protocols regarding infectious agent containment (Anthrax).

### Board Service

1. Cassidy, A. (2014 – present). Agrisafe Board Member (current(=) & Vice Chair (2015-2016). <http://www.agrisafe.org/>  
Cassidy, A. (2013 – present). Member of the NORA AgFF Outreach, Communications, and Partnerships Working Group.
2. Cassidy, A. (2013 – present). Founder and Member of the NIOSH Evaluators, Coordinators, and Outreach (ECO) personnel group.
3. Reynolds, S. J. (2013 – present). NORA Agriculture, Forestry & Fishing Sector Council.
4. Reynolds, S. J. (2011 – present). External Advisory Board Member of the Upper Midwest Agricultural Safety and Health Center (Minneapolis, MN).
5. Reynolds, S. J. (2011 – present). External Advisory Board National Farm Medicine Center Dairy Initiative (Marshfield, WI).
6. Reynolds, S. J. (2010 – present). Colorado Department of Public Health and the Environment (CDPHE) Occupational Health Surveillance Program.
7. Reynolds, S. J. (2010 – present). Worksafe Colorado Advisory Board.
8. Reynolds, S. J., & Cassidy, A. (2010 – present). Wyoming Governor’s Taskforce/Wyoming-Colorado Occupational Safety and Health Coalition.
9. Reynolds, S. J. (2008 – present). International Member of the Canadian Centre for Health and Safety in Agriculture (CCHSA).

## Editors

1. Drs. Stallones and Reynolds serve as Associate Editors for the Journal of Agromedicine and the Journal of Agricultural Safety and Health (2004-present).

## Webinars

1. Reynolds, S. J. (February 20, 2014). *Employee Health Hazards in the Agricultural Industry*. Webinar through Axion Health <http://axionhealth.com/knowledge-resources/webinars>
2. Reynolds, S. J., & Douphrate, D. I. (May 13, 2013). *High Plains Intermountain Center for Agricultural Health & Safety: A Stakeholder Driven Approach to Health & Safety*. Webinar through the AgriSafe Network. [www.agrisafe.org](http://www.agrisafe.org)
3. Campbell, C., Comstock, N., Keifer, M., Ray, B., Reynolds, S. J., Towle, M., & Warner, A. (2011). Epidemiologic and occupational investigation of an Escherichia coli O111 outbreak associated with a correctional facility dairy--Colorado 2010 *AgriSafe Network*.
4. Douphrate, D., & Fry, M. (January 25, 2011). *Incorporating Lean Six Sigma into Occupational Health and Safety*. Webinar through the American Conference of Governmental Industrial Hygienists.

## OTHER

### Outcomes

1. Aurora Organic Dairy (operations in CO and TX) has worked with HICAHS on implementing an OHS Management program for a number of years. Emily Prisco, the Director of Farm Resources who implements that program, is currently pursuing an MPH in the Colorado School of Public Health. Dr. Reynolds is working with her to develop a Total Worker Health Program through an independent study, and collaborating with the new Rocky Mountain Center for Total Worker Health. To our knowledge, this would be the first TWH program for a dairy farm.
2. The emerging issues award to the University of Wyoming has helped HICAHS succeed in fostering new relationships with the logging industry.
3. We have adopted and utilized novel ergonomic exposure metrics for full-shift exposures including Amplitude Probability Distribution Function (APDF), Exposure Variation Analysis (EVA), Median Power Frequency, and Gap Analysis. These metrics will enable comparison of ergonomic exposures to other studies, as well as enable the quantification of intervention effectiveness. In addition, we have developed a novel methodology using image pixel analysis to assess worker performance (teat cleaning effectiveness and consistency). This new methodology will enable future research investigations of the associations between worker fatigue and performance. Additionally, findings from the teat-preparation evaluation facilitated the re-design of the milking tool to reduce the forearm muscle loads on the worker. The manufacturer has made modifications to the tool by moving the location of the drive shaft. By doing so, the center of mass of the tool has been altered thus potentially reducing the load of the forearm muscle activity.

### Research to Practice (R2P)

1. After 15 years of working with the dairy industry, we are now seeing examples of research to practice, with dairy producers implementing integrated health and safety management into their business, hiring appropriate staff, and requesting HICAHS support for their efforts. An article about the Idaho Dairymen's Association's most recent steps can be found at the following link: <http://www.capitalpress.com/Idaho/20161215/idaho-dairymen-to-add-worker-safety-emphasis>. They are now asking Drs. Douphrate and Hagevoort for assistance with training employees on 500 dairy farms, and implementing a comprehensive safety management program on each farm operation. Several other producer organizations are also exploring similar efforts.
2. The investigatory research conducted on the ROPS standards and ROPS design procedures led to the development of the Computer-based ROPS design program (CRDP). The analysis on the database of ROPS dimensions for the 14 ROPS/tractor combinations led to the development of the governing ROPS design equations. This CRDP will be useful during the National ROPS Rebate Program.
3. Allison Cassidy, Vicky Buchan, Louise Quijano continue to participate in the Evaluators, Coordinators, and Outreach (ECO) personnel group, along with the "YouTube," "Awareness," "Evaluation" and other sub-groups. Allison Cassidy founded this group with Diane Kampa and Julie Rainwater in 2012. Ms. Cassidy is the leader of the ECO calls beginning August 2017 and maintains a leadership role in the YouTube group and other *ad-hoc* projects.
4. We continue to work with the Farm and Ranch eXtension Safety and Health (FReSH) Community of Practice which operates through the Cooperative Extension eXtension program. Dr. Stallones serves as the contact person for HICAHS and serves on the Leadership Team for the Farm and Health Safety Community of Practice.
5. 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 U.S. as well as internationally.

6. 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.
7. 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. The initial OHS management system will be beta-tested and evaluated beginning in summer 2014, and further revised in 2014 - 2015. The OHS Management System is anticipated to have a significant positive impact on the industry and will serve as the basis to measure the effectiveness of future interventions.
8. Funding from the Director's Discretionary Fund was provided to Agrimetrica to assist in the development of a human resources program. Agrimetrica is a software company that provides dairy producers with a computerized system for tracking and optimizing milk production and quality; this effort will build on their existing system to manage employee health and safety risk and will include training modules.
9. In 2009 under the leadership of the NIOSH Western States Office and Alaska Pacific Office, HICAHS and the Mountain and Plains Education and Research Center (MAP ERC) partnered with Wyoming government to form a Wyoming Colorado Occupational Safety and Health Coalition (WY-CO OSH). Participants include the Wyoming Departments of Workforce Services R&P (Workers Compensation), OSHA, and Public Health, the Wyoming State Occupational Epidemiologist, Wyoming Extension, and University of Wyoming researchers. The WY-CO OSH Coalition has made important progress in organizing and fostering alliances among industry sectors in Wyoming – starting with Oil and Gas, Refinery, Transportation, Construction, and now Nursing and Agriculture. The goals of the alliances are to improve occupational health and safety, engaging more established businesses to mentor smaller businesses and share resources such as their occupational health and safety management programs. HICAHS and the MAP ERC provide expertise and additional resources to the alliances. Wyoming Extension now has representation on the HICAHS External Advisory Board. Wyoming OSHA has also established a safety improvement program. Participating businesses receive a premium discount on their Workers Compensation premiums. While rates are not available for the most recent year (2013), the WY State Occupational Epidemiologist Report documents a significant reduction in workplace fatalities in Wyoming primarily driven by a drop in transportation-related fatalities. Workers Compensation claims and hospitalizations have also decreased.

## Publicity for Ag Centers YouTube Channel and Ag Center Awareness Events

*A selection of publicity is provided; there were many more articles on Awareness Events.*

### 2015

1. Celebrating Safe and Healthy Ag Workers -- National Ag Day, March 18. (March 4, 2015). *Dairy Herd Management*. Retrieved from <http://www.dairyherd.com/news/celebrating-safe-and-healthy-ag-workers-national-ag-day-march-18>
2. 'Celebrating safe and healthy ag workers'--National Ag Day, March 18. (March 9, 2015). *High Plains/Midwest Ag Journal*. Retrieved from [http://www.hpi.com/general/celebrating-safe-and-healthy-ag-workers---national-ag/article\\_c1a056c0-8141-5d40-992d-9da1a5900bc8.html](http://www.hpi.com/general/celebrating-safe-and-healthy-ag-workers---national-ag/article_c1a056c0-8141-5d40-992d-9da1a5900bc8.html)

### 2014

3. Farm Safety and Health Week begins Sept. 21; farming is the most dangerous profession. (September 15, 2014). *The Rural Blog sponsored by University of Kentucky*. Retrieved from <http://ijrc.blogspot.com/2014/09/farm-safety-and-health-week-begins-sept.html>
4. Rosmann, M. (May 27, 2015). Ag Safety, Health Centers Benefit Farmers. *Yankton Daily Press & Dakotan*. Retrieved from [http://www.yankton.net/life/article\\_d6a1e5c6-e614-11e3-8cc9-](http://www.yankton.net/life/article_d6a1e5c6-e614-11e3-8cc9-)

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[001a4bcf887a.html](#)

5. Farm safety: Quick tips on keeping farm workers protected. (May 20, 2014). *Southeast Farm Press*. Retrieved from <http://southeastfarmpress.com/miscellaneous/farm-safety-quick-tips-keeping-farmworkers-protected>
6. National Farm Safety and Health Week Focuses on 'Protecting What Matters'. (September 18, 2014). *The Crop Site*. Retrieved from <http://www.thecropsite.com/news/16777/national-farm-safety-and-health-week-focuses-on-protecting-what-matters>
7. U.S. Ag Centers Preparing for National Farm Safety Week. (September 10, 2014). *Wisconsin Ag Connection*. Retrieved from <http://www.wisconsinagconnection.com/story-national.php?id=1997&yr=2014>
8. U.S. Ag Centers ready for National Farm Safety and Health Week. (September 19, 2014). *Pork Network*. Retrieved from <http://www.porknetwork.com/pork-news/latest/US-Ag-Centers-ready-for-National-Farm-Safety-and-Health-Week-274605501.html>
9. US Ag Safety and Health Centers celebrate Farm Safety Week. (September 23, 2014). *Dairy Herd Management*. Retrieved from <http://www.dairyherd.com/dairy-news/University-of-Minnesota-other-US-agriculture-centers-ready-for-N-276875541.html>
10. Dreiling, L. (September 22, 2014). Farm safety is everyone's business. *High Plains/Midwest Ag Journal*. Retrieved from [http://www.hpj.com/opinion/farm-safety-is-everyone-s-business/article\\_713fd6d7-aa9f-5d4d-ab8b-0ff93b4d692b.html](http://www.hpj.com/opinion/farm-safety-is-everyone-s-business/article_713fd6d7-aa9f-5d4d-ab8b-0ff93b4d692b.html)
11. Thomas, J. (September 23, 2014). 5 Ways to Make Ag Safety Count During National Farm Safety Week: Sept. 21-27 is National Farm Safety and Health Week. Check out these resources to stay safe as harvest kicks off. *Farm Futures*. Retrieved from <http://farmfutures.com/story-5-ways-make-ag-safety-count-during-national-farm-safety-week-0-118003>

## 2013

12. The virtual meeting, coming to a tailgate near you. (December 10, 2013). *Midwest Producer*. Retrieved from [www.midwestproducer.com](http://www.midwestproducer.com)
13. YouTube Safety Training Video for Dairy Employees. (December 6, 2013). *Ag Web and New Mexico State University*. Retrieved from [www.agweb.com](http://www.agweb.com)
14. Pehr, D. J. (December 5, 2013). NMSU's safety training video for dairy employees part of new YouTube Channel. *New Mexico State University News Center*. Retrieved from <http://newscenter.nmsu.edu/Articles/view/9927/nmsus-safety-training-video-for-dairy-employees-part-of-new-youtube-channel>
15. The virtual meeting, coming to a tailgate near you. (December 5, 2013). *Ag Weekly*. Retrieved from [www.theprairiestar.com](http://www.theprairiestar.com)
16. The Virtual Safety Meeting. (December 1, 2013). *Magic Valley*. Retrieved from <http://magicvalley.com>
17. Ag safety channel created for YouTube. (November 25, 2013). *The Prairie Star*. Retrieved from [www.theprairiestar.com](http://www.theprairiestar.com)
18. Ag safety channel now on YouTube. (November 14, 2013). *Farm and Dairy*. Retrieved from [www.farmanddairy.com](http://www.farmanddairy.com)
19. New YouTube Channel Features Ag Safety Videos. (November 7, 2013). *Wisconsin Ag Connection*. Retrieved from [www.wisconsinagconnection.com](http://www.wisconsinagconnection.com)
20. KTIC Radio Announcement - New YouTube Channel Features Ag Safety Videos. (November 7, 2013). Retrieved from <http://kticradio.com>
21. Farm safety gets instructional YouTube channel. (November 5, 2013). *Southeast Farm Press*. Retrieved from <http://southeastfarmpress.com>
22. Agricultural safety featured on new YouTube channel. (November 5, 2013). *Progressive Dairyman*. Retrieved from <http://www.progressivedairy.com/>
23. Agriculture, forestry, and fishing safety practices featured in new nationwide video project. (November 4, 2013). *Today @ Colorado State*. Retrieved from <http://www.today.colostate.edu/story.aspx?id=9314>
24. Agricultural Safety Featured on New YouTube Channel. (November 4, 2013). *The Southwest Center*

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for *Agricultural Health, Injury Prevention, and Education Newsletter*. Retrieved via email correspondence.

25. New YouTube Channel Focuses on Ag Safety. (November 4, 2013). *Farm Futures*. Retrieved from <http://farmfutures.com>
26. Agriculture, Forestry, and Fishing Safety Practices Featured in New Nationwide Video Project. (November 1, 2013). *Colorado State University Press Release*. Retrieved from <http://www.news.colostate.edu/Release/7064>

### Project Generated Resources

1. Development of an Excel version of the Computer-based ROPS Design Program (CRDP). Using 46 tractor dimension inputs, the final ROPS dimension outputs (28) required for ROPS designs are generated. ROPS construction drawings and a price list of materials is also generated by the program. Successful validation of the CRDP was conducted with 3 tractor ROPS.
2. ATV Safety Tips Sheets
3. U.S. Agricultural Health and Safety Centers YouTube Channel  
<http://www.youtube.com/user/USagCenters>
4. Standard Operating Procedure: IESL Impactor
5. Standard Operating Procedure: Bioaerosol Sampling and Analysis
6. The Evaluation Program, led by Vicky Buchan and Louise Quijano, developed three R2P survey instruments, one for each of the HICAHS Cores (Research Core, Prevention/Intervention Core, and Education and Translation Core).