

**A. COVER PAGE**

|  |  |
|--|--|
| Project Title:<br>Central States Center for Agricultural Safety and Health Administration and Planning |  |
| Grant Number:<br>1U54OH010162  | Project/Grant Period:<br>September 01, 2016 – August 31, 2022  |
| Reporting Period:<br>September 01, 2016- August 31, 2022   | Date Submitted:<br>December 22, 2022   |
| Program Director/ Principal Investigator<br>Risto Rautiainen, Program Director                         | Administrative Official Information<br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| Change of Contact PD/PI:<br>NA   |  |
| Human Subjects:<br>No  | Vertebrate Animals:<br>No  |
| hESC:  | Inventions/Patents:<br>None  |

**B. ACCOMPLISHMENTS**

**B.2. What did you accomplish under these goals?**

The Central States Center for Agricultural Safety and Health (CS-CASH) proposal for the 2016-2022 funding cycle included Planning and Evaluation Core, Pilot/Feasibility Projects, Emerging Issues Projects, Research Core with seven research projects, and the Outreach Core. The productivity of the Center personnel is reflected in their collective publication record: 1271 peer-reviewed publications during their careers (Table 1). The Center’s publication and presentation output during 2016-2022 includes 167 peer-reviewed articles, 97 non-peer-reviewed articles, 183 oral presentations, 84 posters, and 277 training and demonstration events. Several manuscripts will still be submitted for publication during the final year of the current funding cycle. Since 2016, the Center’s Pilot Projects Program has funded 39 pilot projects, 12 of them supported by the UNMC Vice Chancellor for Research. This support is an indication of strong institutional support for the Center, which will continue in the proposed funding cycle. In addition, seven Emerging Issue projects were funded.

The following is a summary of the past performance and accomplishments by Core and project. Further detailed information is provided in the Core and Project Past Performance sections.

Table 1. CS-CASH personnel publications

| First Name                              | Last Name  | Organizational Affiliation    | N           |
|---|------------|-------------------------------|-------------|
| Matt                                    | Beacom     | UNMC COPH, EAOH               | 3           |
| Cheryl                                  | Beseler    | UNMC COPH, EAOH               | 66          |
| Gustavo                                 | Carlo      | UC Irvine                     | 10          |
| Ellen                                   | Duysen     | UNMC COPH, EAOH               | 62          |
| Jenna                                   | Gibbs      | Ag Health and Safety Alliance | 24          |
| Tara                                    | Haskins    | Agrisafe                      | 4           |
| Ryan                                    | Klataske   | Kansas State University       | 0           |
| Daren                                   | Knoell     | UNMC COM, INT MED             | 75          |
| Bethany                                 | Lowndes    | UNMC COM                      | 33          |
| Sahitya                                 | Maiya      | USU                           | 12          |
| Aaryn                                   | Mustoe     | UNO                           | 22          |
| Santosh                                 | Pitla      | UNL                           | 26          |
| Athena                                  | Ramos      | UNMC COPH, CRHD               | 60          |
| Risto                                   | Rautiainen | UNMC COPH, EAOH               | 89          |
| Eleanor                                 | Rogan      | UNMC COPH, EAOH               | 224         |
| Debra                                   | Romberger  | UNMC COM, INT MED             | 177         |
| Sheri                                   | Rowland    | UNMC                          | 12          |
| Natalie                                 | Roy        | Agrisafe                      | 2           |
| Josie                                   | Rudolphi   | University of Illinois        | 13          |
| Mystera                                 | Samuelson  | UNMC COPH, EAOH               | 14          |
| Derrick                                 | Samuelson  | UNMC COM, INT MED             | 35          |
| Carolyn                                 | Sheridan   | Ag Health and Safety Alliance | 3           |
| Joseph                                  | Siu        | UNMC CAHP                     | 70          |
| Bryan                                   | Weichelt   | National Farm Medicine Center | 34          |
| Todd                                    | Wyatt      | UNMC COPH, EAOH               | 173         |
| Aaron                                   | Yoder      | UNMC COPH, EAOH               | 28          |
| <b>Total peer-reviewed publications</b> |            |                               | <b>1271</b> |

**Aim 1.** As part of the Planning and Evaluation Core (PEC), the Administration and Planning Program (APP) has worked closely with the Center Director and Deputy Director, providing the mechanism for leadership, guidance, and management to reach the stated goals of the Center. APP facilitated multi-disciplinary interactions among all Cores, programs, projects, and investigators. APP coordinated planning of Center activities through regular meetings of the advisory committees and communication with project leaders. The new research was supported through the Emerging Issues Program and Pilot/Feasibility Projects. APP sought new funding opportunities and assisted investigators to complement and expand their Center projects with additional extramural funding. The Center Coordinator assisted in coordinating all Center activities and communicating with Core directors and investigators regularly.

**Aim 2.** The APP engaged the External and Internal Advisory Committees in the shared governance of the Center. The committees aid the Center Director in achieving the goals of the Center.

External Advisory Committee provided strategic planning, guidance, and advice to the Center Director, project and program leaders, and key Center personnel. Committee members received regular information, including annual progress reports, and they were asked to guide the Center’s direction, impact, and effectiveness in reaching its goals. CS-CASH has had a formalized External Advisory Board since the Center’s inception in 2011. The Committee has met annually for a full-day meeting in Nebraska to review Center projects, proposals and discuss emerging issues. The number of advisors has ranged from 12 to the current 17 advisors. We have been committed to hearing the views of farmers and ranchers and adjusted our programs, particularly prevention, education, and outreach programs, to be responsive to the needs expressed by farmers and ranchers in the region.

Industry Stakeholder Roundtables. In 2013 our external advisors gave us clear feedback about the need to have more research and outreach related to the health and safety in the cattle industry, which has high injury rates. We acted on this suggestion, obtained funding and connections from ASHCA, and held a Roundtable Meeting of the cattle industry safety and health experts. Based on the recommendations, we designed projects addressing feedyard safety, which is now a significant focus of our Center. Similarly, we have held three Roundtable Meetings with Tribal bison herd

workers, managers, and the InterTribal Buffalo Council. Furthermore, a Roundtable Meeting was held with poultry producers and stakeholders, preparing future work in rapidly growing poultry production.

CS-CASH Member Meetings. CS-CASH has held a monthly Member Meeting since 2011. These meetings are open to all CS-CASH researchers, Pilot Program investigators, Center administrators, staff, and students. These meetings serve as a method of communication of Center research, outreach, objectives, and progress. The CS-CASH Executive committee met monthly to discuss administration, budget, and research topics.

**Aim 3.** The APP monitored the Center's fiscal and resource management. The Center's administrator provided financial reports in the regular monthly meetings of the Executive Committee, which included the Center Director, Deputy Director, Coordinator, and Administrator. Deviations from scheduled use of resources and funds were discussed, and resolutions were recommended to the Center Director and project leaders. Significant budgetary changes and personnel changes were processed formally through the approval of NIOSH. The Evaluation Program staff contacted project leaders periodically to review progress and collect evaluation information. The Evaluation Program continued to use the activity database to maintain basic information on projects and investigators and accumulate information on publications, presentations, and other products. The Coordinator maintained the meeting minutes of all Center meetings. The Evaluation Program provided formative and summative evaluation reports utilized in the Center's mid-year PHS 2590 reports and year-end annual reports.

**Aim 4. Professional Organizations.** The Center is well connected with professional organizations in agricultural health and safety in the US and internationally. Dr. Rautiainen and Dr. Yoder are past presidents of the International Society for Agricultural Safety and Health (ISASH). Currently, Ellen Duysen is Chair of the Membership Committee and manages the ISASH social media, and Dr. Yoder serves as the Chair of Bylaws. Dr. Rautiainen is past Chair of the AgriSafe Network Board of Directors and Board of Directors and member of the Agricultural Health and Safety Alliance. Dr. Yoder has served on the Boards of the Agricultural Safety and Health Council of America (ASHCA), the Progressive Agriculture Foundation, ISASH, and the Grain Handler Safety Coalition. Center personnel contribute to many other professional organizations, including the Children's Safety Network, eXtension, National Ag Safety Database, American Society for Agricultural and Biological Engineers, American Industrial Hygiene Association, Environmental, and Occupational Health Assembly of the American Thoracic Society, among others. Dr. Rautiainen is Chair of the EU-funded Safety Culture and Risk Management in Agriculture network, including members from 32 countries. Strong connections with professional organizations provide the Center with Channels to obtain the latest information and contribute to the development of the field.

Training. APP provided administrative support for the CS-CASH annual agricultural health and safety course offered in July. This course is targeted at rural health providers and professionals, public health personnel, veterinarians, agribusiness, and students.

Research Related Training. All investigators that conduct research as part of CS-CASH projects completed *Responsible Conduct Training in Science* prior to beginning work on their project.

Seminars. The Center hosted regular UNMC seminars to report Center results to colleagues and students. These sessions were recorded and made available to wider audiences using the Centers website.

Conferences. The Center co-sponsored the annual Midwest Rural Agricultural Safety and Health conferences with the Iowa and Minnesota Centers. CS-CASH also co-sponsor the Western Ag Safety Conference, and Dr. Rautiainen and Ellen Duysen served as guest editors for the Conference Issue in the Journal of AgroMedicine. Ellen Duysen served on the planning committee for the ISASH Conference in 2020 and 2021.

National Ag Safety Database (NASD). NASD is the world's most-used agricultural health and safety web resource. NIOSH has supported NASD. CS-CASH hosted NASD for the past four years and will continue contributing to maintaining and updating materials on this website.

Website and Social Media. APP maintained the Center’s website and social media accounts which contain information about the Center, Cores, Projects, Programs, personnel, and activities.

Web meetings. UNMC provides Zoom Meeting and Webinar functions for all CS-CASH researchers.

## Evaluation

The Evaluation program worked closely with the Center Director and Deputy Director to achieve the goals of the Center. Findings from the *Internal Coalition Effectiveness (ICE©)* instrument showed the Center’s leadership and governance structures were consistently rated “very effective” (i.e., FY 6 = 6.41, FY7 = 6.5, FY8 = 6.58, FY9 = 6.51), where 1 = “not at all effective” and 7 = “highly effective” (response rates 66% to 90%). Consistent themes for Center governance and leadership strengths included 1) strong and supportive administrative personnel and structures, 2) valued and accessible research and community outreach resources in agricultural health and safety, 3) promotion of collaborative member relationships, and 4) an active community outreach program. Respondents also provided important recommendations for improvement that were acted upon. The development of the *Project Scoring Matrix for Social Return on Investment (PSM\_SROI)* provided a mechanism for rigorous assessment of whether the Center had met its performance metrics and achieved its goals. The Center’s activities database was successfully utilized for tracking publications, presentations, stakeholder networking, and commercial product development. Field visits with grantees were used for assessment of effective governance, the timely progression of projects, resource accessibility and utilization, and member satisfaction. To measure the strength and quality of our stakeholder relationships, social network analysis was employed in FY6, FY8 and FY9. Our Center leaders showed high density and centrality, indicating they had close connections with many external stakeholders—local, regional, national, and international. We also found that our stakeholders looked to Center leaders for information and expertise in agricultural safety and health. We identified important areas for improved networking. The Center developed a plan to diversify our stakeholder connections to include such industries as agribusiness and technology.

## Pilot and Feasibility Program

The Pilot and Feasibility Program has been an essential component of CS-CASH since the Center was established in 2011. This program has supported projects with funding up to \$20,000 over 18 months. The program goal is to enable investigators to collect preliminary data to support the submission of grant applications for independent, longer-term, larger projects related to agricultural safety and health. The projects selected for support by this program address critical issues in agricultural safety and health and lead to future extensive studies of the selected critical issues. In addition to NIOSH AFF funding over the past 11 years (\$660,000), generous funding from the University of Nebraska Medical Center’s Vice Chancellor for Research (\$500,000), the University of Nebraska Lincoln (UNL) College of Agricultural Engineering (\$20,000), and the UNL Institute of Agriculture and Natural Resources (\$20,000) has allowed **CS-CASH to fund 67 pilot projects**. Additional funding received by Pilot Program investigators due to data generated through their pilot research amounts to \$19,390,183 (Table 2). A return on investment of **1,597%** is calculated from subsequent agricultural safety and health funding received by Pilot/ Feasibility Program recipients. In addition to evaluation plans built into individual project proposals, the CS-CASH evaluation team also assesses each project's progress, outcomes, and outputs. Evaluations are shared with the grantees and Dr. Eleanor Rogan, Pilot Program investigator. CS-CASH provides a range of no-cost resources to investigators from the inception of their project to completion. Resources included expert analytical assistance from the Center’s evaluators and the UNMC Center for Collaboration on Research Design and Analysis (CCORDA) and content expertise provided by CS-CASH researchers and administration. Grant recipients were invited to attend and present at the monthly CS-CASH member meetings and are forwarded all information about grant opportunities, webinars, conferences, and other information that could assist the investigators with their research.

Table 2. Past performance of the CS-CASH Pilot/Feasibility Program

| Grant Year   | # of Pilot Projects | Peer Reviewed Articles | Presentations**Non-Oral / Poster | **Non-Peer Reviewed Articles | ***Other Products | Initial Funding    | ****Additional Funding |
|--|---------------------|------------------------|----------------------------------|------------------------------|-------------------|--------------------|------------------------|
| Y1   | 5                   | 0                      | 20                               | 2                            | 8                 | \$95,000           | \$1,319,581            |
| Y2   | 7                   | 1                      | 25                               | 15                           | 3                 | \$100,000          | \$1,275,712            |
| Y3   | 5                   | 1                      | 3                                | 4                            | 1                 | \$60,780           | \$15,000               |
| Y4   | 4                   | 9                      | 25                               | 15                           | 7                 | \$100,000          | \$3,135,208            |
| Y5   | 5                   | 4                      | 5                                | 7                            | 5                 | \$100,000          | \$1,270,000            |
| Y6   | 7                   | 6                      | 12                               | 2                            | 8                 | \$140,000          | \$1,853,484            |
| Y7   | 7                   | 5                      | 4                                | 7                            | 2                 | \$140,000          | \$120,000              |
| Y8   | 5                   | 7                      | 13                               | 3                            | 22                | \$100,000          | 0                      |
| Y9   | 7                   | 6                      | 8                                | 0                            | 24                | \$138,742          | \$3,149,499            |
| Y10  | 8                   | 5                      | 9                                | 12                           | 6                 | \$140,000          | \$7,251,699            |
| Y11  | 5                   | NA                     | NA                               | NA                           | NA                | \$100,000          | NA                     |
| <b>TOTAL</b>   | <b>65</b>           | <b>44</b>              | <b>124</b>                       | <b>67</b>                    | <b>86</b>         | <b>\$1,214,522</b> | <b>\$19,390,183</b>    |
| *Education / Training includes course/curriculum, material distribution, mtg./conference, training/demonstration, workshop   |                     |                        |                                  |                              |                   |                    |                        |
| **Non-Peer Reviewed Articles include reports, booklet/brochure, factsheet, interview (media/other), newsletter, multimedia, websites   |                     |                        |                                  |                              |                   |                    |                        |
| ***Other Products include reports, focus group, evaluation instrument/tool, questionnaire/survey/checklist, site visit, farm safety audit, consultations, testing and screenings |                     |                        |                                  |                              |                   |                    |                        |

### Emerging Issues program

The Aims of the CS-CASH Emerging Issues Program are to examine trends and identify emerging issues affecting the health and safety of farmers, ranchers, family members and agricultural workers and to respond to issues without delay by delivering coordinated and evidence-based responses and providing small grants to outside entities that are prepared to respond.

Enhanced Media Monitoring. Mr. Murray Madsen has conducted an Enhanced Farm and Agricultural Injury Media Monitoring program for CS-CASH since 2011. This program includes collection and analysis of agriculture-related injuries and fatalities in print, broadcast, and internet media content monthly, creation of a Microsoft Excel record, monthly updates of new and existing incident records in datasets provided to CS-CASH, and summary collations provided quarterly, as well as special reports and summaries as requested. Data from our media monitoring is shared with the Marshfield WI-based AgInjuryNews.org, headed by Dr. Bryan Weichert.

Annual Surveillance Project. Since 2011 the CS-CASH Surveillance program has provided information on injuries and work-related health conditions among self-employed farmers and ranchers that are not covered by any other surveillance system.

Data from monitoring and surveys are used to identify emerging issues. Examples of responses to emerging issues during the last funding cycle are shown below.

- Creation and dissemination of *COVID-19 Pandemic Playbooks* for feedyards and poultry-grower industries in collaboration with the UNMC Global Center for Health Security (GCHS).
- Development of COVID-19 informational series of 9 webinars for rural healthcare providers and agricultural stakeholders: COVID-19 Resources for Agricultural Communities.

- Creation of Train the Trainer Fit-Testing Workshops and Train the Trainer Fit-Testing Guide.
- Creation and dissemination of over 2800 flood mitigation response kits to agricultural communities, including over 200 kits delivered to flood-ravaged Tribal Reservations.
- Development of the Telling the Story Project Website.
- Robust response to increases in agricultural ATV fatalities and Injuries including creation of a stop-motion ATV safety training video, and development of training curriculum to accompany the CS-CASH ATV full-sized training simulator.

### **Agricultural Dust-Induced Airway Injury and Repair: An IL-10 Centered Approach**

Chronic inhalation of organic dust in agricultural environments, particularly from concentrated animal feeding operations (CAFO), results in significant airway diseases including chronic bronchitis, occupational asthma, and obstructive lung disease. We have previously investigated chronic lung disease resulting from exposure to the organic dusts generated during livestock production with a particular focus on swine confinement barns. Understanding how such complex exposures might interact with our own lung physiology to modify innate defense and impact health will help to guide both prevention strategies as well as the development of therapeutic interventions.

Our previously published work establishes a mouse model for evaluating the impact of swine dust on lung injury. This model of either inhaled or nasally instilled sterile aqueous extracts of swine CAFO dust (or organic dust extract; ODE) results in significant lung injury characterized by elevated neutrophils upon a single dose and lymphoid aggregates upon repetitive doses over 3 weeks. Using this model, we have demonstrated a protein kinase C (PKC)-dependent production and release of pro-inflammatory cytokines (TNF $\alpha$ , IL-6, IL-8) responsible for this pathology that also impairs mucociliary clearance of pathogens. We previously characterized the sequence and timing of this kinase-driven mechanism showing the importance of TNF $\alpha$  as an early mediator of subsequent chemokine responses to ODE. Furthermore, we observed that ODE stimulates TNF $\alpha$  by activating the TNF $\alpha$  Converting Enzyme, also known as ADAM-17.

Recently, we found that IL-10 can inhibit ODE-stimulated ADAM-17 resulting in lung recovery from dust injury. We have previously defined mechanisms of organic dust-mediated lung inflammation and repair by interleukin-10 (IL-10). We found that IL-10 plays a role in the repair/recovery response to ODE injury, and we defined the mechanisms governing this repair response. We have also shown enhanced dust-mediated injury in the context of both alcohol exposure and zinc deficiency. Alcohol misuse significantly impaired the normal lung innate defense against inhaled dust through a desensitization of the enzyme regulating proper cilia clearance, the cAMP-dependent protein kinase. Translationally, we identified low zinc levels in a subpopulation of Midwestern agricultural workers with chronic obstructive pulmonary disease (COPD). We showed that inadequate cellular zinc availability alters the innate immune lung response to ODE and that tissue macrophages are a driving force that intensifies the inflammatory process.

### **Improving Safety and Health of Cattle Feedyard Workers**

In 2017 the CS-CASH research project - *Improving Safety and Health in the Cattle Feedyard Industry* was funded. The objectives of this project were to gather data to better understand the burden of injuries and fatalities on feedyards, to develop a network of stakeholders and a training program that improved the safety and health of feedyard workers, thereby reducing Workers' Compensation costs for participating feedyards. This research project has been significantly enhanced by collaboration with safety specialists from Gallagher Insurance, a provider for most feedyards in the Midwest. Expertise, advice and guidance has come from the project's Feedyard Safety Advisory Board (FSAB). The FSAB, made up of 19 feedyard owners, workers, veterinarians, safety specialists, and allied industry representatives, meets bi-yearly to discuss progress and offer recommendations. Enrollment in the intervention arm of the research totals 15 companies representing 21 feedyards, with 2,288 employees in 7 states (CO, ID, KS, NE, OK, SD, UT). A snapshot of the project results to date are shown below.

- Developed a Feedyard Safety Advisory Board that has been actively engaged in the development, implementation, evaluation, and dissemination of research components;

- Created the Feedyard 15 worker safety training model that has been reviewed, evaluated, and now in use by feedyard employers, trainers and employees;
- Feedyard safety trainers have reported a total of 2,056 contact hours of training using the Feedyard 15 training modules. Evaluations of the modules by workers and trainers have been good.
- Collaborated with insurers of feedyards and have been able to access insurance and injury data;
- Accessed Workers' Compensation data that will be used to evaluate the effectiveness of the intervention, using retrospective and prospective data for the study sites;
- Estimated the burden of injuries and illnesses in the cattle feedyard sector using data generated in the project as well as national data from available sources;
- Applied the Rapid Multi-Sited Ethnography (Job Shadowing) for qualitative data collection at study sites to investigate worker perspectives on injury, illness, prevention, and program impact; and
- Developed a first-of-its-kind feedyard commendation process for program sustainability, created, reviewed, and managed by a network of feedyard stakeholders and safety and health experts.

### **Enhancing the Health and Safety of Range Bison Herd Workers**

The aims of the Enhancing the Health and Safety of Range Bison Herd Workers project were met or exceeded including characterizing injuries and hazards associated with working bison under contemporary conditions on tribal reservations and on non-reservation facilities; developing and implement intervention strategies to mitigate worker safety risks; assessing outcomes and impacts of intervention strategies and disseminating updated intervention strategies widely to bison herd managers and bison herd workers.

Our unique partnership with the InterTribal Buffalo Council allowed us access onto bison handling facilities that may have been otherwise inaccessible. We developed 3 novel survey instruments that were used to evaluate tribal and non-tribal bison handling practices and facilities from the perspectives of the herd managers, workers, and veterinarians. Researchers joined bison herdsman during roundups and in the field to assess the facilities and handling practices. The results were used to develop a multi-faceted interventions to reduce injury and illness among a vulnerable population, Native American bison herd workers. Resources that were created in response to safety and health concerns included a bison handler safety tailgate training guide that has been recently updated. Convening a yearly Bison Worker Safety and Herd Health Roundtable allowed the project team to communicate results and best practices to bison herd workers, managers, veterinarians, and other safety professional. The presentations and discussions from each of these 4 meetings were recorded and disseminated to participants and other interested parties. Throughout the project we assisted both tribal and non-tribal bison operations in formulating and implementing evidence-based best management practices to improve worker safety through changes in facilities, handling practices, and safety training.

Following the retirement of Dr. Clayton Kelling in 2020, project PI, Dr. Mystera Samuelson was designated as PI. Dr. Samuelson, an animal behavior expert was brought expertise in bison behavior to the project and provided a unique perspective as a researcher with Native American heritage. Dr. Samuelson's newly funded NIOSH AFF Center project *Establishing a Community-Based Training Network to Enhance Bison Herd Workers Safety on Tribal Lands* will allow established tribal bison herd managers and workers who were involved in the first 5-year project to work with newly established tribal herds sharing their expertise on worker safety.

### **Health and safety risks among immigrant feedlot workers in Nebraska and Kansas**

Despite the challenge of conducting interviews during the COVID-19 pandemic, the project accomplished its goals of (1) exploring and describing the health status and occupational risks among Latino immigrant cattle feedyard workers in Nebraska and Kansas; (2) testing the Ecological Stress-based Model of Immigrant Health and Safety; and (3) reviewing, developing, evaluating, and disseminating bilingual (English/Spanish) health and safety educational and policy materials designed specifically for cattle feedyard operations. Data for achieving these aims came from 243

interviews with immigrant cattle feedyard workers from 2017 to 2020. Our findings were revealing and potentially impactful on the risk of injury.

We found that over 60% of respondents were at risk for hazardous drinking (62.9% of men; 44.4% of women) and 86.6% of hazardous drinkers had been injured on the job compared to 68.6% of those not classified as hazardous drinkers. We also found that physical fatigue, mental fatigue, and need for recovery were significantly negatively correlated with self-rated health, average hours of sleep, and decision latitude, and significantly positively correlated with pain, average hours worked per day, and job demands. Approximately 25% of workers reported that they had not received any health or safety training from their current employer, and only about 9% had ever participated in any OSHA safety training program. More than 93% were interested in receiving more information about health and safety related to their job. Specific topics that workers were interested in obtaining more information about included zoonoses, low-stress cattle handling, injury prevention, hazard and injury reporting, chemical and equipment safety, and teamwork. Workers reported a mean score of 25.8 (SD = 5.0) out of a possible 38 on a safety climate scale. A majority of workers reported that taking risks was part of their job, and over 67% believed that their employer could do more to make their job safer. More than 93% of workers believed that it was likely that they would be injured in the next 12 months at work. Immigration issues was also a serious stressor. Nearly 50% of workers reported knowing someone who had been threatened with deportation, and 26% reported that Immigration and Customs Enforcement (ICE) agents had visited family, friends, or neighbors.

To address some of these issues, we developed a series of educational resources for Latino immigrant cattle feedyard workers including: (1) a “Know your Rights” bilingual flyer for cattle feedyard workers in Nebraska that discusses safe working conditions, how to report unsafe conditions, discrimination, and immigration concerns, which was disseminated through social media and reached over 12,000 people; (2) a bilingual cattle feedyard picture glossary that is currently being finalized and prepared for dissemination; and (3) drafted four supplemental bilingual modules (including PowerPoint slides, speaker notes, quiz questions) for the Feedyard 15 program on fatigue, alcohol use, managing chronic conditions, and dealing with pain.

### **Point Source Personal Protective Equipment Strategy - from Research to Practice**

*Increasing Personal Protective Equipment Use by Point Source Protection Strategy (PSPS)* is a unique approach developed by CS-CASH to address an important factor in personal protection – convenience – by storing personal protective equipment (PPE) near the location where they are needed (on the farm). The objectives of this project were to assess current hazardous exposures and personal protective equipment use on farms, conduct a randomized controlled trial to test if placing customized PPE boxes near targeted exposure sources would increase PPE use, and evaluate the feasibility of the PSPS concept among farmers/ranchers. This project provided assessed whether providing PSPS PPE (vs. PPE alone) would improve usability, and ultimately help protect farmers from hazardous exposures – thus reducing work-related injury and illness in the agricultural sector. Enrollment in this project included 36 farms and 46 individual farmers/ranchers in Nebraska and Iowa. Project findings to date are shown below.

- Completed comprehensive on-farm exposure and PPE use assessments using the Certified Safe Farm review structure for exposures and PPE questionnaire adapted from European questionnaires.
- Provision of personalized education, training, PPE, and exposure assessments aided ‘buy in’ with participants and their efficacy of knowing when, why, and how to use PPE based on their exposures.
- Created and installed 63 customized weather resistant PSPS PPE boxes at 19 intervention farms holding HPDs, respirators, gloves, eye protection and sun protection combinations for protection at grain bins/elevators, machine shops, chemical storage, irrigation wells, livestock buildings and vehicles.
- Both intervention and control participants increased their PPE use based on preliminary findings. Final intervention effect analysis pending due to COVID-19 delay in farm visits and data collection.
- Performed air contaminant exposure assessment in a pullet barn; published in J Agromed.
- We found women in agriculture experience different barriers to PPE use in terms of sizing, fit, effectiveness, and cost.
- PSPS concept and model PSPS Box was well received at the largest Midwestern Agricultural shows; 93% of those surveyed indicating customized PPE boxes was a good idea; 83% expressing interest in owning the PPE

box, and nearly 60% indicating they would purchase the PPE box if available at their local hardware/co-op store. In a survey of youth in tractor safety training programs, 74% expressed PPE boxes would be useful; 65% indicating they would use PPE boxes if available on their farm.

- Co-developed an E-learning module on respirators and their use in agriculture.

**Surveillance**

CS-CASH initiated regional surveys in 2011 covering self-employed farmers and ranchers in the Center’s region of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota. As a unique feature, we merged demographic and production variables from existing Farm Market iD data to the survey response data, enabling short surveys (5 pages), which is critical for response rates. We studied the potential biases due to non-response and found scant evidence of nonresponse bias (Beseler and Rautiainen, 2021). Our most recent surveys in 2018 and 2020 indicate that the non-fatal injury rate was 11.9 ‘recordable’ injuries /100 full time equivalent producers (FTE) in our surveys – 2.3 times higher than the official BLS SOII injury rate (4.1/100FTE) for agricultural workers in 2020 (Adhikari et al., 2021) (Table 3). The average injury cost for medical care and lost time was \$19,322 per injury case (Table 4). Our national estimate for agricultural injury cost is \$10.0 billion in 2021 dollars; 2.05% of the national gross cash farm income. Our new estimate is 11% higher than the previous benchmark, \$4.6 billion (in 1992), after adjustment for inflation. Updated information on injury costs is a critical factor in justifying national investments into research and prevention of injuries and illnesses in agriculture. Further, our surveys found high rates for musculoskeletal pain (MSD) (59%), respiratory conditions (24%), hearing loss (53%), skin cancer (11%), and work-related stress (26%). Stress has a strong association with MSD (OR 5.6) (Du et al., 2021) and injuries (OR 1.9) (Bai et al., 2021). Our analysis of the media monitoring program indicated that the number of fatal agricultural injury cases was nearly identical to official BLS CFOI statistics in our region (New-Aaron et al., 2019). Media monitoring program cases provide valuable information for identifying emerging issues, and specific information for designing preventive efforts.

Table 3 Injuries in Farm and Ranch Health and Safety Survey

|   | n     | Injury rates per 100 operators |                   |
|---|-------|--------------------------------|-------------------|
|   |       | Operators                      | FTE Operators [1] |
| Operators   | 7,915 | N/A                            | N/A               |
| Injured operators / 1st injuries                            | 973   | 0.1229                         | N/A               |
| Injuries, including 1st, 2nd and 3rd injuries               | 1207  | 15.25                          | 20.20             |
| Injuries, medical care or lost time ('Recordable injuries') | 729   | 9.21                           | 12.20             |
| Injuries, professional medical care                         | 707   | 8.93                           | 11.83             |
| Injuries, any lost time                                     | 674   | 8.52                           | 11.28             |
| Injuries, >1 day lost time ('Days away from work injuries') | 411   | 5.19                           | 6.88              |
| Serious injuries, medical care and >1 day of lost time      | 389   | 4.91                           | 6.51              |
| Long-term disability => 30 days of lost time                | 131   | 1.66                           | 2.19              |
| Fatalities [3]  | 3     | 37.90                          | 50.21             |

[1] FTE = full time equivalent worker, working 2000 h/year

[2] Injury proportion = injured operators / all operators

[3] Rate = Fatalities / 100,000 workers

Table 4. Injury costs in Farm and Ranch Health and Safety Survey

|                                       | Injuries<br>n | Average cost<br>per injury | Total cost<br>by category | Cumulative cost |              |
|---------------------------------------|---------------|----------------------------|---------------------------|-----------------|--------------|
|                                       |               |                            |                           | Total           | Per operator |
| 1st injuries                          | 973           | 12,208                     | 11,878,698                | 11,878,698      | 1,501        |
| 1st injuries, long term disability    | 131           | 32,128                     | 4,208,768                 | 16,087,466      | 2,033        |
| 2nd and 3rd injuries                  | 234           | 6,938                      | 1,623,383                 | 17,710,849      | 2,238        |
| Total 1st, 2nd, 3rd injury categories | 1,207         | 14,673                     | 17,710,849                |                 |              |
| Fatalities                            | 3             | 2,192,067                  | 6,576,200                 | 23,497,905      | 2,969        |
| Total, 1st injuries and fatalities    | 976           | 18,909                     | 18,454,898                |                 | 2,332        |
| Total including all categories        | 1,210         | 19,420                     |                           | 23,497,905      | 2,969        |

## Outreach Core

Since the Central States Center for Agricultural Safety and Health (CS-CASH) inception in 2011, the Center has aimed to promote evidence-based interventions that can be effectively adopted and sustained in agriculture across the region and the nation. The Center's long-term goal is to contribute to sustainable improvements in agricultural worker health. To accomplish this goal, the Center continued during the previous 6-year funding cycle to implement a coordinated outreach strategy directed at two primary audiences 1) agricultural producers, with a focus on women and military veteran farmers, and 2) agricultural, health, and safety professionals. The core is strengthened by many MPH and PhD graduate students who participated in outreach activities throughout the Center's seven-states region. The aims of the CS-CASH program in the 2016-2021 funding cycle were to 1) integrate information from the Center's Research, Evaluation and Pilot Program projects, translating it into a coordinated outreach effort and effectively disseminate the information using a wide range of proven methods, 2) to develop and launch radio social marketing campaigns, innovative training webinars, and eHealth web-based toolkits targeted women in agriculture and military veteran farmers and, 3) to support and advance current information technology efforts that disseminate occupational safety and health information and education to ag workers, managers, educators, researchers, and health and safety. The outreach team accomplished these goals through various means.

- Valuable partnerships and collaborations with regional and national organizations, industry affiliations and individuals.
- Translation of Center Research. Center projects were developed to contribute to the outreach effort by producing and disseminating new information relevant to their specific fields of study.
- Using Surveillance Databases to Detect Emerging Issues. The Outreach team used the Center's vast surveillance database to detect emerging issues and to provide a rapid response through the Center's 26,000 member database alerting the ag community to immediate concerns such as the 2015 Avian Influenza poultry worker concerns, 2019 Midwest flood event, and the COVID-19 pandemic.
- Development of Ag Health and Safety Content. Working with an agricultural journalist and CS-CASH researchers, the outreach team created content for distribution. Resource dissemination methods included electronic platforms, CS-CASH website, email, Facebook, Twitter, and Instagram; traditional media, including educational content for print and radio; videos created for the NIOSH U.S. Ag Center YouTube Channel.
- Outreach Focused on Women and Military Veterans. In partnership with the AgriSafe Network, CS-CASH focused outreach programs and projects addressing the needs of women and military veterans in agriculture. Training webinars, face-to-face training, in addition to broadcast and media messages, were designed to improve health and safety outcomes in these special populations of farmers and ranchers.
- Developing and Improving New Technologies for Ag Safety and Health. Dr. Aaron Yoder worked with a network of safety and health and information technology experts to develop new and to improve existing technology tools and methods for disseminating information, determining risk and improving safety and health outcomes.
- Boots on the Ground Trainings, Presentations, and Events – The Hallmark of CS-CASH Outreach. The CS-CASH outreach team, often accompanied by students, spent a significant amount of time over the past six years traveling to all seven states in the CS-CASH region conducting ag safety and health training, demonstrations, presentations, and delivering information on emerging issues. This outreach is seen as the most impactful, as training can be conducted using educational techniques that are shown to improve learning and move participants forward toward behavior change.

## Summary

CS-CASH has met and exceeded its established goals for the 2016-2022 funding period. We have quantified the burden of agricultural injury and illness in the Center's region with new information on injury rates and cost and prevalence rates for common work-related chronic health conditions. We have further defined the need for preventive efforts in basic, intervention, translation, and surveillance studies identifying hazardous exposures and high-risk populations. The Centers intervention, translation, and outreach efforts have demonstrated impact in advancing the health and safety of affected populations. Active engagement and insight of External Advisors into

future development of risks in agriculture have shaped the emerging issue and pilot projects and new projects proposed for the next funding period. CS-CASH has demonstrated its commitment to diversity and inclusiveness in research and outreach, addressing the special issues of women, young and aging farmers, veteran farmers, Latino immigrant workers, and native American Workers. CS-CASH is well-established with a clear vision, mission, strategy, organization, and service area. With the new proposed lines of research and outreach, the Center is well positioned to serve the Center's seven-state region and make an impact in reducing agricultural injury and illness during the 2022-2027 funding cycle.

### **B.3. Competitive Revisions/Administrative Supplements**

NA

### **B.4. What opportunities for training and professional development did the project provide?**

Professional Organizations. The Center is well connected with professional organizations in agricultural health and safety in the US and internationally. Dr. Rautiainen and Dr. Yoder are past presidents of the International Society for Agricultural Safety and Health (ISASH). Currently, Ellen Duysen is Chair of the Membership Committee and manages the ISASH social media, and Dr. Yoder serves as the Chair of Bylaws. Dr. Rautiainen is past Chair of the AgriSafe Network Board of Directors and Board of Directors and member of the Agricultural Health and Safety Alliance. Dr. Yoder has served on the Boards of the Agricultural Safety and Health Council of America (ASHCA), the Progressive Agriculture Foundation, ISASH, and the Grain Handler Safety Coalition. Ellen Duysen serves on the Boards of the Progressive Agricultural Foundation and Omaha Permaculture. Center personnel contribute to many other professional organizations, including the Children's Safety Network, eXtension, National Ag Safety Database, American Society for Agricultural and Biological Engineers, American Industrial Hygiene Association, Environmental, and Occupational Health Assembly of the American Thoracic Society, among others. Dr. Rautiainen is Chair of the EU-funded Safety Culture and Risk Management in Agriculture network, including members from 32 countries. Strong connections with professional organizations provide the Center with Channels to obtain the latest information and contribute to the development of the field.

Training. APP provided administrative support for the CS-CASH annual agricultural health and safety course offered in July. This course is targeted at rural health providers and professionals, public health personnel, veterinarians, agribusiness, and students.

Research Related Training. All investigators that conduct research as part of CS-CASH projects completed *Responsible Conduct Training in Science* prior to beginning work on their project.

Seminars. The Center hosted regular UNMC seminars to report Center results to colleagues and students. These sessions were recorded and made available to wider audiences using the Centers website.

Conferences. The Center co-sponsored the annual Midwest Rural Agricultural Safety and Health conferences with the Iowa and Minnesota Centers. CS-CASH also co-sponsor the Western Ag Safety Conference, and Dr. Rautiainen and Ellen Duysen served as guest editors for the Conference Issue in the Journal of AgroMedicine. Ellen Duysen served on the planning committee for the ISASH Conference in 2020 and 2021.

National Ag Safety Database (NASD). NASD is the world's most-used agricultural health and safety web resource. NIOSH has supported NASD. CS-CASH hosted NASD for the past four years and will continue contributing to maintaining and updating materials on this website.

Website and Social Media. APP maintained the Center's website and social media accounts which contain information about the Center, Cores, Projects, Programs, personnel, and activities.

Web meetings. UNMC provides Zoom Meeting and Webinar functions for all CS-CASH researchers.

**B.5. How did you disseminate the results to communities of interest?**

Each project has a dissemination methodology built into the research plan. See individual project reports for these plans.

The Center administration uses a variety of methods to disseminate research results, agricultural safety and health news and important information on emerging issues. Communication channels include robust social media platforms (US AgCenter YouTube Channel, Facebook, Twitter, Instagram, and Flickr)

In addition, results are disseminated through:

External Advisory Committee provided strategic planning, guidance, and advice to the Center Director, project and program leaders, and key Center personnel. Committee members received regular information, including annual progress reports, and they were asked to guide the Center's direction, impact, and effectiveness in reaching its goals. CS-CASH has had a formalized External Advisory Board since the Center's inception in 2011. The Committee has met annually for a full-day meeting in Nebraska to review Center projects, proposals and discuss emerging issues. The number of advisors has ranged from 12 to the current 17 advisors. We have been committed to hearing the views of farmers and ranchers and adjusted our programs, particularly prevention, education, and outreach programs, to be responsive to the needs expressed by farmers and ranchers in the region.

Industry Stakeholder Roundtables. In 2013 our external advisors gave us clear feedback about the need to have more research and outreach related to the health and safety in the cattle industry, which has high injury rates. We acted on this suggestion, obtained funding and connections from ASHCA, and held a Roundtable Meeting of the cattle industry safety and health experts. Based on the recommendations, we designed projects addressing feedyard safety, which is now a significant focus of our Center. Similarly, we have held three Roundtable Meetings with Tribal bison herd workers, managers, and the InterTribal Buffalo Council. Furthermore, a Roundtable Meeting was held with poultry producers and stakeholders, preparing future work in rapidly growing poultry production.

CS-CASH Member Meetings. CS-CASH has held a monthly Member Meeting since 2011. These meetings are open to all CS-CASH researchers, Pilot Program investigators, Center administrators, staff, and students. These meetings serve as a method of communication of Center research, outreach, objectives, and progress. The CS-CASH Executive committee met monthly to discuss administration, budget, and research topics.

**B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

NA as this is the final report for this funding cycle.

**C. PRODUCTS****C.1. Publications, conference papers, and presentations****CS-CASH Publications Funding Years 2016-2022**

September 1, 2016-August 31, 2022

Achutan C, Girdziute L, Vasiliauskas G, Kampuss K, Staric J, Rautiainen RH. (2019). Use of personal protective equipment among farmers in Nebraska, Lithuania, Latvia, and Slovenia. *European Journal of Public Health*. 29(suppl 4):422-423.

Acosta LM, Andrews AR, Acosta Canchila MN, Ramos AK. (2020). Testing traditional machismo and the gender role strain theory with Mexican migrant farmworkers. *Hispanic Journal of Behavioral Sciences*. 42(2):215-234. doi: 10.1177/0739986320915649

Almeida F, Cramer M, Wendl M, Anderson M, Rautiainen R. (2019). Innovation diffusion in an agricultural center: Moving information to practice. *Journal of Agromedicine*. 24(3):239-247. doi: 10.1080/1059924X.2019.1592046 PMID: 30890037

Andrews AR, Haws JK, Acosta LM, Acosta Canchila MN, Carlo G, Grant KM, Ramos AK. (2020). Combinatorial effects of discrimination, legal status fears, adverse childhood experiences, and harsh working conditions among Latino migrant farmworkers: Testing learned helplessness hypothesis. *Journal of Latino Psychology*. 8(3):179-201. doi: 10.1037/lat0000141

Angeletti M, Hsu WLN, Majo N, Moriyama M, Moriyama EN, Zhang L. (2020) Adaptations of interferon regulatory factor 3 with transitions between aquatic and terrestrial life. *Science Report*. 10:4508. doi.org/10.1038/s41598-020-61365-9

Arens JL, Early CA. (2019). A brief report describing cancer outreach events in the rural midwest. *Journal of Agromedicine*. 24(3):224-227. doi: 10.1080/1059924X.2019.1590271.

Bailey KL, Kharbanda KK, Katafiasz DM, Sisson JH, Wyatt TA. (2018). Oxidative stress associated with aging activates protein kinase C $\epsilon$ , leading to cilia slowing. *American Journal of Physiology: Lung Cellular and Molecular Physiology*. 315(5):L882-L890. doi: 10.1152/ajplung.00033.2018

Bailey KL, Samuelson DR, Wyatt TA. (2021). Alcohol use disorder: A pre-existing Condition for COVID-19? *Alcohol*. 90:11-17. doi: 10.1016/j.alcohol.2020.10.003.

Bailey KL, Smith H, Mathai SK, Huber J, Yacoub M, Yang IV, Wyatt TA, Kechris K, Burnham, EL. (2020). Alcohol use disorders are associated with a unique impact on human bronchial airways epithelial cell gene expression. *Alcoholism Clinical & Experimental Research*. 44(8):1571-1584. doi: 10.1111/acer.14395

Bailey KL, Kharbanda KK, Katafiasz DM, Sisson JH, Wyatt TA. (2018). Oxidative stress associated with aging activates protein kinase C $\epsilon$ , leading to cilia slowing. *Am J Physiol Lung Cell Mol Physiol*. 315(5):L882-L890. doi: 10.1152/ajplung.00033.2018.

Barnason S, Zimmerman L, Schulz P, Pullen C, Schuelke S. (2019). Weight management telehealth intervention for overweight and obese rural cardiac rehabilitation participants: A randomised trial. *Journal of Clinical Nursing*. 28(9-10):1808-18.

Beseler CL, Crawford KJ, Charlier DE, Ramos AK. (2021). The NIOSH agricultural centers' YouTube channel: Time series modeling of viewership of agricultural health and safety videos. *Journal of Agromedicine*. 27(4):368-377. doi: 10.1080/1059924X.2021.2000907.

Beseler CL, Rautiainen RH. (2021). Assessing nonresponse bias in farm injury surveillance data. *Journal of Agricultural Safety & Health*. 27(4):215-227. doi: 10.13031/jash.14554

[Brooks R](#), [Baker JF](#), [Yang Y](#), [Roul P](#), [Kerr GS](#), [Reimold AM](#), [Kunkel G](#), [Wysham KD](#), [Singh N](#), [Lazaro D](#), [Monach PA](#), [Poole JA](#), [Ascherman DP](#), [Mikuls TR](#), [England BR](#). (2022). The impact of disease severity measures on survival in U.S. veterans with rheumatoid arthritis-associated interstitial lung disease *Rheumatology*, keac208, <https://doi.org/10.1093/rheumatology/keac208>

- Burgus S, Duysen E, Wendl M. (2017). What influences farmers to use farm safety and health information? *Journal of Extension*. 55(1):1RIB5.
- Burgus S, Duysen E. (2017). Identifying topics and dissemination methods for agricultural safety and health messages. *Safety*. 3(1):3. doi: 10.3390/safety3010003
- Carrington JM, Poole JA. (2018). The effect of inhalant organic dust on bone health. *Current Allergy and Asthma Reports*. 18(3):16. doi: 10.1007/s11882-018-0773-y
- Chandra D, Poole JA, Bailey KL, Staab E, Sweeter JM, DeVasure JM, Romberger DJ, Wyatt TA. (2018). Dimethylarginine dimethylaminohydrolase (DDAH) overexpression enhances wound repair in airway epithelial cells exposed to agricultural organic dust. *Inhalation Toxicology*. 30(3):133-139, doi: 10.1080/08958378.2018.1474976
- Chengane S, Beseler CL, Duysen EG, Rautiainen RH. (2021). Occupational stress among farm and ranch operators in the midwestern United States. *BMC Public Health*. 21:2076. doi: 10.1186/s12889-021-12053-4
- Chudomelka L, Wyatt TA. (2020). Cross-fading: The importance of tissue injury research on dual misuse of alcohol and JUUL. *Alcohol (Fayettevill, NY)*. 86:43-44. doi: 10.1016/j.alcohol.2020.03.012. PubMed PMID: 32247033.
- Corley B, Bartelt-Hunt S, Rogan E, Coulter D, Sparks J, Baccaglini L, Howell M, Liaquat S, Commack R, Kolok AS. (2018). Using watershed boundaries to map adverse health outcomes: Examples from Nebraska, USA. *Environmental Health Insights*. 12. doi:[10.1177/1178630217751906](https://doi.org/10.1177/1178630217751906)
- Cornell K, Alam M, Lyden E, Wood L, LeVan TD, Nordgren TM, Bailey K, Hanson C. (2019). Saturated fat intake is associated with lung function in individuals with airflow obstruction: Results from NHANES 2007-2012. *Nutrients*. 11(2):317. doi: 10.3390/nu11020317.
- Cramer ME, Araz OM, Wendl MJ. (2017). Social networking in an agricultural research center: Using data to enhance outcomes. *Journal of Agromedicine*. 22(2):170-179. doi: 10.1080/1059924X.2017.1282905
- Cramer ME, Habecker P, Wendl M, Sayles H, Rautiainen R, Dombrowski K. (2022). Social network analysis of an agricultural center: Stakeholders and transfer of information. *Journal of Agromedicine*. 27(1):75-86. doi: 10.1080/1059924X.2020.1850383
- Cramer M, Wendl M, Sayles H, Duysen E, Achutan C. (2017). Knowledge, attitudes, and practices for respiratory and hearing health among the midwestern farmers. *Public Health Nursing*. 34(4):348-358. doi: 10.1111/phn.12306
- Cramer ME, Wulf KJ, Wendl MJ, Keeler H. (2019). Are advanced providers prepared to care for the agricultural population?. *The Journal for Nurse Practitioners*. February; 15(2):e41-e44. doi: 10.1016/j.nurpra.2018.09.018
- Dickinson JD, Sweeter JM, Staab EB, Nelson AJ, Bailey KL, Warren KJ, Jaramillo AM, Dickey BF, Poole JA. (2019). MyD88 controls airway epithelial Muc5ac expression during TLR activation conditions from agricultural organic dust exposure. *American Journal of Physiology: Lung Cellular and Molecular Physiology*. 316(2):L334-L347. doi: 10.1152/ajplung.00206.2018
- Ding L, Tang S, Wyatt TA, Knoell DL, Oupicky D. (2021). Pulmonary siRNA delivery for lung disease: Review of recent progress and challenges. *Journal of Controlled Release*. 330:977-991. doi: 10.1016/j.jconrel.2020.11.005
- Ding L, Tang W, Mosley DD, Yu A, Sil D, Romanova S, Bailey KL, Knoell DL, Wyatt TA, Oupicky D. (2022). Perfluorocarbon nanoemulsions enhance therapeutic siRNA delivery in the treatment of pulmonary fibrosis. *Advanced Science*. Jan 7;e2103676. doi: 10.1002/advs.202103676

- Dodmane PR, Schulte NA, Heires AJ, Band H, Romberger DJ, Toews ML. (2018). Biphasic changes in airway epithelial cell EGF receptor binding and phosphorylation induced by components of hogbarn dust. *Experimental Lung Research*. 44(10):443-454. doi: 10.1080/01902148.2019.1575931.
- Dominguez EC, Heires AJ, Pavlik J, Larsen TD, Guardado S, Sisson JH, Baack ML, Romberger DJ, Nordgren TM. (2020). A high docosahexaenoic acid diet alters the lung inflammatory response to acute dust exposure. *Nutrients*. 12(8):2334. doi: 10.3390/nu12082334
- Donham KJ, Meppelink SM, Kelly KM, Rohlman DS. (2019). Health indicators of a cohort of midwest farmers: Health outcomes of participants in the Certified Safe Farm Program. *Journal of Agromedicine*. 24(3):228-238. doi: 10.1080/1059924X.2019.1591316
- Du Y, Baccaglini L, Johnson A, Puvvula J, Rautiainen RH. (2022). Factors associated with musculoskeletal discomfort in farmers and ranchers in the U.S. Central States. *Journal of Agromedicine*. 27(2):232-244. doi: 10.1080/1059924X.2021.1893880
- Duysen E, Irvine K, Yoder A, Topliff C, Kelling C, Rajaram S. (2017). Assessment of tribal bison worker hazards using trusted research facilitators. *Journal of Agromedicine*. 22(4):337-346. doi: 10.1080/1059924X.2017.1353937.
- Ebel AV, Lutt G, Poole JA, Thiele GM, Baker JF, Cannon GW, Gaffo A, Kerr GS, Reimold A, Schwab P, Singh N, Richards JS, Ascherman DP, Mikuls TR, England BR. (2021). Association of agricultural, occupational, and military inhalants with autoantibodies and disease features in US veterans with rheumatoid arthritis. *Arthritis & Rheumatology*. 73(3):392-400. doi: 10.1002/art.41559
- Eisenhauer CM, Brito FA, Yoder AM, Kupzyk KA, Pullen CH, Salinas KE, Miller J, Hageman PA. (2020). Mobile technology intervention for weight loss in rural men: protocol for a pilot pragmatic randomised controlled trial. *BMJ Open*. 10(4):e035089. doi: 10.1136/bmjopen-2019-035089
- Eisenhauer CM, Brito FA, Kupzyk KA, Yoder AM, Almeida F, Beller RJ, Miller J, Hageman PA. (2021). Mobile health assisted self-monitoring is acceptable for supporting weight loss in rural men: A pragmatic randomized controlled feasibility trial. *BMC Public Health*. 21(1):1568. doi: 10.1186/s12889-021-11618-7
- Elliott KC, Lincoln JM, Flynn MA, Levin JF, Smidt M, Dzugan J, Ramos AK. 2022. Working hours, sleep, and fatigue in the agriculture, forestry, and fishing sector: A scoping review. *American Journal of Industrial Medicine*. July 26. Doi: 10.1002/ajim.23418.
- England BR, Sayles H, Michaud K, Thiele GM, Poole JA, Caplan L, Sauer BC, Cannon GW, Reimold A, Kerr GS, Baker JF, Mikuls TR. (2018). Chronic lung disease in U.S. Veterans with rheumatoid arthritis and the impact on survival. *Clinical Rheumatology*. 37(11):2907-2915. doi: 10.1007/s10067-018-4314-9
- England BR, Duryee MJ, Roul P, Mahajan TD, Singh N, Poole JA, Ascherman DP, Caplan L, Demoruelle MK, Deane KD, Klassen LW. (2019). Malondialdehyde-acetaldehyde adducts and antibody responses in rheumatoid arthritis-interstitial lung disease. *Arthritis & Rheumatology*. 71(9):1483-1493. doi: 10.1002/art.40900. PMID: 30933423
- Farfalla A, Achutan C. (2021). Exposure assessment at a pullet barn – a case study. *Journal of Agromedicine*. 1-7. doi: 10.1080/1059924X.2021.1979154.
- Farfalla AA, Beseler C, Achutan C, Rautiainen R. 2022. Coexposure to solvents and noise as a risk factor for hearing loss in agricultural workers. *Journal of Occupational and Environmental Medicine*. 64(9):754-760. doi: 10.1097/JOM.0000000000002571

- Gaurav R, Mikuls TR, Thiele GM, Nelson AJ, Niu M, Guda C, Eudy JD, Barry AE, Wyatt TA, Romberger DJ, Duryee MJ, England BR, Poole JA. (2021). High-throughput analysis of lung immune cells in a combined murine model of agricultural dust-triggered airway inflammation with rheumatoid arthritis. *PloS One*. 16(2):e0240707. doi: 10.1371/journal.pone.0240707.
- Gaurav R, Poole, JA. (2021). Harness the antiinflammatory power of MyD88 to reduce allergic fungal inflammation? *American Journal of Respiratory and Cell Molecular Biology*. 64(1):1-3. doi: 10.1165/rcmb.2020-0442ED.
- Gaurav R, Poole JA. (2021). Interleukin (IL)-33 immunobiology in asthma and airway inflammatory diseases. *Journal of Asthma*. Dec 27:1-9. doi: 10.1080/02770903.2021.2020815.
- Gibbs SG, Herstein JJ, Le AB, Beam EL, Cieslak TJ, Lawler JV, Santarpia JL, Stentz TL, Kopocis-Herstein KR, Achutan C, Carter GW, Lowe JJ. (2019). Need for aeromedical evacuation high-level containment transport guidelines. *Emerging Infection Diseases*. 25(5):1033-1034. doi: 10.3201/eid2505.181948
- Gorucu S, Fetzer L. (2021). Agricultural safety and health learning methods for agricultural workforces. *Journal of Agricultural Safety and Health*. 27(2):77-85. doi: 10.13031/jash.14355
- Gorucu S, Murphy D, Yoder A, Pate M. (2018). National research and extension agenda for agricultural safety and health assessment. *Journal of Agromedicine*. 23(3):297-301. doi: 10.1080/1059924X.2018.1467807
- Gribben KC, Poole JA, Nelson AJ, Farazi PA, Wichman CS, Heires AJ, Romberger DJ, LeVan TD. (2022). Relationships of serum CC16 levels with smoking status and lung function in COPD. *BMC Respiratory Research*. 23:247.
- Hall R, O'Loughlin J, Billington CK, Thakker D, Sayers I, Hall IP. (2021). Functional Genomics of GPR126 in airway smooth muscle and bronchial epithelial cells. *The FASEB Journal*. 35(7):e21300. doi: 10.1096/fj.202002073R
- Hall SC, Smith DR, Dyavar SR, Wyatt TA, Samuelson DR, Bailey KL, Knoell DL. (2021). Critical role of zinc transporter (Zip8) in myeloid innate immune cell function and the host response against bacterial pneumonia. *The Journal of Immunology*. 207(5):1357-1370. doi: 10.4049/jimmunol.2001395
- Haws JK, Andrews AR III, Acosta Canchila MN, Ramos AK. (2022). Refining the Migrant farmworker Stress Inventory among Latino migrant farmworkers in rural Nebraska. *Journal of Rural Mental Health*. 46(2):100-116 <https://doi.org/10.1037/rmh0000202>
- Herstein JJ, Degarege A, Stover D, Austin C, Schwedhelm MM, Lawler JV, Lowe JJ, Ramos AK, Donahue M. (2021). [Characteristics of SARS-CoV-2 Transmission among Meat Processing Workers in Nebraska, USA, and Effectiveness of Risk Mitigation Measures](#). *Emerging Infectious Disease*. 27(4):1032-1038. doi: 10.3201/eid2704.204800.
- Israel GD, Diehl DC, Galindo S, Ward C, Ramos AK, Harrington M, Kasner EJ. (2020). Extension professionals' information use, protective behaviors, and work-life stress during COVID-19 pandemic. *Journal of Extension*. 58(6):a1.
- Jadhav R, Achutan C, Haynatzki G, Rajaram S, Rautiainen R. (2017). Injury risk factors to farm and ranch operators in the Central United States. *American Journal of Industrial Medicine*. 60(10):889-899. doi: 10.1002/ajim.22757
- Johansson P, Schober D, Tutsch SF, Brueggeman G, Leon M, Lyden E, Schulz PS, Estabrooks P, Zimmerman L. (2019). Adapting an evidence-based cardiovascular disease risk reduction intervention to rural communities. *Journal of Rural Health*. 35(1):87-96. doi: 10.1111/jrh.12306 PMID: 29888458

- Johnson, A, Baccaglini, L, Haynatzki GR, Achutan C, Loomis D, Rautiainen RH. (2021). Agricultural injuries among farmers and ranchers in the central United States during 2011-2015, *Journal of Agromedicine*. 26(1):62-72. doi: 10.1080/1059924X.
- Johnson AN, Harkema JR, Nelson AJ, Dickinson JD, Kalil J, Duryee MJ, Thiele GM, Kumar B, Singh AB, Gaurav R, Glover SC, Tang Y, Romberger DJ, Kielian T, Poole JA. (2020). MyD88 regulates a prolonged adaptation response to environmental dust exposure-induced lung disease. *Respiratory Research*. 22;21(1):97. doi: 10.1186/s12931-020-01362-8
- Karttunen JP, Rautiainen RH, Quendler E. (2019). Gender division of farm work and occupational injuries. *Journal of Agricultural Safety and Health*. 25(3):117-127. doi: 10.13031/jash.13177
- Kaustell KO, Mattila TEA, Ahvonen A, Rautiainen RH. (2019). Occupational injuries and diseases in fish farming in Finland 1996-2015. *International Maritime Health*. 70(1):47-54. doi: 10.5603/IMH.2019.0007 PubMed PMID: 30931517
- Kaustell KO, Mattila TEA, Hurme T, Salmi PS, Rautiainen RH. (2017). Predictors for occupational injuries and diseases among commercial fishers in Finland 1996-2015. *International Maritime Health*. 68(4):196-202. doi: 10.5603/IMH.2017.0037
- Kelly KJ, Poole JA. (2019). Pollutants in the workplace: Effect on occupational asthma. *Journal of Allergy and Clinical Immunology*. 143(6):2014-2015. doi: 10.1016/j.jaci.2019.04.013
- Kesinger E, Liu J, Jensen A, Chia CP, Demers A, Moriyama H. (2018) Influenza D virus M2 protein exhibits ion channel activity in *Xenopus laevis* oocytes. *PLoS One*. 13(6):e0199227. doi: 10.1371/journal.pone.0199227
- Kilanowski JF. (2020). Agricultural safety comic book for Latinx migrant families: Development and evaluation. *Journal of Pediatric Health Care*. 34(3):230-238. doi: 10.1016/j.pedhc.2019.11.003
- Knoell DL, Smith DA, Sapkota M, Heires AJ, Hanson CK, Smith LM, et al. (2019). Insufficient zinc intake enhances lung inflammation in response to agricultural organic dust exposure. *Journal of Nutritional Biochemistry*. 70:56-64. doi: 10.1016/j.jnutbio.2019.04.007
- Knoell DL, Smith D, Bao S, Sapkota M, Wyatt TA, Zweier JL, Flury J, Borchers MT, Knutson M. (2020). Imbalance in zinc metabolism enhances lung tissue loss following cigarette smoke exposure. *Journal of Trace Elements in Medicine and Biology*. 60:126483. doi: 10.1016/j.jtemb.2020.126483, 2020
- Knoell DL, Wyatt TA. (2021). The adverse impact of cadmium on immune function and lung host defense. In *Seminars in Cell & Developmental Biology*. 115:70-76. doi: 10.1016/j.semcd.2020.10.007. PMID: 33158728.
- Kolok AS, Ali JM, Rogan EG, Bartelt-Hunt SL. (2018). The fate of synthetic and endogenous hormones used in the US beef and dairy industries and the potential for human exposure. *Current Environmental Health Reports*. 5(2):225-232. doi: 10.1007/s40572-018-0197-9
- Kukrety SP, Parekh JD, Bailey K. (2018). Chronic obstructive pulmonary disease and the hallmarks of aging. *Lung India*. 35(4):321-327. doi: 10.4103/lungindia.lungindia\_266\_17
- Lander L, Loomis D, Watanabe-Galloway S, Haynatzki G. (2016). 0354 Non-fatal agricultural injuries: Surveillances in the Midwestern United States. *Occupational and Environmental Medicine*. 6(71):A43-A43.

- Leppälä J, Griffin P, McNamara J, Rautiainen R. (eds.). 2021. Safety Culture and Risk Management in Agriculture: Sacurima Cost Action CA16123 Highlights and Conclusions. Natural resources and bioeconomy studies 63/2021. Natural Resources Institute Finland. Helsinki. 84 p.
- LeVan TD, Smith LM, Heires AJ, Mikuls TR, Meza .JL, Weissenburger-Moser LA, Romberger DJ. (2017). Interaction of CD14 haplotypes and soluble CD14 on pulmonary function in agricultural workers. *Respiratory Research*. 18(1):49. doi: 10.1186/s12931-017-0532-y
- LeVan TD, Romberger DJ, Siahpush M, Grimm BL, Ramos AK, Johansson PL, Michaud TL, Heires AJ, Wyatt TA, Poole JA. (2018). Relationship of systemic IL-10 levels with proinflammatory cytokine responsiveness and lung function in agriculture workers. *Respiratory Research*. 19(1):166. doi.org/10.1186/s12931-018-0875-z
- Luedders J, Poole JA. (2022). Influence of rural environmental factors in asthma. *Immunology & Allergy Clinics*. doi: doi.org/10.1016/j.iac.2022.05.008
- Markov SD, Caffrey TC, O'Connell KA, Grunkemeyer JA, Shin S, Hanson R, Patil PP, Shukla SK, Gonzalez D, Crawford AJ, Vance KE, Huang Y, Eberle KC, Radhakrishnan P, Grandgenett PM, Singh PK, Madiyalakan R, Daniels-Wells TR, Penichet ML, Nicodemus CF, Poole JA, Jaffee EM, Hollingsworth MA, Mehla K. (2021). IgE-based therapeutic combination enhances antitumor response in preclinical models of pancreatic cancer. *Molecular Cancer Therapeutics*. 20(12):2457-2468. doi: 10.1158/1535-7163.MCT-21-0368.
- Martenies SE, Schaeffer J, Erlandson G, Bradford M, Poole JA, Wilson A, Weller Z, Reynolds S, Magzamen S.J (2020). Associations between bioaerosol exposures and lung function changes among dairy workers in Colorado. *Journal of Occupational and Environmental Medicine*. 62(6):424-430. doi: 10.1097/JOM.0000000000001856
- Mattila TEA, Heikkinen JM, Kovisto AM, Rautiainen RH. (2018). Predictors for interest to change from conventional to organic horticultural production. *Agricultural and Food Science*. 27(3)217-226.
- Mattila TEA, Ovaska U, Kinnunen B, Tuure VM, Leppälä J, Taattola K, Rinnola V, Rautiainen RH. (2021). Experiences and challenges of foreign agricultural workers in Finland. *Journal of Agricultural Safety and Health*. 27(1):13-28. doi: 10.13031/jash.13893
- Mattila TEA, Perkiö-Mäkelä M, Hirvonen M, Kinnunen B, Väre M, Rautiainen RH. (2021). Work exposures and mental and musculoskeletal symptoms in organic farming. *Ergonomics*. 1-11. doi: 10.1080/00140139.2021.1974102
- Mattila T, Rautiainen RH, Hirvonen M, Vare M, Perkiö-Makela M. (2020). Determinants of good work ability among organic and conventional farmers in Finland. *Journal of Agricultural Safety and Health*. 26(2):67-76. doi: 10.13031/jash.13667
- Merisalu E, Leppälä J, Jakob M, Rautiainen RH. (2019). Variation in Eurostat and national statistics of accidents in agriculture. *Agronomy Research* 17(5):1969-1983. doi.org/10.15159/AR.19.190
- Mikuls TR, Gaurav R, Thiele GM, England BR, Wolfe MG, Shaw BP, Bailey KL, Wyatt TA, Nelson AJ, Duryee MJ, Hunter CD, Wang D, Romberger DJ, Ascherman DP, Poole JA. (2021). The impact of airborne endotoxin exposure on rheumatoid arthritis-related joint damage, autoantigen expression, autoimmunity, and lung disease. *International Immunopharmacology*. 100:108069. doi: 10.1016/j.intimp.2021.108069.
- Murphy D, Gorucu S, Weichelt B, Scott E, Purschwitz M. (2019). Using multiple coding schemes for classification and coding of agricultural injury. *American Journal of Industrial Medicine*. 62(2):87-98. doi: 10.1002/ajim.22932.

- Nelson AJ, Roy SK, Warren K, Janike K, Thiele GM, Mikuls TR, Romberger DJ, Wang D, Swanson B, Poole JA. (2018). Sex differences impact the lung-bone inflammatory response to repetitive inhaled lipopolysaccharide exposures in mice. *Journal of Immunotoxicology*. 15(1):73-81. doi: 10.1080/1547691X.2018.1460425. PubMed PMID: 29648480.
- New-Aaron M, Semin J, Duysen EG, Madsen M, Musil K, Rautiainen RH. (2019). Comparison of agricultural injuries reported in the media and census of fatal occupational injuries. *Journal of Agromedicine*. 24(3):279-87.
- Nissen CG, Mosley DD, Kharbanda KK, Katafiasz DM, Bailey KL, Wyatt TA. (2022). Malondialdehyde acetaldehyde-adduction changes surfactant protein D structure and function. *Frontiers in Immunology*. 13:866795. doi: 10.3389/fimmu.2022.866795.
- Nordgren T, Bailey K. (2016). Pulmonary health effects of agriculture. *Current Opinion in Pulmonary Medicine*. 22(2):144–149. doi: 10.1097/MCP.0000000000000247.
- Nordgren TM, Bailey KL, Heires AJ, Katafiasz D, Romberger DJ. (2018). Effects of agricultural organic dusts on human lung-resident mesenchymal stem (stromal) cell function. *Toxicological Sciences*. 162(2):635-644. doi: 10.1093/toxsci/kfx286 PMID: 29319804
- Nordgren TM, Bauer CD, Heires AJ, Poole JA, Wyatt TA, West WW, Romberger DJ. (2015). Maresin-1 reduces airway inflammation associated with acute and chronic exposures to organic dust. *Translational Research*. 166(1):57–69. doi: 10.1016/j.trsl.2015.01.001
- Nordgren TM, Friemel TD, Heires AJ, Poole JA, Wyatt TA, Romberger DJ. (2014). The omega-3 fatty acid docosahexaenoic acid attenuates organic dust-induced airway inflammation. *Nutrients*. 6(12):5434-5452. doi: 10.3390/nu6125434 PubMed PMID: 25436433
- Nordgren TM, Heires AJ, Bailey KL, Katafiasz DM, Toews ML, Wichman CS, Romberger DJ. (2018). Docosahexaenoic acid enhances amphiregulin-mediated bronchial epithelial cell repair processes following organic dust exposure. *American Journal of Physiology-Lung Cellular and Molecular Physiology*. 314(3):L421-L431. doi: 10.1152/ajplung.00273.2017
- Nordgren TM, Heires AJ, Zemleni J, Swanson BJ, Wichman C, Romberger DJ. (2019). Bovine milk-derived extracellular vesicles enhance inflammation and promote M1 polarization following agricultural dust exposure in mice. *Journal of Nutritional Biochemistry*. 64:110-120. doi: 10.1016/j.jnutbio.2018.10.017
- Nordgren TM, Wyatt TA, Sweeter J, Bailey KL, Poole JA, Heires AJ, Sisson JH, Romberger DJ. (2014). Motile cilia harbor serum response factor as a mechanism of environment sensing and injury response in the airway. *American Journal of Physiology: Lung Cellular and Molecular Physiology*. 306(9):L829-39. doi: 10.1152/ajplung.00364.2013
- Nour MM, Cheng Y-H, Ni J-Q, Sheldon E, Field WE. (2021). Summary of injuries and fatalities involving livestock manure storage, handling, and transport operations in seven central states: 1976-2019. *Journal of Agricultural Safety and Health*. 27(2):105-122. doi.org/10.13031/jash.14343
- Nour MM, Field WE, Ni JQ, Cheng YH. (2021). Farm-related injuries and fatalities involving children, youth, and young workers during manure storage, handling, and transport. *Journal of Agromedicine*. 26(3):323-333. doi: 10.1080/1059924X.2020.1795034 PMID: 32716249
- Nour MM, Field WE, Ni JQ, Cheng C.J. (2019). Development of methodology to document and code farm-related injuries and fatalities involving manure storage, handling and transport - with summary of 2017 incidents. *Journal of Agromedicine*. 24(1):90-100. doi: 10.1080/1059924X.2018.1539420 PMID: 30409078

Ochoa CA, Nissen CG, Mosley DD, Bauer CD, Jordan, DL, Bailey KL, Wyatt TA. (2022). Aldehyde trapping by ADX-102 is protective against cigarette smoke and alcohol mediated lung cell injury. *Biomolecules*. 12(3):393. Doi: 10.3390/biom12030393

Olowogbon TS, Babatunde RO, Asiedu E, Yoder AM. (2020). Agrochemical health risks exposure and its determinants: Empirical evidence among Cassava farmers in Nigeria. *Journal of Agromedicine*. 26(2):199-210. doi: 10.1080/1059924X.2020.1816239

Olowogbon TS, Babatunde RO, Asiedu E, Yoder AM. (2021). Prevalence and exposure to ergonomic risk factors among crop farmers in Nigeria. *Applied Sciences*. 11:11989. doi: 10.3390/app112411989

Olowogbon TS, Yoder AM, Fakayode SB, Falola AO. (2019). Agricultural stressors: identification, causes and perceived effects among Nigerian crop farmers. *Journal of Agromedicine*. 24(1):46-55. doi: 10.1080/1059924X.2018.1538915

Osna NA, Ganesan M, Seth D, Wyatt TA, Kidambi S, Kharbanda KK. (2021). Second hits exacerbate alcohol-related organ damage: an update. *Alcohol and Alcoholism*. 56(1):8-16. doi: 10.1093/alcalc/aaa085

Ouattara BS, Beseler CL, Rautiainen RH. 2022. Agricultural injuries: Risk factors and severity by affected body part among US (Midwest) farmers. *Journal of Agromedicine*. June 15. doi: 10.1080/1059924X.2022.2089421

Ouattara BS, Zahid, M, Rahman FI, Weber KA, Bartelt-Hunt SL, Rogan EG. (2022). Investigation of a possible relationship between anthropogenic and geogenic water contaminants and birth defects occurrence in rural Nebraska. *Water*. 14:2289. <https://doi.org/10.3390/w14152289>

Patel K, Watanabe-Galloway S, Gofin R, Haynatzki G, Rautiainen RH. (2017). Non-fatal agricultural injury surveillance in the United States: A review of national-level survey-based systems. *American Journal of Industrial Medicine*. 60(7): 599-620. doi: 10.1002/ajim.22720

Poole JA, Barnes CS, Demain JG, Bernstein JA, Padukudru MA, Sheehan WJ, Fogelbach GG, Wedner J, Codina R, Levetin E, Cohn JR, Kagen S, Portnoy JM, Nel AE. (2019). Impact of weather and climate change with indoor and outdoor air quality in asthma: A Work Group Report of the AAAAI Environmental Exposure and Respiratory Health Committee. *Journal of Allergy and Clinical Immunology*. 143(5):1702-1710. doi: 10.1016/j.jaci.2019.02.018 PubMed PMID: 30826366

Poole JA, Mikuls TR, Duryee MJ, Warren KJ, Wyatt TA, Nelson AJ, Romberger DJ, West WW, Thiele GM. (2017). A role for B cells in organic dust induced lung inflammation. *Respiratory Research*. 18(1):214. doi: 10.1186/s12931-017-0703-x

Poole JA, Mikuls TR, Thiele GM, Gaurav R, Nelson AJ, Duryee MJ, Mitra A, Hunter C, Wyatt TA, England BR, Ascherman DP. (2022). Increased susceptibility to organic dust exposure-induced inflammatory lung disease with enhanced rheumatoid arthritis-associated autoantigen expression in HLA-DR4 transgenic mice. *Respiratory Research*. 23:160. doi: 10.1186/s1291-022-02085-8

Poole JA, Nordgren TM, Heires AJ, Nelson AJ, Katafiasz DM, Bailey KL, Romberger D. (2020). Amphiregulin modulates murine lung recovery and fibroblast function following exposure to agriculture organic dust. *American Journal of Physiology: Lung Cellular and Molecular Physiology*. 318(1):L180-L191. doi: 10.1152/ajplung.00039.2019

Poole JA, Thiele GM, Janike K, Nelson AJ, Duryee MJ, Rentfro K, England BR, Romberger DJ, Carrington JM, Wang D, Swanson BJ, Klassen LW, Mikuls TR. (2019). Combined collagen-induced arthritis and organic dust-induced airway

inflammation to model inflammatory lung disease in rheumatoid arthritis. *Journal of Bone and Mineral Research*. 34(9):1733-1743. doi: 10.1002/jbmr.3745

Pounds LC, Duysen E, Cramer ME, Wendl M, Rautiainen R, Romberger DJ. (2018). Social marketing campaign promoting the use of respiratory protection devices among farmers. L Racz, & D Yamamoto & R Eninger (Eds), In *Handbook of Respiratory Protection: Safeguarding Against Current and Emerging Hazards* (pp. 193-208) Boca Raton, FL, CRC Press, Taylor & Francis Group.

Puvvula J, Baccaglini L, Johnson A, Du Y, Bell JE, Rautiainen RH. 2022. Prevalence and risk factors for pulmonary conditions among farmers and ranchers in the central United States. *Journal of Agromedicine*. 27(4):378-390. doi: [10.1080/1059924X.2021.2025180](https://doi.org/10.1080/1059924X.2021.2025180)

Ramaswamy SK, Mosher GA. (2016). Approaching safety through quality: Factors influencing college student perceptions. *Journal of Agricultural Safety & Health*. 22(2):149-60. doi: 10.13031/jash.22.11426

Ramos AK. (2018). A human rights-based approach to farmworker health: An overarching framework to address the social determinants of health. *Journal of Agromedicine*. 23(1):25-31. doi: 10.1080/1059924X.2017.1384419

Ramos AK. (2018). Child labor in global tobacco production: A human rights approach to an enduring dilemma. *Health and Human Rights*. 20(2):235-248.

Ramos AK, Adhikari S, Yoder AM, Rautiainen RH. (2021). Occupational injuries among Latino/a immigrant cattle feedyard workers in the Central States region of the United States. *International Journal of Environmental Research and Public Health*. 18(16):8821. doi: 10.3390/ijerph18168821

Ramos AK, Carlo G, Grant KM, Trinidad N, Correa A. (2016). Stress, depression, and occupational injury among migrant farmworkers in Nebraska. *Safety*. 2(4): 23. doi:10.3390/safety2040023

Ramos AK, Carvajal-Suarez M, Trinidad N, Quintero SA, Molina D, Johnson-Beller R, Rowland SA. (2021). Health and well-being of Hispanic/Latino meatpacking workers in Nebraska: An application of the Health Belief Model. *Workplace Health & Safety*. Jun 25;21650799211016907 doi: 10.1177/21650799211016907

Ramos AK, Carvajal-Suarez M, Trinidad N, Michaud TL, Grimm B, LeVan T, Siahpush M. (2020). A cross-sectional study of gender-related differences in reporting fatigue and pain among Latino/a migrant farmworkers. *Journal of Agromedicine*. 25(3):319-329. doi: 10.1080/1059924X.2020.1713272

Ramos AK, Carvajal-Suarez M, Trinidad N, Quintero S, Molina D, Rowland SA. (2021). "No somos máquinas" (We are not machines): Worker perspectives of safety culture in meatpacking plants in the Midwest. *American Journal of Industrial Medicine*. 64(2):84-96. doi: 10.1002/ajim.23206 PMID: 33284493

Ramos AK, Duysen E, Carvajal-Suarez M, Trinidad N. (2020). Virtual Outreach: Using social media to reach Spanish-speaking agricultural workers during the COVID-19 pandemic. *Journal of Agromedicine*. 25(4):353-356. doi: 10.1080/1059924X.2020.1814919

Ramos AK, Duysen E, Yoder AM. (2019). Identifying safety training resource needs in the cattle feeding industry in the midwestern United States. *Safety*. 5(2):26.

Ramos AK, Fuentes A, Carvajal-Suarez M. (2018). Self-reported occupational injuries and perceived occupational health problems among Latino immigrant swine confinement workers in Missouri. *Journal of Environmental and Public Health*. 2018:8710901. doi: 10.1155/2018/8710901

Ramos A, Fuentes A, Trinidad N. (2016). Perception of occupational risks, personal protective equipment (PPE) use, and prevention opportunities among Latino Immigrant hog CAFO workers in Missouri. *Safety*. 2(4):25. doi: 10.3390/safety2040025

Ramos AK, Girdžiūtė L, Starič J, Rautianinen RH. (2021). Identifying "vulnerable agricultural populations" at risk for occupational injuries and illnesses: A European perspective. *J Agromedicine*. 26(3):340-345. doi: 10.1080/1059924X.2020.1771498

Ramos AK, Gustavo C, Grant KM, Bendixsen C, Fuentes A, Gamboa R. (2018). A preliminary analysis of immigrant cattle feedyard worker perspectives on job-related safety training. *Safety*. 4(3):37. doi: 10.3390/safety4030037

Ramos AK, Lowe AE, Herstein JJ, Schwedhelm S, Dineen KK, Lowe JJ. (2020). Invisible no more: The impact of COVID-19 on essential food production workers. *Journal of Agromedicine*. 25(4):378-382. doi: 10.1080/1059924X.2020.1814925

Ramos AK, McGinley M, Carlo G. (2021). Fatigue and the need for recovery among Latino/a immigrant cattle feedyard workers. *Journal of Agromedicine*. 26(1):47-58. doi: 10.1080/1059924X.2020.1845894

Ramos AK, McGinley M, Carlo G. (2021). The relations of workplace safety, perceived occupational stress, and adjustment among Latino/a immigrant cattle feedyard workers in the United States. *Safety Science*. 139:105262.

Ramos AK, Schenker MJB. (2021). [Hired and Contract Agricultural Workforce - Sustainable Solutions](#). *Journal of Agromedicine*. 26(1):45-46. doi: 10.1080/1059924X.2021.1849499.

Ramos AK, Su D, Correa A, Trinidad N. (2018). Associations between social capital and self-efficacy among Latinas in Nebraska. *Social Work in Public Health*. 33(1):31-42. doi: 10.1080/19371918.2017.1391149

Ramos AK, Suraj A, Rautiainen R, Yoder A. (2022). Protecting cattle feedyard workers in the Central States region: Exploring state, regional, and national data on fatal and nonfatal injuries in agriculture and the beef production sector. *Journal of Extension*. 60(3):13.

Ramos AK, Trinidad N, Correa A, Carlo G. (2019). Correlates and predictors of alcohol consumption and negative consequences of alcohol use among Latino migrant farmworkers in Nebraska. *American Journal of Orthopsychiatry*. 89(5):559-568.

Rautiainen, R. (2021). Surveillance of agriculture, forestry, and fishing injury, illness, and economic impacts. *Journal of Agromedicine*, 26(1):59-61. doi: 10.1080/1059924X.2021.1849508

Rautiainen R. (2021). Cultivating collaborations: Western Ag Safety and Health Conference. *Journal of Agromedicine*. 26(1):1-2. doi: 10.1080/1059924X.2021.1860613

Reyes I, Ellis T, Yoder A, Keifer MC. (2016). An evaluation tool for agricultural health and safety mobile applications. *Journal of Agromedicine*. 21(4):301-309. doi: 10.1080/1059924X.2016.1211054

Reyes S, Acosta LM, Domínguez V, Ramos AK, Andrews AR, III. (2022). Immigrant and U.S.-born migrant farmworkers: Dual paths to discrimination-related health outcomes. *American Journal of Orthopsychiatry*, 92(4), 452–462. <https://doi.org/10.1037/ort0000625>

Rowland SA, Ramos AK, Carvajal-Suarez M, Trinidad N, Johnson-Beller R, Struwe L, Quintero SA, Pozehl B. (2021). Musculoskeletal pain and cardiovascular risk in Hispanic/Latino meatpacking workers. *Workplace Health & Safety*. 69(12):556-563. doi: 10.1177/21650799211016908.

- Rudolphi JM, Berg RL, Parsaik A. (2019). Depression, anxiety and stress among young farmers and ranchers: A pilot study community. *Community Mental Health Journal*. 56(1):126-134. doi: 10.1007/s10597-019-00480-y
- Sapkota M, DeVasure JM, Kharbanda KK, Wyatt TA. (2017). Malondialdehyde-acetaldehyde (MAA) adducted surfactant protein induced lung inflammation is mediated through scavenger receptor a (SR-A1). *Respiratory Research*, 18(1):1-10. doi: 10.1186/s12931-017-0517-x
- Schneberger D, DeVasure JM, Bailey KL, Romberger DJ, Wyatt TA. (2017). Effect of low-level CO2 on innate inflammatory protein response to organic dust from swine confinement barns. *Journal of Occupational Medicine and Toxicology*. 12(1):9. doi: 10.1186/s12995-017-0155-8
- Schneberger D, DeVasure JM, Bailey KL, Romberger DJ, Wyatt TA. (2020). Swine barn dust stimulates CCL9 expression in mouse monocytes through PKC-delta activation. *Environmental Disease*. 5(4):93-99.
- Schneberger D, DeVasure JM, Kirychuk SA, Wyatt TA. (2018). Organic barn dust inhibits surfactant protein D production through protein kinase-c alpha dependent increase of GPR116. *PLoS One*. 13(12):e0208597. doi: 10.1371/journal.pone.0208597
- Scott E, Hirabayashi L, Jones N, Krupa N, Jenkins P. Characteristics of agriculture related motor vehicle crashes in rural New York State. *Journal of Agromedicine*. 2020 Apr;25(2):173-178. doi: 10.1080/1059924X.2019.1623143.
- Scott E, Hirabayashi L, Krupa N, Jenkins P. (2019). Emergency medical services pre-hospital care reports as a data source for logging injury surveillance. *Journal of Agromedicine*. 24(2):133-137. doi: 10.1080/1059924X.2019.1572558.
- Scott E, Hirabayashi L, Graham J, Krupa N, Jenkins P. Using hospitalization data for injury surveillance in agriculture, forestry and fishing: a crosswalk between ICD10CM external cause of injury coding and The Occupational Injury and Illness Classification System. *Injury Epidemiol*. 8(1):6. doi: 10.1186/s40621-021-00300-6.
- Schuelke SA, Ellermeier ME. 2022. Agricultural safety and health curriculum: Preparing the next generation of rural nurses. *Journal of Agromedicine*. March 31, 2022. <https://doi.org/10.1080/1059924X.2022.2058665>
- Schulz PS, Zimmerman L, Johansson P. (2018). Seasonal work and cardiovascular risk factors in farmers. *Journal of Cardiovascular Nursing*. 33(4):E35-E39. doi: 10.1097/JCN.0000000000000490
- Sedlacek D, Beacom M, Bista S, Rautiainen RH, Siu K-C. (2021). Comparing objective and subjective measures of sleep loss with balance performance in farmers. *Journal of Agricultural Safety and Health*. 27(2):69-76. doi.org/10.13031/jash.14217
- Sheats MK, Davis KU, Poole JA. (2019). Comparative review of asthma in farmers and horses. *Current Allergy and Asthma Reports*. 19(11):50. doi: 10.1007/s11882-019-0882-2 PubMed PMID: 31599358.
- Shrestha D, Massey N, Bhat SM, Jelesijevic T, Sahin O, Zhang Q, Bailey KL, Poole JA, Charavaryamath, C. (2022). Nrf2 activation protects against organic dust and hydrogen sulfide exposure induced epithelial barrier loss and *K. Pneumoniae* invasion. *Frontiers in Cellular and Infection Microbiology*. 12:848773. doi: 10.3389/fcimb.2022.848773
- Sinha R, Weissenburger-Moser LA, Clarke JL, Smith LM, Heires AJ, Romberger DJ, LeVan, T. (2018). Short term dynamics of the sputum microbiome among COPD patients. *PLoS ONE* 13(3):e0191499. doi: 10.1371/journal.pone.0191499

- Smith LM, Weissenburger-Moser LA, Heires AJ, Bailey KL, Romberger DJ, LeVan TD. (2017). Epistatic effect of TLR-1, -6 and -10 polymorphisms on organic dust-mediated cytokine response. *Genes and Immunity*. 18(2):67-74. doi: 10.1038/gene.2016.51
- Starič J, Hodnik JJ, Drusany Starič K, Ježek J, Janev Holcer N, Leppälä J, Rautiainen RH. (2020). Safety culture regarding zoonoses on domestic ruminants farms. *Veterinarska Stanica*. 51(2). doi: 10.46419/vs.51.2.10
- Tinc PJ, Jenkins P, Sorensen JA, Weinehall L, Gadomski A, Lindvall K. Key factors for successful implementation of the National Rollover Protection Structure Rebate Program: A correlation analysis using the consolidated framework for implementation research. *Scandinavian Journal of Work, Environment & Health*. 2020 Jan 1;46(1):85-95. doi: 10.5271/sjweh.3844.
- Tinc PJ, Gadomski A, Sorensen JA, Weinehall L, Jenkins P, Lindvall K. (2018). Adapting the T0-T4 implementation science model to occupational health and safety in agriculture, forestry, and fishing: A scoping review. *American Journal of Industrial Medicine*. 61(1):51-62. doi: 10.1002/ajim.22787.
- Tinc PJ, Sorensen JA. (2019). Marketing Farm Safety: Using Principles of Influence to Increase PTO Shielding. *Journal of Agromedicine*. 2019 Jan;24(1):101-109. doi: 10.1080/1059924X.2018.1539421.
- Tinc PJ, Sorensen JA, Weinehall L, Lindvall K. (2019). An exploration of rollover protective structures (ROPS) rebate program media coverage: strategies for implementation and sustainment. *BMC Public Health*. 19(1):1257. doi: 10.1186/s12889-019-7586-3.
- Vare M, Mattila TEA, Rikkonen P, Hirvonen M, Rautiainen RH. (2021). Farmers' perceptions of farm management practices and development plans on organic farms in Finland. *Organic Agriculture*. 11(3):457-467. doi: 10.1007/s13165-021-00352-4
- Wan Y, Kang G, Sreenivasan C, Daharsh L, Zhang J, Fan W, Wang D, Moriyama H, Li F, Li QA. (2018). DNA vaccine expressing consensus hemagglutinin-esterase fusion protein protected guinea pigs from infection by two lineages of influenza D virus. *Journal of Virology*. 92:e00110-18. doi: 10.1128/JVI.00110-18
- Warren KJ, Dickinson JD, Nelson AJ, Wyatt TA, Romberger DJ, Poole JA. (2019). Ovalbumin-sensitized mice have altered airway inflammation to agriculture organic dust. *Respiratory Research*. 20(1):1-10. doi: 10.1186/s12931-019-1015-0
- Warren KJ, Poole JA, Sweeter JM, DeVasure JM, Wyatt TA. (2019). An association between MMP-9 and impaired T cell migration in ethanol-fed BALB/c mice infected with respiratory syncytial virus-2A. *Alcohol*. 80:25-32. doi: 10.1016/j.alcohol.2018.09.009.
- Warren KJ, Wyatt TA. (2019). Assessment of lymphocyte migration in an ex vivo transmigration system. *JoVE(Journal of Visualized Experiments)*. 20(151). doi: 10.3791/60060
- Warren K, Wyatt TA, Romberger DJ, Ailts I, West WW, Nelson A, Nordgren TM, Staab E, Heires AJ, Poole JA. (2017). Post-injury and resolution response to repetitive inhalation exposure to agriculture organic dust in mice. *Safety*. 3(1):10. doi:10/3390/safety3010010
- Warren KJ, Dickinson JD, Nelson AJ, Wyatt TA, Romberger DJ, Poole JA. (2019). Ovalbumin-sensitized mice have altered airway inflammation to agriculture organic dust. *Respiratory Research*. 20:51. doi: 10.1186/s12931-019-1015-0.

- Watanabe-Galloway S, Chasek C, Yoder AM, Bell JE. (2022). Substance use disorders in farming population: Scoping review. *Journal of Rural Health*. 38(1):129-150. doi: 10.1111/jrh.12575
- Weichelt B, Gorucu S, Jennissen C, Denning G, Oesch S. (2020). Assessing the emergent public health concern of all-terrain vehicle injuries in rural and agricultural environments: Initial review of available national datasets in the United States. *JMIR Public Health Surveillance*. 6(2):e15477. doi: 10.2196/15477.
- Weichelt B, Heimonen T, Gorucu S, Redmond E, Vechinski J, Pflughoeft K, Bendixsen C, Salzwedel M, Scott E, Namkoong K, Purschwitz M. (2019). Redesigning a sentinel surveillance system for collecting and disseminating near real-time agricultural injury reports: System usability study. *JMIR Formative Research*. 3(3):e13621.
- Weichelt B, Heimonen T, Pilz M, Yoder A, Bendixsen C. (2018). An argument against cross-platform development: Lessons from an augmented reality app prototype for rural emergency responders *JMIR MHealth uHealth*. 7(3):e12207. doi: 10.2196/12207
- Weichelt B, Scott E, Burke R, Shutske J, Gorucu S, Sanderson W, Madsen M, Redmond E, Murphy DJ, Rautiainen R. (2021) JA:2021-40. What about the rest of them? Fatal injuries related to production agriculture not captured by the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI). *Journal of Agromedicine*. Jan. 27(1):35-40. doi: 10.1080/1059924X.2021.1956663
- Weichelt B, Yoder A, Bendixsen C, Pilz M, Minor G, Keifer M. (2018). Augmented Reality Farm MAPPER Development: Lessons learned from an app designed to improve rural emergency response. *Journal of Agromedicine*. 23(3):284-296. doi: 10.1080/1059924X.2018.1470051
- Weichelt B, Bendixsen C, Patrick T. (2019). A model for assessing necessary conditions for rural health care's mobile health readiness: Qualitative assessment of clinician-perceived barriers. *JMIR mHealth uHealth*. 7(11):e11915. doi: 10.2196/11915
- Weissenburger-Moser L, Meza J, Yu F, Shiyabola O, Romberger DJ, Levan TD. (2017). A principal factor analysis to characterize agricultural exposures among Nebraska veterans. *Journal of Exposure Science and Environmental Epidemiology*. 27(2):214-220. doi: 10.1038/jes.2016.20
- Wendl MJ, Cramer ME. (2018). Evaluating effective leadership and governance in a midwestern agricultural safety and health coalition. *Workplace Health & Safety*. 66(2):84-94. doi: 10.1177/216507991772917
- Wells A, Romberger DJ, Thiele GM, Wyatt TA, Staab E, Heires AJ, Klassen LW, Duryee MJ, Mikuls TR, Dusad A, West WW, Wang D, Poole JA. (2017). Systemic IL-6 effector response in mediating systemic bone loss following inhalation of organic dust. *Journal of Interferon & Cytokine Research*. 37(1):9-19. doi: 10.1089/jir.2016.0048
- Wetzel TJ, Wyatt TA. (2020). Dual substance use of electronic cigarettes and alcohol. *Frontiers in Physiology*. 11:593803. doi: 10.3389/fphys.2020.593803
- Wheeler AM, Baker JF, Poole JA, Ascherman DP, Yang Y, Kerr GS, Reimold A, Kunkel G, Cannon GW, Wysham KD, Singh N, Lazaro D, Monach P, Bridges SL Jr., Mikuls TF, England BR. Genetic, social, and environmental risk factors in rheumatoid arthritis-associated interstitial lung disease. doi.org/10.1016/j.semarthrit.2022.152098
- Wickman A, Duysen E, Cheyney M, Pennington W, Mazur J, Yoder A. (2021). Development of an educational YouTube channel: A collaboration between U.S. Agricultural Safety and Health Centers. *Journal of Agromedicine*. 26(1):75-84. doi: 10.1080/1059924X.2020
- Wiese JD, Caven AJ, Zarlenga DS, Topliff CL, Kelling CL, Saltera J. (2021). Gastrointestinal parasites of a reintroduced semi-wild plains bison (*Bison bison bison*) herd: Examining effects of demographic variation, deworming treatments,

and management strategy. International Journal for Parasitology: Parasites and Wildlife. 14:216-227. doi: 10.1016/j.ijppaw.2021.02.004

Wyatt TA, Canady K, Heires AJ, Poole JA, Bailey KL, Nordgren TM, Romberger DJ. (2017). Alcohol inhibits organic dust-induced ICAM-1 expression on bronchial epithelial cells. Safety, 3(1):5. doi:10.3390/safety3010005

Wyatt TA, Nemecek M, Chandra D, DeVasure JM, Nelson AJ, Romberger DJ, Poole JA. (2020). Organic dust-Induced lung injury and repair: Bi-directional regulation by TNF $\alpha$  and IL-10. Journal of Immunotoxicology. 17(1):153-162. doi: 10.1080/1547691X.2020.1776428

Wyatt TA, Warren KJ, Wetzel TJ, Suwondo T, Rensch GP, DeVasure JM, Mosley DD, Kharbanda KK, Thiele GM, Burnham EL, Bailey KL, Yeligar SM. (2021). Malondialdehyde-acetaldehyde adduct formation decreases immunoglobulin A transport across airway epithelium in smokers who abuse alcohol. The American Journal of Pathology. 191(10):1732-1742 doi: 10.1016/j.ajpath.2021.06.007

### C.2. Website(s) or other Internet site(s) – include URL(s)

CS-CASH website <https://www.unmc.edu/publichealth/cscash/>  
 CS-CASH Facebook <https://www.facebook.com/unmccscash/>  
 CS-CASH Instagram <https://www.instagram.com/unmccscash/>  
 CS-CASH Twitter <https://twitter.com/unmccscash/>  
 CS-CASH Flickr <https://www.flickr.com/photos/cscash/>  
 USAg Center YouTube Channel (evaluators, publishers, contributors)  
[https://www.youtube.com/channel/UCRgk3ryTcY8Wcvvv\\_ulZgmA](https://www.youtube.com/channel/UCRgk3ryTcY8Wcvvv_ulZgmA)

### C.3. Technologies or techniques

Please see individual project reports.

### C.4. Inventions, patent applications, and/or licenses

None

### C.5. Other products and resource sharing

Please see individual project reports.

## D. PARTICIPANTS

### D.1. What individuals have worked on the project? Please include calendar, academic, and summer months.

| Commons ID    | S/K | Name              | Degrees(s)  | Role            | Cal | Aca | Sum | Foreign | Country | SS |
|---------------|-----|-------------------|-------------|-----------------|-----|-----|-----|---------|---------|----|
| RAUTIAINEN    | Y   | Rautiainen, Risto | MS, PHD     | PD/PI           | 7.0 |     |     |         |         |    |
| AMYODER       | Y   | Yoder, Aaron      | PHD, MS, BS | Co-Investigator | 8.8 |     |     |         |         |    |
| POOLE.JILL    | Y   | Poole, Jill       | MD          | Co-Investigator | 1.2 |     |     |         |         |    |
| RAMOS.ATHENA  | Y   | Ramos, Athena     | PhD         | Co-Investigator | 7.2 |     |     |         |         |    |
| ROGAN.ELEANOR | Y   | Rogan, Eleanor    | PhD         | Co-Investigator | 0.6 |     |     |         |         |    |
| WYATT.TODD    | Y   | Wyatt, Todd       | BS, PhD     | Co-Investigator | 1.9 |     |     |         |         |    |

|                   |   |                    |     |                               |      |  |  |  |  |  |
|-------------------|---|--------------------|-----|-------------------------------|------|--|--|--|--|--|
| DUYSEN.ELLEN      | Y | Duysen, Ellen      | MPH | Community Outreach Specialist | 12.0 |  |  |  |  |  |
| MATTHEW.BEACOM    | Y | Beacom, Matt       | MD  | Co-Investigator               | 1.6  |  |  |  |  |  |
| SAMUELSON.MYSTERA | Y | Samuelson, Mystera | PhD | Co-Investigator               | 1.2  |  |  |  |  |  |
| BESELER.CHERYL    | Y | Beseler, Cheryl    | PhD | Co-Investigator               | 12.0 |  |  |  |  |  |

**D.2 Personnel updates**

- a. Level of Effort: N/A
- b. New Senior/Key Personnel: N/A
- c. Changes in Other Support: N/A
- d. New Other Significant Contributors: N/A

**E. IMPACT**

**E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES**

**F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**

None

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**

None

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**

None

**G. Special Reporting Requirements**

|   |
|---|
| <b>G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements</b>  |
| <b>G.2 Responsible Conduct of Research</b><br>NA  |
| <b>G.3 Mentor's Research Report or Sponsor Comments</b><br>NA   |
| <b>G.4 Human Subjects</b><br><br>G.4.a Does the project involve human subjects?<br>No<br><br>G.4.b Inclusion Enrollment Data<br>NA<br><br>G.4.c ClinicalTrials.gov<br>No<br><br>Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?<br>No |
| <b>G.5 Human Subject Education Requirement</b><br>Are there personnel on this project who are newly involved in the design or conduct of human subject's research?<br>No  |
| <b>G.6 Human Embryonic Stem Cells (HESCS)</b><br><br>Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?<br>No  |
| <b>G.7 Vertebrate Animals</b><br><br>Does this project involve vertebrate animals?<br>No  |
| <b>G.8 Project/Performance Sites</b><br>University of Nebraska Medical Center   |
| <b>G.9 Foreign Component</b><br>No  |
| <b>G.10 Estimated Unobligated Balance</b><br>See FFR report.  |

G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?

No

#### G.11 Program Income

Is program income anticipated during the next budget period?

No

#### G.12 F&A Costs

Is there a change in performance sites that will affect F&A costs?

No

### I. OUTCOMES

I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets

Note: project outcome information will be made public in NIH RePORTER

The Central States Center for Agricultural Safety and Health has met and exceeded its established goals for the 2016-2022 funding period. We have quantified the burden of agricultural injury and illness in the Center's region with new information on injury rates and cost and prevalence rates for common work-related chronic health conditions. We have further defined the need for preventive efforts in basic, intervention, translation, and surveillance studies identifying hazardous exposures and high-risk populations. The Centers intervention, translation, and outreach efforts have demonstrated impact in advancing the health and safety of affected populations. Active engagement and insight of External Advisors into future development of risks in agriculture have shaped the emerging issue and pilot projects and new projects proposed for the next funding period. CS-CASH has demonstrated its commitment to diversity and inclusiveness in research and outreach, addressing the special issues of women, young and aging farmers, veteran farmers, Latino immigrant workers, and native American Workers. CS-CASH is well-established with a clear vision, mission, strategy, organization, and service area. With the new proposed lines of research and outreach, the Center is well positioned to serve the Center's seven-state region and make an impact in reducing agricultural injury and illness during the 2022-2027 funding cycle.

**A. COVER PAGE**

|   |   |
|---|---|
| <b>Project Title:</b><br>Evaluation   |   |
| <b>Grant Number:</b><br>1U54OH010162  | <b>Project/Grant Period:</b><br>September 01, 2016 – August 31, 2022  |
| <b>Reporting Period:</b><br>September 01, 2016- August 31, 2022   | <b>Date Submitted:</b><br>December 22, 2022   |
| <b>Program Director/ Principal Investigator</b><br>Risto Rautiainen, Program Director<br>Cheryl Beseler, Principal Investigator | <b>Administrative Official Information</b><br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| <b>Change of Contact PD/PI:</b><br>NA   |   |
| <b>Human Subjects:</b><br>No  | <b>Vertebrate Animals:</b><br>No  |
| <b>hESC:</b>  | <b>Inventions/Patents:</b><br>None  |

## B. ACCOMPLISHMENTS

### B.1 What are the major goals of the project?

Aim 1. Assess the effectiveness of CS CASH leadership and governance.

Aim 2. Conduct quality assurance by tracking CS CASH Logic Model Activities, Outputs, and Intermediate Outcomes.

Aim 3. Evaluate CS CASH Logic Model End Outcomes for social and economic impacts

#### B.1.a Have the major goals changed since the initial competing award or previous report?

No changes have occurred.

### B.2. What did you accomplish under these goals?

We collaborated with faculty having content expertise in health economics, social networking, organizational communications, statistical analysis, database management, and coalition building. Our evaluation efforts were consistent with the American Evaluation Association's Standards of Excellence and Guiding Principles to ensure a professional evaluation structure and responsive communications between our Evaluation Team and our stakeholders. We grounded our evaluation in theories and best practices for 1) community engagement; 2) coalition evaluation models published by the Center's Evaluation Director 3) social networking and communication; and 4) social return on investment.

The following describes our performance on each of the three evaluation aims.

Aim 1. The Evaluation Team placed a high value on communication feedback that would promote effective leadership. Every year, we gathered data on Center governance using the *Internal Coalition Effectiveness (ICE©)* instrument. This survey was administered to Center members, leaders, and EAB members (N = 36) via email with a REDCap link. Response rates ranged from 66% to 90%. Findings showed the Center's leadership and governance structures were consistently rated "very effective" (i.e., FY 6 = 6.41, FY7 = 6.5, FY8 = 6.58, FY9 = 6.51, FY10=6.56, FY11 = 6.40), where 1 = "not at all effective" and 7 = "highly effective". The ICE© survey also contained several open-ended questions about Center leadership and governance. Respondents' comments were predominately positive each year. Consistent themes for Center governance and leadership strengths included 1) strong and supportive administrative personnel and structures, 2) valued and accessible research and community outreach resources in agricultural health and safety, 3) promotion of collaborative member relationships, and 4) an active community outreach program. Respondents also provided important recommendations for improvement, and which were acted upon. For example, recommendations included 1) adjusting monthly meeting content to focus more on members' projects, 2) providing more assistance with data analysis to pilot investigators, and 3) making senior investigators available to mentor pilot investigators on research design and manuscript development. All recommendations were discussed each year at a Center Monthly Meeting for the purpose of developing responsive action plans. The Evaluation Team followed up each year to ensure that the action plan steps had alleviated the issues. The evaluation findings and action plans were compiled each year into the comprehensive *Governance and Leadership Reports* and distributed to Center and EAB members. The Evaluation Team published our methodology for governance evaluation in *Workplace Health and Safety*.

The Evaluator conducted field interviews every year with new pilot investigators for 1) orientation to the Center and its resources, and 2) identification of individual needs and concerns. The structured interviews were recorded, transcribed, and analyzed. We shared findings with Center leaders, and we developed a responsive action plan. The Evaluator followed up with pilot investigators one to two months after implementation of the action plan to ensure their individual needs had been satisfactorily met. This work proved crucial to the success of our new pilot investigators, as evidenced by timely milestone completion and *PSM\_SROI* instrument scores for improved dissemination activities. A summative report of findings--*Pilot Investigator Interviews*-- was shared with Center leaders every year. As an additional measure, we administered the Attkisson *Client Satisfaction Questionnaire (CSQ)* in FY8 to all members. Our response rate was N = 22/26 (85%) and the overall score was 98%. Based on these combined

evaluation methodologies, the Center maintained an effective governance and leadership structure that was highly responsive and supportive to members.

Aim 2. The Center's online database was an important tool for monitoring the quality of our internal processes and activities. The database was the result of a collaboration between our Center evaluation team, leaders, and UNMC computer programmers. It contained individualized elements for our Center, and in FY8 we added additional metrics consistent with the NIOSH emphasis on contribution analysis. Every month, the Evaluator gathered process data from the database and reported at member meetings to keep members informed of activities tracking status and provide a forum for feedback on Center goals and milestones. The Evaluation Team also met quarterly with Center leaders to assure that our evaluation standards were appropriately working, flexible, and responsive.

In FY7, the Evaluation Team collaborated with a UNMC health economist, Dr. Fernando Wilson, and Center leaders to develop an innovative new instrument for quantitatively "grading" Center goal achievement; thereby, guiding programmatic quality improvements. The resulting instrument, *Project Scoring Matrix for Social Return on Investment (PSM\_SROI)* was implemented in FY7 - FY9. The instrument included eight highly valued outcome criteria as identified by Center leaders. These included publications, presentations, stakeholder networking, commercial product development, effective governance, timely projects progression, resource accessibility and utilization, and member satisfaction. Each criterion was assigned a weighting (4, 4.5, 5) based on comparative and perceived value. A concurrent rating scale was developed for each criterion based on what Center leaders identified as a standard excellence, where 3 = "high achievement" to -1 = "poor achievement". For example, a "high achievement" score for the publication criterion was defined as "100% of PIs had authored or coauthored at least one publication the past year", and a rating of -1 was "fewer than 25% of PIs authored or coauthored at least one publication the previous year." Each criterion had a score (weight x rating), and the composite score reflected the Center's overall percentage on goal achievement each year. To complete the instrument, the Evaluation Team compiled data for each criterion and from various sources (i.e., PubMed, SNA study, online database). The instrument helped us identify the Center's programmatic strengths and areas for targeted improvement.

The Center placed a high value on stakeholder networking to promote transfer of information and activities into Intermediate Outcomes. To achieve this, we conducted three social network analyses (SNA) studies (FY6, FY8, FY9) to better understand our connections with external stakeholders in terms of quality and quantity of connections, role diversity, and information exchange. We collaborated with faculty from UNMC and UNL who had content expertise in SNA. Our SNA findings revealed important networking strengths. For example, our Center leaders showed high density and centrality, indicating they had close connections with many external stakeholders—local, regional, national and international. We also found that our stakeholders looked to Center leaders for information and expertise in agricultural safety and health. We also identified important areas for improved networking. For example, most of our external connections were with stakeholders in academia and non-profit groups. The Center developed a plan to diversify our stakeholder connections to include such industries as agribusiness and technology. The Evaluation Team published findings in peer-reviewed journals. We also presented SNA findings and implications at four conferences.

Aim 3. An important aim of research is to translate knowledge into practice. This process requires evaluative research that explores target audience readiness to receive information and any barriers they encounter in adopting new practices. According to Schulte et al. (2017), evaluators should investigate the "real world health and safety interventions by focusing on the impact of translation efforts on workplace illnesses and injuries" (p. 1018). To this end, in 2013 the Evaluation Team began monitoring our End User (i.e., agricultural workers) barriers to safety and health measures in terms of their knowledge, attitudes and practices for reducing risks and improving health.

In 2020, the Evaluation Team repeated the study using the innovative instrument we developed, *The Healthy Farmer Survey*. Based on a power analysis, we worked with Farm Market ID to select a random and stratified sample of N = 1,000 farmers living in the seven-state region served by our Center. We collaborated with the Bureau of Sociological Research, University of Nebraska Lincoln to administer our 19-item survey, which covered knowledge, attitudes and practices for respiratory and hearing health. In January 2020 we sent the survey via mail, followed by telephone

reminders. Response rate was 509 (50.9%) as calculated using the American Association for Public Opinion Research's (AAPOR) standard definition for Response Rate 2. The survey findings were useful in directing community outreach activities and education to address knowledge deficits.

### **B.3. Competitive Revisions/Administrative Supplements**

None

### **B.4. What opportunities for training and professional development did the project provide?**

Dr. Beseler, the PI for the evaluation project as of 9/1/21, has worked with Dr. Estabrooks on principles of Implementation Science, has joined the Center for Implementation Research, and has given lectures on contribution analysis to CS-CASH team members.

### **B.5. How did you disseminate the results to communities of interest?**

Disseminating our evaluation findings was important to the success of our efforts. We published 12 articles in peer-reviewed journals during the past six years. We presented at nine regional or national conferences (prior to the Covid 19 pandemic). We authored annual summative evaluation reports, which reflected the extensive feedback and dialogue we had with Center members and leaders. Our summative reports included the *Governance and Leadership Evaluation*, the *Evaluation of Pilot Investigator Interviews*, and the *Comprehensive Annual Evaluation*. Final versions of these reports were disseminated to Center members and the EAB. We provided quarterly process evaluation reports at our Center's Member Meetings to keep everyone apprised of evaluation findings and to generate discussions on evaluation activities, methods, and Center progress as regarded milestones and goals. We also participated in community outreach activities.

Dr. Beseler collaborated on several NIOSH-related projects in collaboration with other NIOSH-funded agricultural centers. In 2021, an evaluation of the NIOSH Agricultural Centers' YouTube Channel was undertaken to assess its growth since its inception in 2013. Members of CS-CASH, GPCAH and UMASH worked collaboratively on the evaluation, which resulted in a manuscript. Extensive time series analysis of total number of views, total watch time, average duration of watch time, and number of subscribers was conducted to analyze the growth in the channel. These results were disseminated through publication to reach agricultural audiences.

Several additional projects aimed at addressing mental health in the agricultural population were undertaken with NIOSH leadership so that information on farmer mental health could be disseminated to a wider audience. The first was a report on research and evaluation of mental health activities across the NIOSH-funded agricultural centers for the Farm and Ranch Stress Assistance Network (FRSAN). This report was a synopsis of research and evaluation work being done by each of the centers and how the work was evaluated. The second project was a Wikipedia page on mental health in agriculture. With contributions from many agricultural centers, a final draft was produced and was released as a Wikipedia page for a general audience.

### **B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

The next reporting period will report on the initial months of the first year of the new grant funding cycle. Activities will align with the new specific aims in the evaluation core.

## **C. Products**

### **C.1. Publications, conference papers, and presentations**

Publications:

1. Cramer ME, Habecker P, Wendl M, Sayles H, Rautiainen R, Dombrowski K. Social Network Analysis of an Agricultural Center: Stakeholders and the Transfer of Information. *J Agromedicine*. 2021 Jan 18;:1-12. doi: 10.1080/1059924X.2020.1850383. [Epub ahead of print] PubMed PMID: 33461423.
2. Almeida, F., Cramer, M., Wendl, M. Rautiainen, R. Innovation Diffusion in an Agricultural Center: Moving Information to Practice. *J Agromedicine*. 2019 Jul;24(3):239-247. doi: 10.1080/1059924X.2019.1592046.
3. Pounds, L.C., Duysen, E., Cramer, M.E., Wendl, M., Rautiainen, R. and Romberger D.J. (2018). Social Marketing Campaign Promoting the Use of Respiratory Protection Devices among Farmers. In L. Racz, & D. Yamamoto &

R. Eninger (Eds), In Handbook of Respiratory Protection: Safeguarding Against Current and Emerging Hazards (pp.193-208).Boca Raton, FL, CRC Press, Taylor & Francis Group

4. Wendl, M. J., & Cramer, M. E. (2017). Evaluating Effective Leadership and Governance in a Midwestern Agricultural Safety and Health Coalition. *Workplace Health & Safety*, <https://doi.org/10.1177/2165079917729172>
5. Burgus, S., Duysen, E., Wendl, M. (2017) What influences farmers to use farm safety and health information? *Journal of Extension* Volume 55 Number 1 Article # 1RIB5
6. Cramer, M., Araz, O., Wendl, M. (2017) Social Networking in an Agricultural Research Center: Using Data to Enhance Outcomes. *J Agromedicine*. 22(2), 170-179 doi: 10.1080/1059924X.2017.1282905.
7. Cramer, M., Wendl, M., Sayles, H., Achutan, C., Duysen, E. (2016) Tracking knowledge, attitudes, and practices on respiratory and hearing health among the Midwestern agricultural population. *Public Health Nursing*. Nov, DOI: 10.1111/phn.12306
8. Cramer, M. E., Habecker, P., Wendl, M., Sayles, H., Rautiainen, R., Dombrowski, K. Social Network Analysis of an Agricultural Center: Stakeholders and the Transfer of Information. *J Agromedicine*. 2021 Jan 18;;1-12. doi: 10.1080/1059924X.2020.1850383. [Epub ahead of print] PubMed PMID: 33461423
9. Almeida, F., Cramer, M., Wendl, M. Rautiainen, R. Innovation Diffusion in an Agricultural Center: Moving Information to Practice. *J Agromedicine*. 2019 Jul;24(3):239-247. doi: 10.1080/1059924X.2019.1592046.
10. Cramer, M., Araz, O., Wendl, M. (2017) Social Networking in an Agricultural Research Center: Using Data to Enhance Outcomes. *J Agromedicine*. 22(2), 170-179 doi: 10.1080/1059924X.2017.1282905
11. Cramer, M.E., Wendl, M.J., Sayles, H., Duysen, E., Achutan, C. Knowledge, Attitudes, and Practices for Respiratory and Hearing Health among Midwestern Farmers. *Public Health Nursing (Boston, Mass.) [Public Health Nurs]*, ISSN: 1525-1446, 2017 Jul; Vol. 34 (4), pp. 348-358; Publisher: Blackwell Scientific Publications; PMID: 27859524
12. Beseler, C. L., Crawford, K., Cherlagne, D., Ramos, A. The NIOSH Agricultural Centers' YouTube Channel: Time series modeling of trends, patterns and associations between viewership and agricultural health and safety videos. *Journal of Agromedicine*. 27(4):368-377. doi: 10.1080/1059924X.2021.2000907

### C.2. Website(s) or other Internet site(s) – include URL(s)

Evaluation program information, including the CS-CASH Project PI Activity Database is housed on the CS-CASH website: <https://www.unmc.edu/publichealth/cscash/ourteam/evaluation-team.html>

### C.3. Technologies or techniques

NA

### C.4. Inventions, patent applications, and/or licenses

NA

### C.5. Other products and resource sharing

NA

## D. PARTICIPANTS

### D.1. What individuals have worked on the project? Please include calendar, academic, and summer months.

| Commons ID     | S/K | Name           | Degrees(s) | Role         | Cal | Aca | Sum | Foreign | Country | SS |
|----------------|-----|----------------|------------|--------------|-----|-----|-----|---------|---------|----|
| BESELER.CHERYL |     | Cheryl Beseler | PhD        | PI/FY10-FY11 | 7.2 |     |     |         |         |    |

**D.2 Personnel updates**

**a. Level of Effort:** NA

**b. New Senior/Key Personnel:** Yes, personnel change occurred. Mary Cramer and Mary Wendl retired and are no longer on the project. Cheryl Beseler is the current evaluator.

**c. Changes in Other Support:** NA

**d. New Other Significant Contributors:** NA

**E. IMPACT**

**E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES**

**F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**

No changes

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**

No challenges or delays

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**

No

**G. Special Reporting Requirements**

**G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements**

NA

**G.2 Responsible Conduct of Research**

NA

**G.3 Mentor's Research Report or Sponsor Comments**

NA

**G.4 Human Subjects**

G.4.a Does the project involve human subjects? No

G.4.b Inclusion Enrollment Data NA

|  |
|--|
| <p>G.4.c ClinicalTrials.gov NA</p> <p>Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA? No</p>   |
| <p><b>G.5 Human Subject Education Requirement</b></p> <p>Are there personnel on this project who are newly involved in the design or conduct of human subject's research? No</p>   |
| <p><b>G.6 Human Embryonic Stem Cells (HESCS)</b></p> <p>Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)? No</p>   |
| <p><b>G.7 Vertebrate Animals</b></p> <p>Does this project involve vertebrate animals? No</p>   |
| <p><b>G.8 Project/Performance Sites</b></p> <p>University of Nebraska Medical Center, Omaha, NE</p>  |
| <p><b>G.9 Foreign Component</b></p> <p>No</p>  |
| <p><b>G.10 Estimated Unobligated Balance</b></p> <p>See financial report.</p> <p>G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?</p> <p>No</p> |
| <p><b>G.11 Program Income</b></p> <p>Is program income anticipated during the next budget period? No</p>   |
| <p><b>G.12 F&amp;A Costs</b></p> <p>Is there a change in performance sites that will affect F&amp;A costs? No</p>  |

## I. OUTCOMES

|  |
|--|
| <p>I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets</p> <p>Note: project outcome information will be made public in NIH RePORTER</p> <p>The goal of the Central States for Agricultural Safety and Health (CS-CASH) Evaluation Program is to provide evaluation of research projects, community outreach, and cross-disciplinary efforts, including fiscal and resource management, maintenance of records, and compilation of Center reports. Center performance is measured by rigorous use of evaluation frameworks and contribution analysis. The Center responds to a changing agricultural environment by monitoring injury and fatality data, designing appropriate risk-reduction communications, and grant funding to address emerging needs.</p> |
|--|

## A. COVER PAGE

|  |   |
|--|---|
| <b>Project Title:</b><br>Pilot Project Program   |   |
| <b>Grant Number:</b><br>1U54OH010162   | <b>Project/Grant Period:</b><br>September 01, 2016 – August 31, 2022  |
| <b>Reporting Period:</b><br>September 01, 2016- August 31, 2022  | <b>Date Submitted:</b><br>December 22, 2022   |
| <b>Program Director/ Principal Investigator</b><br>Risto Rautiainen, Program Director<br>Eleanor Rogan, Principal Investigator | <b>Administrative Official Information</b><br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| <b>Change of Contact PD/PI:</b><br>NA  |   |
| <b>Human Subjects:</b><br>No   | <b>Vertebrate Animals:</b><br>No  |
| <b>hESC:</b>   | <b>Inventions/Patents:</b><br>None  |

**B. ACCOMPLISHMENTS****B.1. What are the major goals of the project?**

The Pilot and Feasibility Program has been an essential component of the Central States Center for Agricultural Safety and Health (CS-CASH) since the Center was established in 2011. This program supports projects with funding up to \$20,000 over 18 months. The program goal is to enable investigators to collect preliminary data to support the submission of grant applications for independent, longer-term, larger projects related to agricultural safety and health. The central hypothesis of this program is that pilot and feasibility projects funded from this Center will result in subsequent grant submissions to NIOSH (National Institute for Occupational Safety and Health) or other funding agencies to advance agricultural health and safety research. The projects selected for support by this program must address a critical issue in agricultural safety and health and lead to future extensive studies of the selected critical issue.

**B.2. What did you accomplish under these goals?**

In addition to NIOSH AFF (Agriculture, Forestry and Fishing) funding (\$660,000), generous funding from the University of Nebraska Medical Center's Vice Chancellor for Research (\$500,000), the University of Nebraska Lincoln (UNL) College of Agricultural Engineering (\$20,000), and the UNL Institute of Agriculture and Natural Resources (\$20,000) has allowed CS-CASH to fund 65 pilot projects over 11 years. Additional funding received by Pilot Program investigators due to data generated through their pilot research amounts to \$19,390,183 (Table 1).

Table 1. CS-CASH Pilot and Feasibility Project Report.

| Grant Year   | # of Pilot Projects | Peer Reviewed Articles | Presentations Oral / Poster | **Non-Peer Reviewed Articles | ***Other Products | Initial Funding    | ****Additional Funding |
|--------------|---------------------|------------------------|-----------------------------|------------------------------|-------------------|--------------------|------------------------|
| Y1           | 5                   | 0                      | 20                          | 2                            | 8                 | \$95,000           | \$1,319,581            |
| Y2           | 7                   | 1                      | 25                          | 15                           | 3                 | \$100,000          | \$1,275,712            |
| Y3           | 5                   | 1                      | 3                           | 4                            | 1                 | \$60,780           | \$15,000               |
| Y4           | 4                   | 9                      | 25                          | 15                           | 7                 | \$100,000          | \$3,135,208            |
| Y5           | 5                   | 4                      | 5                           | 7                            | 5                 | \$100,000          | \$1,270,000            |
| <b>Y6</b>    | <b>7</b>            | <b>6</b>               | <b>12</b>                   | <b>2</b>                     | <b>8</b>          | <b>\$140,000</b>   | <b>\$1,853,484</b>     |
| <b>Y7</b>    | <b>7</b>            | <b>5</b>               | <b>4</b>                    | <b>7</b>                     | <b>2</b>          | <b>\$140,000</b>   | <b>\$120,000</b>       |
| <b>Y8</b>    | <b>5</b>            | <b>7</b>               | <b>13</b>                   | <b>3</b>                     | <b>22</b>         | <b>\$100,000</b>   | <b>0</b>               |
| <b>Y9</b>    | <b>7</b>            | <b>6</b>               | <b>8</b>                    | <b>0</b>                     | <b>24</b>         | <b>\$138,742</b>   | <b>\$3,149,499</b>     |
| <b>Y10</b>   | <b>8</b>            | <b>5</b>               | <b>9</b>                    | <b>12</b>                    | <b>6</b>          | <b>\$140,000</b>   | <b>\$7,251,699</b>     |
| <b>Y11</b>   | <b>5</b>            | <b>NA</b>              | <b>NA</b>                   | <b>NA</b>                    | <b>NA</b>         | <b>\$100,000</b>   | <b>NA</b>              |
| <b>TOTAL</b> | <b>65</b>           | <b>44</b>              | <b>124</b>                  | <b>67</b>                    | <b>86</b>         | <b>\$1,214,522</b> | <b>\$19,390,183</b>    |

\*Education / Training includes course/curriculum, material distribution, mtg./conference, training/demonstration, workshop

\*\*Non-Peer Reviewed Articles include reports, booklet/brochure, factsheet, interview (media/other), newsletter, multimedia, websites

\*\*\*Other Products include reports, focus group, evaluation instrument/tool, questionnaire/survey/checklist, site visit, farm safety audit, consultations, testing and screenings

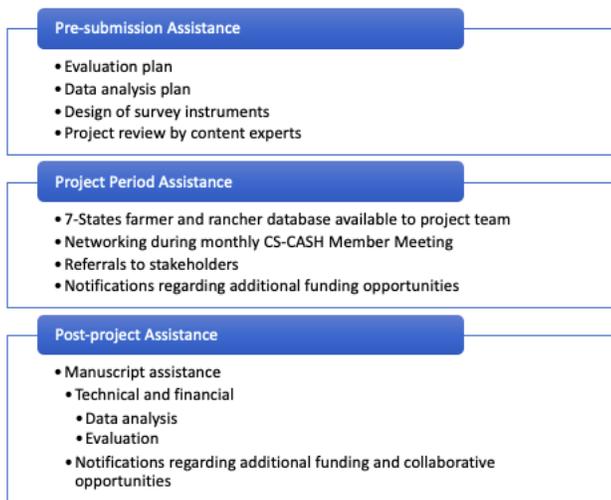
\*\*\*\*Additional Funding includes all grant years including indirect costs.

Return on Investment. A return on investment of 1,597% is calculated from subsequent agricultural safety and health funding received by Pilot/Feasibility Program recipients.

Evaluation of Pilot and Feasibility Projects. In addition to evaluation plans built into individual project proposals, the CS-CASH evaluation team also assesses each project's progress, outcomes, and outputs. Evaluations are shared with the grantees and Dr. Eleanor Rogan, Pilot Program investigator.

Resource Sharing. CS-CASH provides a range of no-cost resources to investigators from the inception of their project to completion. See Figure 1. Resources include expert analytical assistance from Dr. Cheryl Beseler and the UNMC (University of Nebraska Medical Center) Center for Collaboration on Research Design and Analysis (CCORDA) and content expertise provided by CS-CASH researchers and administration. Grant recipients are invited to attend and present at the monthly CS-CASH member meetings and are forwarded all information about grant opportunities, webinars, conferences, and other information that could assist the investigators with their research.

**Figure 1. Available Assistance to Pilot Investigators.**



Funded Regions. Since 2011 CS-CASH has funded 65 Pilot Projects in all 7 of the States served by the Center and several National projects. Recipients include community organizations, health departments, post-doctoral students, scientific researchers, and ag safety and health organizations.

COVID-19 Extensions and Modifications. In 2020 and 2021, CS-CASH worked with each funded investigator to determine whether their project could be safely completed during the COVID-19 pandemic. Project extensions were provided in some cases, and in two cases, modifications to the original aims were allowed.

Impact. Pilot Project data have been used to generate more significant awards totaling \$19,390,183, including \$12,374,682 in the 2015-2021 funding cycle.

**Publications:** There have been 44 publications resulting from funded Pilot research. Pilot researchers have developed 67 non-peer reviewed articles and have presented their research data in oral and poster form 124 times.

### **Project Synopsis 2016-2022**

**Human lung 3D organoids as model of damage and repair of lungs in agricultural airborne biohazards. Rohit Gaurav, MSc, PhD, FAAAAI**

This project used 3D organoid culture from primary human lung cells to investigate the phenotypic and functional changes in structural cells when exposed to Toll Like Receptor agonists from agricultural dust. These data have been used for a successful NIH (National Institutes of Health) (National Institutes of Health) grant application.

**Redesigning National Agricultural Safety Database. Serap Gorucu, PhD**

This project engaged an expert panel in redesigning a long-term plan for the National Agricultural Safety Database. The panel assisted in creating a nationwide survey that has led to achievable site improvements, a long-term plan for addressing site content recommendations from the site evaluations, and the development of a plan for promoting NASD (National Ag Safety Database) and NIOSH safety and health efforts.

**Ag-Operator Monitoring Systems (Ag-OMS) for Safety and Health Risk Detection and Assessment. Santosh K. Pitla, PhD**

This project developed camera systems and instrumentation and used existing tractor technologies to monitor the activities of operators, thereby identifying high-risk behaviors. Artificial Intelligence machine learning techniques were used to analyze tractor data, images, and video feeds to develop a library of behaviors associated with safety and risk while operating agricultural machinery.

**Agricultural Safety and Health Curriculum: Preparing the next generation of rural nurses.****Sue Schuelke PhD, Michelle Ellermeier**

This project demonstrated the impact on the practice, attitude, and behaviors of the nursing students following the inclusion of the agricultural health and safety curriculum into the University of Nebraska College of Nursing program.

**Investigating Opioid and Alcohol Risk and Misuse Among Rural Agricultural Workers.****Christine Chasek, PhD**

This project investigated the feasibility of screening agricultural workers for substance use by administering SBIRT screenings in agricultural work environments and settings rather than a clinic-based setting and determined the risk level of opioid and alcohol misuse among agricultural workers.

**Teledermatology and Increasing Access to Care in Agricultural Populations.****Dillon Clarey, MD and Jennifer Adams, MD**

This project determined the need and acceptance of teledermatology services for agricultural workers in rural regions where dermatologic care is limited or absent. The project provided educational training at health care sites to recognize, diagnose, and treat common skin conditions in this population.

**Modeling Improved Access to Health Screening of Agricultural Populations Through Deployment of a Mobile Clinic and Networking with a Rural Health Care Network. Kelley Donham, DVM, PhD**

In a collaboration between the non-profit Rural Health and Safety of Eastern Iowa (RHSEI) and a regional health care network, this project developed a model for improved access to primary health screening of rural and farm residents through the deployment of a fully equipped mobile health screening and educational facility. Health care provider staff were trained in agricultural medicine to serve rural and agricultural populations better.

**Building A Youth Mental Health Toolkit: Developing crucial resources to support children living and working in agricultural communities. Jana Davidson**

This project brought together a national panel of mental health experts to develop a model curriculum that laypeople will use to discuss mental health and stress with youth working in agriculture.

**Parkinson's Care for Nebraskans in Agriculture. Bethany Lowndes, PhD**

This project evaluated Parkinson's disease signs and disease prevalence in the agricultural community; identified user requirements for rehabilitation engineering and adaptive technology to enable individuals with Parkinson's disease to complete agricultural tasks safely and explored the feasibility of novel modes of early Parkinson's disease deterioration monitoring in the agricultural community.

**Improving Agricultural Worker Health and Safety Awareness through Multimodal, Case-Based Physician Assistant Education. Carey Wheelhouse**

This project developed a curriculum and an educational model for increasing Physician Assistant (PA) student awareness and knowledge of agricultural health and safety issues; and enhancing communication skills regarding occupational risks and hazards with agricultural patients.

**Summary of Seven Central-State Region Injuries and Fatalities Involving Livestock Manure Storage, Handling and Transport Operations: 1975-2019. Mahmoud Nour, PhD**

This project classified, analyzed, and summarized all available injury and fatality cases involving livestock manure storage, handling, and transport facilities and equipment in the CS-CASH 7 states region from 1975-2019 and developed evidence-based prevention strategies to reduce the frequency and severity of these incidents.

**Gathering Local Data and Building Ag Partnerships to Better Reach Ag Families. Chris Blanke**

This project developed and disseminated a model for use by rural public health departments to obtain data on the health and well-being of workers at agricultural businesses and a protocol for directly engaging agribusiness on the topics of stress, substance use, suicide prevention, care for employees after a suicide death, and creating a mental health-friendly workplace.

**Agricultural and Occupational Exposures in U.S. Veterans with Rheumatoid Arthritis and Associations with Disease Severity. Bryant England, MD**

This project characterized the associations between agricultural exposures with rheumatoid arthritis autoantibody and inflammatory cytokine expression in RA (Rheumatoid Arthritis) patients, stratifying by genetic background. Data were used in the successful application for Veterans Administration research funding.

**ATV Aware. Susan Harris Broomfield**

This project gathered data from FFA participants regarding their behaviors while operating or riding ATVs. Pre-and post-surveys (immediate and 6-month) measured impact following an interactive session about proper behaviors and laws. Findings were used in the creation of a curriculum guide for FFA and ATV instructors.

**Creating Enduring Resources for Farm Safety Education. Jana Davidson**

Safety and health professionals were recruited to create unique and effective props for farm safety and health education. Videos (n=25) demonstrate the assembly of the props from start to finish and with designs that meet the needs of individuals with all learning types, including visual, auditory, and kinesthetic. These videos are available on the Progressive Ag Foundation website and the USAg Center YouTube Channel.

**Investigation into the respiratory properties of snow molds. Missy Berry**

This project tested the hypothesis that snow mold-associated species would incite pathogenic pulmonary responses in agricultural workers and those seasonal changes contribute to the immunogenic properties of the fungal species. A manuscript is in production.

**Injury Prevention in Greenhouse and Nursery Workers through Engineering Design Innovation. Katherine Schofield, PhD**

This project ascertained injury rates in a nursery/greenhouse worker population using regional workers' compensation (WC) injury claims and payroll data (2000-2017); evaluated comparative risk factors for injury and severity based on worker, job, and injury event characteristics, including text narratives; determined areas of high injury prevention priority and engineering design feasibility; and innovated and tested the efficacy of an engineering intervention to prevent a high priority nursery industry injury.

**Evaluation of Medication-Related Agricultural Injury among Missouri Farmers.****Kelly Cochran, PharmD**

This project determined the extent to which farm-related injuries resulting from hospital admission or emergency department visits were associated with drug-related problems in the farmers' home medication regimen and characterized and measured the frequency of drug-related problems. This work has led to additional work by Dr. Cochran on the agricultural injuries related to worker medication.

**Blue Ribbon Outreach. Julie Rother, PhD**

This project developed a public health department model for using information technology methods to communicate health, safety, and disaster preparedness information to agricultural workers in rural regions. This model has been presented and adopted in by several rural health departments.

**Identifying the sources of stress and prevalence of anxiety and depression symptoms among young farmers and ranchers in the upper and western Midwest. Josie Rudolph, PhD**

This project identified sources of stress among young farmers and ranchers in the upper and western Midwest; estimated the prevalence of symptoms of self-reported anxiety and depression among young farmers and ranchers in the upper and western Midwest and evaluated the association between work stress and anxiety and depression among young farmers and ranchers in the upper and western Midwest. These data were used to write a successfully funded USDA (United States Department of Agriculture) mental health grant and will be used as part of the CS-CASH 2022 Competitive Renewal grant process.

**Development of ion channel blockers for influenza D virus. Hideaki Moriyama, PhD**

This project developed mathematical models for the influenza type D M2 protein behavior based on experimental results. Results demonstrated the initial process of virus uncoating to release the RNA genome into the cell, modeling the opening and closing of the ion channel using a biophysical model, the Boltzmann equation. This project was instrumental in creating background data for federal-level funding applications. Two peer-reviewed manuscripts have been published.

**MAPPER Immersion: Developing an Augmented Reality prototype to Protect Lives and Increase Emergency Responder Effectiveness. Bryan Weichelt, PhD**

Farm Mapping to Assist Protect and Prepare Emergency Responders (Farm MAPPER) is an interactive, device-agnostic, web-based prototype developed to provide emergency responders with up-to-date information about hazards, resources, and the physical environments of agricultural operations. This pilot project developed an augmented reality version of Farm MAPPER, available on iOS and Android platforms. The application is now part of a 5-year NIOSH-funded study through the UMASH (Upper Midwest Agricultural Safety and Health) NIOSH Ag Center.

**Farmer Evaluation of Agricultural Fatality Messaging: Best Practices for Disseminating Prevention Messages Based on FACE Cases. Stephanie Leonard, MS CIH**

Using farmer-led evaluations of existing FACE format fatality investigation reports, hazard alerts, and media articles, this project developed new ag safety and health messaging; and enhanced knowledge about developing and targeting injury prevention messages.

**Development of a mobile application for agricultural safety, AgHealth. Joseph Siu, PhD**

This project developed and validated the "AgHealth" mobile application. The AgHealth app contains two critical components – balance assessment and education for farm safety. The AgHealth links to important agricultural safety messages from the National Institute for Occupational Safety and Health (NIOSH) and CS-CASH and provides essential information about maintaining a good balance and preventing falls while working in agriculture. The mobile app is currently being evaluated by farmers and their healthcare providers.

**Modeling the role of weather patterns and grain quality in predicting on-farm engulfments and entrapments. Dr. Gretchen Mosher, PhD**

This ongoing project is exploring a new direction for predicting on-farm grain engulfments and entrapments and developing the basis for an alternative approach to an existing intervention strategy.

**Gasoline Safety on the Farm - Developing a strategy to reduce the frequency and severity of gasoline-related explosions, fires, and burns involving the agricultural community. Jane Allsup**

This project is developing an evidence-based strategic plan designed to reduce the frequency and severity of gasoline-related explosions, fires, and burns on farms, and to create educational materials around this topic.

**Sleep in Ag: Investing in the feasibility of measuring sleep quantity and quality in agricultural workers. Susan Harris**

This ongoing project is collecting data to determine the need, value, and efficacy of potential educational interventions to improve sleep quantity and quality in agricultural workers to reduce the risk of accident and injury. This unique project will fill a critical research gap in knowledge of sleep patterns in ag populations.

**Investigation of contaminants in the drinking water of agricultural workers in rural Nebraska.**

**Balkissa Ouattara, M.D., MPH**

This ongoing project will fill spatial and temporal gaps in available ag worker drinking water quality data by monitoring surface and groundwater quality within rural areas with a high incidence of water contamination.

**Healthy Hearing, Healthy Aging in Agriculture. Jan Moore, PhD**

This ongoing project is documenting patterns of cognitive status in aging agricultural workers to determine the relationship between cognitive status, hearing status (degree of hearing loss), and age in agricultural workers.

**2021 Funded Projects**

- Exposure to Zoonotic Diseases in Agricultural Workers of the Great Plains: An evaluation of real and perceived risk and mitigation behaviors in rural agricultural workers of the Great Plains. Mystra Samuelson, PhD
- The Classroom Component: A hands-on experience of agricultural safety and health education aimed at rural youth. Jana Davidson
- The Ability of Adult Female Operators to Reach Agricultural All-Terrain Vehicles Controls. Farzaneh Khorsandi, PhD
- Evidence-Based Training for Employees Exposed to Hazards Associated with the Storage, Handling, Transport, and Processing of Agricultural Wastes. Mahmoud Nour, PhD
- Development of CRC Screening Education Material for Agricultural Workers. Shinobu Watanabe-Galloway, PhD

**B.3. Competitive Revisions/Administrative Supplements**

None

**B.4. What opportunities for training and professional development did the project provide?**

Individual PIs on each of the 39 grants funded may have received or provided training and professional development as part of their project. All PIs were considered "CS-CASH Members." PIs and staff were invited to the monthly CS-CASH Member meeting, provided opportunities to attend Center webinars and were emailed opportunities for professional training through classes, seminars, and conferences. Each PI had the opportunity to work with the CS-CASH evaluator (Cheryl Beseler) and CS-CASH biostatistician (Gleb Haynatzki). After completion of the pilot, CS-CASH personnel worked with the PI on data analysis and manuscript submissions.

**B.5. How did you disseminate the results to communities of interest?**

Many of the PIs published their results in peer-reviewed Journals (see below), in trade journals or in rural media sources. CS-CASH sent out press releases related to the grantees and their projects, assisted with manuscript writing and submission and posted information regarding each project on the CS-CASH website.

**B.6 - What do you plan to do during the next reporting period to accomplish the goals? NA as this is the final report.**

### C. Products

#### C.1. Publications

1. Arens JL, Early CA. (2019). A brief report describing cancer outreach events in the rural midwest. *Journal of Agromedicine*. 24(3):224-227. doi: 10.1080/1059924X.2019.1590271. PubMed PMID: 30894087.
2. Bailey KL, Smith L, Heires AJ, Romberger DJ, LeVan TD. (2016). Aging induces a hyperinflammatory response to organic dust stimulation of peripheral leukocytes. In B24. *Occupational Medicine* (pp. A2993-A2993). American Thoracic Society.
3. Bailey K, Wyatt T, Wells S, Klein E, Robinson J, Romberger D, Poole J. (2014). Dimethylarginine dimethylaminohydrolase (DDAH) overexpression attenuates agricultural organic dust extract-induced inflammation. *Journal of Environmental and Immunological Toxicology*. 2(2):72-78. doi: 10.7178/jeit.15. PubMed PMID: 25221746; PubMed Central PMCID: PMC4159103.
4. Dusad A, Thiele GM, Klassen L, Wang D, Duryee MJ, Mikuls TR, Staab E, West WW, Wyatt TA, Reynolds SJ, Romberger DJ, Poole JA. (2015). Vitamin D supplementation protects against bone loss following inhalant organic dust and lipopolysaccharide exposures in mice. *Immunological Research*. 62(1):46-59. doi: 10.1007/s12026-015-8634-4
5. Ebel AV, Lutt G, Poole JA, Thiele GM, Baker JF, Cannon GW, Gaffo A, Kerr GS, Reimold A, Schwab P, Singh N, Richards JS, Ascherman DP, Mikuls TR, England BR. (2021). Association of Agricultural, Occupational, and Military Inhalants with Autoantibodies and Disease Features in US veterans with rheumatoid arthritis. *Arthritis Rheumatology*. 73(3):392-400. Doi: 10.1002/art.41559
6. England BR, Sayles H, Michaud K, Thiele GM, Poole JA, Caplan L, Sauer BC, Cannon GW, Reimold A, Kerr GS, Baker JF, Mikuls TR. (2018). Chronic lung disease in U.S. Veterans with rheumatoid arthritis and the impact on survival. *Clinical Rheumatology*. 37(11):2907-2915. doi: 10.1007/s10067-018-4314-9. PubMed PMID: 30280369; PubMed Central PMCID: PMC6442481.
7. Gaurav R, Mikuls TR, Thiele GM, Nelson AJ, Niu M, Guda C, Eudy JD, Barry AE, Wyatt TA, Romberger DJ, Duryee MJ, England BR, Poole JA. (2021). High-throughput analysis of lung immune cells in a combined murine model of agricultural dust-triggered airway inflammation with rheumatoid arthritis. *PLoS One*. 16(2):e0240707. doi: 10.1371/journal.pone.0240707.
8. Gaurav R, Poole, JA. (2021). Harness the antiinflammatory power of MyD88 to reduce allergic fungal inflammation? *American Journal of Respiratory and Cell Molecular Biology*. 64(1):1-3. doi: 10.1165/rcmb.2020-0442ED.
9. Golden GA, Wyatt TA, Romberger DJ, Reiff D, McCaskill M, Bauer C, Gleason AM, Poole JA. (2013). Vitamin D treatment modulates organic dust-induced cellular and airway inflammatory consequences. *Journal of Biochemistry and Molecular Toxicology*. 27(1):77-86. doi: 10.1002/jbt.21467. PubMed PMID: 23281135; PubMed Central PMCID: PMC4004104.
10. Gorucu S, Fetzer L. (2021). Agricultural safety and health learning methods for agricultural workforces. *Journal of Agricultural Safety and Health*. 27(2):77-85. doi: 10.13031/jash.14355
11. Johansson P, Schober D, Tutsch SF, Brueggeman G, Leon M, Lyden E, Schulz PS, Estabrooks P, Zimmerman L.

- (2019). Adapting an evidence-based cardiovascular disease risk reduction intervention to rural communities. *Journal of Rural Health*. 35(1):87-96. doi: 10.1111/jrh.12306 PMID: 29888458
12. Kesinger E, Liu J, Jensen A, Chia CP, Demers A, Moriyama H. (2018) Influenza D virus M2 protein exhibits ion channel activity in *Xenopus laevis* oocytes. *PLoS One*. 13(6):e0199227. doi: 10.1371/journal.pone.0199227
  13. Kilanowski JF. (2020). Agricultural safety comic book for Latinx migrant families: Development and evaluation. *Journal of Pediatric Health Care*. 34(3):230-238. doi: 10.1016/j.pedhc.2019.11.003. PubMed PMID: 31983514.
  14. LeVan TD, Smith LM, Heires AJ, Mikuls TR, Meza JL, Weissenburger-Moser LA, Romberger DJ. (2017). Interaction of CD14 haplotypes and soluble CD14 on pulmonary function in agricultural workers. *Respiratory Research*. 18(1):49. doi: 10.1186/s12931-017-0532-y
  15. LeVan TD, Romberger DJ, Siahpush M, Grimm BL, Ramos AK, Johansson PL, Michaud TL, Heires AJ, Wyatt TA, Poole JA. (2018). Relationship of systemic IL-10 levels with proinflammatory cytokine responsiveness and lung function in agriculture workers. *Respiratory Research*. 19(1):166. doi.org/10.1186/s12931-018-0875-z
  16. Murphy D, Gorucu S, Weichelt B, Scott E, Purschwitz M. (2019). Using multiple coding schemes for classification and coding of agricultural injury. *American Journal of Industrial Medicine*. 62(2):87-98. doi: 10.1002/ajim.22932. PubMed PMID: 30561026.
  17. Nour MM, Cheng Y-H, Ni J-Q, Sheldon E, Field WE. (2021). Summary of injuries and fatalities involving livestock manure storage, handling, and transport operations in seven central states: 1976-2019. *Journal of Agricultural Safety and Health*. 27(2):105-122. doi.org/10.13031/jash.14343
  18. Nour MM, Field WE, Ni JQ, Cheng YH. (2021). Farm-related injuries and fatalities involving children, youth, and young workers during manure storage, handling, and transport..*Journal of Agromedicine*. 26(3):323-333. doi: 10.1080/1059924X.2020.1795034. PMID: 32716249
  19. Nour MM, Field WE, Ni JQ, Cheng C.J. (2019). Development of methodology to document and code farm-related injuries and fatalities involving manure storage, handling, and transport - with summary of 2017 incidents. *Journal of Agromedicine*. 24(1):90-100. doi: 10.1080/1059924X.2018.1539420. PMID: 30409078
  20. Poole JA, Nordgren TM, Heires AJ, Nelson AJ, Katafiasz DM, Bailey KL, Romberger D. (2020). Amphiregulin modulates murine lung recovery and fibroblast function following exposure to agriculture organic dust. *American Journal of Physiology: Lung Cellular and Molecular Physiology*. 318(1):L180-L191. doi: 10.1152/ajplung.00039.2019
  21. Poole JA, Mikuls TR, Duryee MJ, Warren KJ, Wyatt TA, Nelson AJ, Romberger DJ, West WW, Thiele GM. (2017). A role for B cells in organic dust induced lung inflammation. *Respiratory Research*. 18(1):214. doi: 10.1186/s12931-017-0703-x
  22. Poole JA, Nelson A, Warren KJ, Romberger D, Duryee M, et al. (2017). Sex differences impact the lung-bone inflammatory response to repetitive inhalant lipopolysaccharide exposures in mice. *Journal of Allergy and Clinical Immunology*. (Suppl. S) 139(2): AB188.
  23. Ramaswamy SK, Mosher GA. (2016). Approaching safety through quality: Factors influencing college student perceptions. *Journal of Agricultural Safety & Health*. 22(2):149-60. doi: 10.13031/jash.22.11426. PubMed PMID: 27373063.

24. Ramaswamy SK, Mosher GA. (2015). Perceptions of agricultural college students on the relationship between quality and safety in agricultural work environments. *Journal of Agricultural Safety & Health*. 21(1):47-64. doi: 10.13031/jash.21.10804. PubMed PMID: 26211353.
25. Ramos AK, Carlo G, Grant KM, Trinidad N, Correa A. (2016). Stress, depression, and occupational injury among migrant farmworkers in Nebraska. *Safety*, 2(4), 23. DOI:10.3390/safety2040023
26. Ramos A, Fuentes A, Trinidad N. (2016). Perception of occupational risks, personal protective equipment (PPE) use, and prevention opportunities among Latino Immigrant hog CAFO workers in Missouri. *Safety*. 2(4):25. doi.org/10.3390/safety2040025.
27. Ramos AK, Su D, Lander L, Rivera R. (2015). Stress factors contributing to depression among Latino migrant farmworkers in Nebraska. *Journal of Immigrant and Minority Health*. 17(6):1627-1634.
28. Rudolphi JM, Berg RL, Parsaik A. (2019). Depression, anxiety and stress among young farmers and ranchers: A pilot study community. *Community Mental Health Journal*. 56(1):126-134. doi: 10.1007/s10597-019-00480-y <https://doi.org/10.1007/s10597-019-00480-y>
29. Schulz PS, Zimmerman L, Johansson P. (2018). Seasonal work and cardiovascular risk factors in farmers. *Journal of Cardiovascular Nursing*. 33(4):E35-E39. doi: 10.1097/JCN.0000000000000490
30. Sedlacek D, Beacom M, Bista S, Rautiainen R, Siu K-C. (2021). Comparing objective and subjective measures of sleep loss with balance performance in farmers. *Journal of Agricultural Safety and Health*. 27(2):69-76. doi.org/10.13031/jash.14217
31. Siu KC, Huang CK, Beacom M, Bista S, Rautiainen R. (2015). The association of sleep loss and balance stability in farmers. *Journal of Agromedicine*. 20(3):327-31. doi: 10.1080/1059924X.2015.1042615.
32. Siu K, Wickwire C, Beacom M, Bista S, Rautiainen R, Tonozzi T. (2014). Quantifying the association of sleeping hours and balance biomarkers in farmers. *Journal of Agromedicine*. 19(2):241-242. doi: 10.1080/1059924X.2014.892857.
33. Wan Y, Kang G, Sreenivasan C, Daharsh L, Zhang J, Fan W, Wang D, Moriyama H, Li F, Li QA. (2018). DNA vaccine expressing consensus hemagglutinin-esterase fusion protein protected guinea pigs from infection by two lineages of influenza D virus. *Journal of Virology*. 92:e00110-18. DOI: 10.1128/JVI.00110-18
34. Warren K, Nelson A, Wyatt T, Romberger D, Poole J, Poole JA, et al. (2019). Co-exposure with organic dust in OVA-allergic asthma model alters airway inflammation; Combined Collagen-Induced Arthritis and Organic Dust-Induced Airway Inflammation to Model Inflammatory Lung Disease in Rheumatoid Arthritis. *Journal of Bone and Mineral Research*. 34(9):1733-43.
35. Warren KJ, Poole JA, Sweeter JM, DeVasure JM, Wyatt TA. (2018). An association between MMP-9 and impaired T cell migration in ethanol-fed BALB/c mice infected with respiratory syncytial virus-2A. *Alcohol*. 80:25-32. doi: 10.1016/j.alcohol.2018.09.009. Epub 2018 Oct 3. PubMed PMID: 30291948.
36. Warren K, Wyatt, TA, Romberger, DJ, Ailts I, West, WW, Nelson A, Nordgren TM, Staab E, Heires A, J Poole JA. (2017). Post-injury and resolution response to repetitive inhalation exposure to agriculture organic dust in mice. *Safety*. 3(1):10. doi:10/3390/safety3010010

37. Warren KJ, Dickinson JD, Nelson AJ, Wyatt TA, Romberger DJ, Poole JA. (2019). Ovalbumin-sensitized mice have altered airway inflammation to agriculture organic dust. *Respiratory Research*. 7;20(1):51. doi: 10.1186/s12931-019-1015-0
38. Watanabe-Galloway S, Chasek C, Yoder AM, Bell JE. (2021). Substance use disorders in farming population: Scoping review. *Journal of Rural Health*. May 6. doi: 10.1111/jrh.12575
39. Weichelt B, Gorucu S, Jennissen C, Denning G, Oesch S. (2020). Assessing the emergent public health concern of all-terrain vehicle injuries in rural and agricultural environments: Initial review of available national datasets in the United States. *JMIR Public Health Surveillance*. 6(2):e15477. doi: 10.2196/15477.
40. Weichelt B, Scott E, Burke R, Shutske J, Gorucu S, Sanderson W, Madsen M, Redmond E, Murphy DJ, Rautiainen R. (2021) JA:2021-40. What about the Rest of Them? Fatal Injuries Not Captured by the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI). *Journal of Agromedicine*, July 29:1-6. doi: 10.1080/1059924X.2021.1956663.
41. Weichelt B, Heimonen T, Gorucu S, Redmond E, Vechinski J, Pflughoeft K, et al. (2019). Redesigning a sentinel surveillance system for collecting and disseminating near real-time agricultural injury reports: System usability study. *JMIR Form Res*. Aug 2;3(3):e13621.
42. Weichelt B, Heimonen T, Pilz M, Yoder A, Bendixsen C. (2018). An argument against cross-platform development: Lessons from an augmented reality app prototype for rural emergency responders *JMIR MHealth uHealth*. 7(3):e12207. doi: 10.2196/12207
43. Weichelt B, Yoder A, Bendixsen C, Pilz M, Minor G, Keifer M. (2018). Augmented Reality Farm MAPPER Development: Lessons Learned from an App Designed to Improve Rural Emergency Response. *Journal of Agromedicine*. 23(3):284-296. doi: 10.1080/1059924X.2018.1470051
44. Weichelt B, Bendixsen C, Patrick T. (2019). A Model for Assessing Necessary Conditions for Rural Health Care's Mobile Health Readiness: Qualitative Assessment of Clinician-Perceived Barriers. *JMIR mHealth uHealth*. Nov 8;7(11):e11915. doi: 10.2196/11915.

### **C.2. Website(s) or other Internet site(s) – include URL(s)**

Pilot Program information (project description, RFA and other announcements are posted on the CS-CASH website. Sample RFA 2022:

<https://www.unmc.edu/publichealth/cscash/documents/research/research-2022-pilot-project-rfa.pdf>

### **C.3. Technologies or techniques**

None

### **C.4. Inventions, patent applications, and/or licenses**

None

### **C.5. Other products and resource sharing**

None

**D. PARTICIPANTS****D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID    | S/K | Name          | Degrees(s) | Role        | Cal | Aca | Sum | Foreign | Country | SS |
|---------------|-----|---------------|------------|-------------|-----|-----|-----|---------|---------|----|
| ROGAN.ELEANOR |     | Eleanor Rogan | PhD        | PI          | 0.6 |     |     |         |         |    |
| DUYSEN.ELLEN  |     | Ellen Duysen  | MPH        | Coordinator | 1.7 |     |     |         |         |    |

**D.2 Personnel updates**

- a. Level of Effort:** As reported – no changes  
**b. New Senior/Key Personnel:** None  
**c. Changes in Other Support:** None  
**d. New Other Significant Contributors:** None

**E. IMPACT****E.1 - What is the impact on the development of human resources, if applicable?**

Not applicable

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

Projects are designed to lead to funding for further research, practice, or outreach in the field of agricultural safety and health.

Notable awards that resulted from the use pilot research data:

- *AgHealth Nebraska* - Nebraska Research Initiative Grant - \$100,000
- *Prevention and Treatment of Agricultural Respiratory Disorders: A Pilot Educational Program of Rural Health Care NPs and PAs* - HRSA Grant - \$769,000
- *Development of a mobile application for agricultural safety, AgHealth* - HRSA Planning Grant - \$85,000
- *Role of pattern recognition receptors in organic dust induced airways disease* - NIEHS R01 (ES019325) \$1,650,000
- *Identifying the sources of stress and prevalence of anxiety and depression symptoms among young farmers and ranchers in the upper and western Midwest.* Josie Rudolphi was awarded \$7,200,000 from the U.S. Department of Agriculture (2020-70028-32728) on a project titled *North Central Farm and Ranch Assistance Center: Engaging programs to support producer well-being.*
- *Agricultural and Occupational Exposures in U.S. Veterans with Rheumatoid Arthritis and Associations with Disease Severity.* Jill Poole and Bryant England awarded \$3,000,000 by the U.S. Department of Defense to study airborne hazards.

**F. CHANGES**

|  |
|--|
| <b>F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures</b><br>No changes. |
| <b>F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them</b><br>No challenges or delays.                 |
| <b>F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents</b><br>No changes.                  |

**G. Special Reporting Requirements**

|   |
|---|
| <b>G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements</b><br>NA  |
| <b>G.2 Responsible Conduct of Research</b><br>NA  |
| <b>G.3 Mentor’s Research Report or Sponsor Comments</b><br>NA   |
| <b>G.4 Human Subjects</b><br><br>G.4.a Does the project involve human subjects?<br>Each project PI is responsible for their IRB/IACUC if the project has human/animal subjects.<br><br>G.4.b Inclusion Enrollment Data<br>NA<br><br>G.4.c ClinicalTrials.gov<br>NA<br><br>Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?<br>No |
| <b>G.5 Human Subject Education Requirement</b><br><br>Are there personnel on this project who are newly involved in the design or conduct of human subject’s research?<br>No  |
| <b>G.6 Human Embryonic Stem Cells (HESCS)</b><br><br>Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?<br>No  |
| <b>G.7 Vertebrate Animals</b><br>Does this project involve vertebrate animals?<br>No  |

|   |
|---|
| <p><b>G.8 Project/Performance Sites</b><br/>University of Nebraska Medical Center, Omaha, NE</p>  |
| <p><b>G.9 Foreign Component</b><br/>None</p>  |
| <p><b>G.10 Estimated Unobligated Balance</b><br/>Reported in financial documents.</p> <p>G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?<br/>No</p> |
| <p><b>G.11 Program Income</b><br/>Is program income anticipated during the next budget period? No</p>   |
| <p><b>G.12 F&amp;A Costs</b><br/>Is there a change in performance sites that will affect F&amp;A costs? No</p>  |

### I. OUTCOMES

|   |
|---|
| <p>I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets</p> <p>Note: project outcome information will be made public in NIH RePORTER</p> <p>The Pilot and Feasibility Program has been an essential component of the Central States Center for Agricultural Safety and Health (CS-CASH) since the Center was established in 2011. This program supports projects with funding up to \$20,000 over 18 months. The program goal is to enable investigators to collect preliminary data to support the submission of grant applications for independent, longer-term, larger projects related to agricultural safety and health. This program is designed to allow researchers to collect data that will result in subsequent grant submissions to NIOSH (National Institute for Occupational Safety and Health) or other funding agencies to advance agricultural health and safety research. The projects selected for support by this program must address a critical issue in agricultural safety and health and lead to future extensive studies of the selected critical issue. In addition to NIOSH AFF (Agriculture, Forestry and Fishing) funding (\$660,000), generous funding from the University of Nebraska Medical Center's Vice Chancellor for Research (\$500,000), the University of Nebraska Lincoln (UNL) College of Agricultural Engineering (\$20,000), and the UNL Institute of Agriculture and Natural Resources (\$20,000) has allowed <b><u>CS-CASH to fund 39 pilot projects in this project period and a total of 65 pilot projects over 11 years.</u></b> Additional funding received by Pilot Program investigators due to data generated through their pilot research amounts to \$19,390,183.</p> |
|---|

## A. COVER PAGE

|   |   |
|---|---|
| <b>Project Title:</b><br>Emerging Issues Program  |   |
| <b>Grant Number:</b><br>1U54OH010162  | <b>Project/Grant Period:</b><br>September 01, 2016 – August 31, 2022  |
| <b>Reporting Period:</b><br>September 01, 2016- August 31, 2022   | <b>Date Submitted:</b><br>December 22, 2022   |
| <b>Program Director/ Principal Investigator</b><br>Risto Rautiainen, Program Director<br>Risto Rautiainen, Principal Investigator | <b>Administrative Official Information</b><br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| <b>Change of Contact PD/PI:</b><br>NA   |   |
| <b>Human Subjects:</b><br>No  | <b>Vertebrate Animals:</b><br>No  |
| <b>hESC:</b>  | <b>Inventions/Patents:</b><br>None  |

## B. ACCOMPLISHMENTS

### B.1. What are the major goals of the project?

The goals of this project are to examine trends and identify emerging issues affecting the health and safety of farmers, ranchers, family members and agricultural workers. CS-CASH identified emerging issues from 1) monthly injury and fatality case reports from the Center's media monitoring service, 2) annual data from the Center's injury surveillance project, 3) reviews of the literature, and 4) case reports from a network of experts in the field.

### B.2. What did you accomplish under these goals?

From 2016-2022 work on the following Emerging Issues program aims was completed.

The CS-CASH research and outreach teams have experience using media monitoring to identify emerging issues. With our growing database of injury and fatality cases, we provided instant responses and reports regarding incidents and prevention. Responses were coordinated within the Center and with our close collaborators, including other NIOSH ag centers. The emerging issues team conducted regular reviews of peer-reviewed literature and ag-industry news to ensure rapid response to emerging issues.

Enhanced Media Monitoring. Mr. Murray Madsen has conducted an Enhanced Farm and Agricultural Injury Media Monitoring program for CS-CASH since 2011. This program includes the following elements: 1) Collection and analysis of relevant print, broadcast, and internet media content monthly; 2) Creation of a Microsoft Excel record including details and source citations for each incident; 3) Monthly updates of new and existing incident records in datasets provided to CS-CASH; 4) Summary collations provided quarterly, year-to-date, and annually to CS-CASH; 5) Annual, a comprehensive summary and multi-dimensional index of injuries provided to CS-CASH; and 6) Special reports and summaries by mutual agreement. While the other proposed surveillance systems produce primarily statistical and scientific content, the media monitoring system produces powerful incident reports that can be used in presentations and reports, illustrating the types of injuries that have happened and should be prevented. In research published in the Journal of Agromedicine, we found that the media monitoring produced nearly identical numbers of agricultural fatalities as the BLS Census of Fatal Occupational Injuries, plus an equal number of non-fatal injury cases. Data from our media monitoring is shared with the Marshfield WI-based AgInjuryNews.org, headed by Dr. Bryan Weichelt.

Annual Surveillance Project. Since 2011 the CS-CASH Surveillance program has provided information on injuries and work-related health conditions among self-employed farmers and ranchers that are not covered by any other surveillance system. Only hired employees on larger operations are covered in the Bureau of Labor Statistics surveys. Our surveys provide data on out-of-pocket and insurance-covered expenses for medical care and lost work time due to injury. These severity measures are not available in other surveillance systems for agricultural populations.

*Aim 2: Respond to identified emerging issues without delay by investigating the problems and solutions and communicating preventive information to the affected populations and stakeholders. CS-CASH will prepare and deliver coordinated, evidence-based responses to identified emerging issues. The program will also fund small grants to outside entities that can respond. Proposals can be submitted at any time. The Center Director and the Pilot Projects Program team will evaluate the proposals and issue expedited funding decisions.*

### **Emerging Issues Programs, Projects, and Funded Grants**

Creation and dissemination of COVID-19 Pandemic Playbooks for feedyards and poultry-grower industries in collaboration with the UNMC Global Center for Health Security (GCHS). In response to the need for guidance for the prevention of COVID-19 in the feedyard and poultry industries, CS-CASH and the GCHS collaborated to create two comprehensive guides for these industries covering topics from re-engineering workspace to personal protective equipment. As time was of the essence, resources were created and disseminated using the CS-CASH extensive industry email and postal mail databases with delivery to 687 poultry growers and 376 feedyards.

Development of COVID-19 informational series of webinars for rural healthcare providers and agricultural stakeholders. In collaboration with the AgriSafe Network, CS-CASH developed and sponsored a 9-part COVID-19 educational webinar series. To provide accurate and timely information to rural healthcare providers and the agricultural community, CS-CASH and AgriSafe brought together content experts to create weekly webinars on topics from basic virology to hygiene in agricultural settings. There were 1097 total attendees to the 9-week series. These webinars are now maintained on the AgriSafe website as enduring resources.

COVID-19 Resources for Agricultural Communities. CS-CASH developed and maintained an electronic resource site on the CS-CASH website. This site was updated weekly from April – December 2020.

Creation of Train the Trainer Fit-Testing Workshops and Train the Trainer Fit-Testing Guide. In response to a lack of personnel qualified to conduct fit testing for pesticide applicators (to meet new Worker Protection Standards), for OSHA ag industry respiratory programs, and workers requiring N-95 respirator use during the COVID-19 pandemic, a Train the Trainer Fit-Testing Workshop and Capacity Building Guide were developed in partnership with the Ag Safety and Health Alliance. These resources, targeted to Public Health, health care, safety professionals, and Extension educators, provide the hands-on training, information, and resources needed to conduct respiratory fit testing in agricultural communities. Training includes education on integrating fit testing into an organization's business model. The workshop and guide have been evaluated and used in training and courses throughout the Midwest.



2019 Midwest Flood Response. In March 2019, a bomb cyclone hit the Midwest, causing record snowfall and rain followed by rapidly warming temperatures unleashing record flooding in 5 of the CS-CASH's 7-states regions. This event cost agricultural producers \$4.5 billion in total sales. Within ten days of the flood event, CS-CASH members working with ag journalist Loretta Sorenson created eleven media publications designed for ag communities on topics ranging from proper PPE for clean-up to protocols for composting dead animals. Over 90 unique news organizations published these articles. In collaboration with UNMC and a philanthropic organization, CS-CASH coordinated the creation and dissemination of over 2800 flood mitigation response kits to agricultural communities, including over 200 kits delivered to flood-ravaged Tribal Reservations (see photos on right). CS-CASH members took part in many flood-related presentations and media appearances, including two RFD-TV and two NE NPR-TV interviews discussing safe flood recovery.



Telling the Story Project (TTSP). Since 2016 members from CS-CASH, Great Plains Center for Agricultural Health (GPCAH), the Upper Midwest Agricultural Safety and Health Center (UMASH), and the National Farm Medicine Children's Center have partnered to develop the Telling the Story Project. The project team includes expertise in industrial hygiene, incident investigation, agricultural engineering, media relations, and educational outreach. This translation activity conveyed emerging issues and injury prevention messaging through personal narratives based on first-hand experiences. These stories and relevant prevention messaging and resources, stored on a dedicated website<sup>34</sup>, have been accessed over 25,700 times as of January 2, 2022. The website houses video and written narratives created by the TTSP team, educational resources, safety vignettes, and discussion guides created by the Telling the Story team. TTSP stories have been featured in SafetyWatch columns and weekly print agricultural media publications that reach over 84,000 households in the Midwest and online at [www.agupdate.com](http://www.agupdate.com). TTSP news articles shared through the Associated Press have reached over 900,000 viewers throughout the U.S.

Response to increases in agricultural ATV fatalities and Injuries. In response to the high number of ATV injuries and fatalities reported in the CS-CASH media monitoring, the following projects were funded through the Emerging Issues Program.

*Assessing the prevalence and underlying causes of 2015-2017 ATV/OHV-related injuries on U.S. farms.* P.I. Dr. Bryan Weichelt (National Farm Medicine Clinic) This study estimated the prevalence of exposure and injuries among farmers and ranchers, including working and non-working youth, and discussed the results in the context of injury prevention, including strategies of parental role modeling, helmet use, alcohol, crush protection devices, and legislation.

*New ATV Safety Design Features: Examining cultural acceptability and piloting an educational intervention among Midwestern youth in agriculture.* Ag Health and Safety Alliance™(AHSA) This project used the AHSA Gear Up for Ag™ Program to examine current awareness, beliefs, and cultural acceptability of new ATV safety design features among Midwestern youth in agriculture. The AHSA staff worked with an educational advisory panel to formulate questions for a standardized presurvey. Educators provided training with pilot-tested ATV safety resources to measure possible changes in beliefs or cultural acceptability. ASHA also developed a 2-minute evidence-based “ATV Safety Design” Motion Graphic highlighting the importance of ATV safety, including information on common causes of fatality/injury among young workers and effectiveness of numerous safety design features.

### **B.3. Competitive Revisions/Administrative Supplements**

NA

### **B.4. What opportunities for training and professional development did the project provide?**

NA

### **B.5. How did you disseminate the results to communities of interest?**

Results from the emerging issues projects and communication of emerging issues to the agricultural community are through the CS-CASH database of approximately 26,000 farmers and ranchers in the Center’s 7 states region, robust social media (Facebook, Twitter, Instagram, YouTube) and via email and postal communication.

### **B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

NA – final report.

## **13. PRODUCTS**

### **C.1. Publications, conference papers, and presentations**

1. COVID-19 Playbooks for the Poultry and Feedyard Industries. <https://www.unmc.edu/healthsecurity/covid-19/playbooks/index.html> (Accessed 12/30/21)
2. COVID-19 Ag Task Force Response Think Tank Series. <https://learning.agrisafe.org/products/covid-19-ag-task-force-response-think-tank-series> (Accessed 12/30/21)
3. CS-CASH COVID-19 Resource Page. <https://spark.adobe.com/page/UO9sw0bOvCIRq/> (Accessed 12/30/21)
4. Respirator Fit-Testing Capacity Building Guide. [https://aghealthandsafety.com/wp-content/uploads/2021/07/July2021062338\\_Respirator-Fit-Testing-Workshop-Guide-Book\\_8.5x11-1-1.pdf](https://aghealthandsafety.com/wp-content/uploads/2021/07/July2021062338_Respirator-Fit-Testing-Workshop-Guide-Book_8.5x11-1-1.pdf) (Accessed 12/30/21)
5. Duysen, E. Consider This - Nebraska Flooding 2019. Interview. <https://nebraskapublicmedia.org/en/series-media/consider-this-video/season-23-video-16392/nebraska-flooding-2019-50009580/> (Accessed 12/30/21)
6. Duysen, E. Consider This – Life After the Flooding. Interview. <https://nebraskapublicmedia.org/en/series-media/consider-this-video/season-22-video-16392/life-after-the-flooding-50008590/> (Accessed 12/30/21)
7. Telling the Story Project Website. <https://tellingthestoryproject.org/> (Accessed 12/30/21)
8. Weichelt B, Gorucu S, Jennissen C, Denning G, Oesch S. Assessing the Emergent Public Health Concern of All-Terrain Vehicle Injuries in Rural and Agricultural Environments: Initial Review of Available National Datasets in the United States. *JMIR Public Health Surveill* 2020;6(2):e15477. doi: [10.2196/15477](https://doi.org/10.2196/15477) PMID: [32469319](https://pubmed.ncbi.nlm.nih.gov/32469319/) PMCID: [7293057](https://pubmed.ncbi.nlm.nih.gov/7293057/)

9. ATV Aware Stop Motion Video. <https://aghealthandsafety.com/atv-safety/> (Accessed 12/30/21)

**C.2. Website(s) or other Internet site(s) – include URL(s)**

Information on emerging issues is stored on the CS-CASH website: <https://www.unmc.edu/publichealth/cscash/>

**C.3. Technologies or techniques**

NA

**C.4. Inventions, patent applications, and/or licenses**

None

**C.5. Other products and resource sharing**

None

**D. PARTICIPANTS**

**D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID | S/K | Name             | Degrees(s) | Role | Cal | Aca | Sum | Foreign | Country | SS |
|------------|-----|------------------|------------|------|-----|-----|-----|---------|---------|----|
| rautiainen |     | Risto Rautiainen | PhD        | PI   | 1.3 |     |     |         |         |    |
|            |     |                  |            |      |     |     |     |         |         |    |
|            |     |                  |            |      |     |     |     |         |         |    |
|            |     |                  |            |      |     |     |     |         |         |    |

**D.2 Personnel updates**

- a. Level of Effort: None
- b. New Senior/Key Personnel: None
- c. Changes in Other Support: None
- d. New Other Significant Contributors: None

**E. IMPACT**

**E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES**

|   |
|---|
| <b>F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures</b><br>None |
| <b>F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them</b><br>None                              |
| <b>F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents</b><br>None                  |

**G. Special Reporting Requirements**

|   |
|---|
| <b>G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements</b><br>NA  |
| <b>G.2 Responsible Conduct of Research</b><br>NA  |
| <b>G.3 Mentor's Research Report or Sponsor Comments</b><br>NA   |
| <b>G.4 Human Subjects</b><br><br>G.4.a Does the project involve human subjects?<br>No<br><br>G.4.b Inclusion Enrollment Data<br>NA<br><br>G.4.c ClinicalTrials.gov<br>NA<br><br>Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?<br>No |
| <b>G.5 Human Subject Education Requirement</b><br><br>Are there personnel on this project who are newly involved in the design or conduct of human subject's research?<br>No  |

**G.6 Human Embryonic Stem Cells (HESCS)**

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

**G.7 Vertebrate Animals**

Does this project involve vertebrate animals?

No

**G.8 Project/Performance Sites**

University of Nebraska Medical Center, Omaha NE

**G.9 Foreign Component**

None

**G.10 Estimated Unobligated Balance**

See FFR

G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?

No

**G.11 Program Income**

Is program income anticipated during the next budget period?

No

**G.12 F&A Costs**

Is there a change in performance sites that will affect F&A costs?

No

**I. OUTCOMES**

I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets

Note: project outcome information will be made public in NIH RePORTER

The aims of the CS-CASH Emerging Issues Program were met during the funding period. The aims were to examine trends and identify emerging issues affecting the health and safety of farmers, ranchers, family members and agricultural workers and to respond to issues without delay by delivering coordinated and evidence-based responses and providing small grants to outside entities that are prepared to respond.

Enhanced Media Monitoring. Mr. Murray Madsen has conducted an Enhanced Farm and Agricultural Injury Media Monitoring program for CS-CASH since 2011. This program includes collection and analysis of agriculture-related injuries and fatalities in print, broadcast, and internet media content monthly, creation of a Microsoft Excel record, monthly updates of new and existing incident records in datasets provided to CS-CASH, and summary collations provided quarterly, as well as special reports and summaries as requested. Data from our media monitoring is shared with the Marshfield WI-based AgInjuryNews.org, headed by Dr. Bryan Weichelt.

Annual Surveillance Project. Since 2011 the CS-CASH Surveillance program has provided information on injuries and work-related health conditions among self-employed farmers and ranchers that are not covered by any other surveillance system.

Data from monitoring and surveys are used to identify emerging issues. Examples of responses to emerging issues during the last funding cycle are shown below.

- Creation and dissemination of *COVID-19 Pandemic Playbooks* for feedyards and poultry-grower industries in collaboration with the UNMC Global Center for Health Security (GCHS).
- Development of COVID-19 informational series of 9 webinars for rural healthcare providers and agricultural stakeholders: COVID-19 Resources for Agricultural Communities.
- Creation of Train the Trainer Fit-Testing Workshops and Train the Trainer Fit-Testing Guide.
- Creation and dissemination of over 2800 flood mitigation response kits to agricultural communities, including over 200 kits delivered to flood-ravaged Tribal Reservations.
- Development of the Telling the Story Project Website.
- Robust response to increases in agricultural ATV fatalities and Injuries including creation of a stop-motion ATV safety training video, and development of training curriculum to accompany the CS-CASH ATV full-sized training simulator.

**A. COVER PAGE**

|   |  |
|---|--|
| Project Title:<br>Enhancing the Health and Safety of Range Bison Herd Workers   |  |
| Grant Number:<br>1U54OH010162   | Project/Grant Period:<br>September 01, 2016 – August 31, 2022  |
| Reporting Period:<br>September 01, 2016- August 31, 2022  | Date Submitted:<br>December 22, 2022   |
| Program Director/ Principal Investigator<br>Risto Rautiainen, Program Director<br>Myстера Samuelson, Principal Investigator | Administrative Official Information<br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| Change of Contact PD/PI:<br>NA  |  |
| Human Subjects:<br>Yes  | Vertebrate Animals:<br>No  |
| hESC:   | Inventions/Patents:<br>None  |

## B. ACCOMPLISHMENTS

### B.1. What are the major goals of the project?

The Aims of this project were to (1) characterize injuries and hazards associated with working bison under contemporary conditions on tribal reservations and on non-reservation facilities; (2) develop and implement intervention strategies to mitigate worker safety risks; (3) assess outcomes and impacts of intervention strategies and (4) to disseminate updated intervention strategies widely to bison herd managers and bison herd workers.

### B.2. What did you accomplish under these goals?

**Research Results, Outcomes, and Impact Aim 1.** *Characterize injuries, working conditions, and hazards to workers handling bison under contemporary reservation field conditions. The document quantifies and compares risks and safety features found on an annual basis of reservation herd sites and non-reservation herd sites.*

A Workplace Safety Assessment checklist was developed using the Certified Safe Farm (CSF) general checklist and the CSF dairy and beef checklist as models.

<https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-handler-safety.pdf>

This checklist was designed to assist researchers in documenting hazardous working conditions and facility conditions. Photos were taken at each site to visually reference the reports shared with the herd manager. Scoring on the first visit provided a baseline for return visits, allowing researchers to document facility upgrades, repairs, or improved safety practices. Additional forms were developed for injury data collection containing OSHA (Occupational Safety and Health Administration) 300 log information, pertinent questions from the CS-CASH injury survey and specific questions to characterize incidents in working with bison. Trained study personnel used this tool to conduct on-site assessments. Assessment of the hazards in animal handling is based on industry standards: use of electric prods, collision with headgate, chute exit speed, injury, and crowding. Data from observations in the field were recorded on the paper forms for later entry into electronic databases. Assessments were made during on-site visits to tribal and non-tribal handling facilities, preferably, but not always when workers were in the process of working bison. Assessment forms were left with herd managers during the first site visits. Forms were also sent to managers at additional tribal sites and non-tribal sites. Managers were asked to record all injuries and keep the forms on file until the next site visit.

Observational Assessment Findings. (Tribal and non-tribal sites) Injuries to personnel working bison were observed and recorded. Bison handling deficiencies were recorded and included unsafe approaches to rounding up bison and inadequate bison confinement practices. Equipment deficiencies included faulty ready chute design, lack of safety barrier fence, poorly maintained and dysfunctional squeeze chutes, high-stress bison handling practices. Practice resulted in animal injuries.

Reports to Herd Manager. Reports were prepared following site visits. Items included a summary of observations (reporting safe and unsafe conditions and equipment), the observational score sheet, and photos of safety or health issues that needed to be addressed. (Figures 3, 4 pictures of facilities needing repair.) Improvements from previous visits were noted. (Figure 3, 4 Innovation and equipment upgrades.)



Figs 3 and 4. Examples of facility repair needs: unsafe gate and ladder.



Figs 5 and 6. Safety features (tire protects water source) and new handling equipment reported (pneumatic squeeze chute).

Example of a section of the observational report from 2017. Survey notes are in italics. Changes from 2016 are in bold text. Numbers in the following text correspond to photos taken of the safety concern.

*Questions for discussion:*

- *Is there a possibility that the light-colored plywood board sections in the pens catch attention due to the big contrast to the rust color metal? – paint the boards about same rust color?*
  - **Improvements made in 2017 – plywood has been painted.**
- *Is there a possibility that bison might use the round bales (set right next to fence) as stepping stool to jump over fence? (While observing, one bison ran over a bale, like he was thinking about it.)*
  - **Improvements made in 2017- bales have been removed from inside runs.**
- *Is it possible to reduce noise from the gates by installing rubber stoppers; and would that help keep bison calm? No improvement noted in 2017.*
- *Are there solutions to bring mother with calf together to be treated? Separation causes greatest anxiety in animals.*
  - **Improvements in 2017 – an effort to keep cow/calf pairs together was observed.**

*In 2017, much of the tube fencing was covered with black plastic tarp. This could be an improvement, keeping bison calmer, moving forward in the facility. One new safety issue is created by the need to climb fences; it is easy to slip and fall when trying to climb a fence covered with a tarp. Consider options to avoid this hazard. Photos: 5767, 5770*

Observational Report Locations. Dr. Kelling or CS-CASH Director Dr. Risto Rautiainen conducted assessments at the following bison herd handling sites - tribal locations: Standing Rock, Fort Peck, Slim Buttes, Taos Pueblo, Sinte Gleska University, Rosebud Sioux, and non-tribal locations: Wind Cave National Park, Konza Prairie (Kansas State University), Neal Smith Wildlife Refuge, Theodore Roosevelt National Park, Niobrara Valley Conservancy.

Annual Surveys. The On-site Observational Survey, Herd Manager Perception Survey and a Veterinarian and a Biologist Perception Surveys, developed as part of Dr. Kelling's CS-CASH 2015 Pilot Project, were administered yearly in the same manner as previously described.

COVID-19 Interruptions. The COVID-19 pandemic prevented on-site assessments and consultations in 2020 and 2021. Surveys were emailed and administered at the Roundtables.

**Research Results, Outcomes, and Impact Aim 2.** *Develop and implement intervention strategies to mitigate worker safety risks. Develop a program involving best practices, workplace improvements, and training for bison herd workers. Implement the intervention in participating operations and evaluate program effectiveness.*

Bison Worker Safety Tailgate Training Guide In response to safety concerns and training needs expressed in the herd manager surveys the Bison Worker Safety Tailgate Training Guide was created. The guide provides managers with a training resource with 15-minute training on topics including personal protective equipment, low-stress bison handling, safe use of animal medication, safe ATV use, lightning and tornados, thermal stress, and others. The guide was sent to all ITBC tribal herds, shared on social media, in newsletters and on the CS-CASH website.

<https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-handler-manual.pdf>

ITBC Conference Safety Training Courses The ITBC introduced a safety training track to their annual conference. CS-CASH researchers Dr. Kelling, Dr. Rautiainen and MPH student Kelsey Palm were invited to present safety initiatives and to collect survey data. These training courses are held in Las Vegas and host over 100 tribal herd managers, workers and elders each year.

2020 Roundtable Conference Special Issue in Stockman's Journal Following the 2020 Roundtable, Whit Hibbard, Keynote Speaker and Editor of the Stockman's Journal, devoted a special issue to the topics discussed at the Roundtable with a focus on low-stress Bison handling. Mr. Hibbard provided hardcopies of the Journal for our 2020 and 2021 Roundtable participants. This special Journal issue allowed information regarding worker and animal safety to be disseminated to a wide audience of herd workers. <https://stockmanshipjournal.com/volume-7/>

Personal Protective Equipment (PPE) Kits Each research herd was supplied with a kit containing PPE that was needed during bison handling, including N-95 respirators, rubberized cloth gloves, ear plugs, safety glasses and first aid supplies. This ensured that lack of PPE was not a factor during roundups and while medicating.

**Research Results, Outcomes, and Impact Aim 3.** *Assess outcomes, impacts of the intervention strategies, and disseminate updated intervention strategies widely to bison herd managers and workers. Use qualitative and quantitative findings from implementing the program elements, update them as needed, and disseminate them in collaboration with tribal organizations to bison operations in the U.S.*

First Annual Bison Worker Safety Roundtable – March 26, 2019. To create an opportunity to share data from the three research surveys and the observational site visits, the first annual Bison Worker Safety and Herd Health Roundtable was held March 26, 2019, in Omaha Nebraska. This meeting brought together 30 herd managers (tribal and non-tribal), researchers, safety experts, and other stakeholders to discuss common safety concerns, present data, hear presentations from experts regarding best practices for protecting bison herd workers, and collect additional data through surveys.

A report of the meeting proceedings was shared with participants, on social media, in newsletters and on the CS-CASH website. The meeting evaluation revealed unanimous consent that this meeting format should be repeated on an annual basis. Participants suggested involving a wide range of stakeholders and continuing to use a live video-stream to allow participation from across the country. Topics for the 2<sup>nd</sup> annual roundtable were discussed and suggestions included tribal safety storytelling, more information on zoonotic disease and emergency preparedness. Report: <https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2019.pdf>

Second Annual Bison Worker Safety Roundtable – August 26, 2020. The 2<sup>nd</sup> Annual Roundtable was held in Rapid City, South Dakota, the home of the InterTribal Buffalo Council. In person participants were limited due to COVID-19 restrictions, but a quality live-stream opportunity brought over 68 participants from across the U.S. to the event through the Zoom platform. The agenda was set by recommendations made by participants of the 2019 meeting. Topics included a report on research progress, a keynote address on low-stress bison handling, holistic handling, bison behavior, low-cost facility fixes, tribal strategies to protect workers, safe bison hauling, and one-health perspectives. The proceedings were recorded in a report that was disseminated to participants and shared through the ITBC contact list. The research surveys were administered to the participants with a response rate of 82%. Roundtable participant evaluations indicated 100% of participants would be interested in attending a future roundtable event that takes place at a bison handling site. An indication of success was that 85% of participants indicated that they would be able to implement something they learned during the event into their herd health and worker safety practices including information on low-stress handling, corral design, bison behavior, and maintaining a healthy herd. Special guest, Chairman Mike Faith Jr., Standing Rock Sioux Tribe, shared his vision for worker safety with the Roundtable participants.

Suggestions of topics for 2021 3<sup>rd</sup> Annual Bison Worker Safety Roundtable included presentations by large producers and herd managers, veterinarian procedures that caretakers can learn to do themselves, developing emergency preparedness plans to protect bison herds and workers in the event of disaster of blizzards, floods, tornados, wildfires, in-land hurricanes, etc. and Tribal historical and spiritual stories, songs, and ceremonies.

Report: <https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2020.pdf>

Third Annual Bison Worker Safety Roundtable – October 13-14, 2021. The 3<sup>rd</sup> Annual Roundtable was again held in Rapid City, SD, as this is a convenient site for many of the tribe members to travel to. We maintained COVID-19 protocols and hosted a live-streamed 2-day hybrid conference with 60 participants. Responding to suggestions from 2020, the agenda included research findings, emergency response information, a tribal perspective of safety while field-dressing bison, worker lung health and zoonosis. Evaluations for this event are being analyzed. A report is currently being prepared and will be shared with participants and through the ITBC channels.

Report: <https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2021.pdf>

Fourth Annual Bison Worker Safety Roundtable July 6-7 2022 in Pierre, SD. This meeting was held in person and virtually. A link to the meeting report can be found here:

<https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2022.pdf>

Presentation to the NIOSH American Indian Worker Safety Conference. Dr. Rautiainen was an invited speaker to the 2019 NIOSH American Indian Worker Safety Conference. He presented the project findings to Tribal and non-Tribal researchers, creating a network of research collaborators.

Evaluation and Reporting. An evaluation of the research, and outreach materials continue to be analyzed in fall 2022 after all data has been collected as of September 2022. The cumulative On-site Observational Survey, Herd Manager Perception Survey and a Veterinarian and a Biologist Perception Survey data are still being analyzed and will be reported back to herd managers, workers, the ITBC and stakeholders in the first quarter of 2023. Results from this study will be developed into several manuscripts.

The bison herd worker safety team looks forward to continuing to move this impactful research forward in collaboration with the InterTribal Buffalo Council during the funded NIOSH AFF project *Establishing a Community-Based Training Network to Enhance Bison Herd Workers Safety on Tribal Lands*.

### **B.3. Competitive Revisions/Administrative Supplements**

NA

### **B.4. What opportunities for training and professional development did the project provide?**

NA

### **B.5. How did you disseminate the results to communities of interest?**

Each annual meeting report was sent to all participants and was posted on the CS-CASH website and promoted via social media.

The Bison Safety Stockman's Journal Issue was provided to all participants of the annual roundtables.

The results of the annual surveys will be disseminated to participants and will be used to inform peer reviewed manuscripts.

### **B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

NA as this is the final report.

## **C. Products**

### **C.1. Publications, conference papers, and presentations**

Manuscript:

Duysen E, Irvine K, Yoder A, Topliff C, Kelling C, Rajaram S. Assessment of Tribal Bison Worker Hazards Using Trusted Research Facilitators. *J Agromedicine*. 2017;22(4):337-346. doi: 10.1080/1059924X.2017.1353937. PMID: 28704160.

Conference Reports:

2019 - <https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2019.pdf>

2020 - <https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2020.pdf>

2021 - <https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2021.pdf>

2022 - <https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-roundtable-2022.pdf>

### **C.2. Website(s) or other Internet site(s) – include URL(s)**

Bison Worker Safety Project resources are housed on the CS-CASH website:

<https://www.unmc.edu/publichealth/cscash/resources/index.html>

**C.3. Technologies or techniques**

NA

**C.4. Inventions, patent applications, and/or licenses**

NA

**C.5. Other products and resource sharing**

Safety Checklist for Bison Handling Facilities

<https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-handler-safety.pdf>

Bison Worker Tailgate Training Safety Manual

<https://www.unmc.edu/publichealth/cscash/documents/resources/resources-bison-handler-manual.pdf>Stockman's Journal Bison Handling Safety Volume (7) <https://stockmanshipjournal.com/volume-7/>**D. PARTICIPANTS****D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID        | S/K | Name              | Degrees(s) | Role        | Cal | Aca | Sum | Foreign | Country | SS |
|-------------------|-----|-------------------|------------|-------------|-----|-----|-----|---------|---------|----|
| SAMUELSON.MYSTERA |     | Mystera Samuelson | PhD        | PI          | 1.2 |     |     |         |         |    |
| rautiainen        |     | Risto Rautiainen  | PhD        | CO-I        | 0.2 |     |     |         |         |    |
| DUYSEN.ELLEN      |     | Ellen Duysen      | MPH        | Coordinator | 0.6 |     |     |         |         |    |

**D.2 Personnel updates N/A**

a. Level of Effort:

b. New Senior/Key Personnel:

c. Changes in Other Support:

d. New Other Significant Contributors:

**E. IMPACT****E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES**

**F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**  
None

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**  
None

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**  
None

**G. Special Reporting Requirements**

**G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements**  
NA

**G.2 Responsible Conduct of Research**  
NA

**G.3 Mentor's Research Report or Sponsor Comments**  
NA

**G.4 Human Subjects**

G.4.a Does the project involve human subjects? Yes

G.4.b Inclusion Enrollment Data  
Exempt IRB

G.4.c ClinicalTrials.gov  
NA

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

No

**G.5 Human Subject Education Requirement**

Are there personnel on this project who are newly involved in the design or conduct of human subject's research?  
No

**G.6 Human Embryonic Stem Cells (HESCS)**

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

|   |
|---|
| NO  |
| <b>G.7 Vertebrate Animals</b><br><br>Does this project involve vertebrate animals?<br>No  |
| <b>G.8 Project/Performance Sites</b><br>University of Nebraska Medical Center, Omaha Nebraska   |
| <b>G.9 Foreign Component</b><br>None  |
| <b>G.10 Estimated Unobligated Balance</b><br><b>See FFR report</b><br><br>G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?<br>No |
| <b>G.11 Program Income</b><br><br>Is program income anticipated during the next budget period?<br>No  |
| <b>G.12 F&amp;A Costs</b><br><br>Is there a change in performance sites that will affect F&A costs?<br>No   |

## I. OUTCOMES

|  |
|--|
| <p>I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets</p> <p>Note: project outcome information will be made public in NIH RePORTER</p> <p>The aims of the Enhancing the Health and Safety of Range Bison Herd Workers project were met or exceeded including characterizing injuries and hazards associated with working bison under contemporary conditions on tribal reservations and on non-reservation facilities; developing and implement intervention strategies to mitigate worker safety risks; assessing outcomes and impacts of intervention strategies and disseminating updated intervention strategies widely to bison herd managers and bison herd workers.</p> <p>Our unique partnership with the InterTribal Buffalo Council allowed us access onto bison handling facilities that may have been otherwise inaccessible. We developed 3 novel survey instruments that were used to evaluate tribal and non-tribal bison handling practices and facilities from the perspectives of the herd managers, workers, and veterinarians. Researchers joined bison herdsman during roundups and in the field to assess the facilities and</p> |
|--|

handling practices. The results were used to develop a multi-faceted interventions to reduce injury and illness among a vulnerable population, Native American bison herd workers. Resources that were created in response to safety and health concerns included a bison handler safety tailgate training guide that has been recently updated. Convening a yearly Bison Worker Safety and Herd Health Roundtable allowed the project team to communicate results and best practices to bison herd workers, managers, veterinarians, and other safety professional. The presentations and discussions from each of these 4 meetings were recorded and disseminated to participants and other interested parties. Throughout the project we assisted both tribal and non-tribal bison operations in formulating and implementing evidence-based best management practices to improve worker safety through changes in facilities, handling practices, and safety training.

Following the retirement of Dr. Clayton Kelling in 2020, project PI, Dr. Mystera Samuelson was designated as PI. Dr. Samuelson, an animal behavior expert, brought expertise in bison behavior to the project and provided a unique perspective as a researcher with Native American heritage. Dr. Samuelson's newly funded NIOSH AFF Center project *Establishing a Community-Based Training Network to Enhance Bison Herd Workers Safety on Tribal Lands* will allow established tribal bison herd managers and workers who were involved in the first 5-year project to work with newly established tribal herds sharing their expertise on worker safety.

## A. COVER PAGE

|   |   |
|---|---|
| <b>Project Title:</b><br>Health and Safety Risks among Immigrant Cattle Feedyard Workers                                      |   |
| <b>Grant Number:</b><br>1U54OH010162  | <b>Project/Grant Period:</b><br>September 01, 2016 – August 31, 2022  |
| <b>Reporting Period:</b><br>September 01, 2016- August 31, 2022   | <b>Date Submitted:</b><br>December 22, 2022   |
| <b>Program Director/ Principal Investigator</b><br>Risto Rautiainen, Program Director<br>Athena Ramos, Principal Investigator | <b>Administrative Official Information</b><br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| <b>Change of Contact PD/PI:</b><br>NA   |   |
| <b>Human Subjects:</b><br>Yes   | <b>Vertebrate Animals:</b><br>No  |
| <b>hESC:</b>  | <b>Inventions/Patents:</b><br>None  |

## B. ACCOMPLISHMENTS

### B.1. What are the major goals of the project?

This project had three primary aims as outlined below:

Aim 1: Systematically explore and describe the health status and occupationally related risks among Latino immigrant cattle feedlot workers in Nebraska and Kansas. (Project years 1-3)

Aim 2: Test the Ecological Stress-based Model of Immigrant Health and Safety. This conceptual model predicts if workers' intrapersonal mechanisms (i.e., stress appraisal, ethnic identity, and cultural values) mitigate culture-related occupational stress and negative health outcomes. (Project years 4)

Aim 3: Review, develop, evaluate, and disseminate bilingual (English/Spanish) health and safety educational and policy materials designed specifically for cattle feedlot operations. (Project years 5-6)

### B.2. What did you accomplish under these goals?

#### Major activities

- Completed data collection in 2020 with 243 Latino immigrant cattle feedlot workers in Kansas and Nebraska (95 in Kansas; 148 in Nebraska)
  - Created a bilingual recruitment flyer for each field worker to disseminate in their coverage area.
  - Obtained an official university ID for field workers
  - Conducted additional on-site spot observations to ensure that the field workers were implementing the protocol as designed in May and December 2019
  - Conducted three site visits (May, July, and December 2019) to cattle feedlots in Nebraska where the team was able to meet with workers and tour facilities
  - Conducted interviews with field team workers to document recruitment challenges and strategies used to overcome such challenges
- Conducted ethnographic field work on the experiences of 5 Latino immigrant cattle feedyard cowboys
- Responded to the COVID-19 pandemic and its impact on farmworkers
  - Led planning committee for the Nebraska "Planting Seeds of Partnership" conference for organizations who serve agricultural workers and developed a full day of training on COVID-19 (April 2021)
  - Developed Nebraska agricultural employer COVID-19 toolkit and shared with organizations that serve farmworkers (April 2021)
  - Developed 2 bilingual COVID-19 feedyard infographics – one related to COVID-19 prevention at work and the other related to coping with anxiety and stress related to the pandemic. These infographics were disseminated widely through social media reaching almost 65,000 people. (2020)
  - Co-authored the "Cattle feeding facility COVID-19 playbook" to enhance infection control and prevention procedures and reduce transmission of virus in the industry (2020)
  - Participated in multiple COVID-19 response teams including AgriSafe Network's COVID-19 Ag Task Force and the cross-center evaluation core team (2020-2021)
- Developed and member-checked a bilingual cattle feedyard picture dictionary and word list (glossary)
- Disseminated findings through 59 oral or poster presentations at state, regional, and international conferences. See section C.1
- Submitted 7 manuscripts for publication directly from this project. See section C.1
- Co-authored 3 papers with other NIOSH-funded Ag Center teams. See section C.1
- Hosted 35 team conference calls and 5 in-person team meetings
- Translated health and safety educational materials into Spanish, including head-to-toe PPE guides and respirator fact sheets
- Participated in the NORA AgFF Sector Council and the Nebraska Cattlemen

#### Significant results, including major findings, developments, or conclusions (both positive and negative)

Alcohol Use & Occupational Injury

Alcohol abuse is a significant public health issue and is a leading cause of preventable death in the United States. We assessed alcohol use and abuse using the AUDIT-C, a brief alcohol screening that reliably identifies individuals who are hazardous drinkers or have active alcohol use disorders. We found that about a third of participants (33.2%) reported that they abstained from alcohol. Among our sample, the AUDIT-C mean score was 4.2 (SD = 2.3). About 33% of those who drank reported drinking heavily at least once a month. Over 60% of respondents were at risk for hazardous drinking (62.9% of men; 44.4% of women). Of hazardous drinkers, 86.6% had been injured on the job compared to 68.6% of those who were not classified as hazardous drinkers. There was a significant difference between those who were classified as hazardous drinkers and those who were not,  $\chi^2 = 6.28, p = .01$ . Clearly, there are high rates of alcohol use and hazardous drinking among Latino immigrant feedyard workers. There was a significant association between hazardous drinking and being injured on the job. Agricultural employers should acknowledge the potential impact of alcohol on workplace safety and take steps to mitigate its negative consequences. Gender specific, culturally, linguistically, and literacy-appropriate health education and consistent screening for alcohol use is needed in primary care and community-based settings.

#### Ecological Stress-Based Model

A path model was used to explore the direct and indirect relations among the number of PPE types and the number of training types, safety climate, occupational stress, and mental health and adjustment outcomes (depression, anxiety, need for recovery, and life satisfaction). The aforementioned transformed variables and control variables were included in the final model. The overall model fit the data perfectly as we examined the saturated model. The  $R^2$  values for anxiety (.20), need for recovery (.23), and life satisfaction (.12) were statistically significant ( $p$ 's < .01). The  $R^2$  for depression (.06) approached statistical significance ( $p = .07$ ). Except for the correlation between anxiety and life satisfaction, the correlations among all outcome variables were statistically significant and in the expected directions. The number of PPE types and the number of training types were positively and significantly correlated, and both positively and significantly predicted safety climate. Safety climate negatively and significantly predicted occupational stress. Occupational stress significantly and positively predicted depression, anxiety, and the need for recovery, and significantly and negatively predicted life satisfaction. The only other significant direct effect in the model was the negative path between the number of PPE types and depression. Except for the path among number of training types, safety climate, occupational stress, and depression, the 95% confidence interval for the standard error estimate of all other indirect effects fell outside of zero. Thus, the relations between number of PPE types and training types and the mental health and adjustment outcomes were generally mediated by perception of safety climate and occupational stress.

#### Fatigue & Need for Recovery

Physical fatigue, mental fatigue, and need for recovery were significantly negatively correlated with self-rated health, average hours of sleep, and decision latitude, and significantly positively correlated with pain, average hours worked per day, and job demands. Need for recovery was significantly positively related to weekly income and ever injured. Physical fatigue was significantly negatively correlated with animal handling. A path model was used to explore direct and indirect relations among job characteristics; health, functioning, and sociodemographic covariates; need for recovery; and physical and mental fatigue. The overall model fit the data perfectly as we examined the saturated model. The  $R^2$  values for need for recovery (.40), physical fatigue (.57), and mental fatigue (.35) were statistically significant ( $p$ 's < .001). Need for recovery was significantly positively related to both physical and mental fatigue. Lower self-reported health, experiencing physical pain, not handling animals, and decreased decision latitude were directly related to increased physical fatigue. Fewer number of years working on cattle feedyards, lower education, experiencing physical pain, and increased job demands were directly related to heightened mental fatigue. Being female, experiencing physical pain, an elevated average of hours worked per day, increased job demands, and less decision latitude were directly related to an increased need for recovery. These significant direct predictors of need for recovery were indirectly related to physical and mental fatigue via need for recovery. The 95% confidence interval for all tested indirect effects fell outside of zero. Thus, the relations among sex, physical pain, average hours worked per day, job demands, and decision latitude and physical and mental fatigue were mediated by need for recovery.

### Healthcare Access

A little over half (58%) of the participants reported having health insurance coverage. More men (61%) compared to women (33%) reported having health insurance coverage. Few participants (36%) reported having someone they considered as their healthcare provider. The sample mean time since last routine check-up was greater than two years (M months =  $27.2 \pm 34.1$ ). Reporting having diabetes or high blood pressure was associated with having a regular healthcare provider.

### Immigration-Related Fear Among Workers

Nearly 50% of workers reported knowing someone who had been threatened with deportation, and 26% reported that Immigration and Customs Enforcement (ICE) agents had visited family, friends, or neighbors. Many reported that ICE had conducted raids at businesses where family and friends work. Nearly a quarter of workers reported that hostile or harmful laws directed towards Latinos had been passed in their local community. Immigration enforcement activities have created a climate of fear among agricultural workers, and there was a significant negative association between ICE visits and workers reporting feeling that their family was safe. In addition to the stress this creates for workers and their families, this has implications for health and safety research and practice, such as for engaging with immigrant participants, developing appropriate community partnerships, and conducting education and outreach activities.

### Job Safety Training

Approximately 25% of workers reported that they had not received any health or safety training from their current employer, and only about 9% had ever participated in any Occupational Safety and Health Administration (OSHA) safety training program. Videos, in-person training, or shadowing another worker were the most frequent methods of safety training reported by those who had received training. More than 93% were interested in receiving more information about health and safety related to their job. Workers preferred that safety information be provided through in-person training at the job site, videos (particularly those accessible through media sources such as YouTube), and written materials. Specific topics that workers were interested in obtaining more information about included zoonoses, low-stress cattle handling, injury prevention, hazard and injury reporting, chemical and equipment safety, and teamwork. Furthermore, a majority of participants preferred to receive information in Spanish, and some noted that language accessibility prevented them from looking for health and safety resources for themselves.

### Occupational Factors Affecting Worker Health

Decision latitude was significantly positively associated with safety climate and life satisfaction and significantly negatively correlated with work fatigue and anxiety. Workplace demands was significantly positively associated with work fatigue and significantly negatively associated with safety climate. Safety climate was significantly positively associated with life satisfaction and significantly negatively correlated with work fatigue and anxiety. In the decision latitude model, indirect effects were found among decision latitude, work fatigue, and depression (95% CI: -.15, -.04), anxiety (95% CI: -.13, -.04), life satisfaction (95% CI: .07, .26), and physical health (95% CI: .06, .24). In the workplace demands model, indirect effects were found among workplace demands, work fatigue, and depression (95% CI: .08, .26), anxiety (95% CI: .10, .30), life satisfaction (95% CI: -.26, -.07), and physical health (95% CI: -.21, -.05). In the safety climate model, indirect effects were found among safety climate, work fatigue, and depression (95% CI: -.14, -.02), anxiety (95% CI: -.12, -.03), life satisfaction (95% CI: .05, .28), and physical health (95% CI: .04, .20). The direct effects among the work-related variables and all outcomes were not significant. The findings suggest that there are important relationships between work-related variables and health outcomes among this worker population. Greater workplace demands predicted more work fatigue (need for recovery), which in turn, predicted less life satisfaction and physical health, and more depression and anxiety. Stronger safety climate and more greater decision latitude were linked to less work fatigue, which in turn, predicted more life satisfaction and physical health, and less depression and anxiety. The findings demonstrate the importance of providing feedyard workers with greater control, fewer demands at work, and a safer work environment to enhance health and well-being -- though their effects were indirect. The need for recovery was consistently related to more mental health problems, poorer physical health, and lower life satisfaction. Given the exposure of work and non-work (e.g., poverty, discrimination) related stressors among Latino immigrant cattle feedyard workers, these findings suggest that these workers are at high-risk for health

and social problems. Programs and policies that improve safety, reduce stress, and increase worker's control over their environment may therefore likely reduce the worker fatigue and need for recovery ultimately leading to improved the health of these immigrant workers.

#### Physical Health of Feedyard Workers

Most participants (88%) reported their general health as "good" to "excellent". Few participants had been diagnosed with a chronic health condition commonly found in the U.S. adult population. Participants reported being diagnosed with high cholesterol (n = 41), high blood pressure (n = 24), diabetes (n = 18), asthma (n = 8), arthritis (n = 8), bronchitis (n = 3). Self-report physical indicators of health included BMI (calculated from reported height and weight) and average hours of sleep in a 24-hour period. Few participants had a normal BMI (18.5 – 24.9), and most were either overweight (53%) or obese (37%). The mean hours of sleep reported per 24-hour period was 7.1 hours  $\pm$  1.1. In general, substance use (i.e., alcohol, tobacco, or other drug use) as indicator of health status, was low. The prevalence of cigarette smoking within the sample was 14%.

#### Work Safety Climate on Cattle Feedyards

Workers reported a mean score of 25.8 (SD = 5.0) out of a possible 38 on a safety climate scale,  $\alpha = .83$ . A majority of workers reported that taking risks was part of their job, and over 67% believed that their employer could do more to make their job safer. More than 93% of workers believed that it was likely that they would be injured in the next 12 months at work. Because there are numerous inherent risks on cattle feedyards, creating an environment that highlights management's commitment to safety and engages workers may lead to better long-term outcomes.

#### Key outcomes or other achievements

PI was recognized multiple times for her efforts to improve the health and well-being of Latinos in the Midwest: (1) Tribute to Women Honoree by the Women's Center for Advancement; (2) University of Nebraska Medical Center Department of Health Promotion "Distinguished Research Award"; (3) Familia y Comunidad Awardee by the Latino Center of the Midlands; (4) NU for Nebraska campaign, <https://nebraska.edu/nuforne/athena-ramos> ; (5) Women in Ag Science, <https://www.womeninagscience.org/post/athena-ramos-ag-health-safety> ; (6) UNO College of Public Affairs and Community Service Alumni Award for Excellence in Public Service, <https://www.unomaha.edu/college-of-public-affairs-and-community-service/news/cpacs-alumni-awardees-named-2021.php> ; (7) UNMC College of Public Health Carruth J. Wagner, M.D., Faculty Prize in Public Health; (8) named a "Science Defender" by the Union of Concerned Scientists; (9) Appointed as a Fellow to the Center for Great Plains Studies

#### **B.3. Competitive Revisions/Administrative Supplements - None**

#### **B.4. What opportunities for training and professional development did the project provide?**

- Four PhD students have had the opportunity to work with the data collected through the project
- PI and four PhD students participated in the 2022 Summer Institute of Occupational Health Psychology & Total Worker Health Symposium (July 2022)
- Three PhD students completed the Masters in Beef Advocacy (MBA) program through the National Cattlemen's Beef Association (2022)
- PI and two team members completed "Diplomado en salud ocupacional" (certificate in occupational health) sponsored by the Health Initiative of the Americas at the UC Berkeley School of Public Health (Summer 2020)
- PI completed a certificate in Psychological First Aid for Migrants, Refugees, and Displaced Persons sponsored by the Health Initiative of the Americas at the UC Berkeley School of Public Health (Fall 2019)
- PI, graduate student, and field team attended the Immigrant Worker pre-session at the Midwest Rural Agricultural Safety and Health Conference (November 2019)
- PI completed the following trainings:
  - OSHA 10-hour general industry course and the "Safety for the Supervisor" course (2019-2020)
  - Children's agricultural injury prevention workshop (June 2019)
  - Measurement in occupational health psychology: From fundamentals to emerging issues (November 2019)

- What you need to know about safety climate and culture: An overview (November 2019)
- Beef Quality Assurance (BQA), standardized feedlot training across the beef industry (2017/2020)
- Various trainings related to scientific writing including “What is Needed in Education Research: An Editor’s View” (April 2018) and “Writing for Publication” (May 2018)
- Project team members participated in the following conferences:
  - Health/Occupational Health conditions of migrant populations living in rural regions conference (October 2020)
  - Congressional Hispanic Caucus Institute Health Summit (November 2020)
  - Work as a social determinant of health workshop (November 2020)
  - Virtual on Migrant and Community Health (March 2021)
  - Cambio de Colores Annual Conference (June 2021)
  - International Society for Agricultural Safety and Health (July 2021/June 2022)
  - Nebraska Beef Summit (November 2021)
  - Midwest Rural Agricultural Safety and Health Conference (November 2018, 2019, 2020, 2021)
  - Nebraska Cattlemen Annual Conference (December 2021)
  - USDA Ag Outlook (February 2022)
  - North American Agricultural Health and Safety Summit (March 2022)
  - East Coast Migrant Stream Forum (April 2022)
  - Nebraska Planting Seeds of Partnership (April 2021/April 2022)
  - National Occupational Injury Research Symposium (October 2018/May 2022)
  - Nebraska Cattlemen Annual Meeting (December 2018, 2019, 2021) and Mid-Year Meetings (2019, 2021)
  - University of Nebraska-Lincoln Minority Health Disparities Initiative Conference (February 2019)
  - University of Nebraska Integrated Beef Systems Initiative (January 2020)
  - Midwestern APA Regional Conference
- PI participated in various webinars related to agricultural health and safety including:
  - Reducing fatigue-related risks
  - Beef producer challenges and opportunities post COVID-19
  - Nebraska Cattlemen: Black Swan series
  - Behavioral health planning: A key to farming in the era of COVID-19
  - Human health: Pathogens and contaminants in livestock systems
  - The connection between industrial agriculture and pandemics
  - NIOSH: The future of work and implications for aging workers
  - CDC: COVID-19 partner update – agriculture, workers, and employers
  - Handling and maneuvering on horseback
  - Using contribution analysis to refine your logic model and manage results
  - AgriSafe Think Tank: Racism and agricultural health
  - Livestock risk management with USDA and national Extension risk management education program
  - Interinstitutional Network on Food, Agriculture, and Sustainability
  - WCAHS Frontline leaders: Enhancing a culture of safety
  - BeSafe seminar on Farm Safety and Safety Culture in Europe
  - NIOSH Foresight Friday
  - NIAAA webinar: Reducing Stigma Around Alcohol Use Disorder in Minority Communities
  - NIOSH Total Worker Health Series: What is Safety Climate? Definition and Practical Applications
  - Precarious Work: Health & Economic Threats
  - The Role of Structural Competency in the Treatment and Prevention of Diabetes in a Vulnerable Agricultural Worker Population
  - Social Network Based Techniques for Understanding Hard To Reach Populations with Examples from Rural and Urban Drug Use
  - Making the Invisible, Visible: Lessons Learned from a Hispanic/Latino Migrant and Seasonal Farm Worker Needs Assessment

- Nuestra Salud: Substance Use Disorder Prevention and Treatment: Best and Promising Practices for Latinos
- Hazard communication
- Understanding Total Worker Health: Where we've been and where we're going
- Protecting farmworkers and their families: Examining new requirements to minimize pesticide exposure
- Improving behavioral health for Latino populations
- Based on the work that has been conducted as part of this project and the Central States Center for Agricultural Safety and Health (CS-CASH), the PI was an invited speaker in April 2019 for the European COST Action on safety culture and risk management in agriculture (SACURIMA) to discuss training and integrating vulnerable agricultural workers. From that work, she was invited as a member of an international advisory board in Denmark focused on safety of migrant farmworkers.

#### **B.5. How did you disseminate the results to communities of interest?**

- Six peer-reviewed papers have been published from the project, and one more is in press. See Section C.1
- PI conducted 59 presentations throughout the project for a variety of audiences and groups including academics, farmworker serving organizations, industry organization such as the Nebraska Cattlemen, and worker advocacy organizations. See section C.1
- PI has been participating in an ongoing interdisciplinary workgroup on farmworker well-being consisting of Nebraska Migrant Education Program, Nebraska Department of Labor, Proteus (Nebraska-affiliate of the National Farmworker Jobs Program), Legal Aid of Nebraska, University of Nebraska Medical Center, College of Public Health, Central States Center for Agricultural Safety and Health (CS-CASH), and other interested organizations.
- PI was a guest on the Workplace Matters Podcast hosted by the Healthier Workforce Center of the Midwest where she talked about her research with Latino immigrant cattle feedyard workers and the meatpacking industry. The episode was entitled, "Protecting Worker Well-Being in Immigrant Populations" **and is available at:** <https://hwc.public-health.uiowa.edu/workplace-matters-protecting-worker-well-being-in-immigrant-populations/>
- PI was interviewed by various media outlets including Rural Radio Network, a Nebraska-based radio station about the CS-CASH feedyard safety projects; The Western Producer, a leading agricultural trade publication in Canada about Latino immigrant farmworkers: <https://www.producer.com/2019/09/life-can-be-hard-for-child-migrants/>; Tri-State Neighbor Newspaper (October 2021) on welcoming and integration of immigrant agricultural workers; and the Flatwater Free Press (November 2021) on visa programs for agriculture.
- PI was the co-chair of the Nebraska Conference for Successful Agricultural Workers & Families 2019 where she led the planning for the overall conference. She developed a specific conference track focused on health and safety. The conference was a collaboration between the Nebraska Migrant Education Program, Nebraska Department of Labor, Proteus (Nebraska-affiliate of the National Farmworker Jobs Program), Legal Aid of Nebraska, University of Nebraska Medical Center, College of Public Health, and the Central States Center for Agricultural Safety and Health (CS-CASH).
- Developed a Spanish-language resource page on the CS-CASH webpage: <https://www.unmc.edu/publichealth/cscash/news/Spanish-resources.html>
- Findings have also been shared using CS-CASH social media channels including Facebook and Twitter

#### **B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

N/A as this is a closeout report

**C.1. Publications, conference papers, and presentations****Publications (n=7 directly associated with project; n=19 related to farmworkers)****Papers direct from project (n=7):**

1. **Ramos, A.K., Carlo, G., Grant, K.M., Bendixsen, C., Fuentes, A., & Gamboa, R.** (2018). A preliminary analysis of immigrant cattle feedyard worker perspectives on job-related safety training. *Safety*, 4(3), 37. DOI: 10.3390/safety4030037
2. **Ramos, A.K.,** Lowe, A.E., Herstein, J.J., Schwedhelm, S., Dineen, K.K., & Lowe, J.J. (2021). Invisible no more: The impact of COVID-19 on essential food production workers. *Journal of Agromedicine*, 25(4), 378-382. DOI: 10.1080/1059924X.2020.1814925
3. **Ramos, A.K., Duysen, E., Carvajal-Suarez, M., & Trinidad, N.** (2021). Virtual outreach: Using social media to reach Spanish-speaking agricultural workers during the COVID-19 pandemic. *Journal of Agromedicine*, 25(4), 353-356. DOI: 10.1080/1059924X.2020.1814919
4. **Ramos, A.K., McGinley, M., & Carlo, G.** (2021). The relations of workplace safety, perceived occupational stress, and adjustment among Latino/a immigrant cattle feedyard workers in the United States. *Safety Science*, 139, 105262. DOI: 10.1016/j.ssci.2021.105262
5. **Ramos, A.K., McGinley, M., & Carlo, G.** (2021). Fatigue and the need for recovery among Latino/a immigrant cattle feedyard workers. *Journal of Agromedicine*, 26(1), 47-58. DOI: 10.1080/1059924X.2020.1845894
6. **Ramos, A.K., Adhikari, S., Yoder, A.M., & Rautiainen, R.H.** (2021). Occupational injuries among Latino/a immigrant cattle feedyard workers in the central states region of the United States. *International Journal of Environmental Research and Public Health*, 18, 8821. DOI: 10.3390/ijerph18168821
7. **Ramos, A.K. & Reynaga, D.** (in press). The TN visa: The future of foreign workers in livestock production. *Journal of Agromedicine*.

**Associated papers (n=19):**

1. **Ramos, A.K., Carlo, G., Grant, K.M., Trinidad, N., & Correa, A.** (2016). Stress, depression, and occupational injury among migrant farmworkers in Nebraska. *Safety*, 2(4), 23. DOI:10.3390/safety2040023
2. **Ramos, A.K., Fuentes, A., & Trinidad, N.** (2016). Perception of job-related risk, training, and use of personal protective equipment (PPE) among Latino immigrant hog CAFO workers in Missouri: A pilot study. *Safety*, 2(4), 25. DOI:10.3390/safety2040025
3. **Ramos, A.K.** (2018). Child labor in global tobacco production: A human rights approach to an enduring dilemma. *Health and Human Rights Journal*, 20(2), 235-248.
4. **Ramos, A.K., Fuentes, A., & Carvajal Suarez, M.** (2018). Self-reported occupational injuries and perceived occupational health problems among Latino immigrant swine confinement workers in Missouri. *Journal of Environmental Research and Public Health*, 2018. DOI: 10.1155/2018/8710901
5. LeVan, T.D., Romberger, D.J., Siahpush, M., Grimm, B.L., **Ramos, A.K.**, Johansson, P.L., Michaud, T.L., Heires, A.J., Wyatt, T.A., & Poole, J.A. (2018). Relationship of systemic IL-10 levels with proinflammatory cytokine responsiveness and lung function in agriculture workers. *Respiratory Research*, 19(1). DOI: 10.1186/s12931-018-0875-z
6. **Ramos, A.K.** (2018). A human rights-based approach to farmworker health: An overarching framework to address the social determinants of health. *Journal of Agromedicine*, 23(1), 25-31. DOI:10.1080/1059924X.2017.138441
7. **Ramos, A.K.,** Trinidad, N., Correa, A., & Carlo, G. (2019). Correlates and predictors of alcohol consumption and negative consequences of alcohol use among Latino migrant farmworkers in Nebraska. *American Journal of Orthopsychiatry*, 89(5), 559-568. DOI: 10.1037/ort0000401
8. **Ramos, A.K., Duysen, E., & Yoder, A.M.** (2019). Identifying safety training resource needs in the cattle feeding industry in the Midwest. *Safety*, 5, 26. DOI: 10.3390/safety5020026
9. Israel, G., Diehl, D.C., Galindo, S., Ward, C. **Ramos, A.K.**, Harrington, M., & Kasner, E.J. (2020). Extension Professionals' Information Use, Protective Behaviors, and Work-Life Stress During the COVID-19 Pandemic. *Journal of Extension*, 58(6). <https://joe.org/joe/2020december/a1.php>

10. **Ramos, A.K.**, Girdžiūtė, L., Starič, J., & **Rautiainen, R.H.** (2020). Defining “vulnerable agricultural populations” at risk for occupational injuries and illnesses: A European perspective. *Journal of Agromedicine*, 26(3), 340-345. DOI: 10.1080/1059924X.2020.1771498
11. Acosta, L.M., Andrews, A.R., Acosta Canchila, N., & **Ramos, A.K.** (2020). Testing traditional machismo and the gender role strain theory with Mexican migrant farmworkers. *Hispanic Journal of Behavioral Sciences*, 42(2), 215-234. DOI: 10.1177/0739986320915649
12. Andrews, A.R., Haws, J.K., Acosta, L.M., Acosta Canchila, M.N., **Carlo, G.**, **Grant, K.M.**, & **Ramos, A.K.** (2020). Combinatorial effects of discrimination, legal status fears, adverse childhood experiences, and harsh working conditions among Latino migrant farmworkers: Testing learned helplessness hypotheses. *Journal of Latinx Psychology*, 8(3), 179–201.
13. **Ramos, A.K.**, **Carvajal-Suarez, M.**, **Trinidad, N.**, Michaud, T.L., Grimm, B.L., LeVan, T., & Siahpush, M. (2020). A cross-sectional study of gender-related differences in reporting fatigue and pain among Latino/a migrant farmworkers. *Journal of Agromedicine*, 25(3), 319-329. DOI:10.1080/1059924X.2020.1713272
14. **Ramos, A.K.** & Schneker, M. (2021). Hired and contract agricultural workforce – Sustainable solutions. *Journal of Agromedicine*, 26(1), 45-46. DOI: 10.1080/1059924X.2021.1849499
15. **Bessler, C.**, Crawford, K., Chandler, D., & **Ramos, A.K.** (2021). The NIOSH Agricultural Centers’ YouTube Channel: Time series modeling of viewership of agricultural health and safety videos. *Journal of Agromedicine*. DOI: 10.1080/1059924X.2021.2000907
16. Haws, J.K., Andrews, A.R., Acosta Canchila, N., & **Ramos, A.K.** (2022). Refining the validity of the Migrant Farmworker Stress Inventory among Latino migrant farmworkers in Nebraska. *Journal of Rural Mental Health*, 46(2), 100-116. DOI: 10.1037/rmh0000202
17. Reyes, S.L., Acosta, L.M., Domínguez, V., Ramos, A.K., Andrews, A.R. (2022). Immigrant and US-born migrant farmworkers: Dual paths to discrimination-related health outcomes. *American Journal of Orthopsychiatry*, 92(4), 452-462. DOI: 10.1037/ort0000625
18. Elliott, K.C., Lincoln, J.M., Flynn, M.A., Levin, J.L, Smidt, M., Dzugan, J., & **Ramos, A.K.** (2022). Working hours, sleep, and fatigue in the agriculture, forestry, and fishing sector. *American Journal of Industrial Medicine*. DOI: 10.1002/ajim.23418
19. Ramos, A.K., Adhikari, S., Rautiainen, R.H., & Yoder, A.M. (2022). Protecting cattle feedyard workers in the Central States region: Exploring state, regional, and national data on fatal and nonfatal injuries in agriculture and the beef production sector. *Journal of Extension*, 60(3). DOI: 10.34068/joe.60.03.13.

#### **Reports/Technical guides (n=2):**

1. Herstein, J., Schwedhelm, M., Lowe, A., Duysen, E., **Ramos, A.**, Grimm, B., Brett-Major, D., Kratochvil, C., Lawler, J., & Lowe, J. (2020). Poultry grower COVID-19 playbook. UNMC Global Center for Health Security and Central States Center for Agricultural Safety and Health. Available at: <https://www.unmc.edu/healthsecurity/documents/Poultry-Growers-Facility-Playbook-Final.pdf>
2. Herstein, J., Schwedhelm, M., Lowe, A., Duysen, E., **Ramos, A.**, Grimm, B., Brett-Major, D., Kratochvil, C., Lawler, J., & Lowe, J. (2020). Cattle feeding facility COVID-19 playbook. UNMC Global Center for Health Security and Central States Center for Agricultural Safety and Health. Available at: <https://www.unmc.edu/healthsecurity/documents/Cattle-Feeding-Facility-Playbook-FINAL.pdf>

#### **Presentations (n=59):**

1. **Ramos, A.K.** *Communicating public health science in diverse communities*. Invited feature presentation at the SciComm Conference, Lincoln, NE, August 19, 2022
2. **Ramos, A.K.** *Farmworker health in the Midwest*. Guest lecture for UNMC COPH ENV 811, Omaha, NE, July 12, 2022.
3. **Ramos, A.K.** *Stress and ecological theory and applications for nursing and health sciences*. Guest lecture for UNMC CON 933, Omaha, NE, June 30, 2022.
4. **Ramos, A.K.** *Migrant farmworker health and well-being in the Midwestern part of the United States*. Invited presentation for International Migrant Farmworker Advisory Board, Copenhagen, Denmark, June 22, 2022.
5. **Ramos, A.K.** *Data informed labor policy: Non-immigrant visa programs in the ag workforce*. Invited presentation at the International Society of Agricultural Safety and Health (ISASH), Fort Collins, CO, June 15, 2022.

6. **Ramos, A.K.** *Fatigue and the need for recovery among Latino immigrant cattle feedyard workers.* National Occupational Injury Research Symposium, May 11, 2022.
7. **Ramos, A.K.** *Building partnerships for health: Farmworkers, communities, and well-being.* Presentation at the Planting Seeds of Partnership Conference, April 19, 2022.
8. **Carvajal-Suarez, M. & Ramos, A.K.** *Alcohol use and correlated variables of interest among Latino/a immigrant cattle feedyard workers in Nebraska and Kansas.* CPH Student Research Conference, Omaha, NE, April 7, 2022.
9. **Ramos, A.K.** *Essential agrifood system workers: Unheard, unprotected, and structurally vulnerable during the COVID-19 pandemic.* Invited guest lecture at the St. Louis University School of Law Symposium, April 1, 2022.
10. **Bendixsen, C., Ramos, A.K., & Holmes, S.** *Structural competency in agricultural health and safety.* Presentation at Agricultural Health and Safety Council of America (ASHCA) North American Agricultural Safety Summit, Las Vegas, NV, March 30, 2022.
11. **Klataske, R. & Ramos, A.K.** *Cattle feedyard safety culture.* Poster presentation at Agricultural Health and Safety Council of America (ASHCA) North American Agricultural Safety Summit, Las Vegas, NV, March 29, 2022
12. **Ramos, A.K.** *Health and well-being of Latino immigrant cattle feedyard workers in the central states region.* Invited guest lecture for the UNL Minority Health Disparities Initiative, March 16, 2022.
13. **Sanchez, M.J. & Ramos, A.K.** *Association between pain and mental health conditions among Latino immigrant cattle feedyard workers.* Poster presentation at the Midwest Rural Agricultural Safety and Health conference, November 11, 2021.
14. **Carvajal-Suarez, M. & Ramos, A.K.** *A snapshot of Immigrant Hispanic women working in feedlots in the Midwest of the U.S.* Poster presentation at the Midwest Rural Agricultural Safety and Health conference, November 9, 2021.
15. **Ahmed, R. & Ramos, A.K.** *Injury-related lost productive time and treatment among Latino immigrant cattle feedyard workers in the central states region of the United States.* Poster presentation at the Midwest Rural Agricultural Safety and Health conference, November 9, 2021.
16. **Ramos, A.K.** Moderator for a panel presentation “*Raising the cloak of invisibility for vulnerable populations.*” Midwest Rural Agricultural Safety and Health (MRASH) Conference, November 9, 2021.
17. Galindo, S., **Ramos, A.K.**, Sampson, S., & Simon, R. *COVID-19 vaccine perceptions among agricultural, fishing, and forestry (AgFF) audiences.* Southeastern Coastal Center for Agricultural Safety and Health webinar, August 25, 2021.
18. **Ramos, A.K.** *Safety culture in agriculture: Findings from cattle feedyards.* ASHCA AgSharp Training program, Lincoln, NE, August 18, 2021.
19. **Ramos, A.K.** *Engaging with diverse people: Practical tools for outreach and education.* Invited presentation at American Society for Agricultural and Biological Engineers (ASABE) annual conference, July 13, 2021.
20. Girdžiūtė, L. & **Ramos, A.K.** *International perspectives: Immigrant safety.* Invited keynote presentation at the International Society for Agricultural Safety and Health (ISASH) annual conference on June 23, 2021
21. **Ramos, A.K. & Carvajal-Suarez, M.** *Occupational and discrimination-related stressors among immigrant cattle feedyard workers in the Central States region.* Presentation at the Cambio de Colores annual conference, June 18, 2021.
22. **Ramos, A.K.** *Health, well-being, and protections of essential workers during the COVID-19 pandemic.* Presentation for Community conversations at Institute for Healing Justice and Equity at St. Louis University, April 27, 2021.
23. McGinley, M., **Ramos, A.K.**, & Carlo, G. (2021). *Workplace predictors of immigrant cattle feedlot workers' social well-being.* Poster presentation at the Midwest Regional American Psychological Association Conference, April 24, 2021.
24. **Ramos, A.K.** *The ghosts in our fields: Migrant farmworker health in Nebraska.* Presentation at the 2021 Nebraska Conference on Health Equity, April 23, 2021.
25. **Ramos, A.K.** *Adapting programming for migrant and seasonal farmworkers and their families.* Presentation for Progressive Agriculture's Booster Session on Special Audiences, April 15, 2020.

26. Holmes, C., Gladney, S., Garay, R., & **Ramos, A.K.** *Connecting with farmworkers during the COVID-19 pandemic: Using research to elevate their voices*. Presentation at the 2021 Virtual Forum for Migrant and Community Health, March 26, 2021.
27. Adhikari, S., Yoder, A.M., **Ramos, A.K.**, & Rautiainen, R.H. (2021). *Feedyard 15: An ongoing project aimed to improve safety and health in the cattle feeding industry*. Poster presentation at ASCHA Safety Summit, March 22-24, 2021.
28. **Ramos, A.K.**, Adhikari, S., Yoder, A.M., & Rautiainen, R.H. *Occupational injuries among Latino/a immigrant cattle feedyard workers in the central states region of the United States*. Poster presentation at ASCHA Safety Summit, March 22-24, 2021.
29. **Ramos, A.K.**, Greer, A., Salzwedel, M., Crawford, K., Corwin, C., & Grzywacz, J.G. (2021). *Recommendations for efficient rollout of COVID-19 vaccine in the agricultural sector*. Poster presentation at the ASHCA Safety Summit, March 22-24, 2021.
30. **Carvajal-Suarez, M.** & **Ramos, A.K.** (2020). *An intersectional description of Latina immigrants working on cattle feedyards in the United States*. Women and Gender in Development Virtual Conference, February 23-26, 2021.
31. **Ramos, A.K.** *COVID-19, health disparities, and essential workers: A recurrent reminder of racial inequities in the United States*. Invited presentation for the UNL CEHS Racial Literacy Roundtable, February 17, 2021.
32. **Ramos, A.K.** *Health and well-being of immigrant and migrant farmworkers in the United States*. Guest lecture for AgriSafe Nurse Scholar program, February 12, 2021.
33. **Ramos, A.K.** *Immigrant farmworker health*. CS-CASH Poultry Grower Roundtable, January 21, 2021.
34. **Ramos, A.K.** *Changing demographics and changing behavior*. Panel presentation, Midwest Rural Agricultural Safety and Health Conference, November 20, 2020.
35. **Ramos, A.K.** & **Carvajal-Suarez, M.** *Work-related opportunities and safety perceptions among Latino immigrant cattle feedyard workers with a TN visa*. Midwest Rural Agricultural Safety and Health Conference, Virtual event, November 18, 2020.
36. **Ramos, A.K.** *Concerns and perceptions related to COVID-19 of Midwestern meat processing facility workers*. Human/e Health and Healthcare (HHH) Symposium, Creighton University, October 24, 2020
37. Galindo, S., Sampson, S., & **Ramos, A.K.** *Impacts of COVID-19 on Extension agents in the United States*. Southeastern Coastal Center State of the Science, September 18, 2020.
38. Oatman, J., Yoder, A., **Ramos, A.**, Keenan, M., & Rautiainen, R. *Improving safety and health in the cattle feedyard industry*. International Society for Agricultural Safety and Health (ISASH) Annual Conference, July 16, 2020.
39. **Ramos, A.K.** Moderator for international panel, *How has your approach to health and safety changed due to COVID-19?* at the International Society for Agricultural Safety and Health Annual Conference, July 9, 2020.
40. **Ramos, A.K.** & Yoder, A.M. *Protecting livestock workers from COVID-19*. Presented on the AgriSafe COVID-19 Ag Think Tank, April 23, 2020.
41. **Ramos, A.K.** *Feedlot safety: Opportunities and resources*. UNL Beef Feedlot Roundtable, West Point, NE, February 20, 2020.
42. **Ramos, A.K.** *Alcohol and job-related injuries: Preliminary findings from Latino immigrant cattle feedyard workers in the Central States region*. Midwest Rural Agricultural Safety and Health Conference, Marshalltown, IA, November 13, 2019.
43. **Ramos, A.K.**, **McGinley, M.**, **Grant, K.M.**, & **Carlo, G.** *Work factors and health outcomes among Latino immigrant cattle feedyard workers in the Central States region*. Poster presentation at Work, Stress, and Health Conference, Philadelphia, PA, November 9, 2019.
44. **Ramos, A.K.** *Physical and mental health of immigrant farmworkers: Effective approaches to promoting well-being*. Invited presentation at the Western Agricultural Safety and Health Conference, Seattle, WA, August 7, 2019.
45. **Ramos, A.K.** *Immigration-related fear, mental health, and challenges in health and safety research*. International Society for Agricultural Safety and Health Annual Conference, Des Moines, IA, June 27, 2019.

46. **Ramos, A.K., Carlo, G., Grant, K.M., & Carvajal-Suarez, M.** *Latino immigrant workers' perceptions of safety climate on cattle feedyards in the Midwest.* Poster presentation at the International Society for Agricultural Safety and Health Annual Conference, Des Moines, IA, June 25, 2019.
47. **Ramos, A.K.** *Immigration-related fear and psychological well-being: Findings from the health and safety risks among immigrant cattle feedyard workers project.* Cambio de Colores Conference, Columbia, MO, June 6, 2019.
48. **Ramos, A.K.** *Training and integrating vulnerable agricultural workers.* Invited speaker for Safety Culture and Risk Management in Agriculture (SACURIMA), EU COST Action 16123, Kaunas, Lithuania, April 26, 2019.
49. **Ramos, A.K.** *Agriculture, labor, and immigration.* Rural Route Radio, Syndicated radio program (Colorado, Kansas, Missouri, Montana, Nebraska), February 1, 2019.
50. **Ramos, A.K., Carlo, G., Grant, K.M., & Bendixsen, C.** *Immigration-related fear: A growing concern in health and safety research.* Poster presentation at the Midwest Rural Agricultural Health and Safety Conference, Council Bluffs, IA, November 28, 2018.
51. **Ramos, A.K., Carlo, G., Grant, K.M., & Carvajal-Suarez, M.** *Latino immigrant workers' perceptions of safety climate on cattle feedyards.* Poster presentation at the Midwest Rural Agricultural Health and Safety Conference, Council Bluffs, IA, November 28, 2018.
52. **Ramos, A.K.** *Occupational injuries on cattle feedyards in the central states region.* Midwest Rural Agricultural Health and Safety Conference, Council Bluffs, IA, November 28, 2018.
53. **Ramos, A.K., Carlo, G., Grant, K., Fuentes, A., Gamboa, R., & Bendixsen, C.** *Immigrant cattle feedyard worker perspectives on job-related safety training.* Poster presentation at the International Society for Agricultural Safety and Health (ISASH), Halifax, Nova Scotia, Canada, June 27, 2018.
54. **Carlo, G., McGinley, M., Ramos, A.K., Gamboa, R., Fuentes, A., & Grant, K.** *Workplace climate, protective factors, and mental health in Latino immigrant cattle feedlot workers.* Poster presentation at the Cambio de Colores Conference, Kansas City, MO, June 7, 2018.
55. **Grant, K., McGinley, M., Carlo, G., Gamboa, R., Fuentes, A., & Ramos, A.K.** *Substance use among immigrant cattle feedyard workers.* Poster presentation at the Cambio de Colores Conference, Kansas City, MO, June 7, 2018.
56. **Ramos, A.K.** *Health and safety of agricultural worker families: Resources and opportunities.* Nebraska Migrant Education Program Conference, Kearney, NE, April 10, 2018.
57. **Ramos, A.K.** *Migrant and immigrant farmworker health resources and research in the Midwest.* Nebraska Department of Labor Migrant and Seasonal Farmworker Training, Hastings, NE, March 14, 2018.
58. **Ramos, A.K.** *Immigration in agriculture in Nebraska.* Rural Radio Network, Lincoln, NE, November 7, 2017.
59. **Ramos, A.K. & Fuentes, A.** *Community perspectives on research: Experiences in community-engaged research.* Panel presentation for Great Plains IDEa-CTR Scientific Meeting, Omaha, NE, October 23, 2017.

### C.2. Website(s) or other Internet site(s) – include URL(s)

We developed a joint feedyard safety website where both this project and Aaron Yoder's project share information. On the section for this project, we have included our educational materials that have been developed, publications, presentations, and how to contact the project team.

UNMC Feedyard Safety webpage: <https://www.unmc.edu/publichealth/feedyard/index.html>

### C.3. Technologies or techniques NA

### C.4. Inventions, patent applications, and/or licenses NA

### C.5. Other products and resource sharing

Educational aids or curricula

- Bovine TB flyer, <https://www.unmc.edu/publichealth/feedyard/workforce/Bovine-TB-Fact-Sheet-Final-Bilingual.pdf>

- Know Your Rights flyer that discusses safe working conditions, how to report unsafe conditions, discrimination, and immigration concerns. This flyer was disseminated through social media and reached over 12,000 people, <https://www.unmc.edu/publichealth/feedyard/workforce/Resources-Recursos/worker-rights.html>
- Bilingual Feedyard Glossary, <https://www.unmc.edu/publichealth/feedyard/documents/feedlot-dictionary.pdf>
- Bilingual Feedyard Picture Dictionary
- Two COVID-19 infographics: <https://www.unmc.edu/publichealth/feedyard/workforce/Resources-Recursos/COVID-19.html>
- COVID-19 Agricultural Employer and Farmworker Advocate Toolkit, <https://www.unmc.edu/publichealth/feedyard/documents/COVID-19-Training-Toolkit,-04-19-21.pdf>
- COVID-19 Cattle Feeding Facility Playbook, <https://www.unmc.edu/publichealth/feedyard/documents/Cattle-Feeding-Facility-Playbook-FINAL.pdf>
- Nutrition during the COVID-19 pandemic (video + ppt slides): <https://www.unmc.edu/publichealth/feedyard/workforce/Resources-Recursos/COVID-19.html>
- Physical activity during the COVID-19 pandemic (video + ppt slides): <https://www.unmc.edu/publichealth/feedyard/workforce/Resources-Recursos/COVID-19.html>
- Four Feedyard 15 modules (alcohol, fatigue, pain, and managing chronic conditions)

Models

Our team developed an Ecological Stress-Based Model of Immigrant Worker Health and Safety based on various psychological and health behavior theories and tested it throughout the project period. The model was used to explore the relations among contextual, intrapersonal, and culture-related factors and occupational injury, physical and psychosocial health, and social well-being.

**Ramos, A.K., McGinley, M., & Carlo, G.** (2021). The relations of workplace safety, perceived occupational stress, and adjustment among Latino/a immigrant cattle feedyard workers in the United States. *Safety Science*, 139, 105262. DOI: 10.1016/j.ssci.2021.105262

**D. PARTICIPANTS**

**D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID   | S/K | Name          | Degrees(s) | Role | Cal | Aca | Sum | Foreign | Country | SS |
|--------------|-----|---------------|------------|------|-----|-----|-----|---------|---------|----|
| RAMOS.ATHENA |     | Athena Ramos  | PhD, MBA   | PI   | 2.4 |     |     |         |         |    |
| GCARLO       |     | Gustavo Carlo | PhD        | Co-I | 0.7 |     |     |         |         |    |

- Research Team Members: Axel Fuentes, Rodrigo Gamboa, Jose Valles, Antonia Correa, Marcela Carvajal, Natalia Trinidad, Sophia Quintero, Karen Schmeits, Rishad Ahmed, Natalia Trinidad, Priscila Soto Prado, Maria Jose Sanchez Roman, Suraj Adhikari, and Drs. Casper Bendixsen, Ryan Klataske, Sahitya Maiya, Meredith McGinley, Risto Rautiainen, Sheri Rowland, Aaron Yoder

**D.2 Personnel updates**

- a. Level of Effort: NA
- b. New Senior/Key Personnel: NA
- c. Changes in Other Support: NA
- d. New Other Significant Contributors: NA

## E. IMPACT

### E.1 - What is the impact on the development of human resources, if applicable? NA

### E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.

The following data will inform public health practitioners who provide outreach to immigrant feedyard workers.

*Alcohol Use & Occupational Injury.* Alcohol abuse is a significant public health issue and is a leading cause of preventable death in the United States. We assessed alcohol use and abuse using the AUDIT-C, a brief alcohol screening that reliably identifies individuals who are hazardous drinkers or have active alcohol use disorders. We found that about a third of participants (33.2%) reported that they abstained from alcohol. Among our sample, the AUDIT-C mean score was 4.2 (SD = 2.3). Over 60% of respondents were at risk for hazardous drinking (62.9% of men; 44.4% of women). Of hazardous drinkers, 86.6% had been injured on the job compared to 68.6% of those who were not classified as hazardous drinkers. There was a significant difference between those who were classified as hazardous drinkers and those who were not,  $\chi^2 = 6.28, p = .01$ . There are high rates of alcohol use and hazardous drinking among Latino immigrant feedyard workers. Agricultural employers should acknowledge the potential impact of alcohol on workplace safety and take steps to mitigate its negative consequences. Culturally, linguistically, gender-tailored, and literacy-appropriate health education and consistent screening for alcohol use are needed in primary care and community-based settings.

*Ecological Stress-Based Model.* A path model was used to explore the direct and indirect relations among the number of PPE types and the number of training types, safety climate, occupational stress, and mental health and adjustment outcomes (depression, anxiety, need for recovery, and life satisfaction). The overall model fit the data perfectly as we examined the saturated model. The  $R^2$  values for anxiety (.20), need for recovery (.23), and life satisfaction (.12) were statistically significant ( $p$ 's < .01). The  $R^2$  for depression (.06) approached statistical significance ( $p = .07$ ). Except for the correlation between anxiety and life satisfaction, the correlations among all outcome variables were statistically significant and in the expected directions. The number of PPE types and the number of training types were positively and significantly correlated, and both positively and significantly predicted safety climate. Safety climate negatively and significantly predicted occupational stress. Occupational stress significantly and positively predicted depression, anxiety, and the need for recovery, and significantly and negatively predicted life satisfaction. The relations between number of PPE types and training types and the mental health and adjustment outcomes were generally mediated by perception of safety climate and occupational stress.<sup>3</sup>

*Fatigue & Need for Recovery.* Physical fatigue, mental fatigue, and need for recovery were significantly negatively correlated with self-rated health, average hours of sleep, and decision latitude, and significantly positively correlated with pain, average hours worked per day, and job demands. Need for recovery was significantly positively related to weekly income and ever injured. Physical fatigue was significantly negatively correlated with animal handling. A path model was used to explore direct and indirect relations among job characteristics; health, functioning, and sociodemographic covariates; need for recovery; and physical and mental fatigue. The overall model fit the data perfectly as we examined the saturated model. The  $R^2$  values for need for recovery (.40), physical fatigue (.57), and mental fatigue (.35) were statistically significant ( $p$ 's < .001). Need for recovery was significantly positively related to both physical and mental fatigue. Lower self-reported health, experiencing physical pain, not handling animals, and decreased decision latitude were directly related to increased physical fatigue. Fewer number of years working on cattle feedyards, lower education, experiencing physical pain, and increased job demands were directly related to heightened mental fatigue. Being female, experiencing physical pain, an elevated average of hours worked per day, increased job demands, and less decision latitude were directly related to an increased need for recovery. These

significant direct predictors of need for recovery were indirectly related to physical and mental fatigue via need for recovery.<sup>4</sup>

*Immigration-Related Fear Among Workers.* Nearly 50% of workers reported knowing someone who had been threatened with deportation, and 26% reported that Immigration and Customs Enforcement (ICE) agents had visited family, friends, or neighbors. Many reported that ICE had conducted raids at businesses where family and friends work. Nearly a quarter of workers reported that hostile or harmful laws directed towards Latinos had been passed in their local community. Immigration enforcement activities have created a climate of fear among agricultural workers, and there was a significant negative association between ICE visits and workers reporting feeling that their family was safe. In addition to the stress this creates for workers and their families, this has implications for health and safety research and practice, such as for engaging with immigrant participants, developing appropriate community partnerships, and conducting education and outreach activities.

*Job Safety Training.* Approximately 25% of workers reported that they had not received any health or safety training from their current employer, and only about 9% had ever participated in any OSHA safety training program. Videos, in-person training, or shadowing another worker were the most frequent methods of safety training reported by those who had received training. More than 93% were interested in receiving more information about health and safety related to their job. Workers preferred that safety information be provided through in-person training at the job site, videos (particularly those accessible through media sources such as YouTube), and written materials. Specific topics that workers were interested in obtaining more information about included zoonoses, low-stress cattle handling, injury prevention, hazard and injury reporting, chemical and equipment safety, and teamwork. Furthermore, a majority of participants preferred to receive information in Spanish, and some noted that language accessibility prevented them from looking for health and safety resources for themselves.<sup>5</sup>

*Occupational Injuries.* Nearly three-fourths of participants (71.2%) reported having experienced one or more injuries in the past while working on a cattle feedyard. The most frequent types of reported injuries, including those not requiring medical care, were bruises/contusions (40%), cuts/lacerations (21%), and sprains/strains (12%). These injuries were mainly caused by animals/livestock (33%), chemicals (23%), falls (12%), and tools (9%). Significant risk factors for injury included male gender (OR 5.9), being over age 35 (OR 2.6), working on a large or an extra-large feedyard (OR 5.4), having 11 or more employees on the feedyard (OR 3.6), and working more than eight hours a day (OR 4.7). Having received safety training was also associated with greater risk of injury in a univariable model (OR 2.6).<sup>6</sup>

*Occupational Factors Affecting Worker Health.* Decision latitude was significantly positively associated with safety climate and life satisfaction and significantly negatively correlated with work fatigue and anxiety. Workplace demands was significantly positively associated with work fatigue and significantly negatively associated with safety climate. Safety climate was significantly positively associated with life satisfaction and significantly negatively correlated with work fatigue and anxiety. In the decision latitude model, indirect effects were found among decision latitude, work fatigue, and depression (95% CI: -.15, -.04), anxiety (95% CI: -.13, -.04), life satisfaction (95% CI: .07, .26), and physical health (95% CI: .06, .24). In the workplace demands model, indirect effects were found among workplace demands, work fatigue, and depression (95% CI: .08, .26), anxiety (95% CI: .10, .30), life satisfaction (95% CI: -.26, -.07), and physical health (95% CI: -.21, -.05). In the safety climate model, indirect effects were found among safety climate, work fatigue, and depression (95% CI: -.14, -.02), anxiety (95% CI: -.12, -.03), life satisfaction (95% CI: .05, .28), and physical health (95% CI: .04, .20). The findings demonstrate the importance of providing feedyard workers with greater control, fewer demands at work, and a safer work environment to enhance health and well-being.

*Work Safety Climate on Cattle Feedyards.* Workers reported a mean score of 25.8 (SD = 5.0) out of a possible 38 on a safety climate scale,  $\alpha = .83$ . A majority of workers reported that taking risks was part of their job, and over 67% believed that their employer could do more to make their job safer. More than 93% of workers believed that it was likely that they would be injured in the next 12 months at work. Because there are numerous inherent risks on cattle feedyards, creating an environment that highlights management's commitment to safety and engages workers in safety may lead to better long-term outcomes.

**F. CHANGES**

|   |
|---|
| <b>F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures</b><br>NA |
| <b>F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them</b><br>NA                              |
| <b>F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents</b><br>NA                  |

**G. Special Reporting Requirements**

|   |
|---|
| <b>G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements</b>  |
| <b>G.2 Responsible Conduct of Research</b><br>NA  |
| <b>G.3 Mentor’s Research Report or Sponsor Comments</b><br>NA   |
| <b>G.4 Human Subjects</b><br><br>G.4.a Does the project involve human subjects? Yes<br><br>G.4.b Inclusion Enrollment Data<br><br>G.4.c ClinicalTrials.gov NA<br><br>Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA? NA |
| <b>G.5 Human Subject Education Requirement</b><br><br>Are there personnel on this project who are newly involved in the design or conduct of human subject’s research? No   |
| <b>G.6 Human Embryonic Stem Cells (HESCS)</b><br><br>Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?<br>No  |
| <b>G.7 Vertebrate Animals</b><br>Does this project involve vertebrate animals? No   |

|  |
|--|
| <p><b>G.8 Project/Performance Sites</b><br/>University of Nebraska Medical Center, Omaha, NE</p>   |
| <p><b>G.9 Foreign Component</b><br/>No</p>   |
| <p><b>G.10 Estimated Unobligated Balance</b><br/>See financial report.</p> <p>G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget? No</p> |
| <p><b>G.11 Program Income</b><br/>Is program income anticipated during the next budget period?<br/>No.</p>   |
| <p><b>G.12 F&amp;A Costs</b><br/>Is there a change in performance sites that will affect F&amp;A costs?<br/>No.</p>  |

## I. OUTCOMES

Despite the challenge of conducting interviews during the COVID-19 pandemic, the project accomplished its goals of (1) exploring and describing the health status and occupational risks among Latino immigrant cattle feedyard workers in Nebraska and Kansas; (2) testing the Ecological Stress-based Model of Immigrant Health and Safety; and (3) reviewing, developing, evaluating, and disseminating bilingual (English/Spanish) health and safety educational and policy materials designed specifically for cattle feedyard operations. Data for achieving these aims came from 243 interviews with immigrant cattle feedyard workers from 2017 to 2020. Our findings were revealing and potentially impactful on the risk of injury.

We found that over 60% of respondents were at risk for hazardous drinking (62.9% of men; 44.4% of women) and 86.6% of hazardous drinkers had been injured on the job compared to 68.6% of those not classified as hazardous drinkers. We also found that physical fatigue, mental fatigue, and need for recovery were significantly negatively correlated with self-rated health, average hours of sleep, and decision latitude, and significantly positively correlated with pain, average hours worked per day, and job demands. Approximately 25% of workers reported that they had not received any health or safety training from their current employer, and only about 9% had ever participated in any OSHA safety training program. More than 93% were interested in receiving more information about health and safety related to their job. Specific topics that workers were interested in obtaining more information about included zoonoses, low-stress cattle handling, injury prevention, hazard and injury reporting, chemical and equipment safety, and teamwork. Workers reported a mean score of 25.8 (SD = 5.0) out of a possible 38 on a safety climate scale. A majority of workers reported that taking risks was part of their job, and over 67% believed that their employer could do more to make their job safer. More than 93% of workers believed that it was likely that they would be injured in the next 12 months at work. Immigration issues was also a serious stressor. Nearly 50% of workers reported knowing someone who had been threatened with deportation, and 26% reported that Immigration and Customs Enforcement (ICE) agents had visited family, friends, or neighbors.

To address some of these issues, we developed a series of educational resources for Latino immigrant cattle feedyard workers including: (1) a "Know your Rights" bilingual flyer for cattle feedyard workers in Nebraska that discusses safe working conditions, how to report unsafe conditions, discrimination, and immigration concerns, which was disseminated through social media and reached over 12,000 people; (2) a bilingual cattle feedyard picture glossary that is currently being finalized and prepared for dissemination; and (3) drafted four supplemental bilingual modules

(including PowerPoint slides, speaker notes, quiz questions) for the Feedyard 15 program on fatigue, alcohol use, managing chronic conditions, and dealing with pain.

**15. COVER PAGE**

|  |   |
|--|---|
| <b>Project Title:</b><br>Improving Safety and Health in the Cattle Feedyard Industry   |   |
| <b>Grant Number:</b><br>1U54OH010162   | <b>Project/Grant Period:</b><br>September 01, 2016 – August 31, 2022  |
| <b>Reporting Period:</b><br>September 01, 2016- August 31, 2022  | <b>Date Submitted:</b><br>December 22, 2022   |
| <b>Program Director/ Principal Investigator</b><br>Risto Rautiainen, Program Director<br>Aaron Yoder, Principal Investigator | <b>Administrative Official Information</b><br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| <b>Change of Contact PD/PI:</b><br>NA  |   |
| <b>Human Subjects:</b><br>Yes  | <b>Vertebrate Animals:</b><br>No  |
| <b>hESC:</b>   | <b>Inventions/Patents:</b><br>None  |

## B. ACCOMPLISHMENTS

### B.1. What are the major goals of the project?

The long-term goal of this project is to reduce the burden of injuries and illnesses among feedyard workers. The objective of the project is to develop, implement and evaluate a comprehensive feedyard safety and health training program. The Specific Aims of this project are to:

#### **Aim 1: Develop and implement a comprehensive feedyard safety and health training program**

To accomplish this specific aim, we are:

- a) Reviewing and developing bilingual training materials for a comprehensive feedyard worker safety and health training program;
- b) Obtaining qualitative information about the safety culture among feedyard managers and workers using the multi sited ethnography method; and
- c) Refining and implementing the comprehensive safety and health training program at fifteen participating feedyards in Nebraska and the region

#### **Aim 2: Evaluate the efficacy of the comprehensive feedyard safety and health training program**

To accomplish this specific aim, we are:

- a) Evaluating the injury and illness experience in the beef production industry using existing and newly collected injury and illness information; and
- b) Evaluating the effectiveness of the feedyard safety and health training program in reducing the number and cost of injuries and illnesses and improving the safety culture on participating feedyards.

This project addresses the health and safety of workers in a hazardous industry subsector that has not benefitted from major research efforts to date. The project will demonstrate the efficacy of a new safety and health program aiming to reduce the high risk of injuries among feedyard workers. CS-CASH has established a network of stakeholders that are able to expand the use of this evidence-based program in livestock operations. The proposed research has high potential to reduce the exceptionally high rates of injury and illness among vulnerable workers in the cattle feedyard industry.

### B.2. What did you accomplish under these goals?

Based on data collected from the pilot grant projects, roundtable discussions, and many meetings with industry workers, managers, and owners, long-term goals, objectives, and aims for a 5-year project (2017-2022) were developed. The goal was to reduce the burden of injuries and illnesses among feedyard workers. The program's objective was to develop, implement and evaluate a comprehensive feedyard safety and health training program. This project aimed to bring together a group of experts in feedyard management, cattle and equipment handling safety, worker training, and research to develop a feedyard safety and health training program and evaluate the efficacy of the safety and health training programs.

This research is ongoing; data collection will be completed in August 2022. Data analysis and manuscript development will be completed in fall 2022. Progress on each of the project research aims follows.

**Feedyard Safety Advisory Board (FSAB)** The Feedyard Safety Advisory Board (FSAB) was established in 2017. FSAB members in 2021 are shown in Table 1. The Board meets twice a year. In 2020 and 2021, during the COVID-19 pandemic, meetings were held via Zoom. One meeting a year is held in conjunction with the Nebraska Cattlemen's Conference. The FSAB has provided valuable input and expert content on the Feedyard 15 training modules, input into feedyard injury surveillance, and valuable assistance with recruiting participating feedyards. The FSAB is a working Board with the members being actively involved in every aspect of the project. Many members have expressed interest in serving on the proposed safety culture and safety climate project.

Table 1. CS-CASH Feedyard Safety Advisory Board 2021

| <b>FSAB Advisor</b> | <b>Affiliation</b>                           |
|---------------------|--|
| Jo Bek              | Nebraska College of Technical Agriculture    |
| Kelly Bruns         | Nebraska Extension                           |
| Meredith Cable      | Nebraska College of Technical Agriculture    |
| Mike Drinnin        | Nebraska Cattlemen                           |
| Rob Eirich          | Nebraska Beef Quality Assurance/NE Extension |
| Dale Grotelueschen  | Great Plains Veterinary Education Center     |
| Susan Harris        | Nebraska Extension                           |
| Joanna Hergenreder  | Nebraska College of Technical Agriculture    |
| Mike Keenan         | Arthur J. Gallagher Co.                      |
| Steve Krull         | Medicine Valley Vet Hospital                 |
| Jerry Kuenning      | Nebraska Cattlemen Feedlot Council           |
| Dan Lee             | Agri-Services Agency                         |
| Barb Miller         | Adams Land and Cattle                        |
| Tom Noffsinger      | PAC DVMS                                     |
| John Roberts        | Nebraska Cattlemen                           |
| Nate Sawicki        | Gottsch Feedyards                            |
| Norbert Schneider   | Innovative Livestock                         |
| Aaron Spanier       | Innovative Livestock                         |
| Dean Wilken         | Nebraska Cattlemen Feedlot Council           |

### **Data Collection - Burden of Injury and Fatalities and Need for Safety Interventions**

Conducting Ethnographic Research. To document and explore emerging issues on feedyards, Dr. Ryan Klataske and Dr. Casper Bendixsen used a rapid multi-sited ethnographic approach to research involving interviews and participant observation. This research involved visiting multiple feedyards, participating in related events, and interviewing and interacting with a wide range of individuals, including workers, managers, workers' compensation experts, and other stakeholders. It focused on exploring multiple areas of feedyard operation and incorporating a diversity of voices to understand better the experiences, perspectives, and needs of workers related to safety and health. Their ethnographic research has contributed to the project by providing "thick descriptions" (Geertz 1973) of feedyards, stakeholder narratives, social and cultural context, as well as insights on the cultural diversity of workers and various social and cultural dimensions of feedyard safety. Klataske and Bendixsen have contributed to project team discussions and highlighted emerging issues, questions, and opportunities for improving safety, health, and training. Their ethnographic findings have complimented the team's quantitative data by documenting worker experiences and perspectives. Some of their findings are detailed in a manuscript currently under review in a peer-reviewed journal (Klataske and Bendixsen 2022). An overview of these findings was presented to the International Society for Agricultural Safety and Health (Klataske 2021). This ethnographic research was shaped by Klataske and Bendixsen's personal and professional backgrounds in ranching, agriculture, and rural life. This rural heritage and experience allowed them to build trust and rapport with feedyard workers and managers, which will help to facilitate future research. Feedyards were recruited for ethnographic research through recommendations from the FSAB and recruitment at Cattlemen's conventions and other industry meetings.

Survey of Feedyard Managers and Workers. A survey of feedyard managers, safety trainers, and operators was conducted to determine the cattle feeding industry's safety training practices and preferences. We found that only half of respondents had dedicated safety personnel; however, there was interest in a safety training program conducted through short hands-on and in-person methods with materials available in English and Spanish. Most

participants were also interested in a feedyard safety certification program. Participants reaffirmed the importance of partnering with industry and other stakeholders when conducting these programs. These results were published (Ramos, Duysen, Yoder 2019) and used to guide the development of feedyard safety training modules and the corresponding recognition program for feedyards and feedyard workers as part of the "Improving Safety and Health of Cattle Feedyard Workers" project.

Data from Project Partners - Workers' Compensation and Descriptive Injury Information. An essential partner in this research, and member of the FSAB, is Mike Keenan, the loss prevention expert at Gallagher Insurance Company. Gallagher Insurance represents Agri-Services Agency (ASA), one of the largest insurers of feedyards in the U.S. Mr. Keenan has provided valuable baseline injury and cost data from feedyards in the form of Workers' Compensation claim data and internal insurance cost analysis. ASA uses these data to set the feedyard's Workers' Compensation costs. For this study, these data are valuable to determine the burden of injuries (example: employee's days lost off work, type and extent of injury, overall rates of injury by source) and determine if safety training and interventions can reduce these rates. Feedyards enrolled in the project intervention arm were all insured by ASA, thereby ensuring access to these valuable data. An example of the unpublished data provided by ASA to CS-CASH researchers can be found in Table 2. Data will continue to be collected from participating feedyards through August 2022. Data from the 5-year study will be analyzed and published in fall 2022.

Table 2. Cumulative incurred costs by most frequent injury cause of 404 injuries occurring at 15 intervention feedlots from 2016-2021.

| Cause of Injury            | Number Injured | % of Total Injuries | Median Cost (\$) | Maximum Cost (\$) |
|----------------------------|----------------|---------------------|------------------|-------------------|
| <b>Animal</b>              | 129            | 31.9                | 749              | 187,207           |
| <b>Falls, slips, trips</b> | 62             | 15.3                | 1,967            | 99,948            |
| <b>Machinery</b>           | 25             | 6.2                 | 1,455            | 81,005            |
| <b>Struck by object</b>    | 14             | 3.5                 | 1,341            | 145,145           |
| <b>All other causes</b>    | 97             | 24.0                | 913              | 5,727,123         |
| <b>Cause unknown</b>       | 77             | 19.1                | 445              | 215,066           |

Data from existing and newly collected injury and illness information.

In addition to collecting insurance data on feedyard injuries and fatalities, data is collected yearly from the Bureau of Labor Statistics, the CS-CASH Injury Surveillance project, and the CS-CASH News Clip Service, thereby providing robust data for the feedyard project, information on emerging issues, and data for use in educational resources.

**Research Methods and Outcomes – Feedyard 15 Training.** The Feedyard Safety Project team and a panel of content experts developed 15 training modules (Feedyard 15) that were subsequently used for training on 21 intervention ASA-insured feedyards. Feedyards and workers completing training receive commendations. After the research project, Workers’ Compensation claims, injuries, and fatalities will be analyzed using baseline data. Intervention data will be compared to the control group, ASA-insured feedyards not enrolled in the training program.

Development of the English and Spanish Language Feedyard 15 Training Modules.

Using Workers’ Compensation data from ASA, the research team determined the 15 most hazardous jobs, processes, and equipment on the feedyard and developed these into 15 PowerPoint presentations with comprehensive training dialogues attached in the presenter section of the slides. Training resources are included with each training. Handouts are available of each module along with supplementary resources.

1. Slips Trips and Falls
2. ATVs/UTVs
3. Feedmill Safety
4. Mobile Equipment/Autos
5. Tractor/Loader
6. Cattle Handling/Stockmanship
7. Processing Cattle
8. Horsemanship
9. Emergency Response
10. Extreme Weather
11. Chemical Hazards
12. Machine Shop Hazards
13. Electrical Hazards
14. Bunker Silos/Silage Piles
15. Manure Lagoons

Fig.2. Feedyard 15 Training Topics

Content experts were paid to create content for the modules. Each module is created on a standardized template with regionally appropriate images and consideration for literacy levels. Each module has been translated into Spanish by a Spanish-speaking safety expert. Translations are verified by the project coordinator, who is proficient in Spanish. Included at the end of each module is a 10 question “learning” quiz that can be used to test comprehension and reinforce learning. Each module was reviewed by the CS-CASH research team prior to release and is evaluated by the feedyard 15 trainers after use. The Feedyard 15 training topics are shown in Figure 2.

**Supplemental Modules.** In response to feedyard incidents or needs to train on a particular topic, additional modules were requested by the Feedyard 15 trainers. The following modules were created and added to the Feedyard 15 curriculum – managing chronic health conditions, fatigue, pain, and alcohol.

**Customized Modules.** Feedyards can customize the modules by requesting additional content, customized images, feedyard logos, or other modifications that are approved by the research team.

**Trainers.** Upon request, trainers for the Feedyard 15 modules may be provided by the Feedyard Safety Research team, including a Spanish-speaking training trainer. Many of the larger feedyards have an employee designated as a safety trainer. This individual will conduct the training, documentation, and evaluation of the modules. A third alternative is to have the feedyard’s Gallagher Insurance safety professional conduct the training. A number of the feedyards have used this option.

**Enrollment.** A total of 15 companies representing 21 feedyards, with 2,288 employees in 7 states (CO, ID, KS, NE, OK, SD, UT) were recruited into the Feedyard 15 intervention group of the research program. Enrolled feedyards agreed to the following.

- Feedyards agree to use the Feedyard 15 training modules at least once a month for training.
- Feedyards can prioritize the modules they will use for training each month and whether they train in English or Spanish.
- The trainer records each training and the number of attendees. They are also asked to evaluate the training and the module on a standardized evaluation document. These documents are returned to the project coordinator and are recorded in the research database.
- Modules are considered to be “living documents” and are edited if there is a need to add, edit, or customize materials.
- Workers will receive Feedyard 15 branded personal protective equipment and incentives from the research team after the 1st, 3rd, 6th, 9th, and 12th training. This equipment includes Feedyard 15 safety yellow hats, decals, vests, multi-tool, and lunch bags. In addition, after completing 12 documented training modules, the worker receives a certificate of commendation. Workers are encouraged to add this training to their resumes. Examples of training incentives are shown in Figure 3.
- After conducting 12 training sessions, the participating Feedyard receives a framed certificate of commendation. Commendations can be used to document training for insurance and inspection purposes.



Fig. 3. Feedyard 15 safety hat and vest training incentives

**Feedyard Trainings.** Feedyard safety trainers have reported a total of 2,056 contact hours of training. Evaluations of the modules have been good. Concerns and comments from trainers and feedyard managers are addressed quickly, and requested changes are discussed during the bi-monthly Feedyard Safety project meetings.

**COVID-19 Pandemic Effect on Trainings and Research.** In March 2020, many feedyards halted face-to-face safety training to limit worker contact and exposure, thereby affecting the training research as data collection was halted for over a year. The research team maintained contact with all training sites during the pandemic. Many training sessions

have resumed, and it is anticipated that they will continue through the end of this project, allowing sufficient data collection for research conclusions to be drawn.

Creation of the COVID-19 Playbook for Feedyard Facilities. With trainings halted in 2020 due to the pandemic, the CS-CASH team, in collaboration with the UNMC Global Center for Health Security (GCHS), created a COVID-19 Feedyard Facilities Playbook (CS-CASH, 2020) This book provided feedyard managers and safety professionals a guide to reduce exposures by engineering controls and provided recommendations for personal protective equipment for workers (see Figure 4). The books were disseminated in electronic format via email and mailed to over 400 feedyards across the U.S. This document is updated as needed and is housed on the CS-CASH and GCHS websites as an enduring resource.

#### Additional Resources Developed

During the project, the feedyard safety team developed resources for all feedyards.

- Many of these resources are housed on the Feedyard Worker Safety Website <https://www.unmc.edu/publichealth/feedyard/index.html>
- A Flickr Feedyard Photo Site was created to provide photos to safety professionals and the public in educational materials and on social media. These high-quality photos are copyright-free and provided free of charge. <https://www.flickr.com/photos/cscash/albums/72157708569289865>
- To supplement Spanish Language Safety Resources: Spanish language resources for feedyard safety training are available on the CS-CASH website. <https://www.unmc.edu/publichealth/cscash/resources/spanish-resources.html>

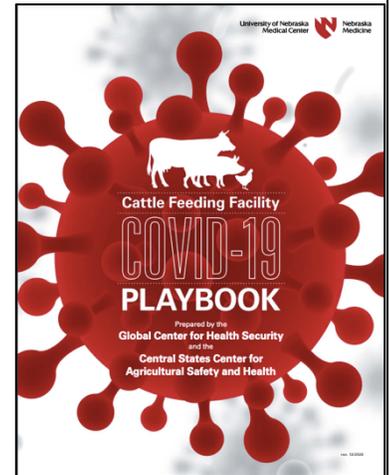


Fig. 4. COVID-19 Playbook for Cattle Feeding Facilities.

#### ***Improving Safety and Health in the Cattle Feedyard Industry Results to Date***

The research project is ongoing, with data collection proceeding through August 2022. However, some results can be discussed at this point, including:

- Developed a Feedyard Safety Advisory Board that was actively engaged in the development, implementation, evaluation, and dissemination of research components. Many members have expressed interest in continuing to work with the research team on the current proposal investigating methods of improving safety culture and safety climate on feedyards and assisting with nationwide dissemination of the no-cost Feedyard 15 training;
- Created the Feedyard 15 safety and health program model that has been accepted by the feedyard industry, both employers and employees;
- Collaborated with insurers of feedyards and have been able to access their clients to recruit study sites;
- Accessed Workers' Compensation data that will be used to evaluate the effectiveness of the intervention, using retrospective and prospective data for the study sites;
- Estimated the burden of injuries and illnesses in the cattle feedyard sector using data generated in the project as well as national data from available sources;
- Applied the Rapid Multi-Sited Ethnography (job shadowing) for qualitative data collection at study sites to investigate worker perspectives on injury, illness, prevention, and program impact; and
- Developed a first-of-its-kind feedyard commendation process for program sustainability, created, reviewed, and managed by a network of feedyard stakeholders and safety and health experts.

This project has significantly expanded the current knowledge of injury characteristics and burden of injury and employer and employee views regarding injury prevention on feedyards. The project team collaborated with industry and insurance partners to create a new evidence-based program model that can be implemented widely in the cattle feedyard industry. An evaluation of the effectiveness of the feedyard safety and health training program to reduce the number and cost of injuries and illnesses and improve the safety culture on participating feedyards is ongoing.

The CS-CASH Feedyard Worker Safety Team looks forward to continuing innovative, impactful work proposed for the 2022-2027 funding cycle. The proposed project addresses safety culture and safety climate on feedyards and will develop and expand the Feedyard 15 program based on the worker, manager, and industry stakeholder experiences. Managing a plan to make the program available at no cost to registered online users will also allow smaller feedyards with limited resources for safety training to benefit from this resource. The proposed research has a high potential to reduce the exceptionally high rates of injury and illness among vulnerable workers in the cattle feedyard industry.

#### B.2.1.3 Significant results

The findings of the US BLS data analysis were presented at professional meetings and published in peer reviewed journals.

The monthly meetings of the core and entire project teams has led to the discovery of additional resources and the design of a comprehensive safety and health training program, the Feedyard 15.

#### B.3. Competitive Revisions/Administrative Supplements

NA

#### B.4. What opportunities for training and professional development did the project provide?

This project was centered around training not just feedyard workers but safety professionals as well. During the project period the research team trained feedyard safety managers on 13 feedyards and trained 4 Gallagher Insurance loss prevention trainers to present and evaluate the Feedyard-15 training modules.

The materials developed from this project have been used in several of the ASHCA AgSHARP workshops to train safety managers, insurance risk control advisors and various other industry members.

#### B.5. How did you disseminate the results to communities of interest?

The results from this program have been disseminated at professional meetings, through peer reviewed publications and probably most importantly through trade journals. The Nebraska Cattlemen's magazine have run feature articles based on the Feedyard-15 training modules in 6 issues. Feedyard safety articles have been written by CS-CASH Loretta Sorenson. These have been widely disseminated through AP sources to rural media. A list of the media releases can be found at <https://www.unmc.edu/publichealth/cscash/newsandevents/index.html>

#### B.6 - What do you plan to do during the next reporting period to accomplish the goals?

Not applicable as this is the close-out report.

### C. Products

#### C.1. Publications, conference papers, and presentations

Ramos, A.K., Duysen, E., & Yoder, A.M. (2019). Identifying safety training resource needs in the cattle feeding industry in the Midwest. *Safety*, 5, 26. DOI: 10.3390/safety5020026

Ramos, A. K., Adhikari, S., Rautiainen, R., & Yoder, A. (2022). Protecting cattle feedyard workers in the Central States region: Exploring state, regional, and national data on fatal and nonfatal injuries in agriculture and the beef production sector. *The Journal of Extension*, 60(3), Article 13. <https://doi.org/10.34068/joe.60.03.13>

Ramos,A.K.;Adhikari,S.; Yoder, A.M.; Rautiainen, R.H. Occupational Injuries among Latino/a Immigrant Cattle Feedyard Workers in the Central States Region of the United States. *Int. J. Environ. Res. Public Health* 2021, 18, 8821. <https://doi.org/10.3390/ijerph18168821>

Book Chapter.

Taming Occupational Stress among Farmers in Developing Nations (2019). Toyin Samuel Olowogbon, Aaron M Yoder, Segun B. Fakayode and Abraham O. Falalo

Survey: Only half of feedyards have dedicated safety personnel

- <https://www.unmc.edu/news.cfm?match=24118>

Raising the bar on feedlot employee safety

- <https://www.progressivecattle.com/topics/management/raising-the-bar-in-feedlot-employee-safety>

Five things to know about efforts to increase feedlot safety

- <https://www.progressivecattle.com/topics/facilities-equipment/five-things-to-know-about-efforts-to-increase-feedlot-safety>

Presentations, Media, Articles (relevant to project) and Meetings

| Start Date | Title  | Location   | Authors/Presenters  |
|------------|--|--|---|
| 12/7/2021  | Feedyard Safety Advisory Board Meeting                       | Advisory Board Meeting and training at the Nebraska Cattlemen's Conference | Aaron Yoder, Risto Rautiainen, Athena Ramos, Ellen Duysen |
| 6/19/2021  | Improving Safety and Health in the Cattle Feedyard Industry, | 2020 ISASH Conference Oral presentation                                    | Oatman, Jill, Athena Ramos, Mike Keenan & Aaron Yoder     |
| 12/5/2020  | Feedyard Safety Advisory Board Meeting                       | Advisory Board Meeting and training at the Nebraska Cattlemen's Conference | Aaron Yoder, Risto Rautiainen, Athena Ramos, Ellen Duysen |
| 12/4/2019  | Feedyard Safety Advisory Board Meeting                       | Advisory Board Meeting and training at the Nebraska Cattlemen's Conference | Aaron Yoder, Risto Rautiainen, Athena Ramos, Ellen Duysen |
| 11/28/19   | Improving Safety and Health in the Cattle Feedyard Industry  | MRASH Conference   | Jill Oatman   |
| 6/22 2019  | Safety and Health Practical Solution for the                 | 2019 ISASH Conference  | Yoder, Ramos, Duysen, Rautiainen                          |

|                  |   |  |  |
|------------------|---|--|--|
| <b>1/3/2019</b>  | Feedyard Industry Agricultural stressors: identification, causes and perceived effects among Nigerian crop farmers.               | Oral presentation<br>Journal of AgroMedicine                               | Olowogbon TS, Yoder AM, Fakayode SB, Falola AO                                       |
| <b>12/6/2018</b> | Feedyard Safety Advisory Board Meeting  | Advisory Board Meeting and training at the Nebraska Cattlemen's Conference | Aaron Yoder, Risto Rautiainen, Athena Ramos, Ellen Duysen                            |
| <b>9/1/2018</b>  | National Research and Extension Agenda for Agricultural Safety and Health Assessment.   | Journal of AgroMedicine  | Gorucu S, Murphy D, Yoder A, Pate M.   |
| <b>8/1/2018</b>  | Developing a feedlot safety training program Article - 2 full page color  | Nebraska Cattlemen's Magazine August 2018 edition                          | Loretta Sorensen   |
| <b>6/27/2018</b> | Improving safety and health of the workforce in the cattle feeding industry   | 2018 ISASH oral presentation   | Kent, D., Duysen, E., Rautiainen, R., Ramos, A., Yoder, A. Keenan, M., Bendixson, C. |
| <b>2/21/2018</b> | Improving Feedyard Worker Training to Reduce Injuries and Fatalities - Phase 1 of a Research and Insurance Industry Collaborative | Nebraska Women in Agriculture presentation                                 | Ellen Duysen   |
| <b>2/9/2018</b>  | Feedyard Safety Planning Meeting  | Advisory Board Meeting at the Nebraska                                     | Aaron Yoder, Dan Kent, Athena Ramos, Ellen Duysen                                    |



Project Participants: Dr. Risto Rautiainen, Dr. Gleb Haynatzki, Daniel Kent, Suraj Adhikari, Gordon Moore, Dr. Casper Bendixsen, Loretta Sorensen, Rodrigo Gamboa

#### **D.2 Personnel updates**

- a. Level of Effort:
- b. New Senior/Key Personnel: NA
- c. Changes in Other Support: NA
- d. New Other Significant Contributors: N

### **E. IMPACT**

**E.1 - What is the impact on the development of human resources, if applicable?**  
NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**  
None

### **F. CHANGES**

**F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**  
None

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**  
None

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**  
None

### **G. Special Reporting Requirements**

**G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements**

**G.2 Responsible Conduct of Research**  
NA

**G.3 Mentor's Research Report or Sponsor Comments**  
NA

**G.4 Human Subjects**

G.4.a Does the project involve human subjects?

No

G.4.b Inclusion Enrollment Data

NA

G.4.c ClinicalTrials.gov

No

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

No

#### **G.5 Human Subject Education Requirement**

Are there personnel on this project who are newly involved in the design or conduct of human subject's research?

No

#### **G.6 Human Embryonic Stem Cells (HESCS)**

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

#### **G.7 Vertebrate Animals**

Does this project involve vertebrate animals?

No

#### **G.8 Project/Performance Sites**

University of Nebraska Medical Center, Omaha, NE

#### **G.9 Foreign Component**

No

#### **G.10 Estimated Unobligated Balance**

**See Financial Report.**

G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?

No

#### **G.11 Program Income**

Is program income anticipated during the next budget period?

No

#### **G.12 F&A Costs**

Is there a change in performance sites that will affect F&A costs?

No

## I. OUTCOMES

I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets

Note: project outcome information will be made public in NIH RePORTER

In 2017 the CS-CASH research project - *Improving Safety and Health in the Cattle Feedyard Industry* was funded. The objectives of this project were to gather data to better understand the burden of injuries and fatalities on feedyards, to develop a network of stakeholders and a training program that improved the safety and health of feedyard workers, thereby reducing Workers' Compensation costs for participating feedyards. This research project has been significantly enhanced by collaboration with safety specialists from Gallagher Insurance, a provider for most feedyards in the Midwest. Expertise, advice and guidance has come from the project's Feedyard Safety Advisory Board (FSAB). The FSAB, made up of 19 feedyard owners, workers, veterinarians, safety specialists, and allied industry representatives, meets bi-yearly to discuss progress and offer recommendations. Enrollment in the intervention arm of the research totals 15 companies representing 21 feedyards, with 2,288 employees in 7 states (CO, ID, KS, NE, OK, SD, UT). A snapshot of the project results to date are shown below.

- Developed a Feedyard Safety Advisory Board that has been actively engaged in the development, implementation, evaluation, and dissemination of research components;
- Created the Feedyard 15 worker safety training model that has been reviewed, evaluated, and now in use by feedyard employers, trainers and employees;
- Feedyard safety trainers have reported a total of 2,056 contact hours of training using the Feedyard 15 training modules. Evaluations of the modules by workers and trainers have been good.
- Collaborated with insurers of feedyards and have been able to access insurance and injury data;
- Accessed Workers' Compensation data that will be used to evaluate the effectiveness of the intervention, using retrospective and prospective data for the study sites;
- Estimated the burden of injuries and illnesses in the cattle feedyard sector using data generated in the project as well as national data from available sources;
- Applied the Rapid Multi-Sited Ethnography (Job Shadowing) for qualitative data collection at study sites to investigate worker perspectives on injury, illness, prevention, and program impact; and
- Developed a first-of-its-kind feedyard commendation process for program sustainability, created, reviewed, and managed by a network of feedyard stakeholders and safety and health experts.

**A. Cover Page**

|  |  |
|--|--|
| Project Title:<br>Agricultural Dust-Induced Airway Injury and Repair: An IL10 Centered Approach                      |  |
| Grant Number:<br>1U54OH010162  | Project/Grant Period:<br>September 01, 2016 – August 31, 2022  |
| Reporting Period:<br>September 01, 2016- August 31, 2022   | Date Submitted:<br>December 22, 2022   |
| Program Director/ Principal Investigator<br>Risto Rautiainen, Program Director<br>Todd Wyatt, Principal Investigator | Administrative Official Information<br>Bethany DeCarolus, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| Change of Contact PD/PI:<br>NA   |  |
| Human Subjects:<br>No  | Vertebrate Animals:<br>Yes   |
| hESC:  | Inventions/Patents:<br>None  |

**B. ACCOMPLISHMENTS****B.1. What are the major goals of the project?**

1. Characterize the role of IL-10 in governing the post-inflammatory homeostasis repair and recovery response in an animal model of agriculture organic dust-induced airway injury.
2. Identify the mechanism(s) of scavenger receptor A (CD204) in regulating the IL-10 response to agricultural dust using in vitro cell models and in vivo animal models.
3. Determine the relationships between systemic IL-10 levels, IL-10 pathway genetic polymorphisms, and pro-inflammatory cytokine hyper-responsiveness in persons with prior agricultural exposure.

**B.2. What did you accomplish under these goals?**

We have completed all three aims. Over the funding period of this award, we have published 40 peer-reviewed manuscripts and 55 abstracts/presentations either directly or indirectly related to the project. By creating a novel murine model of agricultural dust-induced inflammatory lung disease incorporating ovalbumin induced allergy in mice, we are now able to examine allergic inflammation in the context of the agricultural occupational dust environment. We have now published this work in the journal Respiratory Research.

Next, we have made significant progress into the mechanisms of agricultural dust-mediated injury. We have published our work in defining the role that exosomes play in the inflammatory response to dust injury in the Journal of Nutritional Biochemistry. We have begun evaluating the impact of dietary zinc in dust mediated lung inflammation through exploiting a murine model of zinc deficiency through the zinc transporter (zip8) knockout mouse. Our first findings in this area have also been recently published in the Journal of Nutritional Biochemistry. Lastly, we are proceeding with our studies of repair and recovery through examining the amphiregulin response to dust injury in lung. These studies have resulted in a new extramural grant award (Dept of Veterans Affairs I-01) to our CS-CASH co-investigator, Dr. Debra Romberger. Regulation of dust effects on lung fibroblasts were recently reported in the American Journal of Physiology.

Importantly, we completed Aim 3 of our project in studying the impact of IL-10 in response to agricultural exposure in humans to move our laboratory findings from the mouse model in translation to clinical relevance. This has now been published in Respiratory Research. In addition, new findings suggest that macrophages from CD204 knockout mice have a diminished cAMP/PKA pathway of IL-10 stimulated anti-inflammation than normal wild type mice. Furthermore, our dust related studies have now established a link between lung injury and arthritis in a new collaboration recently published in the Journal of Bone Mineral Research. These studies have led to a new extramural grant award to Dr. Jill Poole (NIOSH R-01).

Lastly, this project laid the groundwork for our new research utilizing the NIOSH Exposome Model. We are now examining the sum of all exposures through the course of aging to evaluate the impact of agricultural organic dust on lung injury and repair. In pursuit of this, we are now studying the role of environmental and behavioral exposures such as cigarette smoking, zinc deficiency, and alcohol use as exposome modulators of the lung response to inhaled dust. Furthermore, we are currently responding to the COVID-19 crisis by examining the role of agricultural environment dust exposure on COVID-19 susceptibility and severity. These studies have led to two new extramural grant awards to Dr. Todd Wyatt (NIOSH U54 Project 1 and NIAAA R-01).

**B.3. Competitive Revisions/Administrative Supplements**

NA

**B.4. What opportunities for training and professional development did the project provide?**

Dr. David Schneberger, who was supported through a pilot project award by CS-CASH was hired into a position at the University of Saskatoon, where he conducts agricultural dust injury in a OneHealth model.

Dr. Kristi Warren, who was supported through a pilot project award by CS-CASH to develop this model, was awarded a major VA Career Development Award (CDA-2) and hired into an independent faculty position at the University of Utah. In this regard, CS-CASH has helped to develop a new career researcher into this field.

**B.5. How did you disseminate the results to communities of interest?**

Results were disseminated through peer-reviewed manuscripts, conference presentations, and classroom presentations.

**B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

NA as this is the final project report.

**B. PRODUCTS**

**C.1. Publications, conference papers, and presentations**

Publications Related to this Project:

1. Gerald, C. L., D. J. Romberger, J. M. DeVasure, R. Khazanchi, A. J. Heires, J. H. Sisson, and T. A. Wyatt. Alcohol decreases organic dust-stimulated airway epithelial TNF alpha through a nitric oxide and PKA-mediated inhibition of ADAM-17. *Alcohol Clin Exp Res* 40(2):273-83. doi: 10.1111/acer.12967, 2016.
2. Romberger, D. J., A. J. Heires, T. M. Nordgren, J. A. Poole, M. L. Toews, W. W. West, and T. A. Wyatt. Beta-2 adrenergic agonists attenuate organic dust-induced lung inflammation. *Am J Physiol-Lung*, 311:L101-L110 DOI: 10.1152/ajplung.00125.2016, 2016.
3. Staab, E. B., G. M. Thiele, D. Clarey, T. A. Wyatt, D. J. Romberger, A. Wells, D. Wang, L. W. Klassen, T. R. Mikuls, M. J. Duryee, and J. A. Poole. Toll-like receptor 4 Signaling Pathway Mediates Inhalant Organic Dust-Induced Bone Loss. *PLoS One*, 11(8):e0158735. doi: 10.1371/journal.pone.0158735, 2016.
4. Wells, A., D. J. Romberger, G. M. Thiele, T. A. Wyatt, E. Staab, A. J. Heires, L. W. Klassen, M. J. Duryee, T. R. Mikuls, A. Dusad, W. W. West, D. Wang, and J. A. Poole. Systemic IL-6 Effector Response in Mediating Systemic Bone Loss Following Inhalation of Organic Dust. *J. Interferon Cytokine Research* 37:9-19, 2016.
5. Sapkota, M., K. K. Kharbanda, and T. A. Wyatt. Malondialdehyde-Acetaldehyde (MAA) Adducted Surfactant Protein Alters Macrophage Functions through Scavenger Receptor A. *Alcohol Clin Exp Res* 40:2563-2572, 2016.
6. Warren, K. J., J. M. Sweeter, J. A. Pavlik, A. J. Nelson, J. M. Devasure, J. D. Dickinson, J. H. Sisson, T. A. Wyatt, and J. A. Poole. Sex differences in the localization and activation of type 2 innate lymphoid cells in experimental asthma. *Ann Allergy Asthma Immunol*, 118:226-234, 2017.
7. Wyatt, T. A., K. Canady, A. J. Heires, J. A. Poole, K. L. Bailey, T. M. Nordgren, and D. J. Romberger. Alcohol Inhibits Organic Dust-induced ICAM-1 Expression On Bronchial Epithelial Cells. *Safety* 3(1), 5; doi:10.3390/safety3010005, 2017.
8. Schneberger, D., J. M. DeVasure, K. L. Bailey, D. J. Romberger, and T. A. Wyatt. Effect of Low-level CO<sub>2</sub> on Innate Immune Response to Organic Dust from Swine Confinement Barns. *J Occ Med Toxicol* 12:9, doi: 10.1186/s12995-

017-0155-8, 2017.

9. Sapkota, M., J. M. DeVasure, K. K. Kharbanda, and T. A. Wyatt. Malondialdehyde-Acetaldehyde (MAA) Adducted Surfactant Protein Induced Lung Inflammation is Mediated Through Scavenger Receptor A (SRA). *Respir Res*, doi: 10.1186/s12931-017-0517-x, 18:36-45, 2017.
10. Warren, K., T. A. Wyatt, D. J. Romberger, W. W. West, A. Nelson, T. Nordgren, E. Staab, A. J. Heires, and J. A. Poole. Post-injury homeostasis and resolution response to repetitive inhalation exposure to agriculture organic dust in mice. *Safety* 3(1), 10; doi:10.3390/safety3010010, 2017.
11. Sapkota, M., E. L. Burnham, J. M. DeVasure, J. M. Sweeter, C.D. Hunter, M. J. Duryee, L. W. Klassen, J. H. Sisson, G. W. Thiele, and T. A. Wyatt. MAA-protein adducts and anti-MAA antibodies in the lungs of individuals with alcohol use disorders and cigarette smoking. *Alcohol Clin Exp Res* 41:(12) 2093–2099, 2017.
12. Poole, J. A., T. R. Mikuls, M. J. Duryee, K. J. Warren, T. A. Wyatt, A. J. Nelson, D. J. Romberger, W. W. West, and G. Thiele. A Role for B Cells in Organic Dust Induced Lung Injury, *Respir Res*. 18:214-. doi: 10.1186/s12931-017-0703-x, 2017.
13. Chandra, D., J. A. Poole, E. B. Staab, J. M. Sweeter, J. M. DeVasure, D. J. Romberger, and T. A. Wyatt. Dimethylarginine dimethylaminohydrolase (DDAH) overexpression enhances agricultural organic dust-injured airway wound repair, *Inhalation Toxicol*. 30:133-139, 2018.
14. LeVan, T. D., D. J. Romberger, A. J. Heires, T. A. Wyatt, and J. A. Poole. Relationship of systemic IL-10 levels with proinflammatory cytokine responsiveness and lung function in agriculture workers. *Respiratory Research* 19:166-172, 2018.
15. Bailey, K. L., K. K. Kharbanda, D. M. Katafiasz, J. H. Sisson, and T. A. Wyatt. Oxidative stress associated with aging activates Protein Kinase C Epsilon, leading to cilia slowing. *Am J Physiol Lung Cell Mol Physiol*. 315(5):L882-L890, 2018.
16. Price, M. E., C. L. Gerald, J. A. Pavlik, S. L. Schlichte, M. C. Zimmerman, J. M. DeVasure, T. A. Wyatt, J. H. Sisson. Loss of cAMP-dependent stimulation of isolated cilia motility by alcohol exposure is oxidant dependent, *Alcohol* 80:91-98, 2019.
17. Schneberger, D., J. M. DeVasure, D. J. Romberger, S. A. Kirychuk, and T. A. Wyatt. Organic barn dust inhibits surfactant protein D production through protein kinase-c alpha dependent increase of GPR116. *PLoS ONE* 13(12): e0208597. <https://doi.org/10.1371/journal.pone.0208597>, 2019.
18. Warren, K. J., A. J. Nelson, T. A. Wyatt, D. J. Romberger, and J. A. Poole. Co-exposure with organic dust in OVA-allergic asthma model alters airway inflammation. *Respiratory Research* 20:51, <https://doi.org/10.1186/s12931-019-1015-0>, 2019.
19. Knoell, D. L., D. A. Smith, M. Sapkota, A. J. Heires, C. K. Hanson, J. A. Poole, T. A. Wyatt, and D. J. Romberger. Insufficient zinc intake enhances lung inflammation in response to organic dust exposure, *J. Nutritional Biochem*. 70:56-64, 2019.
20. Warren, K. J. and T. A. Wyatt. Assessment of lymphocyte migration in an ex vivo transmigration system. *JoVE*, Issue 151 doi: 10.3791/60060, 2019.

21. Knoell, D. L., D. A. Smith, S. Bao, M. Sapkota, T. A. Wyatt, J. L. Zweier, J. Flury, M. T. Borchers, and M. Knutson. Imbalance in Zinc Metabolism Enhances Lung Tissue Loss Following Cigarette Smoke Exposure, *J. Trace Elements in Med. and Biol.* Feb 27;60:126483. doi: 10.1016/j.jtemb.2020.126483, 2020.
22. Wyatt, T. A., M. Nemecek, D. Chandra, J. M. DeVasure, A. J. Nelson, D. J. Romberger, and J. A. Poole. Organic Dust Induced Lung Injury and Repair: Bi-directional regulation by TNF $\alpha$  and IL-10, *J Immunotox.* 17:153-162, <https://doi.org/10.1080/1547691X.2020.1776428>, 2020.
23. Osna, N.A., M. Ganesan, D. Seth, T. A. Wyatt, S. Kidambi, K. K. Kharbanda. Second hits exacerbate alcohol-related organ damage: An update. *Alcohol Alcoholism* 56:8–16, <https://doi.org/10.1093/alcalc/aga085>, 2020.
24. Bailey, K. L., D. R. Samuelson, and T. A. Wyatt. Alcohol, lung, and COVID-19. *Alcohol* 90:11-17, 2020.
25. Schneberger, D., J. M. DeVasure, K. L. Bailey, D. J. Romberger, and T. A. Wyatt. Organic barn dust stimulates CCL9 expression in mouse monocytes through PKC-delta activation, *Environ Dis* 3:93-99, 2020.
26. Ding, L., S. Tang, T. A. Wyatt, D. Knoell, and D. Oupický. Pulmonary siRNA delivery for lung disease: review of recent progress and challenges. *J Controlled Release* Volume 330, 10 February 2021, Pages 977-991, doi: 10.1016/j.jconrel.2020.11.005, 2020.
27. Gaurav, R., T. R. Mikuls, G. M. Thiele, A. J. Nelson, M. Niu, C. Guda, J. D. Eudy, A. E. Barry, T. A. Wyatt, D. J. Romberger, M. J. Duryee, B. R. England, and J. A. Poole. High-Throughput Single-Cell Analysis Reveals Unique Cellular Subsets in a Murine Model of Rheumatoid Arthritis-Associated Inflammatory Lung Disease. *PloS One* 16(2): e0240707, 2021.
28. Gaurav, R., D. R. Anderson, S. J. Radio, K. L. Bailey, B. R. England, T. R. Mikuls, G. M. Thiele, H. M. Strah, D. J. Romberger, T. A. Wyatt, J. D. Dickinson, M. J. Duryee, D. M. Katafiasz, A. J. Nelson, and J. A. Poole. IL-33 depletion in COVID-19 lungs. *Chest* Jul 6; S0012-3692(21)01290-3. doi: 10.1016/j.chest.2021.06.058, 2021.
29. Wyatt, T. A., K. J. Warren, T. J. Wetzel, T. Suwondo, G. P. Rensch, J. M. DeVasure, D. D. Mosley, K. K. Kharbanda, G. M. Thiele, E. L. Burnham, K. L. Bailey, and S. M. Yeligar. Malondialdehyde-acetaldehyde adduct formation decreases immunoglobulin A transport across airway epithelium, *Am J Path* (DOI: <https://doi.org/10.1016/j.ajpath.2021.06.007>), 2021.
30. Warren, K. J., J. M. Sweeter, J. M. DeVasure, J. D. Dickinson, R. S. Peebles, J. A. Poole, and T. A. Wyatt. Neutralization of IL-33 broadly limits allergic inflammation in RSV-induced asthma exacerbation. *Respir Res* 22, 206. <https://doi.org/10.1186/s12931-021-01799-5>, 2021.
31. Gaurav R and **Poole JA**. Interleukin (IL)-33 immunobiology in asthma and airway inflammatory diseases. *J Asthma*, 27:1-9. doi: 10.1080/02770903.2021.2020815. PMID 34928757.
32. Mikuls, T. R., R. Gaurav, G. M. Thiele, B. R. England, M. G. Wolfe, B. P. Shaw, K. L. Bailey, T. A. Wyatt, A. J. Nelson, M. J. Duryee, C. D. Hunter, D. Wang, D. J. Romberger, D. P. Ascherman, and J. A. Poole. Airborne endotoxin exposures impact arthritis-associated autoimmunity, lung autoantigens and disease. *Int. Immunopharm* 100:108069. (Doi: 10.1016/j.intimp.2021.108069), 2021.
33. Samuelson, D. R., D. R. Smith, K. C. Cunningham, T. A. Wyatt, S. C. Hall, D. J. Murry, Y. S. Chhonker, and D. L. Knoell. ZIP8-Mediated Intestinal Dysbiosis Impairs Pulmonary Host Defense Against Bacterial Pneumonia. *Int. J. Mol. Sci.*, 23:1022. <https://doi.org/10.3390/ijms23031022>, 2022.

34. Muralidharan, A., T. A. Wyatt, and S. P. Reid. SARS-CoV-2 dysregulates neutrophil degranulation and reduces lymphocyte counts. *Biomedicines*, 10, 382. <https://doi.org/10.3390/biomedicines10020382>, 2022.
35. Nissen, C. G., K. Saavedra, J. M. DeVasure, D. M. Katafiasz, K. L. Bailey, and T. A. Wyatt. Malondialdehyde-acetaldehyde (MAA) adduction decreases surfactant protein D anti-microbial action, *Front. Immunol.* 13: 866795. doi: 10.3389/fimmu.2022.866795, 2022.
36. Poole, J. A., T. R. Mikuls, G. M. Thiele, R. Gaurav, A. J. Nelson, M. J. Duryee, A. Mitra, C. Hunter, T. A. Wyatt, B. R. England, D. P. Ascherman. Increased susceptibility to organic dust exposure-induced inflammatory lung disease with enhanced rheumatoid arthritis-associated autoantigen expression in HLA-DR4 transgenic mice, *Respir Res Jun 18;23(1):160.* doi: 10.1186/s12931-022-02085-8., 2022.
37. Shrestha D, Massy N, Bhat SM, Jelesijevic T, Sahin O, Zhang Q, Bailey KL, **Poole JA**, Charavaryamath C. Nrf2 activation protects against organic dust and hydrogen sulfide exposure induced epithelial barrier loss and K. pneumoniae invasion. submitted to *Frontiers in Cellular and Infection Microbiology*, 2022, April 19; 12:848773. doi: 10.3389/fcimb.2022.848773. PMID 35521223
38. Gribben K, Poole JA, Nelson AJ, Farazi E, Wichman C, Heires AJ, Romberger DJ, LeVan TD. Relationships of serum CCL2 levels with smoking status and lung function in COPD. *Respir Research*, 2022. Sep 16;23(1):247. doi: 10.1186/s12931-022-02158-8. PMID: 36114505
39. Crotty, K., P. Anton, L. G. Coleman, N. L. Morris, S. A. Lewis, D. R. Samuelson, R. McMahan, P. Hartmann, A. Kim, A. Ratna, P. Mandrekar, T. A. Wyatt, M. A. Choudhry, E. J. Kovacs, R. McCullough, and S. M. Yeligar. Recent Knowledge Gained in Alcohol and the Immunological Response Across Tissues. *Alcohol Clin Exp Res (In Revision)*.
40. Poole, J. A., R. Gaurav, A. J. Nelson, A. Gleason, D. J. Romberger, and T. A. Wyatt. Post-endotoxin exposure-induced lung inflammation and resolution consequences beneficially impacted by lung-delivered IL-10 therapy. *Scientific Reports (In Revision)*.

#### Abstracts Related to this Project:

1. Poole, J. A., E. Staab, A. Dusad, T. A. Wyatt, D. J. Romberger, M. J. Duryee, L. Klassen, T. R. Mikuls, D. Wang, and G. M. Thiele. Toll-like receptor 4 Signaling Pathway Mediates Inhalant Organic Dust-Induced Bone Loss. *J. Allergy Clin Immunol.* 137 (2):AB175, 2016.
2. Sapkota, M. and T. A. Wyatt. Malondialdehyde-Acetaldehyde (MAA) Adducted Surfactant Protein Induced Lung Inflammation is Mediated Through Scavenger Receptor A (SRA). *Toxicological Sciences* 150 (1):65; abstract 1280, 2016.
3. Sapkota, M., J. M. DeVasure, and T. A. Wyatt. Malondialdehyde-Acetaldehyde (MAA) Adducted Surfactant Protein Alters SRA/CD204 gene and protein expression in mouse lung. *Am J Respir Crit Care Med* 193:A1492, 2016.
4. Gerald, C. L., J. A. Pavlik, J. M. DeVasure, M. C. Zimmerman, T. A. Wyatt, J. H. Sisson. Alcohol Drives Airway Production Of Reactive Oxygen Species (ROS) That Alter Cilia Function. *Am J Respir Crit Care Med* 193:A5912, 2016.
5. Wyatt, T. A., E. L. Burnham, K. K. Kharbanda, G. M. Thiele, and J. H. Sisson. Pathogenesis of malondialdehyde-acetaldehyde protein adduct-mediated injury in lung. *International Society for Biomedical Research on Alcoholism (ISBRA)*, Berlin, Germany, September 2-5, 2016.

6. Warren, K. J., J. D. Dickinson, J. H. Sisson, T. A. Wyatt, J. A. Poole. Sex differences in the localization and activation of type 2 innate lymphoid cells in experimental asthma. *J. Allergy Clin. Immunol.* 139 (2), Supplement, Page AB82, 2016.
7. Warren K. J., J. A. Poole, and T. A. Wyatt. Neutralization of IL-33 prior to viral infection dampens inflammation and limits immune cell recruitment in ovalbumin treated mice. AIC meetings, Chicago, Nov 19-22, 2016.
8. Bailey, K.L., D. M. Katafiasz, J. H. Sisson, and T. A. Wyatt. Aging slows ciliary beat frequency of wild type, but not protein kinase C epsilon knockout mice. *Am. J. Respir. Critical Care Med.*;195: A2657, 2017.
9. Chandra, D., M. Sapkota, J. M. DeVasure, J. A. Poole, and T. A. Wyatt. Agricultural Dust Exposure induces IL-10 production in tissue macrophages which may have a role in airway inflammation and repair. *Am. J. Respir. Critical Care Med.*;195:A3890, 2017.
10. Warren, K. J., J. A. Pavlik, J. M. DeVasure, J. S. Sweeter, J. D. Dickinson, J. H. Sisson, J. A. Poole, and T. A. Wyatt. Sex differences in ILC2-specific chemokine release during chronic OVA-induced allergic lung inflammation in BALB/c mice. *Am. J. Respir. Critical Care Med.*;195: A2975, 2017.
11. Poole, J. A., T. R. Mikuls, M. J. Duryee, K. J. Warren, T. A. Wyatt, A. J. Nelson, D. J. Romberger, W. W. West, and G. Thiele. A Role for B Cells in Organic Dust Induced Lung Injury, *J. Allergy Clin Immunol.* 141(Issue 2, Supplement):AB198, 2018.
12. Wyatt, T. A., T. J. Wetzel, and J. H. Sisson. Lung mucosal immunity from secretory IgA may be impaired by MAA-adducted protein stimulation of epithelial cell TGF- $\beta$ . *Alcohol* 66:95, 2018.
13. Chandra, D., M. Nemecek, J. M. DeVasure, D. J. Romberger, J. A. Poole, and T. A. Wyatt. Organic Dust Induced Lung Injury and Repair: Bi-directional regulation by TNF $\alpha$  and IL-10. *Am. J. Respir. Critical Care Med.* 197:A2569, 2018.
14. Bailey, K. L., T. A. Wyatt, H. M. Strah, D. M. Katafiasz, A. J. Heires, A. Siddique, T. M. Nordgren, and D. J. Romberger. Exosome inflammatory cytokine cargo from airway epithelial cells and mesenchymal stem cells in COPD patients and never smokers. *Am. J. Respir. Critical Care Med.* 197:A3822, 2018.
15. Knoell, D. L., A. J. Heires, D. Smith, M. Sapkota, C. Hanson, J. A. Poole, T. A. Wyatt, and D. J. Romberger. Insufficient zinc intake enhances lung inflammation in response to organic dust exposure. *Am. J. Respir. Critical Care Med.* 197:A2576, 2018.
16. Chandra, D., M. Nemecek, J. M. DeVasure, D. J. Romberger, J. A. Poole, and T. A. Wyatt. Organic Dust Induced Lung Injury and Repair: Bi-directional regulation by TNF $\alpha$  and IL-10. Midwest Region Agricultural Safety & Health (MRASH) Conference, Council Bluffs, IA, November 28, 2018.
17. Charavaryamath, C., S. Kirychuk, and T. A. Wyatt. Agricultural Organic Dust-Induced Respiratory Disease: What are we doing about it? ISASH 2019, Des Moines, IA, June 24-27, 2019.
18. Wyatt, T. A., M. Nemecek, J. M. DeVasure, A. Nelson J. A. Poole. Swine Barn Dust Induced Lung Injury and Repair: Interleukin-10 decreases PKA activity in CD204 null mice. ISASH 2020, Asheville, NC, June 22-26, 2020 (relocated to Zoom due to COVID-19).
19. R. Gaurav, D. R. Anderson, S. J. Radio, K. L. Bailey, B. R. England, T. R. Mikuls, G. M. Thiele, H. M. Strah, D. J. Romberger, T. A. Wyatt, J. D. Dickinson, M. J. Duryee, D. M. Katafiasz, A. J. Nelson, J. A. Poole. Lung IL-33 Levels Depleted in COVID-19. *Am. J. Respir. Critical Care Med.* 1203:A3087, 2021.

20. Nissen, C. G., D. D. Mosley, K. K. Kharbanda, K. L. Bailey, and T. A. Wyatt. Malondialdehyde acetaldehyde-adduction changes surfactant protein D structure and function. *Alcoholism: Clin Exp Res*, 45:219A, #620, 2021.
21. Samuelson, D. R., D. R. Smith, K. C. Cunningham, S. C. Hall, T. A. Wyatt, and D. L. Knoell. ZIP8-mediated intestinal dysbiosis impairs pulmonary host defense against *S. pneumoniae*. *World Microbe Forum*, <https://bit.ly/3mLJcg1>, June 20-24, 2021.
22. Wyatt, T. A., Swine Barn Dust Exposure Increases COVID-19 Infection. Midwest Rural Agricultural Safety and Health Conference, Kirkwood, IA, Nov. 7-9, 2021.
23. Samuelson, D. R., K. Cunningham, D. R. Smith, D. L. Knoell, D. D. Mosley, and T. A. Wyatt. The role of natural killer cells in host defense against alcohol-associated bacterial pneumonia. AIRIG, Maywood, IL, November 19, 2021.
24. Gaurav, R., A. J. Nelson, E. A. Ramler, A. D. Schwab, D. M. Katafiasz, J. D. Eudy, D. J. Romberger, K. L. Bailey, T. A. Wyatt, and J. A. Poole. Healthy Human 3D Lung Organoids Respond Differentially to Environmental Exposures. AAAAI, Phoenix, AZ, Feb 25-28, 2022.
25. Gaurav, R., T. A. Wyatt, A. J. Nelson, D. J. Romberger, and J. A. Poole. Lung-delivered interleukin (IL)-10 hastens recovery following acute high dose inhalant endotoxin exposure. ATS, San Francisco, CA, May 13-18, 2022.
26. Wyatt, T.A. Cyclic AMP/Protein Kinase C bidirectional regulation of ciliary beat in the alcohol exposome. RSA Conference, Orlando FL, June 25-28, 2022.
27. Ramler, E. A., T. R. Mikuls, G. M. Thiele, A. J. Nelson, M. J. Duryee, R. Gaurav, T. A. Wyatt, A. Schwab, C. Hunter, B. R. England, and J. A. Poole. Combination of repetitive inhalant endotoxin exposure and collagen-induced arthritis interact in a testosterone-dependent manner to drive inflammatory lung processes and arthritis severity in mice. ACR (American College of Rheumatology) meetings, Philadelphia, PA, November 11-14, 2022.

Presentations/Outreach Related to this Project:

1. Invited Lecturer/Professor (Poole JA) at Iowa State University in Ames, Iowa, September 2016. Title of presentation: Respiratory & Systemic Illness from Large Animal Farming Environments: An Immunologic Perspective.
2. Agri-Safe Webinar entitled "Allergic and Non-allergic Respiratory Disease in Farmers" April 26, 2017 (Poole JA).
3. INBRE presentation (Wyatt TA) at Nebraska City, NE, August 7, 2017. Title of Presentation: Organic Dust Induced Lung Injury and Repair: Bi-directional regulation by TNF $\alpha$  and IL-10.
4. American Academy of Allergy, Asthma & Immunology/World Allergy Organization Joint Congress Meeting Plenary Lecture Award (Donald Leung Lectureship) entitled, "Environmental and Agricultural Modifications of Macrophage Function: Impact on Innate Immunity" at Orlando, Florida, March 4, 2018. (Poole JA).
5. Chandra, D., M. Nemecek, J. M. DeVasure, D. J. Romberger, J. A. Poole, and T. A. Wyatt. Organic Dust Induced Lung Injury and Repair: Bi-directional regulation by TNF $\alpha$  and IL-10. Midwest Region Agricultural Safety & Health (MRASH) Conference, Council Bluffs, IA, November 28, 2018.

6. "Environmental Impact of Food Production on Worker Lung Health." University of Nebraska-Lincoln, February 18, 2019.
7. "Swine Barn Dust Induced Lung Injury and Repair: Bi-directional regulation by TNF $\alpha$  and IL-10," 2018 International Society for Agricultural Safety and Health, Halifax, NS, June 27, 2018.
8. "Does my pork chop cause lung disease: Impact of swine CAFO dust on worker health," Guest Lecturer to NRES330, University of Nebraska-Lincoln, March 26, 2018.
9. Romberger: "A Modern Barnyard Story: Safety and Respiratory Health Risks with Agriculture Work." University of Nebraska Medical Center Department of Surgery, Grand Rounds, January 2018.
10. "Environmental Impact of Food Production on Worker Lung Health." University of Nebraska-Lincoln, February 18, 2019.
11. "Swine Barn Dust Induced Lung Injury and Repair: Bi-directional regulation by TNF $\alpha$  and IL-10," 32<sup>nd</sup> Annual McKnight Fellows Conference for Underrepresented Minorities in STEM careers, Tampa, FL, October 11-13, 2019.
12. "Environmental Impact of Food Production on Worker Lung Health." University of Nebraska-Lincoln, February 18, 2019.
13. "Organic Dust Exposure and Anti-Microbial Lung Defense." Emory University October 16-17, 2019. Invited Speaker.
14. "Innate Lung Defense via Mucociliary Clearance is Negatively Impacted by Swine CAFO Dust." Michigan State University, East Lansing, MI, October 28-30, 2019. Invited Speaker.
15. Poole: "Allergic and Nonallergic Respiratory Disease in Famers for Nurse Scholars." AgriSafe Network, Webinar, November 2019.
16. Poole: "Allergies and Respiratory Disease in Rural Farmers." RFD-TV; Live one hour interview with UNMC Chancellor Jeff Gold, Nashville, TN & Omaha, NE, June 2019.
17. Poole: "Targeting Resolution of Exposure-Induced Lung Inflammation." NIEHS Inflammation Resolution Biology Workshop, Research Triangle, NC, March 2019.
18. "Mechanisms of Swine Barn Dust Injury and Repair" North Carolina Central University, Durham, NC, March 25, 2020. Invited Speaker. *Suspended due to COVID-19 travel restrictions.*
19. "Environmental Impact of Food Production on Worker Lung Health." University of Nebraska-Lincoln, April 10, 2020.
20. Poole: "Allergic and Nonallergic Respiratory Disease in Famers for Nurse Scholars." AgriSafe Network, Webinar, February 2021.
21. Poole: "Challenges in the Recognition and Diagnosis of Asthma and Asthma-COPD in Rural Versus Urban Environments. American Academy of Allergy, Asthma & Immunology, February 2021. Invited Speaker, Virtual.

22. "Impact of Alcohol Misuse on Lung Injury Due to Agricultural Occupational Dust Inhalation" National Institute on Alcohol and Alcohol Abuse, Bethesda, MD, April 23-24, 2020. Invited Speaker. *Suspended due to COVID-19 travel restrictions.*
23. "Respiratory Health for Bison Workers." Central States Center for Agricultural Safety and Health (CS-CASH) Annual Bison Workers Conference, Rapid City, SD, October 13, 2021. Invited Speaker.
24. "Live animal Micro CT Scanning and 3D Reconstruction & Analysis of dust-exposed Lungs." Perkin-Elmer In Vivo Imaging User Group Meeting, November 4, 2021. Invited Speaker.
25. "Swine Barn Dust Exposure Increases COVID-19 Infection." Midwest Rural Agricultural Safety and Health (MRASH) Conference, November 12, 2021. Invited Speaker.
26. "Agricultural Organic Dust Exposure and COVID-19 Infection." National AgriSafe monthly presentation, February 2, 2022. Invited Speaker.
27. Poole: "Rural Air Pollutant Health Effects and Approaches in Asthma and Asthma/COPD Overlap." American Academy of Allergy, Asthma & Immunology, February 2022. Invited Speaker, in person.
28. Poole: "COVID-19, Allergies and Respiratory Disease in Rural America." RFD-TV; Live one hour interview with UNMC Chancellor Jeff Gold, Nashville, TN & Omaha, NE, September 2022.

**C.2. Website(s) or other Internet site(s) – include URL(s)**

Project information is housed on the CS-CASH website: <https://www.unmc.edu/publichealth/cscash/>

**C.3. Technologies or techniques N**

None

**C.4. Inventions, patent applications, and/or licenses**

None

**C.5. Other products and resource sharing**

None

**D. PARTICIPANTS****D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID | S/K | Name        | Degrees(s) | Role                | Cal | Aca | Sum | Foreign | Country | SS |
|------------|-----|-------------|------------|---------------------|-----|-----|-----|---------|---------|----|
| WYATT.TODD |     | Wyatt, Todd | PhD        | Co-<br>Investigator | 1.2 |     |     |         |         |    |
| POOLE.JILL |     | Poole, Jill | MD         | Co-<br>Investigator | 1.2 |     |     |         |         |    |
|            |     |             |            |                     |     |     |     |         |         |    |
|            |     |             |            |                     |     |     |     |         |         |    |

**D.2 Personnel updates**

D.2 - a. Level of Effort

b. New Senior/Key Personnel -- **no**

c. Changes in Other Support -- **yes**

d. New Other Significant Contributors -- **no**

e. Multi-PI (MPI) Leadership Plan – **same as before**

|  |
|--|
|  |
|--|

**E. IMPACT**

**E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES**

**F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**

None

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**

None

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**

None

**G. Special Reporting Requirements**

**G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements**

NA

**G.2 Responsible Conduct of Research**

NA

**G.3 Mentor's Research Report or Sponsor Comments**

NA

**G.4 Human Subjects**

G.4.a Does the project involve human subjects?

No

G.4.b Inclusion Enrollment Data

NA

G.4.c ClinicalTrials.gov

NA

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

No

#### **G.5 Human Subject Education Requirement**

Are there personnel on this project who are newly involved in the design or conduct of human subject's research?

No

#### **G.6 Human Embryonic Stem Cells (HESCS)**

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

#### **G.7 Vertebrate Animals**

Does this project involve vertebrate animals?

Yes

#### **G.8 Project/Performance Sites**

University of Nebraska Medical Center

#### **G.9 Foreign Component**

None

#### **G.10 Estimated Unobligated Balance**

See FFR

G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?

No

#### **G.11 Program Income**

Is program income anticipated during the next budget period?

None

#### **G.12 F&A Costs**

Is there a change in performance sites that will affect F&A costs?

No

## **I. OUTCOMES**

I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets

Note: project outcome information will be made public in NIH RePORTER

Chronic inhalation of organic dust in agricultural environments, particularly from concentrated animal feeding operations (CAFO), results in significant airway diseases including chronic bronchitis, occupational asthma, and obstructive lung disease. We have previously investigated chronic lung disease resulting from exposure to the organic dusts generated during livestock production with a particular focus on swine confinement barns. Understanding how such complex exposures might interact with our own lung physiology to modify innate defense and impact health will help to guide both prevention strategies as well as the development of therapeutic interventions.

Our previously published work establishes a mouse model for evaluating the impact of swine dust on lung injury. This model of either inhaled or nasally instilled sterile aqueous extracts of swine CAFO dust (or organic dust extract; ODE) results in significant lung injury characterized by elevated neutrophils upon a single dose and lymphoid aggregates upon repetitive doses over 3 weeks. Using this model, we have demonstrated a protein kinase C (PKC)-dependent production and release of pro-inflammatory cytokines (TNF $\alpha$ , IL-6, IL-8) responsible for this pathology that also impairs mucociliary clearance of pathogens. We previously characterized the sequence and timing of this kinase-driven mechanism showing the importance of TNF $\alpha$  as an early mediator of subsequent chemokine responses to ODE. Furthermore, we observed that ODE stimulates TNF $\alpha$  by activating the TNF $\alpha$  Converting Enzyme, also known as ADAM-17.

Recently, we found that IL-10 can inhibit ODE-stimulated ADAM-17 resulting in lung recovery from dust injury. We have previously defined mechanisms of organic dust-mediated lung inflammation and repair by interleukin-10 (IL-10). We found that IL-10 plays a role in the repair/recovery response to ODE injury, and we defined the mechanisms governing this repair response. We have also shown enhanced dust-mediated injury in the context of both alcohol exposure and zinc deficiency. Alcohol misuse significantly impaired the normal lung innate defense against inhaled dust through a desensitization of the enzyme regulating proper cilia clearance, the cAMP-dependent protein kinase. Translationally, we identified low zinc levels in a subpopulation of Midwestern agricultural workers with chronic obstructive pulmonary disease (COPD). We showed that inadequate cellular zinc availability alters the innate immune lung response to ODE and that tissue macrophages are a driving force that intensifies the inflammatory process.

**A. Cover Page**

|  |  |
|--|--|
| Project Title:<br>Surveillance of Agricultural Injuries  |  |
| Grant Number:<br>1U54OH010162  | Project/Grant Period:<br>September 01, 2016 – August 31, 2022  |
| Reporting Period:<br>September 01, 2016- August 31, 2022   | Date Submitted:<br>December 22, 2022   |
| Program Director/ Principal Investigator<br>Risto Rautiainen, Program Director<br>Risto Rautiainen, Principal Investigator | Administrative Official Information<br>Bethany DeCarolus, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| Change of Contact PD/PI:<br>NA   |  |
| Human Subjects:<br>Yes   | Vertebrate Animals:<br>No  |
| hESC:  | Inventions/Patents:<br>None  |

## B. ACCOMPLISHMENTS

### B.1. What are the major goals of the project?

The aims of the Central States Center for Agricultural Safety and Health (CS-CASH) surveillance are 1) to conduct agricultural health and safety surveys in the Central States region (IA, MN, MO, KS, NE, ND, SD), and 2) to explore alternative surveillance methods for injuries and illnesses, including analyses of existing administrative databases and tracking cases reported in the media.

### B.2. What did you accomplish under these goals?

Aim 1. to conduct agricultural health and safety surveys in the Central States region (IA, MN, MO, KS, NE, ND, SD). The Farm and Ranch Health and Safety Survey (FRHSS) surveys started as a pilot project focusing on agricultural injuries in Iowa and Missouri in 2008; initiated as a collaboration of the University of Iowa and National Agricultural Statistics Service (NASS) and completed at the University of Nebraska Medical Center in 2009. The model was expanded to include a seven-state region in the Central States Center for Agricultural Safety and Health (CS-CASH) initial funding period (2011-2016). The FRHSS surveys were further developed in the second CS-CASH funding period (2016-2022) to include five common work-related chronic conditions (respiratory, hearing, skin, musculoskeletal, and mental health), as well as related exposures and preventive practices. In the 2018 and 2020 surveys, a total of 5,476 farm and ranch operations (7,195 individual operators) responded to surveys which were first conducted annually and later semi-annually. The surveillance was further extended to address special topics; the first special survey was conducted in 2021 focusing on safety culture. Surveys were mailed to 1600 agricultural operators; 326 returned complete data.

The CS-CASH Surveillance program has produced a total of 28 manuscripts that have been published or submitted to peer-reviewed journals. A summary of the findings includes the following:

Dr. Ketki Patel conducted a systematic review of existing national surveillance programs that included non-fatal injuries in agriculture. The review identified and characterized six existing surveillance programs, including their strengths and limitations. A major gap in surveillance is that self-employed farmers and ranchers and workers on small farms are excluded from BLS SOII non-fatal injury surveillance. Regional surveillance has an important role, filling the gaps and contributing to a more comprehensive understanding of injuries, illnesses, exposures, risk factors and related costs in agriculture (Patel et al., 2017).

Dr. Rohan Jadhav conducted a systematic review of risk factors for agricultural injury. He identified more than 25 significant risk factors, and also many that are still inconclusive, including age. The results of the review were published in two articles, Jadhav et al., 2015 and 2016.

Dr. Rohan Jadhav, in addition to his systematic review, investigated injury frequencies and risk factors from the 2011-2013 data collected by the NASS on contract for CS-CASH. The injury rate in during the three years was 7 injuries/100 farm and ranch operators. Several risk factors were identified, including male gender, age 45-55 years of age, full time operation and larger operation size (Jadhav et al., 2017).

MPH candidate Anthony Johnson expanded this research to include the first 5 years of data collected by NASS. A total of 34,777 surveys were sent and 11,226 received. The annual injury rate ranged from 6.1 to 8.3 injuries per 100 operators, showing a decreasing trend during the 5-year period. Several risk factors were identified in this study (Johnson et al., 2021).

Drs. Beseler and Rautiainen (2021) studied the potential biases due to non-response in the 2018 FRHSS survey. Principal operator and farm production characteristics were analyzed using pre-existing data obtained from Farm Market iD. Despite a low response rate of about 18%, there was scant evidence of nonresponse bias. Farm and ranch characteristics of operations responding to a mailed survey were similar to those not responding. A selection bias could still exist, if those who have had injuries or health concerns are more interested in responding.

PhD candidate Yi Du conducted a study of risk factors for musculoskeletal pain and discomfort from the 2018 surveillance data. He found that 59% of the 4,354 respondents had musculoskeletal symptoms affecting one or more body sites. Stress was a major risk factor for MSD symptoms; adjusted Odds Ratios ranging from 4.8 to 5.6 for different types of symptoms. Forceful exertions, repetitive tasks, awkward positions, frequent manual labor, and vibration were among other risk factors (Du et al., 2021).

Two recent studies by Post Doctoral Fellow Sabine Chengane et al., (2021) and MPH candidate Julia Bai et al., (2022) used FRHSS surveillance data for 2018 and 2020 to investigating the association of stress and injuries. The first study found that three work strain indicators; stress, sleep deprivation and exhaustion/fatigue; had a high prevalence ranging from 18.4% to 29.3%. Musculoskeletal pain was the most important predictor for work strain symptoms. In the second study, 1,766 out of 6,744 operators (26%) reported work-related stress. Previous injury, musculoskeletal symptoms, hearing loss, and chemical exposures were identified as risk factors. Stress was reported by 24% of operators with no injuries, 36% with one injury, and 66% with two or more injuries.

PhD candidate Alexandra Farfalla investigated hearing loss and exposure to noise and solvents as risk factors for hearing loss. She found that out of 7,491 respondents, 53% reported at least mild hearing loss. Controlling for age, gender, and farm characteristics, the odds of having moderate/severe hearing loss were elevated among those exposed to solvents chemicals alone (OR 1.49), noise alone (OR 4.42) and solvents and noise together (OR 6.03) (Farfalla et al., 2022).

PhD candidate Jagadeesh Puvvula investigated respiratory conditions from the surveillance data. He found the prevalence of respiratory conditions was 18.0% for any respiratory condition, 8.5% for environmental allergies, 5.4% for rhinitis, 4.9% for sinusitis, 4.4% for asthma, and 2.2% for hypersensitivity pneumonitis. Exposures to grain/hay/feed (OR 2.41), animal confinement dust (OR 1.57), field/road dust (OR 2.11), manure/silage gases (OR 1.66), anhydrous ammonia (OR 1.51), and fuels/solvents (OR 1.92) increased the risk of respiratory conditions. (Puvvula et al., 2022).

PhD candidate Suraj Adhikari studied the costs and lost time from injuries using our surveillance data and existing data from government and insurance sources. This study found that the annual rates of injuries to self-employed farmers and ranchers were 15 injuries/100 operators, or 12 'recordable' injuries per 100 full time equivalent (FTE) workers; 2.3 times higher than the rate published by BLS for hired agricultural workers. Further, this study produced the first national estimate of agricultural injury costs in the US since Leigh et al., (2001) estimate, which was based on 1992 data. When adjusted for inflation, our annual agricultural injury cost estimate in October 2021 dollars was \$10.2 Billion; about 13% higher than the inflation adjusted estimate of Leigh et al.; \$9.0 Billion (Adhikari et al., 2021, submitted).

PhD candidate Balkissa Quattara studied injury frequencies and risk factors by body part injured. She found several risk factors and work tasks that are associated with injuries to specific body parts (Quattara et al., 2022).

PhD candidate Qianqian Li studied the association of injury and chronic health conditions. She found that 94.6% of those with injury cases also reported one or more chronic health conditions. Adjusted Odds Ratios for injury ranged from 1.41 (environmental allergies) to 4.61 (musculoskeletal symptoms) (Li et al., to be submitted in 2023).

Dr. Josie Rudolphi conducted a CS-CASH funded pilot study (n=170 young producers) where 71% of respondents met the criteria for Generalized Anxiety Disorder (GAD-7 score  $\geq 5$ ) and 53% met the criteria for Major Depressive Disorder (PHQ-9 score  $\geq 5$ ) (Rudolphi et al., 2020). The proposed study builds on experience from this and three other recent mental health studies (2019-20).

Aim 2. to explore alternative surveillance methods for injuries and illnesses, including analyses of existing administrative databases and tracking cases reported in the media.

CS-CASH collaborates with the Nebraska Department of Health and Human Services (NDHHS) on injury surveillance. NDHHS conducts NIOSH-funded occupational surveillance, which includes occupational injuries. These data are collected from state designated trauma centers (hospitals) and from hospitals that voluntarily submit information. We will use an ICD-9 (and corresponding ICD-10) E-code- based system to identify probable and possible agriculture-related cases. At the time when the data analyses were scheduled to commence, COVID-19 pandemic required NEHHS surveillance personnel to focus on COVID response and the analyses plans with CS-CASH surveillance project were put on hold. Recently there have been discussions to start analyses of Trauma Registry data, but work has not bene scheduled.

Since 2011 CS-CASH Surveillance has included a media monitoring program for serious injuries. Electronic and print media sources are scanned with search terms to identify agricultural injury cases. Mr. Murray Madsen started his media monitoring effort more than 20 years ago as part of the Iowa FACE program. CS-CASH has a contract with Mr. Madsen and other centers have also contracted with him to provide month injury news updates. PhD candidate Moses New-Aaron studied the fatal and non-fatal injuries and found that local media report more cases that happen on the farm while major media outlets focus more on roadway injuries and fatal injury cases. The number of fatalities from media monitoring was nearly identical to the official BLS CFOI numbers for the same region (New Aaron et al., 2019). CS-CASH provides monthly media monitoring data to AgInjuryNews web service initiated by Dr. Bryan Weichelt in Marshfield WI (Weichelt et al., 2021). This makes our data easily accessible online and provides a major addition to the cases available in AgInjuryNews web service. (Weichelt et al., 2019).

### **B.3. Competitive Revisions/Administrative Supplements**

NA

### **B.4. What opportunities for training and professional development did the project provide?**

Most of the publications have provided opportunities for students and junior investigators to participate as lead or co-authors. A total of 14 Masters or PhD students were co-authors of surveillance publications.

### **B.5. How did you disseminate the results to communities of interest?**

The surveillance project results have been disseminated in 28 peer-reviewed publications, \_ presentations and \_ other media products. CS-CASH provides monthly media monitoring data to AgInjuryNews web service which is available online at no cost to users. CS-CASH co-sponsored the Western Agricultural Health and Safety Conference in 2019. Dr. Rautiainen chaired the surveillance session and served as guest editor of the special edition of the Journal of Agromedicine, published in 2021. Dr. Rautiainen served as chair of the NORA agricultural surveillance group and currently participates in the NIOSH agricultural centers' surveillance working group. This working group has shared information don surveillance efforts in different centers and participated in planning and contributing to the NOIRS injury conference in 2022. NIOSH asked for public comment regarding the decision to discontinue the surveys in the spring of 2015. Dr. Rautiainen prepared and delivered an oral testimony in response to the NIOSH Docket Number 281, CDC-2015-0005, outlining his views on future surveillance activities in agriculture. Dr. Rautiainen has maintained a strong interest in international surveillance efforts. He recently co-authored a study of the Eurostat statistics for agricultural injuries and illnesses. This study revealed major undercounting of injuries to self-employed farmers who are mostly excluded from occupational injury statistics in Europe, just like they are excluded from non-fatal injury statistics of the Bureau of Labor Statistics Survey of Occupational Injury and Illness.

### **B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

This project period ended. CS-CASH Surveillance project was funded to continue surveillance with similar methods as in this reporting period.

## C. PRODUCTS

### C.1. Publications, conference papers, and presentations

1. Beseler CL, Rautiainen RH. Assessing Nonresponse Bias in Farm Injury Surveillance Data. *J Agric Saf Health*. 2021;27(4):215-227. doi:10.13031/jash.14554
2. Patel K, Watanabe-Galloway S, Gofin R, Haynatzki G, Rautiainen R. Non-fatal agricultural injury surveillance in the United States: A review of national-level survey-based systems. *Am J Ind Med*. 2017;60:599–620. <https://doi.org/10.1002/ajim.22720>
3. Jadhav R, Achutan C, Haynatzki G, Rajaram S, Rautiainen R. Risk Factors for Agricultural Injury: A Systematic Review and Meta-analysis. *J Agromedicine*. 2015;20(4):434-449. doi:10.1080/1059924X.2015.1075450
4. Jadhav R, Lander L, Achutan C, Haynatzki G, Rajaram S, Patel K, Rautiainen R. Review and Meta-analysis of Emerging Risk Factors for Agricultural Injury. *Journal of Agromedicine*. 2016, VOL. 21, NO. 3, 1–14. <http://dx.doi.org/10.1080/1059924X.2016.1179611>
5. Jadhav R, Achutan C, Haynatzki G, Rajaram S, Rautiainen R. Injury risk factors to farm and ranch operators in the Central United States. *Am J Ind Med*. 2017;60(10):889-899. doi:10.1002/ajim.22757
6. Johnson A, Baccaglini L, Haynatzki GR, Achutan C, Loomis D, Rautiainen RH. Agricultural Injuries among Farmers and Ranchers in the Central United States during 2011-2015. *J Agromedicine*. 2021;26(1):62-72. doi:10.1080/1059924X.2020.1845268
7. Yi Du, Lorena Baccaglini, Anthony Johnson, Jagadeesh Puvvula & Risto H Rautiainen (2021) Factors associated with musculoskeletal discomfort in farmers and ranchers in the U.S. Central States, *Journal of Agromedicine*, DOI: 10.1080/1059924X.2021.1893880
8. Chengane S, Beseler CL, Duysen EG, Rautiainen RH. Occupational stress among farm and ranch operators in the midwestern United States. *BMC Public Health*. 2021;21(1):2076. Published 2021 Nov 12. doi:10.1186/s12889-021-12053-4
9. He Bai, Cheryl Beseler, Lorena Baccaglini, Risto Rautiainen (2023) Work-Related Stress as a Risk Factor for Farm Injuries in the Central United States. *Journal of Agricultural Safety and Health*. 29(1): x <https://doi.org/10.13031/jash.14951>
10. Jagadeesh Puvvula, Lorena Baccaglini, Anthony Johnson, Yi Du, Jesse E. Bell & Risto H. Rautiainen (2022) Prevalence and Risk Factors for Pulmonary Conditions among Farmers and Ranchers in the Central United States, *Journal of Agromedicine*, 27:4, 378-390, DOI: 10.1080/1059924X.2021.2025180
11. Adhikari S, Baccaglini L, Wilson F, Rautiainen R. Cost of agricultural injuries in the United States: Estimates based on regional surveillance. *Safety Science*. Submitted December 2021.
12. Balkissa S Ouattara, Cheryl L Beseler & Risto H Rautiainen (2022) Agricultural Injuries: Risk Factors and Severity by Affected Body Part among US (Midwest) Farmers, *Journal of Agromedicine*, DOI: 10.1080/1059924X.2022.2089421
13. Farfalla, Alexandra A.; Beseler, Cheryl; Achutan, Chandran; Rautiainen, Risto. (2022). Coexposure to Solvents and Noise as a Risk Factor for Hearing Loss in Agricultural Workers. *Journal of Occupational and Environmental Medicine*, Volume 64, Number 9, 11 September 2022, pp. 754-760(7). <https://doi.org/10.1097/JOM.0000000000002571>
14. Li Q, Bell J, Du Y, Baccaglini L, Dai H, Rautiainen R. Chronic health conditions as risk factors for agricultural injuries in the Central United States. To be submitted in 2022.
15. Ramos AK, Adhikari S, Yoder AM, Rautiainen RH. Occupational Injuries among Latino/a Immigrant Cattle Feedyard Workers in the Central States Region of the United States. *Int J Environ Res Public Health*. 2021;18(16):8821. Published 2021 Aug 21. doi:10.3390/ijerph18168821
16. New-Aaron M, Semin J, Duysen EG, Madsen M, Musil K, Rautiainen RH. Comparison of agricultural injuries reported in the media and census of fatal occupational injuries. *J Agromedicine*. 2019;24(3):279-287. doi:10.1080/1059924X.2019.1593276
17. Weichelt B, Heimonen T, Gorucu S, et al. Redesigning a Sentinel Surveillance System for Collecting and Disseminating Near Real-Time Agricultural Injury Reports: System Usability Study. *JMIR Form Res*. 2019;3(3):e13621. Published 2019 Aug 2. doi:10.2196/13621

18. Risto Rautiainen (2021) Surveillance of Agriculture, Forestry, and Fishing Injury, Illness, and Economic Impacts, *Journal of Agromedicine*, 26:1, 59-61, DOI: 10.1080/1059924X.2021.1849508
19. Karttunen JP, Rautiainen RH, Quendler E. Gender Division of Farm Work and Occupational Injuries. *J Agric Saf Health*. 2019;25(3):117-127. doi:10.13031/jash.13177
20. Leppälä, Jarkko; Griffin, Pat; McNamara, John; Rautiainen, Risto (2021). Safety culture and risk management in agriculture: Sacurima COST Action CA16123 highlights and conclusions. Available at: <http://urn.fi/URN:ISBN:978-952-380-271-1>
21. Beseler C, Rautiainen R. Safety practices and priorities in farm and ranch operators in the central United States. *Journal of agricultural Safety and Health*. Submitted October 2021.
22. Kaustell KO, Mattila TEA, Hurme T, Salmi PS, Rautiainen RH. Predictors for occupational injuries and diseases among commercial fishers in Finland 1996-2015. *Int Marit Health*. 2017;68(4):196-202. PubMed PMID: 29297570.
23. Karttunen JP, Rautiainen RH, Leppälä J. Characteristics and Costs of Disability Pensions in Finnish Agriculture Based on 5-Year Insurance Records. *J Agromedicine*. 2015;20(3):282-91. doi: 10.1080/1059924X.2015.1042179
24. Tiina E. A. Mattila, Merja Perkiö-Mäkelä, Maria Hirvonen, Birgitta Kinnunen, Minna Väre & Risto H. Rautiainen (2021) Work exposures and mental and musculoskeletal symptoms in organic farming, *Ergonomics*, DOI: 10.1080/00140139.2021.1974102
25. Rudolphi, J.M., Berg, R.L. & Parsaik, A. Depression, Anxiety and Stress Among Young Farmers and Ranchers: A Pilot Study. *Community Ment Health J* 56, 126–134 (2020). <https://doi.org/10.1007/s10597-019-00480-y>
26. Rudolphi JM, Berg R, Marlenga B. Who and How: Exploring the Preferred Senders and Channels of Mental Health Information for Wisconsin Farmers. *International Journal of Environmental Research and Public Health*. 2019; 16(20):3836. <https://doi.org/10.3390/ijerph16203836>
27. Josie M. Rudolphi & Kathrine L. Barnes (2020) Farmers' Mental Health: Perceptions from a Farm Show, *Journal of Agromedicine*, 25:1, 147-152, DOI: 10.1080/1059924X.2019.1674230
28. Josie Rudolphi (2020) Diversity of Mental Health Issues in Agriculture, *Journal of Agromedicine*, 25:1, 1, DOI: 10.1080/1059924X.2020.1694821

## C.2. Website(s) or other Internet site(s) – include URL(s)

<https://aginjurynews.org/>

<https://www.unmc.edu/publichealth/cscash/>

## C.3. Technologies or techniques

Linking publicly available (Farm Market iD) agricultural production data with newly collected FRHSS data. This provides a possibility to keep the surveys short as demographic and operation characteristics are known for all participants, also those who do not respond to the survey. This feature is unique, enabling comparison of respondents and non-respondents and for analyses of potential response biases.

## C.4. Inventions, patent applications, and/or licenses

None

## C.5. Other products and resource sharing

Data or Databases

Research datasets from surveys.

Educational aids or curricula

UNMC College of Public Health course on Injury Epidemiology

Survey Instruments

Farm and Ranch Health and Safety Survey

**D. PARTICIPANTS****D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID     | S/K | Name             | Degrees(s) | Role | Cal | Aca | Sum | Foreign | Country | SS |
|----------------|-----|------------------|------------|------|-----|-----|-----|---------|---------|----|
| rautiainen     |     | Risto Rautiainen | PhD        | PI   | 1.8 |     |     |         |         |    |
| BESELER.CHERYL |     | Cheryl Beseler   | PhD        | Co-I | 4.8 |     |     |         |         |    |

Faculty not supported: Dr. Dana Loomis, Dr. Fernando Wilson, Dr. Chandran Achutan, Dr. Josie Rudolphi.  
 Students: Ketki Patel, Rohan Jadhav, Kelsie Musil, Anthony Johnson, Yi Du, Jagadeesh Puvvula, Alexandra Farfalla, Quinquin Li, Suraj Adhikari, Balkissa Quattara, He Bai, Moses New-Aaron, Sabrina Shengane

**D.2 Personnel updates NA****E. IMPACT****E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES****F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**

No

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**

None

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**

None

**G. Special Reporting Requirements****G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements**

NA

**G.2 Responsible Conduct of Research**

NA

**G.3 Mentor's Research Report or Sponsor Comments**

|   |
|---|
| <p><b>NA</b></p>  |
| <p><b>G.4 Human Subjects</b></p> <p>G.4.a Does the project involve human subjects?<br/>Yes, IRB Exempt</p> <p>G.4.b Inclusion Enrollment Data<br/>NA</p> <p>G.4.c ClinicalTrials.gov<br/>NA</p> <p>Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?<br/>No</p> |
| <p><b>G.5 Human Subject Education Requirement</b></p> <p>Are there personnel on this project who are newly involved in the design or conduct of human subject's research?<br/>No</p>  |
| <p><b>G.6 Human Embryonic Stem Cells (HESCS)</b></p> <p>Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?<br/>No</p>  |
| <p><b>G.7 Vertebrate Animals</b></p> <p>Does this project involve vertebrate animals?<br/>No</p>  |
| <p><b>G.8 Project/Performance Sites</b><br/>University of Nebraska Medical Center, Omaha, NE</p>  |
| <p><b>G.9 Foreign Component</b><br/>No</p>  |
| <p><b>G.10 Estimated Unobligated Balance</b><br/><b>See FFR report</b></p> <p>G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?<br/>No</p>  |
| <p><b>G.11 Program Income</b></p> <p>Is program income anticipated during the next budget period?<br/>No</p>  |

**G.12 F&A Costs**

Is there a change in performance sites that will affect F&A costs?

No

**I. OUTCOMES**

I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets

Note: project outcome information will be made public in NIH RePORTER

The aims of the Central States Center for Agricultural Safety and Health (CS-CASH) surveillance are 1 to conduct agricultural health and safety surveys in the Central States region (IA, MN, MO, KS, NE, ND, SD) and to explore alternative surveillance methods for injuries and illnesses, including analyses of existing administrative databases and tracking cases reported in the media. This project resulted in 28 manuscripts published or submitted to peer-reviewed journals. Surveys found 11.9 'recordable' injuries / 100 full time equivalent operators - 2.3 times higher rate than the published BLS SOII rate for agriculture. The average cost of an agricultural injury was found to be \$19,322. Surveillance surveys found the prevalence of chronic work-related conditions to be musculoskeletal pain (59%), respiratory conditions (24%), hearing loss (53%), skin cancer (11%), and work-related stress (26%). Prevalence of respiratory conditions was found to be 18% (without COPD). Stress, exhaustion, and sleep deprivation were associated with injury. PPE use when exposed to high levels was found to be respiratory (37%), hearing (31%), and dermal protection (52%).

**A. COVER PAGE**

|  |  |
|--|--|
| Project Title:<br>Increasing Personal Protective Equipment Use by Point Source Protection Strategy   |  |
| Grant Number:<br>1U54OH010162  | Project/Grant Period:<br>September 01, 2016 – August 31, 2022  |
| Reporting Period:<br>September 01, 2016- August 31, 2022   | Date Submitted:<br>December 22, 2022   |
| Program Director/ Principal Investigator<br>Risto Rautiainen, Program Director<br>Risto Rautiainen Principal Investigator<br>Previously Dr. Chandran Achutan | Administrative Official Information<br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| Change of Contact PD/PI:<br>NA   |  |
| Human Subjects:<br>Yes   | Vertebrate Animals:<br>No  |
| hESC:  | Inventions/Patents:<br>None  |

## B. ACCOMPLISHMENTS

### B.1. What are the major goals of the project?

Aim 1: Assess the participants' baseline PPE use and exposures as potential targets for intervention. We will conduct comprehensive on-farm exposure and current PPE use assessments using the Certified Safe Farm review procedure. Our *working hypothesis* is that at baseline, participating farmers and workers will have work situations where known exposure limits are exceeded, and that their current PPE use is not adequate to protect them from hazardous exposures, potentially leading to work-related illnesses.

Aim 2: Conduct a randomized controlled trial to test if the *point source protection strategy (PSPS)*, placing customized PPE Boxes near targeted exposure sources, increases PPE use.

We will conduct a trial where intervention farms receive needs assessment, training, and customized PPE Boxes placed in targeted high exposure sites. Control farms receive similar assessment, training, and PPE but no placement in Boxes at exposure sites. Our *working hypothesis* is that farmers in the *PSPS* group will significantly increase their PPE use while only modest gains are observed in the control group.

Aim 3: Evaluate the feasibility and demand for the Point Source Protection Strategy and PPE Boxes. We will analyze the feasibility and demand for the *PSPS*; work settings where it is most/least helpful, and the readiness among farmers/ranchers to purchase and install PPE Boxes in different exposure areas. We will use outreach events and focus groups to gather information on farmer perceptions. Our *working hypothesis* is that there is considerable demand for well-designed PPE Boxes, if they were available on the market.

### B.2. What did you accomplish under these goals?

Major Activities.

#### Major Activities.

#### Farm Recruitment & Enrollment.

In year two of the project recruitment efforts were expanded extensively via mailer and reached 2,720 farms located throughout Nebraska and Iowa. Initial farm and participant enrollments are shown in Table 1. As of January 2021, our farm and participant enrollment totals decreased resulting from the SARS-CoV-2 Pandemic. Farms that dropped out were either unreachable, no longer farming, or felt they could no longer participate.

**Table 1. Initial Farm Enrollment**

| Farm          | Enrolled  | Participants |
|---------------|-----------|--------------|
| Intervention  | 19        | 27           |
| Control       | 19        | 26           |
| <b>Totals</b> | <b>38</b> | <b>53</b>    |

**Table 2. Farm Enrollment – January 2021**

| Farm          | Enrolled  | Participants |
|---------------|-----------|--------------|
| Intervention  | 20        | 24           |
| Control       | 16        | 22           |
| <b>Totals</b> | <b>36</b> | <b>46</b>    |

**Farm Hazard Assessment.**

**PPE usage questionnaire.** Baseline PPE use indicated only 28% of farmers use PPE every time they believe it is needed. PPE questionnaire results indicated gloves and respirators as the most common protection used by farmers (85% and 74% respectively). Dual cartridge respirators, and/or respirators with shields were the least likely PPE item used at 8% followed by hearing protection devices. While respirators were cited as the most common PPE used by farmers, upon investigation researchers discovered many farms were using surgical masks or non-NIOSH certified respirators.

**Certified Safe Farm Review.** A farm walkthrough was completed with the participant to identify comprehensive on-farm exposures and hazards. During this walkthrough, participants were able to discuss with researchers what farm tasks, equipment, and exposures they identified as being potentially harmful to their health. This process helped prioritize and specialize what type of PPE would be most useful to each farm, and locations for PPE box placement at intervention farms.

**Exposure Measurements.** Exposures including noise, ammonia and dust levels were assessed and measured on farms which researchers were unsure of the risk, and thusly what level of personal protection was needed. Samples for ammonia and dust were measured at two different confined animal feeding operations following NIOSH method 6016 and NIOSH method 0500. Noise dosimeters were used to sample sound of various farm machinery and equipment.

**PPE Disbursement.** All farms enrolled have been visited twice and received PPE, educational materials, and PPE use training. Table 3 represents totals of PPE items provided to every farm in the study. Regardless of farm status, each farm received some form of respiratory protection, hand protection, eye protection, and hearing protection device.

**Table 3. Personal Protective Equipment Totals**

| Farm          | Respirators | Gloves     | Earmuffs   | Earplugs    | Eye Protection |
|---------------|-------------|------------|------------|-------------|----------------|
| Intervention  | 765         | 161        | 55         | 1901        | 130            |
| Control       | 386         | 99         | 46         | 1700        | 107            |
| <b>Totals</b> | <b>1151</b> | <b>260</b> | <b>101</b> | <b>3601</b> | <b>237</b>     |

**Point Source Protection Strategy.** Using a PSPS, customized PPE boxes were installed near targeted sites of exposure. A total of 63 PPE boxes were installed at 19 intervention farms. Table 4 represents boxes placed at targeted high exposure sites. Boxes installed at “other” locations included semi-trucks, irrigation wells, and other farm vehicles. PPE provided to each box was relevant to the box locations exposure sources. A photo collage representing some of the installation sites is shown in Figure 1.

**Table 4. Exposure Areas of PPE Box Install.**

| Location           | Quantity  |
|--------------------|-----------|
| Grain Bin/Elevator | 18        |
| Machine Shop       | 25        |
| Chemical Storage   | 10        |
| Livestock          | 5         |
| Other•             | 5         |
| <b>Total</b>       | <b>63</b> |

**Figure 1. PPE Boxes**



**Education.** The needs assessment during visit one helped to inform the type of education and training provided to participants at visit two. Every participant was provided with information on hearing loss prevention and respiratory protection. If participants were provided with different types of respirators (i.e., N95, P100, R95), sufficient time was spent discussing the appropriate environments in which to wear different respirators and how to maintain and properly store respirators. Nearly all participants were provided with respiratory protection unless they indicated medical conditions which prevented respiratory protection use. Fit-testing was also offered to participants. Furthermore, for participants who had previously used surgical masks and/or non-NIOSH respirators, information was reviewed and provided on how to identify NIOSH approved respirators. Other educational resources and information on the following topics were provided to participants upon their request: pesticide disposal; manure pit dangers, hazards, and monitoring; safe play spaces for children on the farm; flood relief.

**Training.** Intervention and control farmers were provided training on the appropriate use and maintenance of the PPE provided. The training consisted of demonstrating the correct use and maintenance of the PPE and included a transfer of knowledge component where farmers were asked to demonstrate to the research team the correct way of using PPE such as earplugs and respirators. Qualitative respirator fit tests were also provided upon request.

**PPE Use Evaluation**

Collection of PPE use was ongoing and collected quarterly in October, January, April, and July months. Preliminary analysis of the data indicates respirator and ear protection use among intervention participants was greater during the summer and fall seasons ( $\leq 90\%$ ). Data collected during the winter season quarter indicates a reduction in the use of ear plugs, respirators, safety glasses, and gloves. Reasons cited by participants for non-use included: forgetting to use and not needing to use PPE. Some participants indicated not needing to use PPE during the winter season for reasons of travel.

**PSPS Box Evaluation On Farms**

During the Spring-Fall of 2021, researchers re-visited both intervention and control farms to replenish PPE supplies. Upon inspection of PPE boxes, there was no apparent damage externally or internally to the contents inside the PSPS box. It should be noted that some boxes were utilized at the onset of the study on a couple of farms which were remnants from the previous hearing protection device (HPD) PSPS; because these boxes were altered to supply the frequency of HPD use meter, the box's integrity was altered thus allowing moisture to enter the box. All other unadulterated PSPS boxes were proven to be effective at keeping moisture, dust, insects, etc. from entering the box and thus contents inside. Participants were generally surprised at how well PSPS boxes held up over the course of the project being exposed to the elements.

Additional visits to farms over the course of the study indicated PSPS boxes on grain bins were utilized seasonally but more frequently than other box locations. Although beneficial for ease of access to PPE in machine shops, items from the PSPS boxes did not usually make it back into the box after use as researchers noted contents dispersed within shops. Participants enrolled in the PSPS study provided verbal feedback from their participation in the study with overall feedback on the PSPS described as positive. Those in the control group also provided positive feedback regarding learning the importance of when to use PPE and were surprised at the variety of PPE product types (e.g. earplugs, gloves).

**PSPS Concept Feasibility and Demand**

Due to the COVID-19 pandemic, the objectives of specific aim III had to be amended. Participants enrolled in the PSPS study provided verbal feedback from their participation in the study. To gauge external feedback, feasibility, and demand of the PSPS product concept among two groups – emerging farmers and current farmers. Those who identified as primary operators of a farm, ranch or both were surveyed at Husker Harvest Days in 2021. Researchers at the CS-CASH booth presented a PSPS prototype of a 'typical' PSPS box installed on grain bins. Farmers at the event were explained the PSPS concept, able to ask questions about the PSPS and were also provided photos of the PSPS installed at different locations on the farm. 100 farmers agreed to participate in the survey. Survey questions were designed using the theory of planned behavior intent to purchase. Descriptive analysis indicated 94% of farmers thought the PSPS boxes could be useful on their farm. One out of four farmers indicated they would be very interested in owning a PSPS product. Nearly half of those surveyed (48%) indicated they would probably buy the PSPS product if it were currently available in their local store.

The second group surveyed were emerging farmers – those enrolled in the National Safe Tractor and Machinery Operation Program. Youth in this training were also presented the PSPS box while engaged in PPE safety training. This group provided qualitative feedback on the concept and feasibility of the PSPS box including the following comments: "I think there a great idea and should become something you find on every farm. It needs to be everywhere just like first aid kits"; "I think they could be useful just people might not put stuff back"; "they are a great idea; I think everyone on a working operation would benefit from them."; "make it a bright colored box". Although both groups were convenience samples, they provided honest, valuable feedback on the applicability of incorporating PSPS boxes into agricultural operations.

Lastly researchers met with an insurance agency which primarily provides policy to agricultural operations. This meeting provided insight into the feasibility of incorporating PSPS boxes on farms. The consensus was bringing the PSPS box concept to scale on large agricultural operations would be challenging due to the variation on sizes needed for the quantity of employees and locations of boxes. PSPS boxes may be better suited for smaller family operated farms than larger farms.

**B.3. Competitive Revisions/Administrative Supplements**

NA

**B.4. What opportunities for training and professional development did the project provide?**

Throughout the entirety of the reporting period, the project has provided training and professional development for the PI through the following:

- Conferences: Annual National Hearing Conservation Association (Feb. 2019); International Society for Agricultural Safety and Health (June 2019); Western Agricultural Safety and Health Conference (August 2019); International Occupational Health and Safety Congress Meeting (October 2019); European Public Health Conference (November 2019); 44<sup>th</sup> Annual National Hearing Conservation Association (NHCA) Conference. Destin, Florida. (February 2020);
- Seminar: *Instructed* - Noise Exposures and Hearing Loss in Agriculture (UNMC Ag. Safety and Health course, July 2019); *Moderated* - Prevention Through Design (Western Ag. Safety and Health conference, August 2019).
- Other: Production of educational content for of Council for Accreditation in Occupational Hearing Conservation

Throughout the entirety of the reporting period, the project has provided training and professional development for the field research association through the following:

- Conferences: Nebraska Women in Agriculture (February 2019); International Society for Agricultural Safety and Health (June 2019); International Society for Agricultural Safety and Health (June 2022)
- Workshops: Child Agricultural Injury Prevention (June 2019) Qualitative Respirator Fit-Testing (July 2019);
- Virtual Workshops: Halverson, C. (2020, May 14). Tools / Trainings to Aid in the Selection of PPE and Fit Testing. [Webinar]. AgriSafe Learning Lab.; Agricultural Safety and Health Council of America State Guidance and Potential New Rules to Protect Ag Workers from Covid-19 Go to Webinar hosted by ASHCA (2020, May 21).
- Individual Study: *Graduate level course work* -Fundamentals of Industrial Hygiene (Fall 2019); Occupational Noise Exposure and Hearing Loss (Spring 2020); Climate Change and Human Health (Fall 2020); Introduction to SAS Programming (Fall 2020);
- Other: Hands on training and implementation of exposure assessments for contaminants of interest at various farms (October, November & December 2019)

**B.5. How did you disseminate the results to communities of interest?**

The PPE questionnaire used in this research has been adapted for use by European colleagues. Collection of data has finished but analysis is underway. The data collected from this project will be used to inform the project's field researcher's doctoral dissertation with an anticipated date of completion by or before December 2023. Preliminary results have been presented in various formats at academic and industry specific conferences.

**B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

NA. This is the final reporting period.

**D. PRODUCTS****C.1. Publications, conference papers, and presentations****Publications.**

**Achutan C**, Girdžiūtė L, Vasiliauskas G, Kampuss K, Starič J, Rautiainen R, Use of personal protective equipment among farmers in Nebraska, Lithuania, Latvia, and Slovenia, *European Journal of Public Health*, Volume 29, Issue Supplement\_4, November 2019, ckz186.107, <https://doi.org/10.1093/eurpub/ckz186.107>

Johnson A, Baccaglini L, Haynatzki GR, **Achutan C**, Loomis D, **Rautiainen RH**. Agricultural Injuries among Farmers and Ranchers in the Central United States during 2011-2015. *J Agromedicine*. 2021 Jan;26(1):62-72. doi: 10.1080/1059924X.2020.1845268. Epub 2021 Jan 18. PMID: 33131463.

**Achutan C**. Prevention through Design in New Technologies. *J Agromedicine*. 2021 Jan;26(1):3-5. doi: 10.1080/1059924X.2021.1849107. Epub 2021 Jan 25. PMID: 33487143.

Farfalla A, **Achutan C**. Exposure Assessment at a Pullet Barn - A Case Study. *J Agromedicine*. 2022 Oct;27(4):339-345. doi: 10.1080/1059924X.2021.1979154. Epub 2021 Oct 26. PMID: 34511041

Farfalla AA, Beseler C, **Achutan C**, **Rautiainen R**. Coexposure to Solvents and Noise as a Risk Factor for Hearing Loss in Agricultural Workers. *J Occup Environ Med*. 2022 Sep 1;64(9):754-760. doi: 10.1097/JOM.0000000000002571. Epub 2022 Jun 9. PMID: 35703294; PMCID: PMC9426749.

### **Presentations.**

A Farfalla, E Duysen, C. Achutan. *Exploring Personal Protective Equipment Use and Perceptions Among Female Farmers*. [Poster Presentation] International Society for Agricultural Safety and Health Conference in Des Moines, Iowa. (2019, June)

C Achutan, K Musil, A Farfalla, R. Rautiainen. *Evaluating Use of Personal Protective Equipment Among Farmers*. [Poster Presentation]. International Society for Agricultural Safety and Health Conference, Des Moines, Iowa. (2019, June)

C Achutan, K Kampuss, L Girdžiūtė, G Vasiliauskas, J Starič, R Rautiainen. *Personal protective equipment use among farmers in Nebraska, Latvia, Lithuania, and Slovenia*. [Oral Presentation]. Western Agricultural Safety and Health Conference. Seattle, Washington. (2019, August).

C Achutan, L Girdžiūtė, G Vasiliauskas, K Kampuss, J Starič, R Rautiainen. *Use of personal protective equipment among farmers in Nebraska, Lithuania, Latvia, and Slovenia*. [Oral Presentation]. European Public Health Conference. Marseille, France. (2019, November)

C Achutan, J Ehlers, S Navarette, E Lyden, L Baccaglini, R Rautiainen. *Noise and Hearing Loss among Farmers: results from a point source intervention study [Presentation]*. National Hearing Conservation Association Annual Meeting, Grapevine, Texas. (2020, February).

C Achutan, B Oztekin, B Onal, R Rautiainen. *Comparison of Personal Protective Equipment Use Among Farmers In Turkey, and the United States*. Presented at the International Occupational Health and Safety Congress in Adana, Turkey. (2020, October)

C Achutan and A Farfalla. *Measuring Air Contaminates in Poultry Barns*. [Roundtable session]. University of Nebraska Medical Center's 1<sup>st</sup> Annual Poultry Worker Safety Roundtable, Fremont, NE, United States. (*Roundtable canceled*) (2020, April)

### **C.2. Website(s) or other Internet site(s) – include URL(s)**

Information from this project is housed on the CS-CASH website: <https://www.unmc.edu/publichealth/cscash/>

### **C.3. Technologies or techniques**

None

### **C.4. Inventions, patent applications, and/or licenses**

None

**C.5. Other products and resource sharing****Educational aids or curricula**

Achutan, C., Girard, E., and Farfalla, A. [2020, November 4]. *Respirators and Their Application in Agriculture*. [Educational Learning Module]. University of Nebraska Medical Center, E-Learning Funded Awards Program.

Achutan, C. et al. *Noise Measurement* [virtual course]. Council for Accreditation in Occupational Hearing Conservation. 2021. Milwaukee, WI. Available at: <https://www.caohc.org/products/noise-measurement-course>

**D. PARTICIPANTS****D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID       | S/K | Name               | Degrees(s) | Role               | Cal | Aca | Sum | Foreign | Country | SS |
|------------------|-----|--------------------|------------|--------------------|-----|-----|-----|---------|---------|----|
| ACHUTAN.CHANDRAN |     | Chandran Achutan   | PhD        | PI 2016-Mar.2022   | 0.4 |     |     |         |         |    |
| rautiainen       |     | Risto Rautiainen   | PhD        | PI 2022            | 0.6 |     |     |         |         |    |
|                  |     | Alexandra Farfalla | MA, MPH    | Research Assistant | 12  |     |     |         |         |    |
| BEACOM.MATTHEW   |     | Beacom, Matthew    |            | Co-Investigator    | 1.2 |     |     |         |         |    |

**D.2 Personnel updates**

**a. Level of Effort:** NA

**b. New Senior/Key Personnel:** Dr. Achutan assumed a role at NIOSH in the last year of the project. Dr. Rautiainen acted as Principal Investigator to complete the project.

**c. Changes in Other Support:** No

**d. New Other Significant Contributors:** No

**E. IMPACT****E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES****F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**

None

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**

None

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**

None

**G. Special Reporting Requirements****G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements**

NA

**G.2 Responsible Conduct of Research**

NA

**G.3 Mentor's Research Report or Sponsor Comments**

NA

**G.4 Human Subjects**

G.4.a Does the project involve human subjects?

Yes, IRB Exempt

G.4.b Inclusion Enrollment Data

NA

G.4.c ClinicalTrials.gov

No

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

No

**G.5 Human Subject Education Requirement**

Are there personnel on this project who are newly involved in the design or conduct of human subject's research?

No

**G.6 Human Embryonic Stem Cells (HESCS)**

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

**G.7 Vertebrate Animals**

Does this project involve vertebrate animals?

No

**G.8 Project/Performance Sites**

|   |
|---|
| University of Nebraska Medical Center, Omaha, NE  |
| <b>G.9 Foreign Component</b><br>None  |
| <b>G.10 Estimated Unobligated Balance</b><br><b>See FFR report</b><br><br>G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?<br>No |
| <b>G.11 Program Income</b><br><br>Is program income anticipated during the next budget period?<br>No  |
| <b>G.12 F&amp;A Costs</b><br><br>Is there a change in performance sites that will affect F&A costs?<br>No   |

## I. OUTCOMES

|  |
|--|
| <p>I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets<br/> Note: project outcome information will be made public in NIH RePORTER</p> <p><i>Increasing Personal Protective Equipment Use by Point Source Protection Strategy (PSPS)</i> is a unique approach developed by CS-CASH to address an important factor in personal protection – convenience – by storing personal protective equipment (PPE) near the location where they are needed (on the farm). The objectives of this project were to assess current hazardous exposures and personal protective equipment use on farms, conduct a randomized controlled trial to test if placing customized PPE boxes near targeted exposure sources would increase PPE use, and evaluate the feasibility of the PSPS concept among farmers/ranchers. This project provided assessed whether providing PSPS PPE (vs. PPE alone) would improve usability, and ultimately help protect farmers from hazardous exposures – thus reducing work-related injury and illness in the agricultural sector. Enrollment in this project included 36 farms and 46 individual farmers/ranchers in Nebraska and Iowa. Project findings to date are shown below.</p> <ul style="list-style-type: none"> <li>Completed comprehensive on-farm exposure and PPE use assessments using the Certified Safe Farm review structure for exposures and PPE questionnaire adapted from European questionnaires.</li> <li>Provision of personalized education, training, PPE, and exposure assessments aided ‘buy in’ with participants and their efficacy of knowing when, why, and how to use PPE based on their exposures.</li> <li>Created and installed 63 customized weather resistant PSPS PPE boxes at 19 intervention farms holding HPDs, respirators, gloves, eye protection and sun protection combinations for protection at grain bins/elevators, machine shops, chemical storage, irrigation wells, livestock buildings and vehicles.</li> <li>Both intervention and control participants increased their PPE use based on preliminary findings. Final intervention effect analysis pending due to COVID-19 delay in farm visits and data collection.</li> <li>Performed air contaminant exposure assessment in a pullet barn; published in J Agromed.</li> </ul> |
|--|

- We found women in agriculture experience different barriers to PPE use in terms of sizing, fit, effectiveness, and cost.
- PSPS concept and model PSPS Box was well received at the largest Midwestern Agricultural shows; 93% of those surveyed indicating customized PPE boxes was a good idea; 83% expressing interest in owning the PPE box, and nearly 60% indicating they would purchase the PPE box if available at their local hardware/co-op store. In a survey of youth in tractor safety training programs, 74% expressed PPE boxes would be useful; 65% indicating they would use PPE boxes if available on their farm.
- Co-developed an E-learning module on respirators and their use in agriculture.

Final data analysis on significant differences between the research groups is ongoing as part of a PhD thesis.

**A. COVER PAGE**

|   |   |
|---|---|
| <b>Project Title:</b><br>Outreach Program   |   |
| <b>Grant Number:</b><br>1U54OH010162  | <b>Project/Grant Period:</b><br>September 01, 2016 – August 31, 2022  |
| <b>Reporting Period:</b><br>September 01, 2016- August 31, 2022   | <b>Date Submitted:</b><br>December 22, 2022   |
| <b>Program Director/ Principal Investigator</b><br>Risto Rautiainen, Program Director<br>Debra Romberger Principal Investigator | <b>Administrative Official Information</b><br>Bethany DeCarolis, CRA<br>Assistant Director, Sponsored Programs Administration<br>987835 Nebraska Medical Center<br>Omaha, NE 68198-7835<br>402-559-7456 |
| <b>Change of Contact PD/PI:</b><br>NA   |   |
| <b>Human Subjects:</b><br>No  | <b>Vertebrate Animals:</b><br>No  |
| <b>hESC:</b>  | <b>Inventions/Patents:</b><br>None  |

## B. ACCOMPLISHMENTS

### B.1. What are the major goals of the project?

The aims of the CS-CASH program in the 2016-2021 funding cycle were to integrate information from the Center's Research, Evaluation and Pilot Program projects, as well as information from external sources, translating it into a coordinated outreach effort and effectively disseminate the information using a wide range of proven methods. To develop and launch radio social marketing campaigns, innovative training webinars, and eHealth web-based toolkits targeted women in agriculture and military veteran farmers. Support and advance current information technology efforts that disseminate occupational safety and health information and education to workers, managers, educators, researchers, and health and safety professionals in the agricultural industry. Through crowdsourcing and citizen science, identify, evaluate, and disseminate new technology products and applications to workers, managers, educators, researchers, and health and safety professionals in the agricultural industry.

### B.2. What did you accomplish under these goals?

#### CS-CASH Outreach Programs, Projects, Partnerships and Initiatives 2016-2021

Valuable Partnerships. Outreach efforts of the Center were strengthened and broadened by working in partnership with members of the AgriSafe Network, USDA Extension Service, National Agricultural Safety Database, Ag Health and Safety Alliance, Progressive Ag Foundation, Farm Bureau, Brownfield Broadcasting, Women in Agriculture Organizations, Military Veteran Farmer Organizations, CHS (farmer-owned cooperative), agri-insurance agencies, agricultural news organizations, Grain Handling Safety Coalition (and OSHA Grain Handling Alliance), NE, IA and MO Farm Bureau, Nebraska Public Power District, rural news organizations, and other NIOSH funded Agricultural Centers.

Translation of Center Research. Center projects were developed to contribute to the outreach effort by producing and disseminating new information relevant to their specific fields of study. Research, Evaluation, and Pilot projects served an essential role in testing and evaluating outreach models and communicating evidence-based interventions to specific target audiences. Research projects helped define new knowledge translated in training, videos, electronic and hard-copy resources, coursework, and webinars. In the past 5 years research was translated from CS-CASH research projects on the topics including pulmonary disease, feedyard safety, immigrant worker health, tribal bison worker safety, surveillance findings and emerging issues. Examples of translational research is outlined in this report.

Using Surveillance Databases to Detect Emerging Issues. The Outreach team used the Center's vast surveillance database to detect emerging issues and to provide a rapid response to immediate concerns affecting the agricultural community. The Center provided immediate response to the COVID-19 pandemic in 2020 and throughout 2021, the devastating Midwest flooding in 2019, threats to poultry worker's health during the Avian Influenza outbreak in 2015, health threats posed by an aflatoxin outbreak in 2014 and ongoing heat stress concerns in Midwest immigrant workers, the 2019 devastating flooding that affected many farms and ranches across the Midwest and Central States Center most recently the COVID19 pandemic. The CS-CASH response to COVID-19 in agricultural communities is detailed below.

Development of Ag Health and Safety Content. Working with an agricultural journalist and CS-CASH researchers, the outreach team created content for distribution. Resource dissemination methods included

- electronic platforms, CS-CASH website, email, Facebook, Twitter, Flickr and Instagram;
- traditional media, including educational content for print and radio;
- videos created for the NIOSH U.S. Ag Center YouTube Channel; and
- hard-copy educational materials handed out at farm shows throughout the CS-CASH 7-states region.

Community Contact Network (CCN). The CS-CASH outreach team maintained and grew the Community Contact Network, a database of over 26,000 farmers, ranchers, health care professionals, Extension Educators, Public Health professionals, veterinarians, immigrant support organizations, health and safety professionals, and agribusiness

contacts. This database was used to communicate information to stakeholders regarding emerging issues (i.e., flood mitigation protocols, COVID-19 resources, and Avian Influenza worker protection communications), new resources developed by CS-CASH addressing agricultural worker safety, webinars, and new CS-CASH training opportunities (i.e., fit testing train the trainer workshops and OSHA Alliance Stand Up for Grain Safety Week training).

Outreach Focused on Women and Military Veterans. In partnership with the AgriSafe Network, CS-CASH focused outreach programs and projects addressing the needs of women and military veterans in agriculture. Training webinars, face-to-face training, in addition to broadcast and media messages, were designed to improve health and safety outcomes in these special populations of farmers and ranchers.

Developing and Improving New Technologies for Ag Safety and Health. Dr. Aaron Yoder worked with a network of safety and health and information technology (IT) experts, including participants from eXtension, NASD, USagCenters, and the YouTube group to develop new and to improve existing technology tools and methods for disseminating information, determining risk and improving safety and health outcomes. Dr. Aaron Yoder also worked in collaboration with agricultural "citizen scientists" to evaluate new technologies intended to improve the health and safety of workers.

Boots on the Ground Trainings, Presentations, and Events – The Hallmark of CS-CASH Outreach. The CS-CASH outreach team, often accompanied by students, spent a significant amount of time over the past six years traveling to all seven states in the CS-CASH region conducting ag safety and health training at farm shows, agribusiness events, FFA conferences, Women in Ag Conferences, Veteran Farmer Coalition Conferences, Grain Handling Conferences, as well as small events that we were invited to attend. This outreach is seen as the most impactful, as training can be conducted using educational techniques that are shown to improve learning and move participants toward behavior change. Training topics included

- respiratory protection (techniques to engineer out dust as well as proper selection, use, and care of respirators);
- hearing conservation (techniques to measure and engineer out noise as well as proper selection, use, and care of hearing protection);
- prevention of thermal stress;
- tractor and equipment handling safety (including an annual 12 sites two-day/site tractor and equipment safety training certification for young farmers) and training on emerging issues topics as they arise.

#### **Program Highlights.**

**The COVID-19 Pandemic – CS-CASH Outreach – Innovation By Necessity.** The COVID-19 pandemic presented obstacles to the face-to-face outreach that has been the program's core for the past 11 years. By employing innovative training methods, acquiring state-of-the-art video streaming equipment, partnering with trusted organizations, and implementing strict safe training protocols, the outreach team continued to conduct quality training throughout the pandemic.

Feedyard and Poultry Facility COVID-19 Playbooks. In collaboration with the UNMC Global Center for Health Security, CS-CASH developed guidebooks containing information for feedyard and poultry grower facilities to follow to protect their workers from infection with COVID-19. This guidebook was developed on a fast track and reviewed by content experts. Playbooks were delivered via postal mail and email to over 700 poultry growing facilities and 430 feedyards across the U.S. using the contact information in the CS-CASH CCN database. Gallagher Insurance also disseminated this playbook to their feedyard clients. The Playbooks are living documents, with changes made as the pandemic progresses (Figure 1).

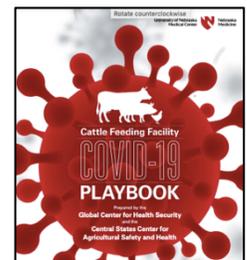


Figure 1.

COVID-19 Playbook

COVID-19 Think Tank. In collaboration with the AgriSafe Network and the Texas AFF Center, CS-CASH planned, developed, sponsored, and provided administrative support for the AgriSafe COVID-19 Think Tank. The Think Tank was a series of 9 webinars held April 2, 2020 – May 28, 2020. Attendees numbered 1097. Post-webinar surveys

indicated that 95% of attendees agreed that the webinars were a valuable use of time and were satisfied or very satisfied with the webinars. These webinars are now enduring materials that can be accessed free of charge on the AgriSafe website. The Series featured content experts presenting on a wide variety of topics, including Rural Epidemiology of COVID-19, Covid-19 Resources and Guidance for Agricultural Operations and Communities (Presented by Ellen Duysen), Farm Financial Assistance Options During the Pandemic and Beyond, Rural Healthcare Updates, Protecting Feed yard Workers During the Covid-19 Pandemic (presented by Dr. Aaron Yoder), Navigating Covid-19 on the Farm, Best Practices for Daily Management of Sanitation, Deliveries, and Equipment on the farm (presented by Ellen Duysen).

COVID-19 Resource Guide for the Ag Community. A resource guide containing COVID-19 resource information ag workers, their family's and community is housed on the CS-CASH website as a Spark Adobe document and was shared widely with stakeholders. Resources are updated and added regularly to the site.

Safety and Health Training Course: A Thank You to Essential Workers During the COVID-19 Pandemic. The 10th (2020) and 11th (2021) Annual Agricultural Safety and Health 4-day courses were delivered as live-streamed training and included a virtual farm tour. These training were held as a Thank You to essential workers during the COVID-19 pandemic and were offered free of charge, providing necessary continuing education credits. Attendees earned up to 36.75 hours of AMA, Nursing, or EMS continuing education credits<sup>5</sup> or 3 hours of academic credit. The response was excellent. In 2020, 190 participants registered, 158 joined the live Sessions A (95% retention) and B (91% retention), and 136 attended session C recorded sessions. A total of 3084 hours of CEU credit was awarded to 143 unique learners, and eight students received academic credit: There was a similar response in 2021, with only slightly lower numbers of attendees and credit earned. A virtual farm tour, yoga during breaks, and a virtual respiratory fit testing training were among the innovative educational techniques implemented in this 4-day training. Because of the tremendous response, **CS-CASH will use external and internal (College of Public Health) grant funding and sponsorships to continue to offer this course free of charge to all.** Thereby significantly increasing the number of rural health care providers, safety and health professionals, and others who will significantly benefit from this training.

Social Media Outreach to Spanish Speaking Agricultural Workers. A Facebook campaign reached Spanish-speaking agricultural workers with COVID19 prevention messaging (Figure 2). A targeted “boosted” campaign was run from April 12 to May 6, 2020, to reach these workers with COVID-19 prevention messaging. This campaign reached 54,408 Facebook feeds with an impressive engagement of 2,939. The number of post engagements set a record for the CS-CASH Facebook page. A report on the impact of this outreach was published in the Journal of Agromedicine<sup>7</sup>.

Vaccine Hesitancy in Rural Communities Workgroup. Ellen Duysen and Athena Ramos served on two workgroups (one focused in Nebraska and one National Organization) that addressed vaccine hesitancy in rural communities. Outputs from the Nebraska group included PSAs and billboards with information on vaccine safety.

### 2019 Midwest Flood Outreach – Immediate Response.



Figure 3. Safe Flood Mitigation Kits

In March 2019, a bomb cyclone hit the Midwest, causing record snowfall and rain followed by rapidly warming temperatures unleashing record flooding in 5 of the CS-CASH's 7-states regions. This event cost agricultural producers \$4.5 billion in total sales. Within ten days of the flood event, CS-CASH members working with ag journalist Loretta Sorenson created eleven media publications designed for ag communities on topics ranging from proper PPE for clean-up to protocols for composting dead animals. Over 90 unique



Figure 2. Spanish

COVID-19 Post

news organizations published these articles. In collaboration with UNMC and a philanthropic organization, CS-CASH coordinated creating and disseminating over 2800 flood mitigation response kits (Figure 3) to agricultural communities, including over 200 kits delivered to flood-ravaged Tribal Reservations. CS-CASH members took part in many flood-related presentations and media appearances, including two RFD-TV and two NE NPR-TV interviews discussing safe flood recovery.

### **Outreach 2016-2021**

Social Media and Electronic Outreach. The Center created content for distribution, including internet-based applications, to reach farm families and workers on the more than 480,000 farms and ranches in our Center's region. Our comprehensive 26,000 member database is made up of farmers and ranchers, public health officials, and safety and health professionals has provided an effective, rapid method to reach farmers and ranchers with information via email regarding emerging issues, as well as with other safety and health information. The CS-CASH website was accessed 9780 times in 2021. CSCASH social media platforms, including Facebook, Twitter, and Instagram (@UNMCCSCASH), have successfully reached agricultural workers, managers, safety and health professionals, and stakeholders. The CS-CASH Ag Safety and Health Flickr Photo Sharing site provides agribusiness, the media, and safety professional images to promote safe practices with over 1400 copyright-free images, with over 13,000 downloads.

Boots on the Ground Outreach. Face-to-Face outreach continued as an effective method for the Center to conduct training, demonstrate and discuss proven safety and health measures. As previously stated, in 2020 and 2021, during the COVID-19 pandemic, this mode of outreach required caution and innovative measures. When necessary, as with driving testing for safety certification, face-to-face outreach was conducted. Extreme measures were employed to protect the participants and trainers against the transmission of COVID-19.

Tractor and Equipment Safety Training and Certification. From 2016-2021 the CS-CASH outreach team, in collaboration with NE Extension, trained 512 students as part of the National Safe Tractor and Machinery Operation Program (NSTMOP) certification program. This 2-day (16-hour course) provides training on a wide range of topics, from safe tractor operation to the proper use of personal protective equipment. The COVID-19 pandemic forced safety training programs across the U.S. to find alternative methods of delivering required safety training to young agricultural workers. CS-CASH developed a pandemic plan for the 2020 and 2021 courses. Plans were implemented to protect the health of the students and trainers. Students attended the first day of the course online through the eXtension Foundation Campus website. After completing the online course, the required driving test was available to the student at 5 locations instead of the usual 12. To protect students and trainers, cohorts were created of 3 to 4 students per 2-hour training and testing session. To ensure compliance, frequent messages outlining the safety protocols were sent to parents and students prior to the training. All students and trainers were required to always wear a mask. Masks were provided along with instructions for proper use. All equipment was disinfected before and after each student completed their testing. Students who had a fever or persistent cough within 14 days of testing or exposure to a COVID-positive patient were required to reschedule their driving test. Using these safety protocols, 62 students received training and certification in 2020 and 84 students in 2021. Pictures taken during the 2020 and 2021 tractor and equipment training course are shown below (Figures 4, 5, and 6).



Fig 4. Tractor Driving Exam



Fig 5. Tractor hitching and PTO training



Fig 6. ATV Aware training with simulator

### **Cross-Center and Stakeholder Collaborations.**

U.S. Ag Center YouTube Channel. CS-CASH members continue to participate in the leadership of the U.S. Ag Centers YouTube group, including maintaining the website, loading videos, and reporting analytics. This channel has proven to be a successful collaboration between all eleven NIOSH Ag Centers. The YouTube channel<sup>16</sup> features 167 videos, produced and peer-reviewed by the Ag Centers, including 34 videos produced by CS-CASH. The channel has had over 38,700 watch time hours with 2525 subscribers and 523,200 views since its inception in 2013. Two manuscripts have been published describing this successful collaborative educational resource.

Agricultural Safety and Health Conferences. CS-CASH sponsored agricultural safety and health conferences and served on the planning committee of the Midwest Rural Agricultural Safety and Health Conference (MRASH), the International Society for Agricultural Safety and Health (ISASH), the Agricultural Safety and Health Council of America (ASHCA) conference and the Western Ag Safety and Health Conference. CS-CASH members serve on the Board for the ISASH and ASHCA organizations. CS-CASH partnered with the Washington, Colorado, Texas, and California NIOSH AFF Centers to plan and present the Western Ag Safety and Health Conference in 2019. Dr. Risto Rautiainen and Ellen Duysen served as the guest editors for a special conference edition of the Journal of Agromedicine.

National FFA Convention. In partnership with CareerSafe Online, CS-CASH participated in the Safety Exhibit at the National FFA Convention in Indianapolis, IN, 2017-2021. In 2019 CS-CASH outreach team provided ATV training on the Center's ATV simulator (Figure 7). The training was conducted on proper personal protective equipment and body positioning to maintain balance. Contact was made with approximately 2000 students over three days each year.



Fig 7. FFA ATV simulator training

Boots on the Ground Training – CS-CASH 7-States Region. From 2016-2021 CS-CASH outreach personnel participated in 89 agricultural farm shows and agribusiness events across the Center's seven-state region. Many of these training sessions are in partnership with other NIOSH Ag Center outreach personnel, saving money on booth space and providing a selection of outreach topics. Training and demonstrations to place at the following locations (except during 2020 and 2021 during the COVID pandemic) Husker Harvest Days (NE), AgConnect (MO), Veteran's Farmer Coalition (changes location yearly), FarmFest (MN), Women in Agriculture Conferences (NE, IA, MO); Sustainable Ag Conference (SD), Lake Region Extension Roundup (ND), Custom Harvesters Convention (KS, NE), and Farm Progress (IA). CS-CASH provides training and demonstrations at these events, interacting with up to 500 people/day at some of the larger events. These valuable training sessions and demonstrations reach large numbers of farmers and ranchers in all seven of our regional states, encouraging long-term community relationships to flourish and valuable new relationships to be established.

**Spanish Language Agricultural Safety and Health Resources.** CS-CASH continued to translate its educational resources into Spanish. These materials are available to the public at farm shows, training, and the CS-CASH website.

**Rural Media.** Ag journalist Loretta Sorensen continues to create media-ready, Ag safety and health-related stories for rural newspapers, farm journals, a farm blog, and radio and television stations. Story content is created using experts in the field, with the final copy reviewed by two content experts. UNMC Public Relations and Loretta disseminate the articles through Midwestern media sources and the Associated Press. These articles are available to the media and the public on the CS-CASH website as "Ag Stories Ready to Go". UNMC supports a news-tracking service that provides metrics, including the source running the article/interview, date, frequency, circulation, article size, ad value, and the page number.

**Progressive Agriculture Foundation (PAF) Safety Days.** CS-CASH outreach personnel participate in PAF Safety Days across the Centers 7-states region. CS-CASH has developed a training curriculum on hearing conservation, respiratory health, sun safety, and eye safety. In 2020 CS-CASH collaborated with PAF to produce two videos for the PAF virtual safety days on hearing conservation and Sun Safety. These videos are now used as part of the Virtual Safety Days held across the U.S. during the pandemic.

**National Ag Safety Database (NASD).** CS-CASH continued to support the maintenance, software updates, and administration of the National Ag Safety Database<sup>21</sup>. NASD has continued to grow with training materials, videos, and additional resources.

### **Farm Women and Military Veteran Farmers Outreach in Partnership with the AgriSafe Network**

#### **Specific Aims**

- ❖ Increase outreach education for farm women and military veteran farmers working in agriculture regarding occupational health and safety practices.
- ❖ Establish media relationships to bring awareness to issues of women and military veteran farmers to the broader agricultural community
- ❖ Development of syndicated health and safety information via the AgriSafe website platform to house evidence-based information specific to the needs of women and military veterans.
- ❖ Assess and rapidly address emerging health hazards specific to agriculture populations related to weather events, COVID-19, and Avian Influenza

#### **Summary**

While building on outreach projects and producer reach as outlined in the previous five years of annual reports, AgriSafe Network continued forward momentum during year six to serve the occupational health needs of women and veterans working in agriculture. Fiscal years one through three were heavily focused on assessment of women's health needs and subsequent evidence-based initiatives to meet those needs. Fiscal years three through six were focused on the health and safety of the Veteran farmer. The below bulleted points illustrate our accomplishments.

#### **Women's Health**

- Presentation: University of Nebraska Medical Center College of Public Health AgriMed course, - "Optimizing the Health of the Female Producer" (a comprehensive review of the female producer's work and health hazards), - Over 300 clinical and public health professionals trained.
- Additional trainings: Building capacity from the work funded by CS CASH, OSHA's women health project has developed 12 training topics related to the physical hazards in agriculture [Women's Health - AgriSafe Network](#), - Over 800 females trained this past year.
- Women's Health website page: AgriSafe dedicated women's health page connects the learner to fact sheets, webinar, women's ag health risk assessment, related website and articles framing the occupational hazards and appropriate mitigation strategies- Over 950 unique views since development

- Downloadable resources: Free downloadable posters and tutorial video were created to educate producers on doable mitigation strategies to address the musculoskeletal occupational health hazards of the female producer-432 poster downloads and 272 video views.
- Video stories to connect: Stories from the Field “Carey’s Story”, is a compelling narrative of a female cattle manager’s recovery following a MVA.- Over 130 You Tube views.
- Addendum women’s health resource: Expanding on the topic of Reproductive Health, AgriSafe recently researched and created a “What You Need to Know: Feed Yard Animal Handling” resource for female feed yard workers. Please see the attached document. This resource will be included in the UNMC COPH Feed yard 15 project.

### **Veteran Farmer Health**

- Presentations: Veteran farmer groups and organizations, “Great Resources for the Veteran Farmer” (a juxtaposition review of the unique military and agricultural workplace exposures and mitigation strategies. - 20 VFW and auxiliary members and 35 military veterans trained at the national gathering at the Farmer Veteran Coalition conference. AgriSafe also tabled an exhibit of occupational health resources at the forementioned conference of over 250 individuals. AgriSafe coordinated and collaborated with Veteran Farmer health and safety experts to host a Frontlines panel presentation “Ag Safety and Health Risks and Remedies for Veterans” at the annual Midwest Regional Ag and Safety Conference. - Over 50 trained.
- Veteran Farmer Health website page: Dedicated webpage featuring five topics related to veteran farmer health and safety including a webinar validated for continuing education credits, fact sheets and guides, and other website resources, [Veterans - AgriSafe Network](#)- Over 800 unique views.
- Video stories to connect: Stories from the Field “Cindy’s Story” is an account of the mental and physical exposures and injuries related to active-duty service during war time from the voice of an Army Veteran and female farmer.
- Veteran Farmer social and traditional media outreach: Using keyword, AgriSafe Veteran Farmer, Meltwater software analytics reveal a substantial tracking of Veteran Farmer topics- Over 1,000,000,000 reached.
- Partnership: AgriSafe has established a working relationship with the Farmer’s Veteran Coalition and will present at an upcoming regional conference regarding occupational health standards for the beginning farmer.

### **Emerging Issues**

Rapid response to emerging issues specific to agriculture remains a high priority. Webinars related to Winter Farm Floods and SARS COVID-19 pulled in national experts to discuss objectives relevant to living and working in farm and ranch country. In 2021-2022, the Avian Influenza was and continues to be a major threat to producer flocks. A newly dedicated webpage offers a menu of resources for the producer to monitor for the virus as well as appropriate PPE for depopulation, removal, and composting.

### **Impactful Outreach**

National Farm Safety and Health week continues to reach ag health professionals and producers via a robust lineup of topics and speakers. Over 450 individuals registered for the event as well as 81 individuals qualified for badge certification. Meltwater analytics revealed over 96 million folks were reached via news/media and social media. AgriSafe is grateful for the continued support in the project in part by the Central States Center of Ag Safety and Health.

### **Participants**

Outreach work is led by Linda Emanuel RN. Linda is the Community Health Director for AgriSafe and a producer on her three generational family farms in Nebraska. She continues her “boots on the groundwork” by connecting Ag producers, Ag Business and health care professionals caring for this population with education and resources appropriate to meet the needs of the underserved population of rural America.

**B.3. Competitive Revisions/Administrative Supplements**

NA

**B.4. What opportunities for training and professional development did the project provide?**

The backbone of the CS-CASH outreach is training. Training includes not only stakeholders (farmers, farm workers, ranchers and management) but other safety professional through seminars, webinars and conferences. CS-CASH has a commitment to educating MPH and PhD students who are involved in the Center through lectures, experiential learning opportunities in outreach, and through Capstone projects. The CS-CASH outreach team attended the ISASH, ASHCA, MRASH, and ASABE conferences yearly. These conferences provided an opportunity for not only presenting outreach results but learning from other safety and health professionals.

**B.5. How did you disseminate the results to communities of interest?**

See full description of dissemination in narrative above.

**B.6 - What do you plan to do during the next reporting period to accomplish the goals?**

NA as this is the final reporting for this funding cycle.

**E. PRODUCTS****C.1. Publications, conference papers, and presentations**

1. COVID-19 Ag Task Force Think Tank Website. <https://learning.agrisafe.org/products/covid-19-ag-task-force-response-think-tank-series#tab-product> [tab overview](#)
2. Cattle Facility COVID-19 Playbook. [https://www.unmc.edu/publichealth/cscash/documents/Cattle-Feeding-Facility-Covid-19-Playbook\\_12Jan21.pdf](https://www.unmc.edu/publichealth/cscash/documents/Cattle-Feeding-Facility-Covid-19-Playbook_12Jan21.pdf)
3. Poultry Grower Facility COVID-19 Playbook. [https://www.unmc.edu/publichealth/cscash/documents/Poultry-Growers-Facility-PlaybookFinal\\_14Jan21.pdf](https://www.unmc.edu/publichealth/cscash/documents/Poultry-Growers-Facility-PlaybookFinal_14Jan21.pdf)
4. CS-CASH COVID-19 Resources for Ag Communities. <https://spark.adobe.com/page/UO9sw0bOvCIRq/>
5. University of Nebraska Medical Center Continuing Education Department. CS-CASH Ag Health and Safety Course Description. <https://www.unmc.edu/cce/>
6. CS-CASH Annual Ag Health and Safety Course – Results of 2020 Training “A Thank You to Essential Workers”. <https://documentcloud.adobe.com/spodintegration/index.html?r=1&locale=en-us>
7. Ramos, A.K., Duysen, E., Carvajal-Suarez, M., & Trinidad, N. Virtual outreach: Using social media to reach Spanish-speaking agricultural workers during the COVID-19 pandemic. *Journal of Agromedicine*. 2020 Sept.12:1-4.
8. Duysen, E. Consider This - Nebraska Flooding 2019. Interview. <https://nebraskapublicmedia.org/en/series-media/consider-this-video/season-23-video-16392/nebraska-flooding-2019-50009580/>
9. Duysen, E. Consider This – Life After the Flooding. Interview. <https://nebraskapublicmedia.org/en/series-media/consider-this-video/season-22-video-16392/life-after-the-flooding-50008590/>
10. Wickman A, Duysen E, Cheyney M, Pennington W, Mazur J, Yoder A. Development of an Educational YouTube Channel: A Collaboration between U.S. Agricultural Safety and Health Centers. *J Agromedicine*. 2021 Jan;26(1):75-84. doi: 10.1080/1059924X.2020.1845269. Epub 2021 Apr 11. PMID: 33138734; PMCID: PMC8117175.

11. Beseler CL, Crawford KJ, Charlier DE, Ramos AK. The NIOSH Agricultural Centers' YouTube Channel: Time Series Modeling of Viewership of Agricultural Health and Safety Videos. J Agromedicine. 2021 Nov 6:1-10. doi: 10.1080/1059924X.2021.2000907. Epub ahead of print. PMID: 34719344.
12. Central States Center for Agricultural Safety and Health - Spanish Ag Safety and Health Resources. <https://www.unmc.edu/publichealth/cscash/news/Spanish-resources.html>.
13. Central States Center for Agricultural Safety and Health - Ag Stories Ready to Go. <https://www.unmc.edu/publichealth/cscash/news/index.html>.
14. National Ag Safety Database. <http://nasdonline.org/>.
15. AgriSafe Veteran in Agriculture Web page. <https://learning.agrisafe.org/veteranshealth>
16. AgriSafe Women in Agriculture Web page. <https://www.agrisafe.org/healthcare/women/>

**C.2. Website(s) or other Internet site(s) – include URL(s)**

1. Central States Center for Agricultural Safety and Health Website. <https://www.unmc.edu/publichealth/cscash/>
2. Central States Center for Agricultural Safety and Health Facebook. <https://www.facebook.com/unmccscash/>
3. Central States Center for Agricultural Safety and Health Twitter. <https://twitter.com/unmccscash>
4. Central States Center for Agricultural Safety and Health Instagram. <https://www.instagram.com/unmccscash/>
5. Central States Center for Agricultural Safety and Health Flickr Photo Sharing Site: <https://www.flickr.com/photos/cscash/>
6. U.S. Ag Center YouTube Channel. <https://www.youtube.com/user/USagCenters>

**CA.3. Technologies or techniques**

NA

**C.4. Inventions, patent applications, and/or licenses**

NA

**C.5. Other products and resource sharing**

English resources created by CS-CASH housed here:

<https://www.unmc.edu/publichealth/cscash/resources/index.html>

Spanish resources created by CS-CASH housed here:

<https://www.unmc.edu/publichealth/cscash/resources/spanish-resources.html>**D. PARTICIPANTS****D.1. What individuals have worked on the project?** Please include calendar, academic, and summer months.

| Commons ID   | S/K | Name            | Degrees(s) | Role        | Cal | Aca | Sum | Foreign | Country | SS |
|--------------|-----|-----------------|------------|-------------|-----|-----|-----|---------|---------|----|
| DROMBERG     |     | Debra Romberger | MD         | PI          | 0.4 |     |     |         |         |    |
| DUYSEN.ELLEN |     | Ellen Duysen    | MPH        | Coordinator | 2.4 |     |     |         |         |    |
| AMYODER      |     | Aaron Yoder     | PhD        |             | 3.3 |     |     |         |         |    |
|              |     |                 |            |             |     |     |     |         |         |    |

**D.2 Personnel updates****a. Level of Effort:****b. New Senior/Key Personnel:** No**c. Changes in Other Support:** No**d. New Other Significant Contributors:** No

|  |
|--|
|  |
|--|

**E. IMPACT**

**E.1 - What is the impact on the development of human resources, if applicable?**

NA

**E.2 - What is the impact the Public Health Relevance and Impact? The investigator should address how the findings of the project relate beyond the immediate study to improved practices, prevention or intervention techniques, legislation, policy, or use of technology in public health.**

NA

**F. CHANGES**

**F.1 – Changes in approach and reasons for change, including changes that have a significant impact on expenditures**

None

**F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them**

No

**F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents**

None

**G. Special Reporting Requirements**

**G.1 Special Notice of Award Terms and Funding Opportunities Announcement Reporting Requirements**

NA

**G.2 Responsible Conduct of Research**

NA

**G.3 Mentor's Research Report or Sponsor Comments**

NA

**G.4 Human Subjects**

G.4.a Does the project involve human subjects?

No

G.4.b Inclusion Enrollment Data

NA

G.4.c ClinicalTrials.gov

No

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

No

**G.5 Human Subject Education Requirement**

Are there personnel on this project who are newly involved in the design or conduct of human subject's research?

No

**G.6 Human Embryonic Stem Cells (HESCS)**

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

**G.7 Vertebrate Animals**

Does this project involve vertebrate animals?

No

**G.8 Project/Performance Sites**

University of Nebraska Medical Center, Omaha, NE

**G.9 Foreign Component**

None

**G.10 Estimated Unobligated Balance**

See FFR

G.10.a Is it anticipated that an estimated unobligated balance (including prior year carryover) will be greater than 25% of the current year's total approved budget?

No

**G.11 Program Income**

Is program income anticipated during the next budget period?

No

**G.12 F&A Costs**

Is there a change in performance sites that will affect F&A costs?

No

## I. OUTCOMES

I. Provide a concise summary of the outcomes or findings of the award, written for the general public in clear and comprehensible language, without including any proprietary, confidential information or trade secrets

Note: project outcome information will be made public in NIH RePORTER

Since the Central States Center for Agricultural Safety and Health (CS-CASH) inception in 2011, the Center has aimed to promote evidence-based interventions that can be effectively adopted and sustained in agriculture across the region and the nation. The Center's long-term goal is to contribute to sustainable improvements in agricultural worker health. To accomplish this goal, the Center continued during the previous 6-year funding cycle to implement a coordinated outreach strategy directed at two primary audiences 1) agricultural producers, with a focus on women and military veteran farmers, and 2) agricultural, health, and safety professionals. The core is strengthened by many MPH and PhD graduate students who participated in outreach activities throughout the Center's seven-states region. The aims of the CS-CASH program in the 2016-2021 funding cycle were to 1) integrate information from the Center's Research, Evaluation and Pilot Program projects, translating it into a coordinated outreach effort and effectively disseminate the information using a wide range of proven methods, 2) to develop and launch radio social marketing campaigns, innovative training webinars, and eHealth web-based toolkits targeted women in agriculture and military veteran farmers and, 3) to support and advance current information technology efforts that disseminate occupational safety and health information and education to ag workers, managers, educators, researchers, and health and safety. The outreach team accomplished these goals through various means.

- Valuable partnerships and collaborations with regional and national organizations, industry affiliations and individuals.
- Translation of Center Research. Center projects were developed to contribute to the outreach effort by producing and disseminating new information relevant to their specific fields of study.
- Using Surveillance Databases to Detect Emerging Issues. The Outreach team used the Center's vast surveillance database to detect emerging issues and to provide a rapid response through the Center's 26,000 member database alerting the ag community to immediate concerns such as the 2015 and 2022 Avian Influenza poultry worker hazards, 2019 Midwest flood event, and the COVID-19 pandemic.
- Development of Ag Health and Safety Content. Working with an agricultural journalist and CS-CASH researchers, the outreach team created content for distribution. Resource dissemination methods included electronic platforms, CS-CASH website, email, Facebook, Twitter, and Instagram; traditional media, including educational content for print and radio; videos created for the NIOSH U.S. Ag Center YouTube Channel.
- Outreach Focused on Women and Military Veterans. In partnership with the AgriSafe Network, CS-CASH focused outreach programs and projects addressing the needs of women and military veterans in agriculture. Training webinars, face-to-face training, in addition to broadcast and media messages, were designed to improve health and safety outcomes in these special populations of farmers and ranchers.
- Developing and Improving New Technologies for Ag Safety and Health. Dr. Aaron Yoder worked with a network of safety and health and information technology experts to develop new and to improve existing technology tools and methods for disseminating information, determining risk and improving safety and health outcomes.
- Boots on the Ground Trainings, Presentations, and Events – The Hallmark of CS-CASH Outreach. The CS-CASH outreach team, often accompanied by students, spent a significant amount of time over the past six years traveling to all seven states in the CS-CASH region conducting ag safety and health training, demonstrations, presentations, and delivering information on emerging issues. This outreach is seen as the most impactful, as training can be conducted using educational techniques that are shown to improve learning and move participants forward toward behavior change.