A. COVER PAGE

Project Title: High Plains Intermountain Center for Agricultural Health and Safety (HICAHS)	
Grant Number: 5U54OH008085	**Project/Grant Period**: 09/15/2016 - 09/14/2022
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Program Director/ Principal Investigator STEPHEN J REYNOLDS, PHD MS BA Phone number: 970-491-3141 Email: Stephen.Reynolds@Colostate.edu	**Administrative Official Information** TRISHA SOUTHERGILL 2002 Campus Delivery Fort Collins, CO 805232002 Phone number: (970) 491-6153 Email: trisha.southergill@colostate.edu Signing Official: Kelly Bergeron 601 S. Howes Fort Collins, CO 80523 Phone number: 970-491-8437 Email: kelly.bergeron@colostate.edu
Change of Contact PD/PI: Not applicable	
Human Subjects: HS Exempt: No Phase III Clinical Trial: No	**Vertebrate Animals: No**
hESC: **No**	**Inventions/Patents: No**

OVERALL

B. ACCOMPLISHMENTS

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

The Mission of HICAHS is to be a dynamic catalyst for transdisciplinary research, training, and outreach that reduces the burden of human morbidity and mortality in agriculture and forestry in the high plains intermountain region and beyond. The overall goal of HICAHS is to integrate new and existing knowledge and to utilize multiple routes of dissemination to move from research to improved agricultural health and safety practice. Our projects are driven by ongoing stakeholder feedback. The HICAHS Center has been developed to provide the structure and means to effectively address the responsibilities and challenges described in the PAR-15- 353.

The Center consists of three Cores: 1. Administration, Planning, and Evaluation Core; 2. Research Core including Pilot Projects, two Intervention Research projects, and one Translation Research project; 3. Outreach Core integrating our Community grants program.

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

Planning & Evaluation (Center Administration, Evaluation Program, Emerging Issues Program). The administrative structure and function effectively managed the Center and facilitated synergy among investigators, External Advisory Board members, and partners, leading to new collaborations, projects, and products to improve agricultural health and safety. While COVID-19 prevented us from connecting in-person during the last two years of the grant cycle, communication has strengthened between Internal Committee and External Advisory Board. Our communications occurred frequently by videoconferencing, telephone, and email. We held our annual External Advisory Board meeting virtually in September 2020 and September 2021.

HICAHS Leadership Team members represented HICAHS at producer meetings, scientific conferences, meetings with other NIOSH Centers and other agencies. Faculty provided consultation to producers, producer organizations, policy-making and regulatory bodies, and to NIOSH, and CDC more broadly on COVID-19 agricultural worker guidance. Drs. Reynolds and Douphrate served on the NORA AgFF Sector Council. Dr. Stallones continued serving on the leadership team for the Farm and Health Safety Community of Practice, which operates through the Cooperative Extension eXtension program. Drs. Stallones, Reynolds and Douphrate served as Associate Editors for the *Journal of Agromedicine* and the *Journal of Agricultural Safety and Health*.

The HICAHS Evaluation Program continued to track the Center's outputs (publications, presentations, impact of published works through citation indices) and identify worker health and safety needs in the region by conducting needs assessments with the Advisory Board and other agriculture serving organizations. Under the leadership of Dr. Stallones, staffing increased during the cycle and the team used several innovative evaluation approaches.

The HICAHS Evaluation Team pilot tested a Needs Assessment Survey with our HICAHS Advisory Board in 2018. After incorporating feedback into the instrument, it was circulated to partners and at farm shows in the region in early 2019. This assessment helped the center leadership identify emerging issues to fund during the final years of the current grant cycle as well as develop research ideas to pursue in the next application for research core funding. It also elucidated some specific issues related to the work environment (e.g., extreme weather, wildfires, etc.) for HICAHS to address. This portion of the assessment was added after the pilot testing revealed a generic concern about the impacts of climate change. The instrument was augmented to define more specific concerns related to the impacts of climate change.

The Evaluation Team also conducted a Social Network Analysis to determine HICAHS' connectivity and relation to other organizations and stakeholders in the region. The success of agricultural health and safety centers depends on partnership among academia, industry, government, agricultural operators/owners, employees, and stakeholders engaged in agricultural safety and health. Promoting worker health and safety requires comprehensive engagement throughout this network, and there may be overlap in activities of different organizations, which can lead to inefficient delivery of services and information. A paper from this work, "Assessing Connections in an Agricultural Community using Social Network Analysis," was published in *the Journal of Agromedicine.* The analysis showed that the most prominently connected organizations in the HICAHS region are Extension and education; other agricultural health and safety centers; and cattle, dairy, and pork producers and organizations that support agriculture. The Evaluation and Outreach teams used the results of the analysis to inform our strategies. Specifically, we are using the results of the Social Network Analysis in tandem with the needs assessment to identify potential partnership and networking opportunities with the highest potential impact in the region. This effort informed our reorganization of the External Advisory Board.

In 2020-2021, the evaluation team collaborated with colleagues from the other US Agricultural Health and Safety Centers in two program-wide evaluation projects: one evaluating regional needs related to the COVID-19 pandemic and another developing a Contribution Analysis on cross-center activities to reduce tractor overturn fatalities through Rollover Protective Structure (ROPS) research and programs. The team also implemented an Evaluator Cultural Self-Assessment and identified priorities for growing its internal capacity, competencies, and approaches to incorporate greater cultural responsiveness and humility into the core. This assessment addresses the use of cultural heritage, cultural stereotypes, diverse team membership, equity, selection of data collection instruments that are appropriate for the target population, and differential impacts on diverse populations in approaching evaluation. As a team, with the addition of Whitney Pennington (Outreach Coordinator), we took a training on Intergroup Dialogue, designed to understand how to communicate and discuss across differences. The topics included group facilitation skills and their applications in inclusive, diverse settings; group processes and dynamics involving social power; social identity group development; prejudice and stereotyping and their effects on groups; difference and dominance and the nature of social oppression.

The Emerging Issues Grant Program enabled HICAHS to identify and respond to issues of high priority for regional producers. During the grant cycle, the leadership of the Emerging Issues program was shifted from center director Stephen Reynolds to Morgan Valley, under the mentorship of Drs. Reynolds and Stallones. Specific topics addressed by emerging issues grant recipients include mental health, wildfire and extreme weather, and respiratory exposures and protections. Recent examples of Emerging Issues grants include:

- Understanding the Mental Health Safety Net for Foreign-born Farmworkers in Colorado and Utah, led by Annie Keeney and Anita Alves Pena at Colorado State University;
- Supporting Resilience and Suicide Prevention in Agricultural Workers, led by Stacia McNeely at Regis University;
- Wildfire Information Project, led by John Volckens at Colorado State University, which led to the creation of 8 state-specific factsheets on respiratory protection for wildfire smoke (including Spanish-language versions);
- Heat Acclimation in Wildland Firefighters, led by Miranda Zamora, Masters Candidate, University of Wyoming;
- Assessing the 3D Facial Anthropometrics of LatinX Workers, led by John Rosecrance of Colorado State University;
- Piloting a regional respiratory protection education and fit testing model for pesticide applicators in Colorado's marijuana industry, led by Annyce Mayer at National Jewish Health;
- Train the Trainer: Building Capacity for Respiratory Protection and Respiratory Safety Program Administrators in Utah, led by Michael Wierda, Pesticide Safety Education Program Coordinator, Utah State University;
- Study of Environmental Mixtures and Periurban Respiratory Outcomes (SEMIPRO), led by Sheryl Magzamen at Colorado State University, who received an R21 from the National Institute of Environmental Health Sciences to continue this work.

Outreach Core. During the last grant cycle, the HICAHS Outreach Team contributed to webinars and attended regional farm shows, expos, seminars, and Extension workshops in every state in the region. Educational information shared at these events focused on respiratory protection (including during wildfires), hearing protection, COVID-19 prevention, worker training resources, and grant opportunities. We also shared new research outputs, administrative updates, and safety and health information through a quarterly newsletter and on Facebook, Instagram, Twitter, and YouTube. In response to COVID-19, the Outreach Team published more than 100 posts across the center's social media channels promoting best practices and vaccination information. The use of YouTube was particularly effective for reaching a wide audience with safety information, and HICAHS video content on YouTube (see more details in the Outreach section).

The Community-Initiated Grants Program moved into the Outreach Core this grant cycle and funded 20 occupational health and safety projects with 12 community partners in Colorado, Montana, South Dakota, Utah, and Wyoming. During this period, more than $300,000 in small grants was provided to organizations that represent farmers, ranchers, professional loggers, and dairy workers (primarily Latinx) in the HICAHS region working to improve occupational safety in their communities. Outreach Team members aided these partners in the development, conduct and evaluation of safety initiatives that addressed community-identified needs and solutions. This program fostered close relationships with the Montana Logging Association and the South Dakota State University Dairy Extension program. These two organizations received multiple grants for their ability to create and implement research-based activities to improve worker safety and health. These partnerships also greatly contributed to the Center's ability to reach into the entire region.

HICAHS Research Core. HICAHS investigators have partnered with producers to understand and address the health and welfare of the agricultural workforce in the region.

- Building on previous research on the occupational health and safety training needs of this primarily immigrant workforce, David Douphrate (University of Texas Health) and collaborators aimed to design and implement a supervisor training program to increase the safety leadership skills of supervisors and improve safety culture on the dairy overall. See more details in the Dairy Leadership component.
- Stephen Reynolds, Joshua Schaeffer, and colleagues (Colorado State University) continued to test the effectiveness of a nasal rinse to prevent respiratory inflammation in dairy workers. See more details in the Nasal Intervention component.
- Through the "Agricultural Safety Education Initiative," Michael Pate (Utah State University) and collaborators aimed to reduce fatalities of youth agricultural workers on US farms by increasing the safety knowledge of agricultural education teachers. See more details in the Ag Safety component.
- Paul Ayers led a project on foldable rollover protective structures (ROPS), which are a popular addition to mowers and to tractors used on orchards. See more details in the FROPS component.

Pilot/Feasibility Program. Pilot awardees for the 2016-2022 cycle disseminated findings to both scientific and industry audiences. Grantees have presented work at numerous annual meetings and conferences. See more details in the Pilot component.

In partnership with the HICAHS Outreach and Evaluation and Planning Core Teams, the Pilot/Feasibility program hosted two HICAHS Research Days. The events featured investigators who received HICAHS funding through our research core or one of our grant programs. At our advisory board's request, we hosted the event in coordination with the annual board meeting. This gave board members the opportunity to engage with researchers and see the full scope of projects funded recently. Though hosted by HICAHS at Colorado State University, the event's seven speakers represented five different academic institutions. Presentation topics included anthropology, communications, economics, education, engineering, and immunology. It was a great showcase of the diversity of agricultural health and safety research that HICAHS supports.

HICAHS faculty, staff, and students have continued to be highly productive. During the 2016-2022 grant period we secured or continued more than 25 **new grants and contracts totaling more than $9.8 million**. Our collaborating partners have secured several more at their institutions. Recent examples include:

Years	Title of Proposal	Agency	Amount
2018-2021	Grain Bin Safe Entry System Evaluation (PI: Pate)	NIOSH/Bassett HealthCare Network	$300,547
2020-2022	Shaping the Future to Ensure Worker Health and Well-being: Shifting paradigms for Research, Training and Policy. (PI: Gimeno)	CDC/NIOSH	$168,844
2020-2022	Health and exposure effects of California's chlorpyrifos ban on agricultural communities (PI: Magzamen)	NIH/NIEHS	$275,000

2020-2022	COVID-19 in the US Dairy Industry: Development, Delivery and Evaluation of Training Resources for Producers and Workers (PI: Douphrate)	National Institute of Food and Agriculture/USDA	$639,000
2020-2024	Antimicrobial Resistant Bacteria: Exposures and Health of Cattle Workers (PI: Schaeffer; Co-I: Reynolds)	HHS-CDC-NIOSH	$583,992
2020-2021	Emergency expansion of multisystem suicide prevention and treatment across Colorado in response to COVID-19. (Co-Investigator: Stallones)	SAMHSA	$797,848
2020-2023	Western Region Farm & Ranch Stress Assistance Network, Washington State University. (Co-Investigator: Stallones)	USDA	$49,326.00
2021	Digital Innovations for Youth Farm Safety Education and Certification Instructors - A Professional Development and Training Program. (PI: Pate)	USDA/NIFA	$113,719

B.3. Competitive Revisions/Administrative Supplements
Not applicable

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

Advising, Young Investigator Mentorship, & Capacity Development. In the reporting period, 17 PhD and 9 MS were awarded to students supported by HICAHS funds. In the past grant cycle, HICAHS team members have advised or supported over 50 graduate students in industrial hygiene, epidemiology, ergonomics, occupational health psychology, social work, education, communications, engineering, animal science, and production agriculture. HICAHS' Pilot/Feasibility Program has successfully increased junior faculty members' capacity to address the health and safety needs in agriculture and forestry through innovative research. For example, in June 2021, previous grantee Ruth Menger (Colorado State University), PhD, completed her dissertation, titled "Developing Paper-based Devices for Mapping Agricultural Pesticides and Environmental Contaminants," which included data from her 2020 pilot project. Dr. Menger also published an article, titled, "Sensors for Detecting Per- and Polyfluoroalkyl Substances (PFAS): A Critical Review of Development Challenges, Current Sensors, and Commercialization Obstacles"[5] in *Chemical Engineering Journal*, drawing in part from lessons during the pilot project. This year, two previous pilot grantees published articles based on their pilot projects: Sumali Pandey (Minnesota State University) and colleagues published an article based on their 2018 pilot project in the *International Journal of Environmental Research and Public Health,* titled, "Factors Contributing to Sex Differences in Mice Inhaling Aspergillus fumigatus;" and Anita Pena (Colorado State University) and colleagues published an article based on their 2016 pilot project in the *Applied Economic Perspectives and Policy*, titled, "Pesticide Exposure and the Physical and Economic Health of US Crop Workers."

HICAHS is committed to fostering diversity, equity, and inclusiveness (DEI) in the Center and throughout our research, outreach, and administrative efforts to address health equity among historically underserved and underrepresented agricultural communities. One reflection of our DEI commitment is through young investigator mentorship. Center personnel is committed to identifying and mentoring the next generation of AgFF worker health and safety researchers. Since its founding, HICAHS has included young investigators (students, graduates, and faculty) on research projects to provide research opportunities and mentorship. For example, Dr. Anabel Rodriguez joined Dr. Douphrate's research team as a master's student and continued as a doctoral student. She has played instrumental roles on multiple AgFF research projects. Dr. Rodriguez comes from an agricultural migrant family from the Rio Grande Valley in Texas. Dr. Rodriguez is the first in her family to receive a doctoral degree and is now on faculty at The University of Texas School of Public Health (UTHealth SPH) in San Antonio. She brings a unique perspective to AgFF research and will make a vital contribution to Dr. Douphrate's 2022-2027 study on fatigue assessment among dairy workers. HICAHS continues to build on its history of mentoring young investigators to ensure the ongoing training and success of underrepresented faculty.

B.5. How did you disseminate the results to communities of interest?
Across the 2016-2022 cycle, the HICAHS team disseminated findings and resources to both scientific and industry audiences through peer-reviewed articles, conference presentations, trade publications and shows, social media channels, quarterly newsletters, youtube videos, webinars, and more. Please see each component for more details.

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

This is the final report for the grant cycle.

C. PRODUCTS

C.1. Publications, conference papers, and presentations

Over the reporting period, HICAHS researchers have disseminated findings across a variety of mediums and audiences.

One of our trade publications from 2019, the Idaho Dairy Workforce Training and Safety Program, developed by Drs. Douphrate and Hagevoort, was also adopted by the National Milk Producers Federation. Dr. Reynolds served on the Advisory Board for this program, which was instrumental in the negotiations which ultimately included dairy worker safety program management principles in the Farm Worker Modernization Act currently being discussed with a bi-partisan group in the US House and Senate to assist dairy producers with worker recruitment.

Refereed publications were in a variety of high-impact, multi-disciplinary and targeted journals and included:

***Winner of the 2018 Michigan Industrial Hygiene Society's Best Paper Award for articles in industrial hygiene journal*:** Davidson ME, Schaeffer J, Clark ML, Magzamen S, Brooks EJ, Keefe TJ, Bradford M, Roman-Muniz IN, Mehaffy J, Dooley G, Poole J, Mitloehner FM, Reed S, Schenker MB, and Reynolds SJ. 2017. Personal Exposure of Dairy Workers to Dust, Endotoxin, Muramic Acid, Ergosterol and Ammonia on Large-Scale Dairies in the High Plains Western United States. *JOEH*, 15(3):112. https://DOI.org/10.1080/15459624.2017.1403610

Winner of the 2017 MAP ERC Research Day Best Poster Award: Erlandson, G., Root, K.S., Magzamen, S.L., Reynolds, S.J., & Schaeffer, J.W. (2017, March). Indoor air quality across three different higher education building types. Presented at MAP ERC Research Day, Westminster, CO.

The most cited works of those published within the last grant cycle included:

Young, B.N., Clark, M.L., Rajkumar, S., Benka-Coker, M.L., Bachand, A., Brook, R., Nelson, T.L., Volckens, J., Reynolds, S.J., L'Orange, C., Africano, S., Osorto Pinel, A.B., & Peel, J.L. (2019). Exposure to household air pollution from biomass cookstoves and blood pressure among women in rural Honduras: A cross-sectional study. Indoor Air, 29(1): 130-142. doi:10.1111/ina.12507. PMCID: PMC6301093. **[40 citations]**

Schaeffer, J. W., Reynolds, S., Magzamen, S., VanDyke, A., Gottel, N. R., Gilbert, J. A., Owens, S.M., Hampton-Marcell, J.T., Volckens, J. (2017). Size, composition, and source profiles of inhalable bioaerosols from Colorado dairies. Environmental Science & Technology, 51(11), 6430-6440. doi: 10.1021/acs.est.7b00882. **[25 citations]**

Schwatka, N. V., Atherly, A., Dally, M. J., Fang, H., Brockbank, C., Tenney, L., Goetzel, R. Z., Jinnett, K., Witter, R., Reynolds, S., McMillen, J. & Newman, L. S. (2017). Health risk factors as predictors of workers' compensation claim occurrence and cost. Occup Environ Med, 74(1), 14-23. doi: 10.1136/oemed-2015-103334. **[24 citations]**

PUBLISHED WORKS

Journal Articles

2022

1. Edwards-Callaway, L., Simpson, H., Román-Muñiz, N., Cramer, C., Mijares, S., Stallones, L., Rivera-Gonzalez, J., & Aberle, J. (2022). Preliminary exploration of weekly peer group discussions as a strategy for coping with feelings associated with euthanasia in dairy caretakers. *International Journal of Environmental Research and Public Health, 19*(4), 2177. https://doi.org/10.3390/ijerph19042177. **PMCID: PMC8872095**
2. Smalley, S. W., Perry, D. K., Shultz, A., Lawver, R. G., Pate, M. L., Hanagriff, R., & Ewell, C. (2022). Assessing Youth Safety Knowledge through the Agricultural Experience Tracker (AET). *Journal of Agricultural Safety and Health*, 28(2): 87-98. doi: 10.13031/jash.14801. NIHMSID:1833793
3. Stallones, L., Valley, M., & Pennington, W. (2022). Colorado Agricultural Workers' Rights of Access to Key Healthcare Providers: A Policy Brief. *Frontiers in Public Health*, *10,* 1-4. https://doi.org/10.3389/fpubh.2022.856878. **PMCID: PMC9199895**
4. Sturm, E. T., Castro, C., Mendez-Colmenares, A., Duffy, J., Burzynska, A. A. Z., Stallones, L., & Thomas, M. L. (2022). Risk Factors for Brain Health in Agricultural Work: A Systematic Review. *Int. J. Environ. Res. Public Health* 2022, *19*(6), 3373; https://doi.org/10.3390/ijerph19063373. **PMCID: PMC8954905**

2021

1. Beseler, C., Keeney, A., Garratt, R., Wertheimer, A., Stallones, L. (2021) Assessing Connections in an Agricultural Community Using Social Network Analysis. *Journal of Agromedicine, 26*(2): 245–255. doi:10.1080/1059924X.2020.1837317. **PMCID: PMC8329729**
2. Douphrate, D. (2021). Animal agriculture and the One Health approach. *Journal of Agromedicine, 26*(1), 85-87. DOI: https://doi.org/10.1080/1059924X.2021.1849136. **PMCID: PMC9590376**
3. Guifarro, L., Stallones, L., Rosecrance, J., & Rovai, M. (2021). Assessing dairy employees' mental health status in South Dakota: Family and community. *American Dairy Science Association, 104*(1).
4. Keeney, A.J., Hernandez, P., & Meng, Y. (2021). Assessing farm stress and community supports in a US-Mexico border county. *Journal of Agricultural Safety and Health*, *27*(1), 1-12. https://doi.org/10.13031/jash.14213. **PMCID: PMC8684411**.
5. Menger, R.F., Funk, R., Borch, T., & Henry, C.S. (2021). Sensors for detecting per- and polyfluoroalkyl substances (PFAS): A critical review of development challenges, current sensors, and commercialization obstacles. *Chemical Engineering Journal, 417*, 129133. doi: 10.1016/j.cej.2021.129133.NIHMSID:1833822
6. Palomares Velosa, J. E., Salman, M. D., Roman-Muniz, I. N., Reynolds, S., Linke, L., Magnuson, R., ... & Rao, S. (2021). Socio-ecological Factors of Zoonotic Diseases Exposure in Colorado Dairy Workers. *Journal of Agromedicine*, *26*(2), 151-161. doi: 10.1080/1059924X.2020.1725700. **PMCID:9552966**
7. Pena, A. A. & Dixon, B. (2021). Pesticide exposure and the physical and economic health of US crop workers. *Applied Economic Perspectives and Policy*. https://doi.org/10.1002/aepp.13194. NIHMSID:1833833
8. Román-Muñiz, I.N., Cramer, M.C., Edwards-Callaway, L.N., Stallones, L., Kim, E., Thompson, S., Simpson, H., & Mijares, S. (2021). Dairy caretaker perspectives on performing euthanasia as an essential component of their job. *Animals, 11*(2), 289. https://doi.org/10.3390/ani11020289. **PMCID: PMC7912631**
9. 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. *J Agromedicine*, *26*(1):75-84. doi:10.1080/1059924X.2020.1845269. **PMCID:PMC8117175**.

2020

1. Beseler, C.L., & Stallones, L. (2020). Using a neural network analysis to assess stressors in the farming community. *Safety, 6*(2), 21. doi.org/10.3390/safety6020021. **PMCID: PMC8455151**
2. Martenies, S., Schaeffer, J. W., Erlandson, G., Bradford, M., Poole, J. A., Wilson, A., Weller, Z., Reynolds, S. J., & Magzamen, S. (2020). Associations Between Bioaerosol Exposures and Lung Function Changes Among Dairy Workers in Colorado. *Journal of Occupational and Environmental Medicine, 62*(6), 424–430. https://doi.org/10.1097/JOM.0000000000001856. **PMCID:9580837**
3. Masci, F., Rosecrance, J., Mixco, A., Cortinovis, I., Calcante, A., Mandic-Rajcevic, S., & Colosio, C. (2020). Personal and occupational factors contributing to biomechanical risk of the distal upper limb among dairy

workers in the Lombardy region of Italy. *Applied Ergonomics*, *83*, 102796. DOI:10.1016/j.apergo.2018.12.013. **PMCID:PMC9531529**

4. Perry, D., Smalley, S., and Pate, M. (2020). Effectiveness of utilizing an evidence based safety curriculum to increase student knowledge. *Journal of Agricultural Education, 61*(3), 294-307. https://doi.org/10.5032/jae.2020.0300294 NIHMSID: 1637474 NIHMSID:1833960 (new)
5. Rodriguez A, Douphrate, D, Gimeno Ruiz de Porras D, Perez A, Hagevoort R, Nonnenmann M, Prot E. (2020) Bovine tuberculosis case intervention using T.SPOT.TB assay to screen dairy workers in Bailey County, Texas. *Frontiers in Public Health*, *8*, 479. doi: 10.3389/fpubh.2020.00479. **PMCID: PMC7493632**
6. Schaefer, A.L., Ceesay, M., Leier, J.A., Tesch, J., Wisenden, B.D., Pandey, S. (2020). Factors contributing to sex differences in mice inhaling aspergillus fumigatus. *Int. J. Environ. Res. Public Health, 17*(23), 8851. https://doi.org/10.3390/ijerph17238851. **PMCID: PMC7729525**
7. Walker, J.B., Roman-Muniz, I.N., Edwards-Callaway, L.N. (2020). Timely euthanasia in the United States dairy industry–Challenges and a path forward. *Animals, 10*(1), 71. https://doi.org/10.3390/ani10010071. **PMCID: PMC7022783**

2019

1. Ayers, P.D., Khorsandi,F, K., Poland, M.J., & Hilliard, C.T. (2019). Foldable rollover protective structures: Universal lift-assist design. *Biosystems Engineering, 185,* 116-125. doi: 10.1016/j.biosystemseng.2019.02.014. **PMCID: PMC7177207.**
2. Berumen, B., Rodriguez, A., Cienega, L., Casanova, V., Pompeii, L., Gimeno Ruiz de Porras, D., & Douphrate, D. (2019). Evaluation of safety management and leadership training using mobile technologies among logging supervisors. *Journal of Agromedicine, 24*(2)*,* 197-204. doi: 10.1080/1059924X.2019.1567420.**PMCID: PMC7008448**
3. Douphrate, D., Fethke, N., Nonnenmann, M., Rodriguez, A., & Gimeno Ruiz de Porras. (2019). Reliability of observational- and machine-based teat hygiene scoring methodologies. *Journal of Dairy Science, 102*(8),7494-7502. doi: 10.3168/jds.2019-16351. **PMCID: PMC6939313**.
4. Erlandson, G., Magzamen, S., Carter, E., Sharp, J., Reynolds, S.J., & Schaeffer, J. (2019). Characterization of indoor air on a college campus: A pilot study. *International Journal of Environmental Research and Public Health, 16*(15), 2721. doi:10.3390/ijerph16152721. **PMCID: PMC6695958.**
5. Lagerstrom E, Magzamen S, Brazile W, Stallones L, Ayers P, Rosecrance J. A Case Study in the Application of the Systematic Approach to Training in the Logging Industry. (2019). *Safety*, 5(3). doi:10.3390/safety5030043.
6. Lagerstrom E, Magzamen S, Kines P, Brazile W, Rosecrance J. Determinants of Safety Climate in the Professional Logging Industry. (2019). *Safety*, 5(2) doi:10.3390/safety5020035
7. Lagerstrom E, Magzamen S, Brazile W, Rosecrance J. (2019) Active Surveillance of Musculoskeletal Disorder Symptoms in the Development of Safety Interventions for Professional Loggers. *Safety*, 5(2). doi:10.3390/safety5020023
8. Menger-Ogle, L., Pezzutti, F.,Ogle-Menger, A.D., Stallones, L., Rosecrance, J., & Roman-Muniz, N. (2019). Occupational safety and health of foreign-born, Latinx dairy workers in Colorado. *Journal of Occupational and Environmental Hygiene, 61*(1), 61-68. doi: 10.1097/JOM.0000000000001472. **PMCID:7305838**.
9. Pate, M.L., Lawver, R.G., Smalley, S.W., Perry, D.K., Stallones, L., & Shultz, A. (2019). Agricultural safety education: Formative assessment of a curriculum integration strategy. *Journal of Agricultural Safety and Health, 25*(2),63-76. doi:10.13031/jash.13113. **PMCID: PMC7233796**
10. Rodriguez, A., Gimeno Ruiz de Porras, D., Casanova, V., Levin, J., & Douphrate, D. (2019). Work-related musculoskeletal symptoms among loggers in the Ark-La-Tex region. *Journal of Agromedicine, 24*(2), 167-176. doi:10.1080/1059924X.2019.1567423 **PMCID: PMC7008449.**

2018

1. Ayers, P., Khorsandi,F., Wang, X., & Araujo, G. (2018). ROPS designs to protect operators during tractor rollovers. *Journal of Terramechanics, 75*,(SI) 49-55. doi: 10.1016/j.jterra.2017.05.003. **PMCID: PMC7177195.**

2. Cardenas, V.M., Cen, R., Clemens, M.M., Conner, J.L., Victory, J.L., Stallones, L., & Delongchamp, R.R. (2018). Morbidity and mortality from farm tractor and other agricultural machinery-related injuries in Arkansas. *Journal of Agricultural Safety and Health, 24*(4), 213-225. doi: 10.13031/jash.12828. **PMCID: PMC7427046**
3. Lyu, C, Pei, J, Beseler, CL, Yuling, LI, Jianhui, LI, Ren, M, Stallones, L., & Ren S. (2018). Case control study of impulsivity, aggression, pesticide exposure and suicide attempts using pesticides among farmers. *Biomedical and Environmental Science, 31*, 242-246..doi: 10.3967/bes2018.031. **PMCID: 7413211**
4. Khorsandi, F. & Ayers, P. (2018). The effect of friction on actuation forces of the foldable ROPS. *Journal of Agricultural Safety and Health, 24*(4), 227-242. doi: 10.13031/jash.12844. **PMCID: 7384238.**
5. Schaeffer, J.W., Chandler, J.C., Davidson, M., Magzamen, S.L., Pérez-Méndez, A., Reynolds, S.J., Goodridge, L.D., Volckens, J. Franklin, A.B., Shriner, S.A., & Bisha, B. (2018). Detection of viruses from bioaerosols using anion exchange resin. *JoVE, 138* doi: 10.3791/58111. **PMCID: PMC6231709**.

2017

1. Chandler, J. C., Schaeffer, J. W., Davidson, M., Magzamen, S. L., Pérez-Méndez, A., Reynolds, S. J., . . . Bisha, B. (2017). A method for the improved detection of aerosolized influenza viruses and the male- specific (F+) RNA coliphage MS2. *Journal of Virological Methods, 246* (Supplement C), 38-41. doi: 10.1016/j.jviromet.2017.04.004. **PMCID: PMC7113747.**
2. Davidson, M.E., Schaeffer,J., Clark, M.L., Magzamen, S., Brooks, E.J., Keefe, T.J., Bradford, M., Roman-Muniz, N., Mehaffy, J., Dooley, G., Poole, J., Mitloehner, F.M., Reed, S., Schenker, M.B., & Reynolds, S.J. (2017). Personal exposure of dairy workers to dust, endotoxin, muramic acid, ergosterol and ammonia on large-scale dairies in the High Plains Western United States. *Journal of Occupational and Environmental Hygiene, 15(*3), 1-12. doi: 10.1080/15459624.2017.1403610. **PMCID: PMC8641559**
    a. **Michigan Industrial Hygiene Society Best Paper Award**
3. Douphrate, D. I., Fethke, N. B., Nonnenmann, M. W., Rodriguez, A., Hagevoort, R., & Gimeno Ruiz de Porras, D. (2017). Full-shift and task-specific upper extremity muscle activity among US large-herd dairy parlour workers. *Ergonomics, 60*(8), 1042-1054. doi: 10.1080/00140139.2016.1262464. **PMCID: PMC7020102.**
4. Douphrate, D., Gimeno Ruiz de Porras, D., Nonnenmann, M., Hagevoort, R., Reynolds, S.J. Rodriguez, A., & Fethke, N. (2017). Effects of milking unit design on upper extremity muscle activity during attachment among U.S. large-herd parlor workers. *Applied Ergonomics, 58,* 482-490. doi:10.1016/j.apergo.2016.08.008. **PMCID: PMC7008452**.
5. Hill, L., & Ayers, P. (2017). Evaluation of foldable tractor ROPS clearance. *The Journal of Undergraduate Research, 8*(1), 85-92.**PMCID: Not required**
6. Jakob, M.C., & Rosecrance, J. (2017). International perspectives on health and safety among dairy workers: Challenges, solutions and the future (Editorial). *Frontiers in Public Health, 5*. doi: 10.3389/fpubh.2017.00294. **PMCID: PMC5698274**.
7. Khorsandi, F., Ayers, P. D., & Truster, T. J. (2017). Developing and evaluating a finite element model for predicting the two-posts rollover protective structure nonlinear behaviour using SAE J2194 static test. *Biosystems Engineering, 156*, 96-107. doi: 10.1016/j.biosystemseng.2017.01.010. **PMCID: 7380891**.
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9. Martin, L. & Ayers, P. (2017). Evaluation of foldable tractor roll-over protective structures (ROPS) clearance. *Pursuit - The Journal of Undergraduate Research at the University of Tennessee, 8*(1). Retrieved from https://trace.tennessee.edu/pursuit/vol8/iss1/9.**PMCID: Not required**
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12. Pate, M. L., Beard, F. R., & Hall, K. (2017). Utah regional differences in respirator use and fit testing among pesticide applicators. *Journal of Agricultural Safety and Health, 23*(1), 55-66. doi: 10.13031/jash.11765. **PMCID: PMC7110908**.
13. Rosecrance, J., Lagerstrom, E., & Murgia, L. (2017). Job factors associated with occupational injuries and deaths in the United States forestry industry. *Chemical Engineering Transactions*, *58,* 115-120. doi: 10.3303/CET1758020.
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15. Schaeffer, J. W., Reynolds, S., Magzamen, S., VanDyke, A., Gottel, N. R., Gilbert, J. A., Owens, S.M., Hampton-Marcell, J.T., Volckens, J. (2017). Size, composition, and source profiles of inhalable bioaerosols from Colorado dairies. *Environmental Science & Technology*, 51(11), 6430-6440. doi: 10.1021/acs.est.7b00882. **PMCID: PMC9552963**
16. Schwatka, N. V., Atherly, A., Dally, M. J., Fang, H., Brockbank, C., Tenney, L., Goetzel, R. Z., Jinnett, K., Witter, R., Reynolds, S., McMillen, J. & Newman, L. S. (2017). Health risk factors as predictors of workers' compensation claim occurrence and cost. *Occup Environ Med, 74*(1), 14-23. doi: 10.1136/oemed-2015-103334. **PMCID: PMC5241501**
17. Stenkamp-Strahm, C., McConnel, C., Magzamen, S., Abdo, Z., & Reynolds, S. (2017). Associations between Escherichia coli O157 shedding and the fecal microbiota of dairy cows. *Journal of Applied Microbiology, 124* (3), 881-898. doi:10.1111/jam.13679. PMID: 29280543 NIHMSID:1553247.
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1. Douphrate, D. I., Nonnenmann, M. W., Hagevoort, R., & Gimeno Ruiz de Porras, D. (2016). Work- related musculoskeletal symptoms and job factors among large-herd dairy milkers. *Journal of Agromedicine, 21*(3), 224-233. doi: 10.1080/1059924x.2016.1179612. **PMCID: PMC7005927.**
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3. Khorsandi, F., Ayers, P., Jackson, D., & Wilkerson, J. (2016). The effect of speed on foldable ROPS actuation forces. *Journal of Agricultural Safety and Health, 22*(4), 285-298. doi: 10.13031/jash.22.11752.. **PMCID: PMC7336580**
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7. Mixco, A., Masci, F., Brents, C. A., & Rosecrance, J. (2016). Upper limb muscle activity among workers in large-herd industrialized dairy operations. *Frontiers in Public Health, 4*(134). doi: 10.3389/fpubh.2016.00134. **PMCID: PMC4923124**.

Proceedings

1. Gilkey, D., Rosecrance, J., Neves, H., & Lagerstrom, E. (2017). ATV safety in agriculture: Injury, illness, analysis and interventions. *Proceedings of the 8th International Conference on Applied Ergonomics and Human Factors, Los Angeles, CA*.
2. Hagevoort R., D. Douphrate, R. Naerebout, J. Brose, J. White, A. Rodriguez. (2017). Challenges surrounding training the next generation. *Proceedings of the Western Dairy Management Conference,* Reno, NV. Retrieved: http://wdmc.org/2017/Hagevoort.pdf
3. Hobbs-Murphy K, Morris K, Brazile B, & Rosecrance J. Respirators, Face Masks, and Diverse Populations: An Analysis of 3D Facial Anthropometrics. Proceedings of 3DBODY.TECH 2021 12th Int. Conference and Exhibition on 3D Body Scanning and Processing Technologies, 19-20 Oct. 2021, Lugano, Switzerland. https://doi.org/10.15221/21.60.
4. Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., & Sorensen, T. J. (2017). Multi-state supervised agricultural experience safety award program. *Proceedings of the American Association for Agricultural Educators Conference, San Luis Obispo, CA*.
5. Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., Quijano, L., Buchan, V., & Miller, R. (2017). Assessing agricultural safety education initiative impact using geospatial data. *Proceedings of the ISASH Annual Meeting, Logan, UT*.
6. Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., & Stallones, L. (2018). Multi-state agricultural safety curriculum integration: A formative assessment of a professional development strategy. *Proceedings of the ISASH Annual Meeting, Halifax, Nova Scotia, Canada*.
7. Pate, M., Lawver, R. G., Smalley, S. W., Perry, D. K., Stallones, L, & Shultz, A. (2018). Agricultural safety education: Formative assessment of a curriculum integration strategy. *Proceedings of the ASABE Annual International Meeting, Detroit, MI*. doi: 10.13031/aim.201800862.
8. Hagevoort, R. & Noa Roman-Muniz, I.N. (2019). Engaging dairy labor through effective training. *Proceedings of the Western Dairy Management Conference*, Reno, Nevada.
9. Lagerstrom, E., & Rosecrance, J. (2019). The association between safety climate and musculoskeletal symptoms in the U.S. Logging Industry. In S. Bagnara, R. Tartaglia , S. Albolino, T. Alexander, & Y. Fujita (Eds.), Proceedings of the 20th Congress of the International Ergonomics Association: Vol. 821. *Advances in Intelligent Systems and Computing* (pp. 214-219). doi.org/10.1007/978-3-319-96080-7_25
10. Rosecrance, J., & Lagerstrom, E. (2019). Injury claims from steep slope logging in the United States. In S. Bagnara, R. Tartaglia , S. Albolino, T. Alexander, & Y. Fujita (Eds.), Proceedings of the 20th Congress of the International Ergonomics Association: Vol. 820. *Advances in Intelligent Systems and Computing* (pp. 277-282). doi.org/10.1007/978-3-319-96083-8_37
11. Hischke, M., Arroyo, G., Reiser, R.F., & Rosecrance, J. (2019). A comparison of sensor placement for estimating trunk postures in manual material handling. In S. Bagnara, R. Tartaglia , S. Albolino, T. Alexander, & Y. Fujita (Eds.), Proceedings of the 20th Congress of the International Ergonomics Association: Vol. 819. *Advances in Intelligent Systems and Computing* (pp. 85-99). doi.org/10.1007/978-3-319-96089-0_9
12. Masci, F., Mandic-Rajcevic, S., Ruggeri, G., Rosecrance, J., & Colosio C. (2019) Comparing the strain index and the revised strain index application in the dairy sector. In S. Bagnara, R. Tartaglia , S. Albolino, T. Alexander, & Y. Fujita (Eds.), Proceedings of the 20th Congress of the International Ergonomics Association: Vol. 820. *Advances in Intelligent Systems and Computing* (pp 261-268). doi.org/10.1007/978-3-319-96083-8_35
13. N.J. Nealon, J. Daniels, K. Murray, I.N. Román-Muñiz, J.E. Palomares Velosa, R. Magnuson, J. Scaria, S. Rao. 2020. Occupational exposure of dairy farm workers and working environment to multidrug resistant Salmonella enterica. Conference of Research Workers in Animal Diseases (CRWAD). https://crwad.org/wp-content/uploads/CRWAD-2020-Proceedings-FINAL.pdf
14. Calaba, E., L.N. Edwards-Callaway, C. Cramer, I. N. Roman-Muniz, L. Stallones, S. Thompson, S. Ennis, H. Simpson, E. Kim, and M. Pairis-Garcia, 2020. Preliminary exploration of swine veterinarian perspectives on euthanasia on-farm, Journal of Animal Science, 98 (4): 216-7.

15. Simpson, H., L.N. Edwards-Callaway, C. Cramer, I.N. Roman-Muniz, L. Stallones, S. Thompson, S. Ennis, E. Kim, and M. Pairis-Garcia, 2020. Preliminary exploration of caretaker and manager perspectives of on-farm euthanasia on swine operations, Journal of Animal Science, 98 (4): 225-6.
16. *Simpson, H., C. Cramer, L.N. Edwards-Callaway, L. Stallones, S. Thompson, S. Ennis, E. Kim, and I. N. Roman-Muniz, 2020. Dairy worker perspectives on performing euthanasia as an essential component of their job, Journal of Animal Science, 98 (4): 216.
17. Perry, D. K., Smalley, S. W., & Pate, M. L. (2020, May). Effectiveness of utilizing an evidence-based safety curriculum to increase student knowledge. American Association for Agricultural Education Proceedings of the Annual National Research Conference, 47. Virtual Conference, http://aaaeonline.org.

Book Sections

1. Autenrieth, D., & Román-Muñiz, N. (2018). Needs and Opportunities for Applying Voluntary Occupational Health and Safety Management Systems in the High-Hazard U.S. Dairy Production Industry. In: Arezes P. (eds) Advances in Safety Management and Human Factors. AHFE 2017. Advances in Intelligent Systems and Computing, vol 604. Springer, Cham.
2. Jakob, M., & Rosecrance, J., eds. (2018). International Perspectives on Health and Safety among Dairy Workers: Challenges, Solutions and the Future. Lausanne: Frontiers Media. doi: 10.3389/978-2-88945-390-0
3. Hancock, J. P., Edgar, D. W., Pate, M. L., Dyer, L. A., & Hoover, B. (2017). Agricultural mechanics and technology systems. Tinley Park, IL: The Goodheart-Willcox Company, Inc.

Reports

Trade Publications

1. Ayers, P. & Khorsandi, F. (2017). Reducing tractor rollover fatalities: Progress in ROPS Technology. ASABE Resource, 24 (6) 6-7.
2. Roman-Muniz, N., Menger-Ogle, L., Stallones, L., & Rosecrance, J. (2017). Survey: Dairy workers appreciate supervisors who prioritize both productivity and safety. Progressive Dairyman. https://www.progressivedairy.com/topics/management/survey-dairy-workers-appreciate-supervisors-who-prioritize-both-productivity-and-safety
3. Douphrate, D. (2018, November). Research Update 2: Job factors and musculoskeletal symptoms among parlor workers. New Mexico Dairy Extension E-Newsletter.
4. Douphrate, D. (2018, October). Research Update 1: Musculoskeletal symptoms of milking parlor workers. New Mexico Dairy Extension E-Newsletter.
5. Douphrate, D., & Hagervoot, R. (2019). Safety reference manual. FARM Workforce Development. Retrieved from: https://nationaldairyfarm.com/producer-resources/worker-safety-human-resources/
6. Douphrate, D. (2019, April). Research Update 4: Evaluation of milking unit design on parlor worker muscle activity. New Mexico Dairy Extension E-Newsletter.
7. Douphrate, D. (2019, March). Research Update 3: Evaluation of teat scrubber effects on parlor worker muscle activity. New Mexico Dairy Extension E-Newsletter.
8. Hagevoort, R. (2019, October). Managing cows and people: Both human and animal wellbeing is important on farms. Agrinews.
9. Hagevoort, R. (2019, October). How much does the welfare of people affect the welfare of animals? Hoard's Dairyman.
10. Rovai, M. (2020, January). We must prioritize employee health. Hoard’s Dairyman.
11. Rodriguez, A., & Douphrate, D. (2020, March). What dairy farmers must know about COVID-19. Hoard’s Dairyman. https://hoards.com/article-27444-what-dairy-farmers-must-know-about-covid-19.html
12. Douphrate, D. & Rodriguez, A. (2020, April). Dairy Farming and COVID-19. New Mexico Dairy Extension E-Newsletter.
13. Pennington W. (2021, January). Some things shouldn’t be shared. Hoard’s Dairyman, 42.

Conference Papers, Presentations, Abstracts

2022

1. Pennington W. (2022). Review of Occupational Heat Exposure Regulations for Agricultural Businesses in the Western United States. Agricultural Safety and Health Council of America Safety Summit. 2022 Mar 28-30; Las Vegas, (NV). [Poster].

2021

1. Keeney, A.J., Hernandez, P.J., Meng, Y. (2021, March). Assessing farm stress and community support in a US-Mexico border county. Poster presentation at the Agricultural Safety and Health Council of America Safety Summit, United States.
2. Douphrate, D. (2021, June). Dairy consortium. Poster presentation at US Dairy Education and Training Consortium, New Mexico.
3. Guifarro Rodriguez LS, Stallones L, Rosecrance J, Rovai M. (2021). Assessing dairy employees' mental health status in South Dakota: Workplace. Poster presented at: American Dairy Science Association 2021 Virtual Annual Meeting; July 11-14, 2021; virtual.
4. Pate, M. L., Miller, B., Beard, F. R., Miller, R., Hendry, D. (2021). Choice Based assessment: Utilizing a Project-Based Focus for Agricultural Systems Technology Programming during the COVID Pandemic. ASABE Annual International Meeting. Virtual Conference, July 12-16. https://www.asabe.org/Portals/0/21AIM_Session_Listing.pdf
5. Roman-Muniz, N. (2021, June). Accurate Assessment and Advocacy: Animal Welfare in Production Animals. Panel presentation at CVMA, Fort Collins, Colorado.
6. Smalley, S.W., Perry, D.K., Lawver, R.G., Pate, M.L., Shultz, A., Hanagriff, R., Ewell, C. (2021, July). Assessing Youth Safety Knowledge through the Agriculture Experience Tracker (AET). Paper and presentation at the ASABE Virtual Conference.
7. Lawver, R.G., Pate, M.L., Smalley, S.W., Perry, D.K. & Shultz, A. (2021, July). Tractor and Machinery Instructor Training: Impact of Sequential Professional Development. Paper and Presentation at the ASABE Virtual Conference.
8. Masci, Spatari, Giorgianni, Bortolotti, Rosecrance, & Colosio. (2021, June). A wearable device to assess the spine biomechanical overload in a sample of loggers. Presentation at the 21st Triennial Congress of the International Ergonomics Association, Virtual Congress. Vancouver, British Columbia, CA
9. Rosecrance J, Hischke M, Todde G, & Caria M. (2021, Sept). Quantification of trunk postures among vegetable and fruit pickers. The example in Sardinia. VI International Conference on Safety, Health and Welfare in Agriculture and Agro-food Systems RAGUSA SHWA.

2020

1. Garcia Buitrago, J.A., Hagevoort, G.R., Spencer, J., & Piñeiro, J. (2020).Evaluation of animal handling trainings provided to Central Texas dairy workers. J. Dairy Sci. 103 Suppl. 1: 226-227 [Abstract]
2. Keeney, A.J., Hernandez, P.J., Meng, Y. (2021, March). Assessing farm stress and community supports in a US-Mexico border county. Poster presentation at the Agricultural Safety and Health Council of America Safety Summit, United States.
3. Roman-Muniz, I.N. (2020, October). Dairy Worker Perspectives on Performing Euthanasia as an essential component of their job. HICAHS Virtual Research Day. https://youtu.be/DOc74xr8EB0
4. Rosecrance, J. (2020, September). Agricultural field research in the time of the COVID-19 Pandemic. Keynote speaker at the International Conference on Safety, Health and Welfare in Agriculture and Agro-food Systems. Ragusa, Italy (Virtual via Zoom)
5. Hischke, M., Caria, M., Todde, G., Rosecrance, J. (2020, March). Estimating trunk postures among vegetable and fruit pickers. 18th Annual Regional National Occupational Research Agenda (NORA) Young Investigators Conference. Rocky Mountain ERC, Salt Lake City, UT (Virtual via Zoom).

6. Hischke, M., Rosecrance, J., Caria, M., Todde, G. (2020, February). Trunk postures among vegetable and fruit pickers in Colorado and Sardinia, Italy. Presentation at ERC Exposure Assessment Symposium. Auburn University, Auburn, Alabama.
7. Perry, D. K., Smalley, S. W., Pate, M. L. (2020) Effectiveness of utilizing an evidence based safety curriculum to increase student knowledge. COVID-19 - Online: American Association for Agricultural Education Annual Conference.
8. Pate, M. L., Fetzer, L., Ploeckelman, M., Pennington, W., Schossow, M., & Yoder, A. (2020). SAE Safety for All: How to Launch Foundational Safety Programs for Agricultural Education Students. Invited Presentation, New Jersey Fall FANRE Professional Development Conference Surviving & Thriving in the Virtual World. Zoom Conference, September 25.
9. Seidel, J., Leibler, J., Gray, G., Nunez, J., Bradford, M., Erlandson, G., Reynolds S. J., Schaeffer, J. W., (2020). Exposure to viruses among dairy workers in the High Plains region. [Poster presentation] The Mountain & Plains Education and Research Center (MAP ERC) Research Day. Virtual.

2019

1. Ayers, P. (2019, August). Evaluation of foldable ROPS universal lift-assist design. Paper presentation at the Western Ag Safety & Health Conference, Seattle, WA.
2. Ayers, P. (2019, August).National ROPS Rebate Program (NRRP). Poster presentation at the Western Ag Safety & Health Conference, Seattle, WA.
3. Ayers, P., Khorsandi,F., Poland, M. & Hilliard, C. (2019, July). Universal foldable ROPS lift assist designs with torsion spring. Poster presented at the ASABE Conference, Boston, MA.
4. Ayers, P. (2019, September). Engineering designs for off-road vehicle rollover protection. Poster presented at the ISTVS Conference, Prague, Czech Republic.
5. Beseler, C.L., Keeney, A.J., & Stallones, L. (2019, August). Application of a social network analysis to assess connectedness within the agricultural community. Poster presentation at the Western Ag Safety & Health Conference, Seattle, WA.
6. Douphrate, D. (2019, August). Logging machine operators, health and safety training. Paper presentation at the Western Ag Safety & Health Conference, Seattle, WA.
7. Douphrate, D., & Rodriquez, A. (2019, August). Dairy safety and management leadership training project in the Southwestern United States. Presentation at the International Dairy Research Consortium, Seattle, WA.
8. Douphrate D., Rabinowitz P, Nonnenmann M, Fowler H Hagevoort R., & Austin E. (2019, August). Animal agriculture and the One Health approach. Moderator at the Western Ag Safety and Health Conference: Cultivating Collaborations, Seattle, WA.
9. Guifarro, L., da Rosa, P., & Rovai, M. (2019, June). Assessing dairy employees' health status in South Dakota. Poster presentation at the American Dairy Science Association, Cincinnati, Ohio.
10. Guifarro, L., da Rosa, P., & Rovai, M. (2019, June). Assessing dairy employees' health status in South Dakota: Eating habits and general health care. Poster presentation at the American Dairy Science Association, Cincinnati, Ohio.
11. Hagevoort, R. (2019, August). Addressing worker and livestock safety during livestock handling activities. Paper presentation at the Western Ag Safety & Health Conference, Seattle, WA.
12. Hagevoort, R. (2019, August). Informal overview of PFAS contamination in New Mexico milkshed. Presentation at the International Dairy Research Consortium, Seattle, WA.
13. Khorsandi, K., Chou, H-Y., Fong, E., Ayers, P.D., & Fathallah, F. (2019, August). Crush protection devices for agricultural all-terrain vehicles. Poster presentation at the Western Ag Safety & Health Conference, Seattle, WA.
14. Pena, A. (2019, August). Occupational health and safety of U.S. farmworkers in the high plains. Paper presentation at the Western Ag Safety & Health Conference, Seattle, WA.
15. Pennington, W. (2019, August). Best practices for using social media to connect with AgFF stakeholders. Panel presentation at the Western Ag Safety & Health Conference, Seattle, WA.

16. Pennington, W., Kolb, P., Pintauro, K., Scott, J., Schaeffer, J., Stallones, L., Reynolds, S.J., Long, M. & Volckens, J. (2019, August). Wildfire respirator information project. Poster presentation at the Western Ag Safety & Health Conference, Seattle, WA.
17. Román-Muniz, N., Rink, K., Menger, L., Stallones, L., Pinedo, P., Rosecrance, J., & Amaya-Soto, F. (2019, August). Culturally congruent training program on infectious and zoonotic disease prevention for Latinx. Poster presentation at the Western Ag Safety & Health Conference, Seattle, WA.
18. Román-Muniz, N. (2019, August). Foreign-born dairy workers: Health and safety perceptions of the invisible stakeholders. Paper presentation at the International Dairy Research Consortium, Seattle, WA.
19. Rosecrance, J. (2019, August). Mixed-methods analysis of logging injuries in Montana and Idaho. Paper presentation at the Western Ag Safety & Health Conference, Seattle, WA.
20. Erlandson, G., Schaeffer, J., Reynolds, S.J., Magazamen, S., Jones, K., Nonnenmann, M., & Sharp, J. (2019, August). Hygienic intervention and its effect on nasal inflammation and microbiome in dairy workers. Poster presentation at the Western Ag Safety & Health Conference, Seattle, WA.
21. Erlandson, G., Reynolds, S.J., Magzamen, S., Nonnenmann, M., Jones, K., Sharp, J., Wickum, A., & Schaeffer, J. (2019, May). Hypertonic saline nasal lavage intervention in dairy workers. Poster presented at the American Industrial Hygiene Conference and Exposition, Minneapolis, MN.
22. Guifarro, L., da Rosa, P., & Rovai, M. (2019, June). Assessing dairy employees' health status in South Dakota: Vision care. Abstract presentation at the American Dairy Science Association Annual Meeting, Cincinnati, Ohio.
23. Guifarro, L., da Rosa, P., & Rovai, M. (2019, June). Assessing dairy employees' health status in South Dakota: Eating habits and general health care. Abstract presentation at the American Dairy Science Association Annual Meeting, Cincinnati, Ohio.
24. Isaacs, C., Bauer, J., Magzamen, S., Reynolds, S.J., & Schaeffer, J. (2019, May). Indoor Air Quality in Elementary Schools in North Denver. Poster presented at the American Industrial Hygiene Conference and Exposition, Minneapolis, MN.
25. Pate, M. L. & Perry, D. K. (2019, June). Agricultural safety education: Efficacy of a train the trainer event. Abstract presentation at the International Society for Agricultural Safety and Health Annual Conference, Des Moines, IA.
26. Rosencrance, J. (2019, February). Presentation at Northwest Logging Safety Summit, Springfield, OR.
27. Rosencrance, J. (2019, February). Presentation at the Oregon Logging Conference, Eugene, OR.

2018

1. Ayers, P. (2018, June).Development of Engineering Controls to reduce foldable ROPS overturn fatalities. Poster presentation at the International Society of Agricultural Health and Safety (ISASH), Nova Scotia.
2. Ayers, P. (2018, July). Development of engineering controls to reduce foldable ROPS overturn fatalities. Paper presentation at American Society of Agricultural and Biological Engineers (ASABE), Detroit, Michigan.
3. Douphrate, D. (2018, August 24-25). Sustainable forestry management: The role of worker health and safety. Invited keynote presentation. Arkansas Timber Producer Association Annual Meeting, Hot Springs, AR.
4. Douphrate, D., Hagevoort, R., Murphy, D., Naerebout, R., & Rodriguez, A. (2018, February 21-23). Addressing key safety and health issues on the dairy. Invited panel organizer and moderator at the Raising Safety: North American Agricultural Safety Summit, Scottsdale, AZ.
5. Douphrate D.(2018, February). Dairy parlor ergonomics raising safety. North American Agricultural Safety Summit, Scottsdale, AZ.
6. Hischke, M., Arroyo, G., Reiser, R.F., & Rosecrance J. A (2018, August). Comparison of sensor placement for estimating trunk postures in manual material handling. Presentation at the 20th International Ergonomics Association Conference, Florence, Italy.
7. Lagerstrom, E. & Rosecrance, J. (2018, August). Association between safety climate and musculoskeletal symptoms in the U.S. logging industry. Presentation at the 20th International Ergonomics Association Conference, Florence, Italy.

8. Magzamen, S., Schaeffer, J.W., Poole, J.A., Van Dyke-Gonnerman, A., Anderson, K., Bradford, M., Morse, J., Volckens, J. & Reynolds, S.J. (2018, May). Associations of cross-shift changes in pulmonary function and endotoxin exposure among dairy workers. Presentation at American Thoracic Society, San Diego, CA.
9. Masci, F., Mandic-Rajcevic, S., Ruggeri, G., Rosecrance, J., & Colosio C. (2018, August). Comparing the strain index and the revised strain index application in the dairy sector. Presentation at the 20th International Ergonomics Association Conference, Florence, Italy.
10. Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., & Stallones, L. (2018, July). Agricultural safety education: Form native assessment of a curriculum integration strategy. Paper presentation at the American Society of Agricultural and Biological Engineers Conference, Detroit, MI.
11. Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., & Stallones, L. (2018, June). Multi-state agricultural safety curriculum integration: A formative assessment of a professional development strategy. Paper presentation at the International Society for Agricultural Safety and Health Conference, Halifax, Nova Scotia, Canada.
12. Reynolds, S.J. & Schaeffer, J.W. (2018, August). The Air microbiome and respiratory health implications among dairy workers. Paper presentation at Nordic Meeting on Agricultural Occupational Health & Safety, Hurdal, Norway.
13. Rink, K., Amaya-Soto, F. M., Menger-Ogle, L., Stallones, L., Pinedo, P. J., Roman-Muniz, I. N. (2018). Assessing the effectiveness of a training program for Latino(a) dairy workers on Colorado dairies. Abstract in *Journal of Animal Science, 96*,3, 199. doi.org/10.1093/jas/sky404.432
14. Rink, K., Amaya-Soto, F., Menger-Ogle L., Stallones, L., Pinedo P., & Roman-Muniz, N. (2018, July). Assessing the effectiveness of a training program for Latino(a) dairy workers on Colorado dairies. Poster presentation at American Society of Animal Science Annual Meeting, Vancouver, BC.
15. Root, K.S., Sharp, J.L., Magzaman, J.L., Reynolds, S.J., Van Dyke, M., & Schaeffer, J.W. (2018, March). Is the environmental relative moldiness index suitable for indoor marijuana grow operations? Poster presentation at MAP ERC Research Day, Broomfield, CO.
16. Root, K.S., Sharp, J.L., Magzamen, S.L., Reynolds, S.J., & Schaeffer, J.W. (2018, May). The fundal burden of indoor marijuana grow operations: ERMI vs. Microscopy the application of the Environmental moldiness index in indoor marijuana grow operations. Presented at the American Industrial Hygiene Conference and Exposition (AIHce) 2018, Philadelphia, PA.
17. Rosecrance, J. (2018, August). 21st century agriculture health and safety. Keynote speaker at the 20th International Ergonomics Association Conference, Florence, Italy.
18. Rosecrance, J. & Lagerstrom, E. (2018, August). Injury claims from steep slope logging in the United States. Presentation at the 20th International Ergonomics Association Conference, Florence, Italy.
19. Schaeffer, J.W. & Reynolds, S.J. (2018, April 15-19). Pilot sampling for silica and other aerosols during sugar cane harvesting at Pantaleon in Guatemala. In support of Newman research effort.
20. Schaeffer, J.W., & Reynolds, S.J. (2018, August). Dairy bioaerosol exposures and interventions to attenuate pro-inflammatory markers in workers. Paper presentation at Nordic Meeting on Agricultural Occupational Health & Safety, Hurdal, Norway.
21. Stallones L. (2018, November). Listening to the voices of migrant workers. American Public Health Association. San Diego, CA.
22. Stenkamp-Strahm, C., McConnel, C., Magzamen, S., Abdo, Z., & Reynolds, S.J. (2018, March). Escherichia coli O157 shedding is associated with low diversity and changes of specific taxa within the dairy cow microbiome. Poster presentation at American Medical Student Association Conference, Washington D.C.
23. Wendl, M., Cramer, M., & Keeney, A.J. (2018, November). Evaluation methods to measure agriculture center end outcomes. Poster session presentation at the Midwest Rural Agricultural Safety and Health (MRASH) Conference, Council Bluffs, IA.

2017

1. Ayers, P. (2017, January). Development of engineering controls to reduce foldable ROPS overturn fatalities. Presented at the HICAHS Advisory Board Meeting, Fort Collins, CO.

2. Ayers, P. & Khorsandi, F. (2017, July). Measuring foldable ROPS actuation forces. Poster presented at the American Society of Agricultural and Biological Engineers Annual International Meeting, Spokane, WA.
3. Ayers, P. (2017, May). Improving commercial mower safety: foldable ROPS. Presented at the Tennessee Association of Physical Plant Administrators, Conference, Knoxville, TN.
4. Ayers, P. & Khorsandi, F. (2017, June). Foldable ROPS lift assist preliminary design considerations. Presented at the International Society for Agricultural Safety and Health Conference, Logan, UT.
5. Chandler, J.C., Schaeffer, J.W., Davidson, M., Magzamen, S.L., Pérez-Méndez, A., Reynolds,S.J., Goodridge,L.D., Volckens, J., Franklin, A.B., Shriner, S.A., & Bisha, B. (2017, July). A method for the improved detection of aerosolized influenza viruses using impingers that incorporate anion exchange resin. Presented at the International Association for Food Protection Annual Meeting, Tampa, FL.
6. Douphrate, D. (2017, June 14-15). Dairy farm safety and leadership. Presented at the U.S. Dairy Consortium Teaching: Advanced Dairy Herd Management, Clovis, NM.
7. Douphrate, D. (2017, November). Dairy worker safety: issues, research and solutions. Presented at United Dairymen of Idaho Annual Meeting, Boise, ID.
8. Douphrate, D. (2017, August). Worker safety and performance: past, current and future research and outreach efforts. Presented at Idaho Milk Processors Annual Convention, Sun Valley, ID.
9. Erlandson, G., Root, K.S., Magzamen, S.L., Reynolds, S.J., & Schaeffer, J.W. (2017, June). Indoor air quality across three different higher education building types. Presented at AIHCE, Seattle, WA.
10. Erlandson,G., Root, K.S., Schaeffer, J.W., Reynolds, S.J., & Magzamen, S.L. (2017). Pilot indoor air quality study in three higher education buildings. Presented at CVMBS Research Day, Fort Collins, CO.
11. Erlandson, G., Root, K.S., Magzamen, S.L., Reynolds, S.J., & Schaeffer, J.W. (2017, March). Indoor air quality across three different higher education building types. Presented at MAP ERC Research Day, Westminster, CO.

Best Poster Award.

12. Gilkey, D., Rosecrance, J., Neves, H., & Lagerstrom, E. (2017, July). ATV safety in agriculture: Injury, illness, analysis and interventions. Presented at the 8th International Conference on Applied Ergonomics and Human Factors, Los Angeles, CA.
13. Hagevoort, R., Douphrate, D., Naerebout, B., & Brose White, J. (2017, February-March). Challenges surrounding training the next generation in dairy. Panel discussion at the Western Dairy Management Conference, Reno, NV.
14. Khorsandi, F. & Ayers, P. (2017, July). Developing a finite element model to predict the performance of ROPS with minor structural modification under standard tests. Presented at the American Society of Agricultural and Biological Engineers Annual International Meeting, Spokane, WA.
15. Menger-Ogle, L., Pezzutti, F., Ogle, A., Amaya, F., Rosecrance, J., Stallones, L., & Roman-Muniz, I. (2017, June). Occupational safety and health among immigrant, Latino/a dairy workers in Colorado. Presented at the 12th International Work, Stress & Health Conference, Minneapolis, MN.
16. Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., & Sorensen, T. J. (2017, May). Multi-state supervised agricultural experience safety award program. Poster presentation at the American Association of Agricultural Educators, San Luis Obispo, CA.
17. Pate, M.L. (2017, June). Presented at the International Society for Agricultural Safety and Health Annual Conference Meeting, Logan, UT.
18. Pate, M.L. (2017, July). Presented at American Society of Agricultural and Biological Engineers Annual International Meeting, Spokane, WA.
19. Reynolds, S.J. (2017, June). Emerging Robotic Technologies. Co-host for topic table at the Expanding Research Partnerships: State of the Science Conference, Aurora, CO.
20. Reynolds, S.J. (2017, February). HICAHS and MAP ERC Programs Overview. Presented at Edith Cowan University, Joondelap, Australia.
21. Reynolds, S.J., Schaeffer, J.W., & Magzamen, S.L. (2017, October). Inhalable bioaerosols, bacterial microbiome, and inflammation: A day in the life of a dairy worker, part 2. Symposium conducted at the meeting of Environmental, Occupational and Community Exposures to Livestock Agriculture, International Society for Exposure Science, Durham, NC.

22. Reynolds, S.J., Schaeffer, J.W., Burket, T., VanDyke, A., Davidson, M., Mehaffy, J., Escobar, M., Anderson, K., Jocker, B., Brindley, S., Newman, L., Volckens,J., & Magzamen, S. (2017, June). Dairy bioaerosol exposures and inflammatory markers in workers: A panel study. Presented at NIOSH Expanding Research Partnerships: State of Science, Denver, CO.
23. Rodriguez, A., Douphrate, D.I., & Gimeno Ruiz de Porras, D. (2017, April). The association of worksite ergonomic and safety risk factors with work-related musculoskeletal health outcomes among logging machine operators in the Texas, Louisiana and Arkansas region. Poster presented at the University of Texas Health Science Center at Houston Research Day, Houston, TX.
24. Rosecrance, J., Lagerstrom, E., & Murgia, L. (2017, June). Job factors associated with occupational injuries and deaths in the US forestry industry. Presented at XXXVII CIOSTA & CIGR International Conference: Research and Innovation for the Sustainable and Safe Management of Agricultural and Forestry Systems, Palermo, Italy.
25. Schaeffer, J.W., Reynolds, S.J., & Magzamen, S.L. (2017, October). Inhalable bioaerosols, bacterial microbiome, and inflammation: A day in the life of a dairy worker, part 1. Symposium conducted at the meeting of Environmental, Occupational and Community Exposures to Livestock Agriculture, International Society for Exposure Science, Durham, NC.
26. Stenkamp-Strahm, C., Magzamen, S., McConnel, C., Abdo, Z., VanDyke-Gonnerman, A., Schaeffer, J.W. & Reynolds, S.J. (2017, July). Microbial community drivers of E. coli O157 shedding in early lactation dairy cattle. Presented at the International Food Protection Conference, Tampa, Florida.
27. Stenkamp-Strahm, C., Magzamen, S.L., Abdo, Z., Reynolds, S.J., & McConnel, C. (2017, June). E. coli O157 shedding is associated with low diversity and changes of specific taxa within the dairy cow microbiome. Presented at Gaussi Symposium, Colorado State University, Fort Collins, CO.
28. VanDyke, A., Reynolds, S.J., Schaeffer, J.W., & Magzamen, S.L. (2017, June). Dairy worker exposure to airborne endotoxins and β Glucans. Presented at NIOSH - Expanding Research Partnerships: State of Science, Denver CO.
29. Van Dyke, A., Reynolds, S.J., Schaeffer, J.W., & Magzamen, S.L. (2017, June). Dairy exposures to airborne endotoxins and β-Glucans. Presented at AIHCE, Seattle, WA.

Non-Conference Presentations, Trainings and/or Workshops

2022

1. Pennington, W. (2022, February). Reducing risk of farmworker injury: ergonomics and heat-related illness. Colorado Fruit and Vegetable Growers Association; Denver, (CO).

2021

1. Pennington, W. (2021, February). Keeping farmworkers COVID safe. Colorado Fruit and Vegetable Grower's Conference. https://www.youtube.com/watch?v=k08YjfrDMTE
2. Pennington, W. (2021, December). Reducing risk of farmworker injury: ergonomics and heat-related illness. Colorado Fruit and Vegetable Growers Association;Aurora, (CO).
3. Douphrate D. Dairy farm safety and leadership. (2021, June). U.S. Dairy Consortium Teaching: Advanced Dairy Herd Management. Clovis, NM.
4. Douphrate D. (2021, September). Safety Training in the Dairy Industry. NMPF FARM Quick Convo. Virtual.
5. Román-Muñiz IN, (2021, Nov). Euthanasia Decision Making Case Studies (Early Lactation Cow and Calf Pneumonia). 2 sessions/2 different dairies. (AOD at High Plains, CO, Nov 2021; Mountain View Farm, Loveland CO, Nov 2021).
6. Stallones, L., Kennedy, A., & Hill, A. (2021, October). Colorado Ag Workers' Rights Rule Making: An Overview of Key Issues and Resources in the 2021 Policy Process. Panel hosted by Colorado State University's Regional Economic Development Institute.
7. Yuma, P. & Stallones, L. (2021, March). Coping with Covid & Mental Health Support. Colorado Livestock Association Safety Group Meeting.

2020

1. Pate, M. L., Fetzer, L., Ploeckelman, M., Pennington, W., Schossow, M., & Yoder, A. (2020). SAE Safety for All: How to Launch Foundational Safety Programs for Agricultural Education Students. Invited Presentation, New Jersey Fall FANRE Professional Development Conference Surviving & Thriving in the Virtual World. Zoom Conference, September 25.
2. Pate, M. L. (2020). Agricultural workers: Managing COVID risks. Invited Presentation, Utah State Extension Fruit Growers Meeting. Zoom Conference, June 23.
3. Pate, M. L., Anthony, R., & Nonnenmann, M. (2020). Human health: Pathogens and contaminants in livestock operations. Invited Presentation, eXtension Livestock and Poultry Environmental Learning Community Educational Webinar Series, Zoom Conference, May 15. Available at https://lpelc.org/human-health-pathogens-and-contaminants-in-livestock-systems/
4. Pate, M. L., & Lawver, R. G. (2020). Digital resources for hands-on activities: Animal handling for safe student interactions. Invited Presentation, National Association for Agricultural Educators Online Professional Development, April 28
5. Pate, M. L. (2020). Putting machinery safety in motion: Tips and tricks for hosting a machinery safety workshop. Utah State Extension Annual Conference, Logan, UT, February 25.
6. Pennington W. Zoonotic Disease Risks for Livestock Workers. (2020, August). Colorado Livestock Association Burlington Safety Meeting; virtual.
7. Pennington W. Zoonotic Disease Risks for Livestock Workers.(2020, August). Upper Midwest Agricultural Safety and Health Center Online Expo; virtual.
8. Pennington W. Zoonotic Disease Risks for Livestock Workers. (2020, March). Colorado Livestock Association Lamar Safety Meeting; Lamar, (CO).
9. Pennington W. Zoonotic Disease Risks for Livestock Workers. (2020. February). Colorado Livestock Association Fort Morgan Safety Meeting; Fort Morgan, (CO).

2018

1. Douphrate, D. (2018, January 16-18). Dairy safety train the trainer workshop. Idaho Dairymen's Association. Twin Falls, ID.
2. Gimeno Ruiz De Porras, D. (2018, September). Research on surveys of working conditions, employment and health. Department of Environmental and Occupational Health, Colorado School of Public Health, University of Colorado, Aurora, Colorado.
3. Perry, D. K. & Pate, M. L. (2018, October). Keep their eyes from rolling: Building a mini-tilt table for tractor rollover demonstrations. Workshop presentation at the 91st annual National FFA Convention, Indianapolis, IN.
4. Perry, D. K. (2018, October). Agricultural Education Safety Initiative. ATV/UTV safety workshop presentation at Montana Association of Agricultural Educators, Big Timber, MT.
5. Perry, D. K. (2018, October). Keeping agricultural youth safe: The AgEd Safety Initiative. Presentation at the 2018 Montana State University College of Agriculture Connects symposium, Bozeman, MT.

2017

1. Douphrate, D. (2017, June 14-15). Dairy farm safety and leadership. U.S. Dairy Consortium Teaching: Advanced Dairy Herd Management. Clovis, NM.
2. Perry, D. K. (2017). Agricultural Education Safety Initiative. Tractor safety workshop presentation at Montana Association of Agricultural Educators Summer Update, Bozeman, MT.

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

Nothing to report

C.3. Technologies or techniques

Nothing to report

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

Not applicable

C.5. Other products and resource sharing

See each component for details on project products and resource sharing.

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
SJREYNOLDS	Y	Reynolds, Stephen J	BA, MS, PhD	PD/PI	0.0	4.0	2.0	Admin Core-7931; Core-7937 (Research Core - Evaluation...o bioaerosols)	USA	
DDOUPH7	Y	Douphrate, David Irvin	OTH,OTH, MS,PHD, MS,BS	Co-Investigator	5.0	0.0	0.0	Admin Core-7931; Project-7933 (Intervention (R2) - Occupa...d Dairy Farms)	USA	
DUSTINPER RY	Y	Perry, Dustin	PhD	Co-Investigator	0.0	1.0	1.0	Project-7934 (Translation (R3) - Agricul...on Initiative)	USA	
GIMENOD	Y	Gimeno Ruiz de Porras, David	PHD,MS	Co-Investigator	1.0	0.0	0.0	Project-7933 (Intervention (R2) - Occupa...d Dairy Farms)	USA	
JOHNROSE CRANCE	Y	Rosecrance, John	PhD	Co-Investigator	0.0	2.0	0.0	Core-7936 (Outreach Program)	USA	
JSCHAEFFE R	Y	Schaeffer, Joshua	PhD	Co-Investigator	0.0	3.0	1.0	Admin Core-7931; Core-	USA	

								7937 (Research Core - Evaluation...o bioaerosols)		
N.ROMAN-MUNIZ	Y	Roman-Muniz, Noa	PhD	Co-Investigator	0	1.0	0	Project-7933 (Intervention (R2) - Occupa...d Dairy Farms)	USA	
R.GARRATT	N	Garratt, Robyn	BS	Graduate Student (research assistant)	3.0	0.0	0.0	Admin Core-7931 (APE Core - Center Administ...alu a tion Core)	USA	
RLAWVER	Y	Lawver, Rebecca	PhD	Co-Investigator	0.0	1.0	0.0	Project-7934 (Translation (R3) - Agricul...on Initiative)	USA	
SMALLEY1	Y	Smalley, Scott	PhD	Co-Investigator	0.0	1.0	0.0	Project-7934 (Translation (R3) - Agricul...on Initiative)	USA	
Z.WELLER	N	Weller, Zach	PhD	Statistician	0.0	1.0	0.0	Core-7937 (Research Core - Evaluation...o bioaerosols)	USA	
A.KEENEY	N	Keeney, Adrianne	PhD	Research Associate III	6.0	0.0	0.0	Admin Core-7931	USA	
ARODRIGUE Z19	N	Rodriguez, Anabel	MPH, PhD	Research Coordinato r	6.0	0.0	0.0	Project-7933 (Intervention (R2) - Occupa...d Dairy Farms)	USA	
K.PETERSE N	N	Petersen, Kathy		Accounting Technician IV	1.0	0.0	0.0	Admin Core-7931	USA	
S_HALSTED	N	Halsted, Sarah			1.0	0.0	0.0	Admin Core-7931	USA	
KL.JONES	N	Jones, Kenneth L.	PhD	Consortium PI - UOHSC	0.0	1.0	0.0	Core-7937 (Research Core - Evaluation...o bioaerosols)	USA	
LORANNS	Y	Stallones, Lorann	MPH, PhD	Project Lead for Outreach; Deputy	0.0	3.0	0.0	Admin Core-7931; Core-7936	USA	

				Director for Center; Project Lead for Evaluation				(Outreach Program)		
M.BRADFORD	N	Bradford, Mary T		Research Associate	10	0	0	Core-7937 (Research Core-Evaluation...o bioaerosols)	USA	
MALROSE	N	ROSE, MALCOLM	MS	Research Associate	1.0	0	0	Project-7934 (Translation (R3) - Agricul...on Initiative)	USA	
MLPATE	Y	Pate, Michael Lynn	PhD	Consortium PI – Utah State Univ	0.0	3.0	0.0	Project-7934 (Translation (R3) - Agricul…on Initiative)	USA	
W.PENNINGTON	N	Pennington, Whitney	MPH	Outreach Coordinator	5.0	0.0	0.0	Core-7936 (Outreach Program)	USA	
A_BLOM	N	Blom, Amy		Graduate Student (research assistant)	6.0	0.0	0.0	Core-7936 (Outreach Program)	USA	
G_BORSARI	N	Borsari, Giovanni		Graduate Student (research assistant)	3.0	0.0	0.0	Core-7936 (Outreach Program)	USA	
M_VALLEY	Y	Valley, Morgan	MPH, PHD	Center Coordinator	3.5	0.0	0.0	Admin Core-7931; Core-7935 Research Core - Pilots and Feasibility Program	USA	
JESSICA.E	Y	Elf, Jessica	MPH, PHD	Pilot Program Director	0.0	0.28	0.09	Core-7935 Research Core - Pilots and Feasibility Program	USA	
ANEOPHYTOU	Y	Neophytou, Andreas	Sc.D	Pilot Program Co-Director	0.0	0.28	0.09	Core-7935 Research Core - Pilots and Feasibility Program	USA	
A_PENA	Y	Alves Pena, Anita	PHD	Pilot Program Director	0.0	0.0	1.0	Core-7935 Research Core - Pilots and	USA	

								Feasibility Program		

D.2 Personnel updates

- **a. Level of Effort**: Not applicable
- **b. New Senior/Key Personnel**: Anita Alves Pena has filled the Pilot/Feasibility Director Role.
- **c. Changes in Other Support**: Kathy Petersen retired, and Sarah Halsted filled her position as financial administrator.
- **d. New Other Significant Contributors**:

E. IMPACT

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

Two examples of HICAHS impact at the overall center-level include our response to COVID-19 and our efforts in the dairy industry.

COVID-19 Response. In response to the COVID-19 pandemic, the HICAHS team collaborated with partners nationwide to respond and provide resources to support agricultural workers. We collaborated with the other US Centers for Agricultural Safety and Health to draft the CDC and Department of Labor's COVID-19 Interim Guidance for the agricultural sector. We partnered with local Extension and commodity groups to help interpret that guidance and provide actionable recommendations. We lent support to State Departments of Agriculture as they advocated for increased access to personal protective equipment. We revised our recommendations for preventing exposure to wildfire smoke to help producers protect their families and employees from a dual threat: COVID-19 and smoke. While the pandemic limited our field research and in-person outreach efforts during the last 2 years of the grant cycle, the HICAHS team found new ways to support agricultural workers and rural populations. Several HICAHS researchers used their expertise to support new projects responding to COVID-19. The outreach core used digital avenues to connect and build new partnerships.

HICAHS aimed to leverage our three small grant programs to support agricultural businesses and workers in their on-going response to COVID-19. Through targeted recruitment, we funded six projects that directly or indirectly addressed COVID-19 through vaccine education and distribution. For example, we funded Dr. Maristela Rovai, Assistant Professor and Dairy Extension Specialist at South Dakota State University, on a vaccine education project for local dairies. Her team addressed misinformation online through a Spanish-language Facebook page, communicated with dairy workers via WhatsApp, and helped community organizations coordinate their vaccine clinics.

IDRC & Dairy Efforts Beyond HICAHS Region. A prime example of HICAHS' impactful work in the r2p paradigm has been our scholarship and outreach with the dairy industry, with national and international impact spanning from the research bench to the dairy barn to policy. This success is built on transdisciplinary, commitment to community engagement, and attention to policy implications of our work. HICAHS Research and Outreach Cores have maintained a targeted focus with the dairy industry for more than two decades. In that time, the Center has led numerous research studies and served as technical experts for local, regional, and national industry groups on worker safety and health.

Because of increased consumer concern for worker welfare in the dairy industry, the Idaho Dairymen's Association has launched a multi-year initiative to address worker safety on dairy farms throughout the state. The Idaho Dairyman's Association (IDA) is taking a proactive approach by partnering with HICAHS personnel Drs. David Douphrate and Robert Hagevoort (previous HICAHS Advisory Board Member) to implement a comprehensive safety management program on IDA member farms and provide safety training and consultation to all 500 IDA farm members. Drs. Douphrate and Hagevoort serve on the National Milk Producer Federation task force on dairy worker safety and welfare and developed an Idaho Dairy Workforce Training and Safety Program, described above, which was also adopted by the National Milk Producers Federation. Dr. Reynolds has served on the Advisory Board for this program, which has led to the development of a Worker Health program to the National Milk Producer Federation's Dairy Program using our 2019 FARM Workforce Development Safety Reference Manual developed by Dr. Douphrate with input from several NIOSH AgFF Directors including Dr. Reynolds. Additionally, Idaho Senator Simpson has developed a Farm Workforce Modernization Act for the nation informed by our research and programs.

During the previous grant cycle, we have hosted three formal gatherings of the International Dairy Research Consortium (IDRC), with participants from across North America, Europe, and Oceania. IDRC members have edited and compiled three peer-reviewed journal special issues, each with a HICAHS representative serving as editor, with two in the past cycle.[8] One of the IDRC gatherings occurred as part of the Western Ag Health and Safety Conference in August 2019. Thirty-one researchers and industry members from five different countries gathered to discuss applying a Total Worker Health™ approach to the dairy industry. The meeting has inspired new collaborations and prompted discussions on better standardization across worker health studies worldwide.

F. CHANGES

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

Not applicable in the overall center. Reported in each component as relevant. See FFR for unobligated balance.

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

Not applicable in the overall center. Reported in each component as relevant.

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

Not applicable in the overall center. Reported in each component as relevant.

G. Special Reporting Requirements

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

Not applicable in the overall center. Reported in each component as relevant.

G.2 Responsible Conduct of Research

Not applicable in the overall center. Reported in each component as relevant.

G.3 Mentor's Research Report or Sponsor Comments

Not applicable in the overall center. Reported in each component as relevant.

G.4 Human Subjects

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

Yes

G.4.b Inclusion Enrollment Data

Inclusion Enrollment Data; included in each relevant project

G.4.c ClinicalTrials.gov

Not applicable

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

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. All personnel who work in research have completed CITI training.

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)?

This project does not involve human embryonic stem cells.

G.7 Vertebrate Animals

Does this project involve vertebrate animals?

This project does not involve vertebrate animals.

G.8 Project/Performance Sites

Organization Name	DUNS	Congressional District	Address
Primary: COLORADO STATE UNIVERSITY	785979618	CO-002	COLORADO STATE UNIVERSITY-FORT COLLINS 2002 Campus Delivery - Sponsored Programs FORT COLLINS CO 805232002

The University of Texas Health Science Center at Houston	800771594	TX-021	San Antonio Regional Campus 7411 John Smith Drive, Suite 1100 San Antonio TX 782296018
The University of Texas Health Science Center at Houston	800771594	TX-009	1200 Pressler Street, RAS Bldg Houston TX 770303900
Montana State University	625447982	MT-001	309 Montana Hall Street Bozeman MT 59717
Iowa State University	005309844	IA-004	1138 Pearson Hall Ames IA 50011
Utah State University	072983455	UT-001	2300 UMC 1498 N 800 E Logan UT 84322

G.9 Foreign Component

Not applicable

G.10 Estimated Unobligated Balance

The unobligated balance is reported in our FFR, attached.

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?

Yes, the unobligated balance is reported in our FFR, attached.

G.11 Program Income

Is program income anticipated during the next budget period?

No program income is anticipated during the next budget period.

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

Since 1991, HICAHS has served the agriculture, forestry, and fishing population of Public Health Service (PHS) Region VIII, including six states (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming) and 33 tribal nations. Our work extends nationally and internationally with Outreach and Research Core activities in states including Idaho, New Mexico, Nebraska, and Texas because of our close collaborative relationships with partners in these states and because of our leadership in dairy worker health and safety.

During the 2016 to 2022 cycle, we brought together an internationally recognized leadership team, outstanding young investigators, and a well-developed regional partnership network to address the promotion of health and reduction of work hazards among the high-risk industries of agriculture and forestry in the Federal Public Health Region VIII. Our accomplishments were grounded in engaging and listening to our stakeholders and responding to their needs with sound and relevant research and outreach efforts. We have fostered a One Health approach, which optimizes the health of people, animals, and the environment with the rapidly expanding dairy industry in our region. We have developed a successful model for advancing research to practice (r2p) – moving from etiological research to assessment of efficacy in practice, toward adoption and implementation. Two examples of this include the HICAHS response to COVID-19 and our efforts in the dairy industry.

COVID-19 Response. In response to the COVID-19 pandemic, the HICAHS team collaborated with partners nationwide to respond and provide resources to support agricultural workers. We collaborated with the other US Centers for Agricultural Safety and Health to draft the CDC and Department of Labor's COVID-19 Interim Guidance for the agricultural sector. We partnered with local Extension and commodity groups to help interpret that guidance and provide actionable recommendations. We lent support to State Departments of Agriculture as they advocated for increased access to personal protective equipment. We revised our recommendations for preventing exposure to wildfire smoke to help producers protect their families and employees from a dual threat: COVID-19 and smoke. While the pandemic limited our field research and in-person outreach efforts during the last 2 years of the grant cycle, the HICAHS team found new ways to support agricultural workers and rural populations. Several HICAHS researchers used their expertise to support new projects responding to COVID-19. The outreach core used digital avenues to connect and build new partnerships.

HICAHS aimed to leverage our three small grant programs to support agricultural businesses and workers in their on-going response to COVID-19. Through targeted recruitment, we funded six projects that directly or indirectly addressed COVID-19 through vaccine education and distribution. For example, we funded Dr. Maristela Rovai, Assistant Professor and Dairy Extension Specialist at South Dakota State University, on a vaccine education project for local dairies. Her team addressed misinformation online through a Spanish-language Facebook page, communicated with dairy workers via WhatsApp, and helped community organizations coordinate their vaccine clinics.

IDRC & Dairy Efforts Beyond HICAHS Region. A prime example of HICAHS' impactful work in the r2p paradigm has been our scholarship and outreach with the dairy industry, with national and international impact spanning from the research bench to the dairy barn to policy. This success is built on transdisciplinary, commitment to community engagement, and attention to policy implications of our work. HICAHS Research and Outreach Cores have maintained a targeted focus with the dairy industry for more than two decades. In that time, the Center has led numerous research studies and served as technical experts for local, regional, and national industry groups on worker safety and health.

Because of increased consumer concern for worker welfare in the dairy industry, the Idaho Dairymen's Association has launched a multi-year initiative to address worker safety on dairy farms throughout the state. The Idaho Dairyman's Association (IDA) is taking a proactive approach by partnering with HICAHS personnel Drs. David Douphrate and Robert Hagevoort (previous HICAHS Advisory Board Member) to implement a comprehensive safety management program on IDA member farms and provide safety training and consultation to all 500 IDA farm members. Drs. Douphrate and Hagevoort serve on the National Milk Producer Federation task force on dairy worker safety and welfare and developed an Idaho Dairy Workforce Training and Safety Program, described above, which was also adopted by the National Milk

Producers Federation. Dr. Reynolds has served on the Advisory Board for this program, which has led to the development of a Worker Health program to the National Milk Producer Federation's Dairy Program using our 2019 FARM Workforce Development Safety Reference Manual developed by Dr. Douphrate with input from several NIOSH AgFF Directors including Dr. Reynolds. Additionally, Idaho Senator Simpson has developed a Farm Workforce Modernization Act for the nation informed by HICAHS research and programs.

A. COVER PAGE: Admin Core 7931

Project Title: APE Core - Center Administration, Planning, and Evaluation Core
Component Project Lead Information: REYNOLDS, STEPHEN J

B. ACCOMPLISHMENTS

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

Administrative Component

Aim 1. Provide vision, leadership, strategic planning, and management.
Aim 2. Ensure transdisciplinary coordination and synergy through the structure and functions of the Internal Advisory Board and External Advisory Board, and through continued engagement of HICAHS researchers and staff.
Aim 3. Coordinate and facilitate innovative, high impact-programs in Outreach and Research.
Aim 4. Continue to foster and enhance the HICAHS Dairy Health and Safety Network and the HICAHS International Dairy Consortium.

Emerging Issues Component

Aim 1: To provide leadership and resources for Projects addressing high priority emerging issues in Public Health Service Region VIII in a timely manner.

Evaluation Component

Aim 1: Use a novel logic model to evaluate the quality, effectiveness, and impact of the HICAHS Agricultural Center over the next five years.
Aim 2: Collect evaluation data from research participants, advisory board members, and constituents to provide feedback and assess regional needs.
Aim 3: Provide feedback and guidance to each HICAHS project and program, based upon evaluation metrics related to specific aims, outputs, outcomes, potential long-term goals, and impacts.
Aim 4: Evaluate and document Center-wide collaborations with multiple entities, including NIOSH and other NIOSH Agricultural Centers, as well as partnerships to accomplish Center goals.

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

Administrative Component

Specific Aim 1.
The Internal Advisory Committee met every month. Minutes are recorded and shared with all HICAHS staff. The Internal Committee including the Core Directors, Program Leads and Principal Investigators contribute skills that significantly broaden and strengthen the administrative team. Other communications occurred more frequently by videoconferencing, telephone, and email.

Specific Aims 2, 3, and 4.
Each of the Internal Advisory Committee members facilitated communication between the administrative team; staff and investigators facilitated communication within their respective programs and projects. As a group, the Internal Advisory Committee was responsible for interdisciplinary coordination and integration of projects and programs within HICAHS and with HICAHS external partners. The Internal Advisory Committee

also implemented and coordinated all programs with the Evaluation Program and Outreach/Translation initiatives and assisted in identifying and prioritizing Emerging Issues.
While COVID-19 prevented us from connecting in-person during half of the reporting period, communication strengthened between Internal Committee and External Advisory Board. Our communications frequently occurred by videoconferencing, telephone, and email. We held our annual External Advisory Board meeting virtually in September 2021 and in 2022 had a hybrid board meeting in June. Since then, we've had External Advisory Board members reach out to engage the HICAHS Team to collaborate. We welcomed Bethany Alcauter, Manager of Evaluation and Special Programs at the National Center for Farmworker Health, to the HICAHS Advisory Board in September. Dr. Alcauter has collaborated with HICAHS Outreach on a webinar for fruit and vegetable growers in Colorado, sought input from HICAHS Administration on COVID-19 safety guidance for H-2A workers, and participated in a virtual interdisciplinary engaged scholarship discussion.

Emerging Issues Component

Aim 1: To provide leadership and resources for Projects addressing high priority emerging issues in Public Health Service Region VIII in a timely manner.

The HICAHS Emerging Issues Program funded projects listed in the table below, demonstrating the wide range of priority topics that were funded to address regional needs.

Year Awarded	PI Name, Organization	Project Title
2021	Annie Keeney, San Diego State University	Understanding the Mental Health Safety Net for Foreign-born Farmworkers ir Colorado and Utah
2021	Annyce Mayer, National Jewish Health	Piloting a Regional Respiratory Protection Education and Fit Testing Model fo Pesticide Applicators in Colorado's Marijuana Industry
2020	John Rosecrance, Colorado State University	Assessing the 3D Facial Anthropometrics of LatinX Workers
2020	Ruger Carter, Utah State University	COVID-19 Vaccination Clinics for Large Scale Agriculture Operations in Centra Utah
2020	Maristela Rovai, South Dakota State University	Overcoming Dairy Employee's Hesitancy to the COVID-19 Vaccine: Using Outreach, Education, Media, and Community
2019	Sheryl Magzamen, Colorado State University	Assessment of Joint Effects of Pesticides and Air Pollution in Pediatric Asthma Study findings enabled the PI to receive a R21 from the National Institute of Environmental Health Sciences.
2019	Michael Wierda at Utah State University Extension	Train the Trainer: Building Capacity for Respiratory Protection and Respirator Safety Program Administrators in Utah
2019	Stacia McNeely, Regis University	Supporting Resilience and Suicide Prevention in Agricultural Workers
2019	Pat Sample, Colorado State University	Understanding Sources of Farmer Stress and Stress Reduction Resources

2019	Cynthia (Thia) B. Walker, Colorado State University Extension	Train the Trainer: Building Capacity for Respiratory Protection in Rural CO and UT
2019	Tommy Rock, Utah State University	Potential Total Petroleum Hydrocarbon Exposures in Native American Communities along the Missouri River
2018	Miranda Zamora, University of Wyoming	Heat Acclimation in Wildland Firefighters
2018	Joshua Schaeffer, Colorado State University	BDF Studies; Cell Interaction with the Environment
2018	Noa Roman-Muniz, Colorado State University	Dairy Worker Perspectives of Performing Euthanasia as an Essential Component of their Job
2018	John Volckens, Colorado State University	Respirator Use and Safety Facts during Wildfire Season. This project led to the creation of 8 state-specific factsheets on respiratory protection for wildfire smoke (including Spanish-language versions)
2017	Trevor Durbin, University of Wyoming	Assessing Worker Perceptions of Health and Safety Risk in Beetle-killed Forests. The findings were published in: Trevor J. Durbin, Casper G. Bendixsen, Danielle Jensen-Ryan, Abigaile Molzer & Sarah Strauss (2019): The Dangerous Middle: Situational Awareness and Worker Perception of Beetle Kill, Journal of Agromedicine, 22:1-10.
2016	Robert Hagevoort; New Mexico State University	Dairy Stockman Vignettes. Online Vignettes are available on the YouTube Ag Channel in three Languages- English, Spanish, and K'iche
2016	Joshua Schaeffer, Colorado State University	Antibiotic Resistance Genes in Bacteria Water, Up- Down-Wind Dairies
2016	Anita Pena, Colorado State University	Occupational Health and Safety of U.S. Farmers in the High Plains and Beyond

Additionally, to provide resources and respond to the emerging issues, the Evaluation & Planning Core Team and Outreach Core Teams hosted a series of virtual Engaged Scholarship Discussions that involved a facilitated panel and small group discussions. In the evaluation of these discussions, attendees reported that they gained new knowledge, made new connections, or strengthened existing relationships. The events expanded the network of attendees including researchers and practitioners engaged in addressing pressing issues in agricultural safety and health such as youth safety and COVID-19 impacts.

Evaluation Component

Specific Aim 1: Use a novel logic model to evaluate the quality, effectiveness, and impact of the HICAHS Agricultural Center.

The HICAHS Evaluation Program continued to track the Center's outputs (publications, presentations, impact of published works through citation indices) and outcomes using our logic model as a guide and identified worker health and safety needs in the region by conducting needs assessments with the Advisory Board and other agriculture serving organizations. The team used evaluation method based on narrative storytelling to gather and assess the evidence generated from HICAHS research or funded (e.g., pilots, community-initiated, emerging issues) projects from the viewpoint of principal investigators, HICAHS staff, and partners. These narrative stories captured rich qualitative data about the local, region, and national impacts of HICAHS projects and to explore the cause and effect relationships between the Center's efforts and health and safety in agricultural, forestry and fishing in the region.

The Evaluation Team also conducted a Social Network Analysis to determine HICAHS' connectivity and relation to other organizations and stakeholders in the region. The success of HICAHS depends on partnership among academia, industry, government, agricultural operators/owners, employees, and stakeholders engaged in agricultural safety and health. Promoting worker health and safety requires comprehensive engagement throughout this network, and there may be overlap in activities of different organizations, which can lead to inefficient delivery of services and information. A paper from this work, "Assessing Connections in an Agricultural Community using Social Network Analysis", was published in *the Journal of Agromedicine*. The analysis showed that the most prominently connected organizations in the HICAHS region are Extension and education; other Ag Centers; and cattle, dairy, and pork producers and organizations that support agriculture. The Evaluation and Outreach teams used the results of the analysis to inform our strategies. Specifically, we are using the results of the Social Network Analysis in tandem with the needs assessment to identify potential partnership and networking opportunities with the highest potential impact in the region. This effort informed our reorganization of the External Advisory Board.
Specific Aim 2: Collect evaluation data from research participants, advisory board members, and constituents to provide feedback and assess regional needs.

The HICAHS Evaluation Team pilot tested a Needs Assessment Survey with our HICAHS Advisory Board in 2018. After incorporating feedback into the instrument, it was circulated to partners and at farm shows in the region in early 2019. This assessment helped HICAHS leadership identify emerging issues to fund during the final years of the grant cycle as well as develop research ideas to pursue in the next cycle. It also elucidated some specific issues related to the work environment (e.g., extreme weather, wildfires, etc.) for HICAHS to address. This portion of the assessment was added after the pilot testing revealed an increased concern about the impacts of climate change. The instrument was augmented to define more specific concerns related to the impacts of climate change. The Team reported evaluation results to the HICAHS Leadership.

Specific Aim 3: Provide feedback and guidance to each HICAHS project and program, based upon evaluation metrics related to specific aims, outputs, outcomes, potential long-term goals, and impacts.

The Team has been working on new approaches to measure success blending ideas from a classic Logic Model and the Contribution Analysis Approach that has been underway for several years in order to better identify impacts of the work being done.

Findings from evaluation activities have been shared at Leadership Meeting and with the External Advisory Board and have inform the Center's strategies and ongoing work.

Specific Aim 4: Evaluate and document Center-wide collaborations with multiple entities, including NIOSH and other NIOSH Agricultural Centers, as well as partnerships to accomplish Center goals.

In 2020-2021, the Evaluation team collaborated with colleagues from the other Ag Centers in two program-wide evaluation projects: one evaluating regional needs related to the COVID-19 pandemic and another developing a Contribution Analysis on cross-center activities to reduce tractor overturn fatalities through Rollover Protective Structure (ROPS) research and programs. The team also implemented an Evaluator Cultural Self-Assessment and identified priorities for growing its internal capacity, competencies, and approaches to incorporate greater cultural responsiveness and humility into the Center. This assessment addresses the use of cultural heritage, cultural stereotypes, diverse team membership, equity, selection of data collection instruments that are appropriate for the target population, and differential impacts on diverse populations in approaching evaluation. As a team, with the addition of Whitney Pennington (Outreach Coordinator), we took a training on Intergroup Dialogue, designed to understand how to communicate and discuss across differences. The topics included group facilitation skills and their applications in inclusive, diverse settings; group processes and dynamics involving social power; social identity group development; prejudice and stereotyping and their effects on groups; difference and dominance and the nature of social oppression.

B.3. Competitive Revisions/Administrative Supplements

Not applicable

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

Administrative Component

Graduate students and junior faculty participated in the External Advisory Board meetings, gaining experience in planning and conducting a meeting with partners, and learning opportunities that enhanced their preparation for effective careers in research and practice in occupational health. They also have participated in HICAHS Leadership meetings on a regular basis and the HICAHS Research Day events.

Emerging Issues Component

Several of the Emerging Issues funded projects developed training materials for agricultural health and safety professionals. For example, three Emerging Issues funded projects addressed respiratory health education. The Utah State University project led by Michael Wierda resulted in the creation of two self-paced online respiratory safety courses, which have been disseminated to applicators nationwide. The project at National Jewish Health resulted in respiratory protection education for pesticide applicators in Colorado's marijuana industry. The project led by Thia Walker at Colorado State University used a train-the-trainer approach to build capacity for respiratory protection in rural CO and UT.

Evaluation Component

The Evaluation team has supported and mentored several graduate research assistants, who have worked on projects including the Social Network Analysis, the narrative storytelling interviews, and tracking our Center's outputs. These students were introduced to the challenges in reducing occupational injuries in agricultural health and safety and their experiences in HICAHS have contributed to their ability to continue to work in public health and in some cases agricultural health. For instance, our 2021 graduate research assistant reported that her experience at HICAHS helped her feel prepared for her current as a research associate in the Upskilling Academy Initiative based at Colorado State University's College of Agricultural Sciences.

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

Administrative Component

As part of Center Administration, the HICAHS Executive Leadership Team represented HICAHS at producer meetings, scientific conferences, meetings with partner US Agricultural Health and Safety Centers (Ag Center) and other agencies across the previous grant cycle. Our team provided consultation to producers, producer organizations, policy-making and regulatory bodies, and to NIOSH, and CDC more broadly on issues including COVID-19 agricultural worker guidance. Drs. Reynolds and Douphrate served on the NORA AgFF Sector Council. Dr. Stallones continued serving on the leadership team for the Farm and Health Safety Community of Practice, which operates through the Cooperative Extension eXtension program. Drs. Stallones, Reynolds, and Douphrate served as Associate Editors for the *Journal of Agromedicine* and the *Journal of Agricultural Safety and Health*. Drs. Reynolds and Douphrate participated in planning the 2020 ASHCA meeting and included Dairy Industry participants. Dr. Douphrate and Dr. Hagevoort (Advisory Board) developed an Idaho Dairy Workforce Training and Safety Program which was also adopted by the National Milk Producers Federation. Dr. Reynolds served on the Advisory Board for this program. Drs. Douphrate and Hagevoort are serving on the National Milk Producer Federation FARM Program Advisory Board.

In 2019 and 2020, the Evaluation & Planning Core Team partnered with the Pilot/Feasibility Program and Outreach Core Teams to host Research Day events where researchers and practitioners shared the methods and findings from their projects that were funded through HICAHS' small grant streams. Each Research Day provided professional development opportunities and built new partnerships that led to innovative projects. Due to the COVID-19 pandemic, our 2020 event was hosted virtually, which led to participation and attendance from researchers and practitioners across the country. In 2020, ten presenters shared their HICAHS-funded work on topics including agriculture exposure assessment, building safety capacity, and dairy worker health and safety. Presenters represented four of the six states in the HICAHS region and included community partners, graduate students, and professors who received funding from HICAHS' Pilot/Feasibility, Emerging Issues, and Community-Initiated grants. To reach an audience beyond the 62 attendees and 10 presenters who attended by Zoom, HICAHS livestreamed the event on Facebook to 10 additional event attendees and shared presenter quotes on Twitter using #HICAHSResearch, which more than 2,800 twitter users viewed. The promotion of the event directed traffic to the Pilot/Feasibility Program website and added 33 people to the HICAHS email listserv, growing HICAHS' network in the region. Attendees who completed the post-event survey reported increasing their knowledge of agriculture exposure assessment, building safety capacity, and dairy worker health and safety. Additionally, they reported that the information presented in the three topics will inform and change their behaviors, practice, and research.

Emerging Issues Component

The projects funded by the HICAHS Emerging Issues Grant program disseminated findings through our HICAHS Research Day events and through other academic and community presentations. For example, the Utah State University project led by Michael Wierda resulted in the creation of two self-paced online respiratory safety courses, which have been disseminated to applicators nationwide. The team recently sent out their first notice to all pesticide safety education programs and many state lead agencies to inform them of the courses, so they can get them approved for education credits in their states, as appropriate. The courses are also available for free viewing (for education only) on the USU PSEP YouTube channel.

Evaluation Component

Results from the Social Network Analysis were published in the Journal of Agromedicine. Publication of these results provide a framework for other Ag Centers to better understand how agricultural organizations are likely to be connected within a region. Importantly, understanding what important partnerships are missing from the network can lead to partnerships that are necessary to promote worker health and safety.

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

This is the final report for the grant cycle.

C. PRODUCTS

C.1. Publications, conference papers, and presentations

1. Beseler, C.L., Keeney, A.J., Garratt, R., Wertheimer, A., & Stallones, L. (2020). Assessing connections in an agricultural community using social network analysis. *Journal of Agromedicine*. https://doi.org/10.1080/1059924X.2020.1837317
2. Beseler, C.L. & McNeely, S. (2021). Using text analysis to assess the mental health impacts of COVID-19 on rural healthcare providers. *OJRRP, 17*(1), 1-9. https://doi.org/10.4148/1936-0487.1110
3. Durbin, T.J., Bendixsen, C. G., Jensen-Ryan, D., Molzer, A., & Strauss, S. (2019). The dangerous middle: Situational awareness and worker perception of beetle kill. *Journal of Agromedicine, 24*(2), 157-166. doi: 10.1080/1059924X.2019.1567424. PMID: 30668265

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

Nothing to report

C.3. Technologies or techniques

Nothing to report

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

Not applicable

C.5. Other products and resource sharing

Audio or Video:
Dairy worker safety training vignettes have been developed and deployed in English, Spanish, and K'iche' and are available for public use on the U.S. Ag Centers YouTube channel. Vignettes are also deployed on mobile platforms and can be downloaded by dairy producers free of charge. Drs. Douphrate and Rodriguez recently published in the Journal of Agromedicine findings from training effectiveness evaluations of training programs using these vignettes. There are four videos and their titles are provided below. The translations in K'iche' are the most recent additions. These vignettes incorporate Human and Bovine Safety and Health.

The Utah State University Emerging Issues project led by Michael Wierda resulted in the creation of two self-paced online respiratory safety courses, are available to view for free (for education only) on the USU PSEP YouTube channel.

The U.S. Ag Center YouTUBE channel continues to allow for dissemination through: https://www.youtube.com/user/USagCenters/. These videos are also being used in the national programs described above.
Video content includes the following:

1. Part I Introduction to "Considering Human and Animal Safety: Dairy Safety Training"
   i. Sub-parts:
      1. Introduction
      2. Outside Animal Care
      3. Milking Barn Safety
      4. Feeding and Other
2. Safety Issues Part II "General & Outside Worker Safety"
   i. Sub-Parts
      1. Introduction
      2. Milker & Calf Caretaker Safety
      3. Feeder Safety

D. PARTICIPANTS

Reported in the overall section.

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.

Research to Practice

After almost 20 years of working with the Dairy industry, the HICAHS team is excited to witness the translation of our research into practice, with Dairy producers implementing integrated Health and Safety Management into their business, hiring appropriate staff, and requesting HICAHS support for their efforts. Most recently Dr. Douphrate and Dr. Hagevoort (HICAHS Advisory Board) developed an Idaho Dairy Workforce Training and Safety Program which was also adopted by the National Milk Producers Federation (https://www.nmpf.org/wp-content/uploads/2019/07/FARM-Workforce-Safety.png). Dr. Reynolds served on the Advisory Board for this program. This program was instrumental in the negotiations which ultimately included dairy worker safety program management principles in the Farm Worker Modernization Act which is currently being discussed with a bi-partisan group in the US House and Senate to assist dairy producers with worker recruitment.

Administrative Component's Impact and Public Health Relevance

Over the past 5 years HICAHS has worked in response to our Regional Needs Assessment to address health and safety in dairy production and emerging needs (e.g., forestry safety, all-terrain vehicle safety on ranches, vulnerable workers) of this region with cross-cutting, innovative research, intervention, and outreach translation.

We continued using a One Health approach with the rapidly expanding dairy industry in our region, established a regional Dairy HS Network and an International Dairy Research Consortium. Our administrative team has developed strong partnerships in occupational safety across the region to enhance the adoption of research into practice including in often under-served industries such as the logging industry in Montana.

Emerging Issues Component

The Emerging Issues awards enabled HICAHS partners to address regional priorities including topics such as agricultural community mental health, fit of personal protective equipment, respiratory health, pesticide exposure, and response and education about COVID-19 (see table of grantees in section B.2).

Evaluation Component

In addition to tracking HICAHS' progress on our goals, the Evaluation core employed and mentored graduate students who were introduced to the challenges in reducing occupational injuries in agricultural health and safety. They will take what they learned into their professional life and advocate for the agricultural communities in which they work.

F. CHANGES

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

No significant changes to report.

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

No significant changes to report.

F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents
No significant changes to report.

G. Special Reporting Requirements

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

Not applicable in the overall center. Reported in each component as relevant.

G.2 Responsible Conduct of Research

Not applicable in the overall center. Reported in each component as relevant.

G.3 Mentor's Research Report or Sponsor Comments

Not applicable in the overall center. Reported in each component as relevant.

G.4. Human Subjects

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

If you selected Yes, answer the following questions:

Is the research exempt from Federal regulations? ☐Yes ☒No

If it is exempt, check appropriate exemption numbers(s).

☐E1 ☐E2 ☐E3 ☐E4 ☐E5 ☐E5

Does this project involve a clinical trial? ☐Yes ☒No

G.4.b. Enrollment table attached

G.4.c. Not Applicable

G.5 - Human Subjects Education requirement

All team members have completed their Human Subjects Education.

G.6. Human Embryonic Stem Cell (hESCs)
Not applicable.

G.7 - Vertebrate Animals
Not applicable.

G.8 - Project/Performance Sites
See overall section.

G.9 - Foreign Component
Not applicable.

G.10 Estimated unobligated balance and explanation of balance
The unobligated balance is reported in our FFR, attached.

G.11 Program Income
Not applicable.

G.12 F&A Costs
Not applicable.

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

Since 1991, HICAHS has served the agriculture, forestry, and fishing population of Public Health Service (PHS) Region VIII, including six states (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming) and 33 tribal nations. Because of our close collaborative relationships with partners and because of our leadership in dairy worker health and safety, our work has extended nationally and internationally.

During the 2016 to 2022 cycle, we brought together an internationally recognized leadership team, outstanding young investigators, and a well-developed regional partnership network to address the promotion of health and reduction of work hazards among the high-risk industries of agriculture and forestry in the PHS Region VIII. Our accomplishments were grounded in engaging and listening to our stakeholders and responding to regional needs with sound and relevant research and outreach efforts.

Center Administration

HICAHS' Center Administration united all Center cores and projects under a shared Vision, Mission, and Values and facilitated transdisciplinary engagement in the Center's research-to-practice efforts. The administrative structure and function effectively managed the Center and facilitated synergy among investigators, External Advisory Board members, and partners, leading to new collaborations, projects, and products that aimed to improve agricultural health and safety in the region.

COVID-19 Response. In response to the COVID-19 pandemic, the HICAHS team collaborated with partners nationwide to provide resources to support agricultural workers. The HICAHS Evaluation & Planning Core and Outreach Teams collaborated with the other Ag Centers to draft the CDC and Department of Labor's COVID-19 Interim Guidance for the agricultural sector. We partnered with local Extension and commodity groups to help interpret that guidance and provide actionable recommendations. We lent support to State Departments of Agriculture as they advocated for increased access to personal protective equipment. We revised our recommendations for preventing exposure to wildfire smoke to help producers protect their families and employees from a dual threat: COVID-19 and smoke. While the pandemic limited our in-person connections during the last 2 years of the grant cycle, the HICAHS team found new ways to support agricultural workers and rural populations.

IDRC & Dairy Efforts Beyond HICAHS Region. A prime example of HICAHS' impactful work in the r2p paradigm has been our scholarship and outreach with the dairy industry, with national and international impact spanning from the research bench to the dairy barn to policy. Because of increased consumer concern for worker welfare in the dairy industry, the Idaho Dairymen's Association has launched a multi-year initiative to address worker safety on dairy farms throughout the state. The Idaho Dairyman's Association (IDA) has taken a proactive approach by partnering with HICAHS personnel Drs. David Douphrate and Robert Hagevoort (previous HICAHS Advisory Board Member) to implement a comprehensive safety management program on IDA member farms and provide safety training and consultation to all 500 IDA farm members. Drs. Douphrate and Hagevoort served on the National Milk Producer Federation task force on dairy worker safety and welfare and developed an Idaho Dairy Workforce Training and Safety Program, which was also adopted by the National Milk Producers Federation. Dr. Reynolds has served on the Advisory Board for this program, which has led to the development of a Worker Health program to the National Milk Producer Federation's Dairy Program using our Safety Reference Manual developed by Dr. Douphrate with input from several NIOSH AgFF Directors including Dr. Reynolds. Additionally, Idaho Senator Simpson has developed a Farm Workforce Modernization Act for the nation informed by our research and programs.

During the previous grant cycle, the HICAHS Evaluation & Planning Core and Outreach Core Teams hosted three formal gatherings of the International Dairy Research Consortium (IDRC), with participants from across North America, Europe, and Oceania. IDRC members have edited and compiled three peer-reviewed journal special issues, each with a HICAHS representative serving as editor, with the latest in the past cycle. One of the IDRC gatherings occurred as part of the Western Ag Health and Safety Conference in August 2019. Thirty-one researchers and industry members from five different countries gathered to discuss applying a Total Worker Health™ approach to the dairy industry. The meeting inspired new collaborations and prompted discussions on better standardization across worker health studies worldwide.

Evaluation Program

The HICAHS Evaluation Program continued to track the Center's outputs (publications, presentations, impact of published works through citation indices) and identify worker health and safety needs in the region by conducting needs assessments with the Advisory Board and other agriculture serving organizations. Under the leadership of Dr. Stallones, staffing increased and the team used evaluation approaches including a needs assessment, social network analysis, contribution analysis, and narrative storytelling. In 2020-2022, the Evaluation team collaborated with colleagues from the other Ag Centers in two program-wide evaluation projects: one evaluating regional needs related to the COVID-19 pandemic and another developing a Contribution Analysis on cross-center activities to reduce tractor overturn fatalities through Rollover Protective Structure (ROPS) research and programs. The team also implemented an Evaluator Cultural Self-Assessment and identified priorities for growing its internal capacity, competencies, and approaches to incorporate greater cultural responsiveness and humility into the Center.

Emerging Issues Grant Program

The HICAHS Emerging Issues Program enabled the Center to identify and respond to issues of high priority for regional producers. During the grant cycle, the leadership of the Emerging Issues program was shifted from center director Dr. Reynolds to Dr. Valley, under the mentorship of Drs. Reynolds and Stallones. Grants awarded in the last grant cycle addressed numerous priority issues and included: agricultural community mental health, fit of personal protective equipment, respiratory health, pesticide exposure, wildfire smoke exposure, and response and education about COVID-19. With funding from the Emerging Issues Grant Program, Dr. Volckens team led a project on wildfire safety that resulted in guidance documents on wearing personal protective equipment for preventing exposure to wildfire smoke. These products and associated messaging were incorporated into the HICAHS communications plan beginning in the 2018 wildfire season. Over subsequent years, HICAHS Outreach created additional resources in collaboration with other US Centers for Agricultural Safety and Health ("Ag Centers") including short graphical videos optimized for social media, an FAQ document, and an employer training video. Between the 2018 – 2021 fire seasons, these wildfire safety resources were viewed more than 26,000 times.

A. COVER PAGE: Core-7936

Project Title: Outreach Program
Component Project Lead Information: Stallones, Lorann

B. ACCOMPLISHMENTS

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

The HICAHS Outreach Core focuses on opportunities to strengthen the effectiveness of our outreach activities and of the community-initiated activities among our community partners involved in agricultural and forestry (AgF) safety and health. HICAHS investigators will utilize a participatory approach in which university personnel and AgF stakeholders are engaged in a process focusing on the needs of the AgF community.
The following are the specific aims of the Outreach Core:
1.To design, implement and evaluate a communication plan.
2.To work in partnership with other NIOSH funded Agricultural Safety and Health Centers on cross-site initiatives to increase the use of evidence-based occupational safety and health programs.
3.To conduct training programs for agricultural injury prevention.
4.To augment regional AgF safety and health education programs by providing community-initiated small grants to regional partners involved in the prevention of agricultural and forestry occupational injuries, illnesses, and deaths.

B.2. What did you accomplish under these goals?
Specific Aim 1: Design, implement, and evaluate a Communications Plan
A formal Communications Plan was developed that identified three specific objectives of the HICAHS communication strategy: 1) to promote farm safety, 2) to improve delivery of safety measures, and 3) increase visibility of HICAHS among farmers in the region. The plan also outlined a strategy for utilizing digital media channels to disseminate specific farm safety messaging to target audience groups. Throughout the project period, the plan was revisited quarterly to revise target messages and assess the effectiveness of specific channels. Table 1 below summarizes the annual impressions (total views) generated by content posted to HICAHS' digital communication channels.

Table 1: Impression of HICAHS content shared on digital media platforms.

Year	**1** **(9/16-9/17)**	**2** **(9/17-9/18)**	**3** **(9/18-9/19)**	**4** **(9/19-9/20)**	**5** **(9/20-9/21)**	**6** **(9/21-9/22)**
Facebook	--	25,043	27,431	9,234	16,508	15,287
Instagram	--	2,302	3,973	4,640	8,652	6,017
Twitter	--	29,877	96,753	111,021	119,128	58,049
Email	1,017	1,774	4,153	2837	4,229	2,671
Total	**1,017**	**58,996**	**132,310**	**127,732**	**148,517**	**82,024**

In response to the COVID-19 pandemic, we added a fourth objective to the Communications Plan in the summer for 2020: to respond to current and emerging COVID-19 challenges through the dissemination of relevant resources. Our initial activities included listing regional and national resources on the HICAHS website and identifying gaps where additional resources and guidance were needed. In partnership with Colorado State University Extension, we developed guidance for sharing farm vehicles. This need was established by Extension to help crop producers who share planting and harvesting vehicles among non-family households. We also partnered with the Central States Center for Agricultural Safety and Health and the Ag Health and Safety Alliance to provide guidance for conserving respirator supplies in the wake of the shortage of N95 respirators. After this guidance and the official CDC guidance were published, we partnered with the other US Ag Centers to develop social media messaging and graphics to reinforce COVID-19 prevention best practices. In the late fall of 2020, we noticed many images posted on social media of ranchers attending livestock markets and auctions without practicing COVID-19 prevention measures. In response, we created an additional social media campaign focused on COVID-19 safety at livestock markets.

The initial Communication Plan included specific messages to disseminate via digital and traditional media outlets. Topics are listed in the table below with asterisks demarcating topics added after project year 1.

Table 2: Seasonal messaging topics in the Communications Plan

Fall	**Winter**	**All Season***
Harvest safety Farm vehicle safety Preparing for winter Tractor rollover and ROPS	Animal safety in winter Snowmobile safety Slips, trips, and falls*	Mental health* Hearing protection* Respiratory protection* Equipment safety* Manure pits/gas* COVID-19*
Spring	**Summer**	
Zoonotic disease prevention Livestock handling Calving* Working in the rain Irrigation safety Farm vehicle safety*	Dry weather/fire safety ATV safety Farm safety for kids Flood safety Skin protection Heat related illness* Chemical exposure safety Wildfire smoke exposure*	

As a means of accomplishing research-to-practice (r2p), the new messaging was added to the Communications Plan to reflect new evidence-based information and products created through HICAHS grant programs and research. One specific success was the incorporation of wildfire safety products created through the HICAHS Emerging Issues Program: guidance documents on wearing personal protective equipment for preventing exposure to wildfire smoke. These products and associated messaging were incorporated into the HICAHS Communications Plan beginning in 2018. Over subsequent years, the HICAHS Outreach Core created additional resources in collaboration with Ag Centers including: short graphical videos optimized for social media, a frequently asked questions document, and an employer training video. During the 2018 – 2021 fire seasons, these wildfire safety resources were viewed more than 26,000 times.

Specific Aim 2: Work in partnership with other NIOSH funded Ag Safety and Health Centers on cross-site initiatives to increase the use of evidence-based programs.
HICAHS Outreach Core personnel continue to participate in the Ag Centers joint "Evaluators, Coordinators, Outreach" (ECO) colleague group and initiatives. Specifically, we participated in the annual national social media campaigns for *Farm Safety and Health Week* and *Ag Safety Awareness Programs Week*. Ms. Pennington was also an active participant in the cross-center initiatives related to the 2020 Coronavirus Pandemic that produced draft COVID-19 prevention guidance for the agricultural industry for CDC and a suite of social media images and messages to promote CDC guidance.

Both Ms. Pennington and Ms. Cassidy (before leaving HICAHS in early 2018) served in leadership roles in the ECO group. Since 2019, Ms. Pennington has served as the review coordinator of the centers' joint YouTube channel. Throughout her tenure, Pennington has facilitated the addition of 39 new videos to the channel. Additionally, Pennington was a co-author of a joint publication on the channel's creation and success published in the *Journal of Agromedicine*[1] in 2021. The publication highlights how the involvement of all US Ag Centers in building, maintaining, and promoting the channel led to more than 220,000 cumulative video views for a total of more than 10,500 hours between 2013-2019. The channel experiences relative peaks in watch time during coordinated Farm Safety and Health Week and Ag Safety Awareness Programs Week promotional campaigns.

The joint Ag Centers YouTube channel continues to serve as an impactful platform for promoting farm safety and HICAHS resources. During this project period, we added eight new videos to the channel: a seven-part dairy safety series in K'iche and a Spanish-language zoonotic disease training for dairy workers developed by the HICAHS Research Core in the 2011-2016 project period. During this project period, the 29 HICAHS-produced videos on the channel have been viewed a combined 356,000 times for a cumulative watch time of 39,400 hours. This success is driven by the two-part chainsaw safety video series entitles "How to Use a Chainsaw Safely" developed during the 2011-2016 funding period. The use of YouTube enables the dissemination of safety content at a pace that far exceeds the capacity of the HICAHS Outreach Core personnel.

Outside of the formal ECO group efforts, the HICAHS Outreach Core collaborated with individual centers on outreach activities with broad regional impact. This included collaboration in the execution of the Western Ag Safety and Health Conference (2019) and collaboration to provide safety information at regional expos: Central Plains Dairy Expo (2019) and the Midwestern Stream Forum for Agricultural Worker Health (2019). In 2021, the Outreach Core partnered with the National Children's Center for Rural and Agricultural Health and Safety to host a virtual panel discussion on youth safety on farms. In early 2022, we collaborated with the Western Center for Agricultural Health and Safety to tailor their existing heat illness prevention training scripts to be compliant with new Colorado heat illness training regulations. These collaborations served to synergize Ag Center efforts by reducing duplicative efforts and building the necessary foundation for future partnerships.

Specific Aim 3: Conduct training programs for agricultural injury prevention
Over the course of the grant period, the HICAHS Outreach Core led trainings related to the Worker Protection Standard, zoonotic disease prevention in livestock production, mental health, heat-related illness, ergonomics/musculoskeletal stress, and COVID-19 prevention. Additionally, we co-hosted trainings on grain bin safety, the use personal protective equipment, and mental health where training content was delivered by a non-HICAHS partner.

The COVID-19 pandemic has galvanized the conversation around safety and health in agriculture and logging. The renewed interest and the broad utilization of virtual meeting platforms allowed us to reach across geographic and institutional barriers to conduct training with new partners, particularly in the areas of mental health and COVID-19. We collaborated with the Colorado Fruit and Vegetable Growers Association, Colorado State University Extension, the National Center for Farmworker Health, and Western Growers to conduct multiple COVID-19 prevention trainings for produce growers. We also partnered with the Colorado AgrAbility Project to co-host a virtual webinar delivered by Dr. Stallones entitled "Biological Factors Associated with Farm and Ranch Stress and Suicide".

Several additional training programs were supported by the Community-Initiated Grants program described below under Specific Aim 4.

Specific Aim 4: Augment regional health and safety education by providing community-initiated small grants to regional partners
The Community-Initiated Program funded 20 occupational health and safety projects in Colorado, Montana, South Dakota, Utah and Wyoming (Table 3). During the project period, $300,000 in small grants was awarded to community partners working to improve occupational safety in their respective regions. The HICAHS Outreach Core provided assistance to community partners in the development, conduct and evaluation of projects. These projects focused on health and safety issues identified by the grantee. The 12 organizations funded all that represented or directly worked with dairy workers, farmers, ranchers, professional loggers, and/or pesticide applicators in the HICAHS region. The

program was particularly successful in supporting programming in three areas: all-terrain (ATV) safety, logging safety culture in Montana, and LatinX dairy worker health.

ATV Safety Across the Region: HICAHS funded four integrated projects targeting ATV safety in Wyoming and Colorado. Following several agricultural related ATV deaths in 2017, we worked with the Wyoming Governor's Ag Safety Coalition to engage Extension and the ranching community in ATV safety education projects. As a result, the Wyoming Stock Growers Association was funded by HICAHS to jointly develop and disseminate a 10-page brochure on safe practices in ATV operation to ranchers and other stock growers across the state of Wyoming. Funding was then provided to University of Wyoming Extension to develop greater expertise within their Extension programs (agents and specialists) in ATV safety specific to farming and ranching operations. At the same time, Extension agents in Southwest Colorado also identified the need to build safe ATV ridership skills among youths in farming and ranching. The Wyoming Extension agents, having completed the ATV Safety Institute's course, traveled with their ATVs to Colorado to deliver a hands-on safe riding program for the Colorado teachers and Extension agents in a train-the-trainer model. The Colorado teachers and agents then worked together to develop a week-long classroom curriculum on ATV safety for local high school students in 4H and FFA programs. The HICAHS Community-Initiated Program funding enabled the Wyoming and Colorado Extension agents to provide ATV safety training to 900 agricultural workers (youth, ranchers, and pesticide applicators) during the project period.

Enhancing Safety Culture in Montana's Logging Industry: Through a partnership with the Montana Logging Association, HICAHS funded five projects that enhanced safety culture in the Montana logging industry. Over the course of this funding cycle, projects progressed from development of first aid training materials to the implementation of a safety leadership program for apprentices and experienced loggers. Due to the partnership with faculty and graduate students at HICAHS, all logging safety programs were empirically based and involved participatory action-based research methods. This long-term partnership supported the education of more than 1,000 loggers annually and build capacity for safety culture and safety leadership.

Toolbox Approach for LatinX Dairy Workers: HICAHS provided three grants to South Dakota State University Dairy Extension specialists to create and implement evidence-based safety intervention training for LatinX dairy workers. This innovative training course was modeled after the successful short training programs (toolbox talks) common in engineering and construction trades. The "Dairy Toolbox Talks" program was conducted in Spanish at three South Dakota dairies each week over a 10-week period. Two sets of focused programming were delivered during the year: 1) occupational health and safety issues and 2) cow handling and hygiene issues during the milking process. Interviews with owners, managers, and supervisors indicated positive changes in employee work methods, improved working relations, positive attitude at the workplace, and greater awareness of both worker and cow health issues. Dairy workers stated that they had greater awareness of mental health issues, risk of work injuries, and the importance of eye protection and vision screenings. Other notable observations were that employees moved cows better by being patient, calm, and consistent with them. The Dairy Extension specialist is now using the toolbox training throughout the state and developed an additional unit on COVID-19 vaccination using Emerging Issues funds.

*Table 3: Summary of projects funded via the Community-Initiated Grant Program from 2016-2022. *State denotes location of program implementation.*

Year	Project Title	Recipient	State*
2016-2017	Production and Evaluation of Video-Based Emergency First-Aid	Montana Logging Association	MT
2017-2018	ATV Safety Institute Training for Extension Agents	University of Wyoming Extension	WY
	ATV Safety Tips Brochure for Wyoming Agriculture	Wyoming Stock Growers Association	WY

	Dairy Employee' Health Toolbox: A Health Approach Pilot Project	South Dakota State Univ. Dairy Extension	SD
	Video Based Logger Training for Equipment Operations	Montana Logging Association	MT
2018-2019	ATV Safety Training for Ag Youth in Southwestern Colorado	Colorado State University Extension – Montezuma Co.	CO
	Dairy Employees' Behavioral Health Toolbox: Stress Factors and Implications	South Dakota State Univ. Dairy Extension	SD
	Simulator-Based Logging Safety Training Program	Montana Logging Association	MT
	UTV Safety Training Certification	Montana Weed Control Association	MT
	Wyoming Good Riding Practices for ATV Use in Agriculture (WY-GRiP)	University of Wyoming Extension	WY & CO
2019-2020	Emerging Leaders Program	Montana Logging Association	MT
	"Gear Up for Ag Health and Safety" Program Delivery at CSU	Ag Health and Safety Alliance	CO
	Stress Management Skills for Hispanic Dairy Workers in the I-29 Corridor	South Dakota State Univ. Dairy Extension	SD
2020-2021	Expansion and Evaluation of Video/Web-Based Logging Safety Training Program	Montana Logging Association	MT
	Reaching H-2A Workers on Colorado's Western Slope	Project Protect Promotora Network	CO
2021-2022	Expanding Health Education for Migrant and Season Agricultural Workers in Montrose and Delta Counites, CO	Olathe Community Clinic, River Valley Heath Centers	CO
	From Farm to Kitchen: Safe Work Design	Cultivating Connections Montana	MT
	Logging Safety Conference & Expansion of Safety Videos for Logger Safety Training Program	Montana Logging Association	MT
	On-Farm Safety Kit Project	Utah State University Extension	UT
	Reducing Farmworker Risk of Injury and Heat-Related Illness	Colorado Fruit and Vegetable Growers Association	CO

B.3. Competitive Revisions/Administrative Supplements

Not applicable

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

The Outreach Core employed six graduate students to assist in implementing the Communications Plan. These students assumed responsibility for executing social media campaigns and newsletters and participated in social media evaluation activities. Through their involvement, these future public health professionals gained experience and skills in health communications, social media management, and occupational safety Doing so has enabled them to develop skills for anticipated careers in public health program development and practice. The students also had the opportunity to attend conferences that allow them to grow in knowledge of agricultural safety and health and the agricultural landscape of the region: Midwest Regional Ag Safety and Health Conference, Colorado Fruit and Vegetable Growers Association, and the Ag Safety and Health Association of America's 2021 Safety Summit.

Additionally, three graduate students participated in program development and evaluation under the Community-Initiated Grant Program. Two of those students completed their work during this reporting period.

Dissertations and Theses Supported by HICAHS Community-Initiated Grant Funding

1. Guifarro Rodriguez LS. *Assessing Dairy Farm Employees Health*. Master's thesis. South Dakota State University; 2021.
2. Lagerstrom E. *Occupational injury prevention among loggers in the Intermountain region of the United States*. Dissertation. Colorado State University; 2018.

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

Research highlights, training opportunity promotion, and safety message were disseminated regularly via the following digital communications channels:

- HICAHS Website
- Facebook
- Twitter
- Instagram
- YouTube
- Electronic Newsletter

Additionally, HICAHS work/personnel were featured or interviewed in popular press (Title, Source, Date, Personnel)

- Study finds improved conditions on US farms, may curb exposure to foodborne illness. *KUNC*, September 19, 2018, featuring Pilot Grantee work by Anita Pena
- High plains intermountain center researches agricultural safety, health. *Rocky Mountain Collegian*, September 26, 2018.
- As dairy farms expand, mobile training helps workers prevent injury and death. *KUNC*, September 26, 2018, featuring David Douphrate
- Public Health at Colorado State: An Interview with Dr. Lorann Stallones. *The More You NoCo Podcast*, October 9, 2018, featuring Lorann Stallones
- Cargill's new robot herds cattle so workers don't have to. KUNC*,* November 12, 2018, featuring David Douphrate
- Idaho is Raising the Bar with Workforce Development. *US Farm Report*, December 9, 2018, featuring David Douphrate.
- Faculty and students captures multiple awards at national industrial hygiene conference. *CSU Source*, June 20, 2019, authored by Whitney Pennington
- Being a dairy worker: Blessing or curse? It will depend on your attitude. *Progressive Dairy*, September 11, 2019, featuring Community-Initiated Grantee work by Maristela Rovai (available in English and Spanish)
- CSU professor receives award for excellence in global health. *The Rocky Mountain Collegian*, November 14, 2019, featuring Lorann Stallones
- Agricultural health and safety center provides national guidance on COVID-19 protections for agricultural workers. *CSU Source*, June 3, 2020, authored by Whitney Pennington
- CSU study links physical stress on the job with brain and memory decline in older age. *CSU Source*, July 16, 2020, featuring Lorann Stallones

- Colorado State emphasizes suicide prevention work in agricultural communities. *Ag Journal*, December 1, 2020, featuring Lorann Stallones
- Study of suicide risk factors unique to rural communities examines chemical exposure, diet. *Ag Journal*, December 1, 2020, featuring Lorann Stallones
- CSU scholars discuss COVID-19's impacts on the food system and ag workers. *CSU Source*, December 18, 2020, authored by Whitney Pennington
- Some things shouldn't be shared, *Hoard's Dairyman*, January 11, 2021, authored by Whitney Pennington
- Zoonotic Disease Prevention. *Farm to Fork* radio segment, February 19, 2021, featuring Whitney Pennington
- Dairy Specialist Teaching Dairy Workers About COVID Vaccinations. *Brownfield Ag News for America*, April 13, 2021, featuring Community-Initiated Grantee work by Maristela Rovai.
- The Other Half. *Keloland News*, April 14, 2021, featuring Community-Initiated Grantee work by Maristela Rovai.
- Colorado State University forms labor issues group in response to new bill, *La Junta Tribune-Democrat*, October 6, 2021, featuring Lorann Stallones.
- Michael Pate Leads International Society for Agricultural Safety and Health. *Utah State TODAY*, October 21, 2021, featuring Michael Pate.
- USU Agricultural Education Faculty Honored for Efforts in Career and Technical Education. *Utah State TODAY*, March 2, 2022, featuring Michael Pate
- Upcoming work in vegetable production safety radio interview on Morning Show of KSIR, April 14, 2022, featuring Whitney Pennington
- Livestock worker safety radio interview on Morning Show of KSIR, May 2, 2022, featuring Whitney Pennington
- CSU professor recognized by International Society for Agricultural Safety and Health. *CSU Source*, June 30, 2022, featuring Dr. Lorann Stallones
- Childhood Ag Safety Network Starts First Campaign. *Mid-West Farm Report*, August 20, 2022, featuring Whitney Pennington
- National Farm Safety and Health Week Promotion, *Farm 2 Market RFD-TV*, September 12, 2022, featuring Whitney Pennington
- Agricultural health and safety center celebrate 30 years of impact and collaboration. *CSU Source*, September 14, 2022, authored by Whitney Pennington

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

This is the final reporting period of the grant cycle.

C. PRODUCTS

C.1. Publications, conference papers, and presentations
Peer-Reviewed Publications

1. 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*. 01 2021;26(1):75-84. doi:10.1080/1059924X.2020.1845269. PMCID:PMC8117175.
2. Masci F, Rosecrance J, Mixco A, et al. Personal and occupational factors contributing to biomechanical risk of the distal upper limb among dairy workers in the Lombardy region of Italy. *Appl Ergon*. Feb 2020;83:102796. doi:10.1016/j.apergo.2018.12.013 PMID:30611466.
3. Masci F, Crespi E, Pernigotti E, Tassoni M, Rosecrance J, Colosio C. Carpal tunnel syndrome among milking parlor workers in Northern Italy: a comparison of screening approaches. *Med Lav*. Aug 26 2019;110(4):271-277. doi:10.23749/mdl.v110i4.8359. PMCID:PMC7809995.

4. Lagerstrom E, Magzamen S, Brazile W, Stallones L, Ayers P, Rosecrance J. A Case Study in the Application of the Systematic Approach to Training in the Logging Industry. *Safety*. 2019;5(3) doi:10.3390/safety5030043
5. Lagerstrom E, Magzamen S, Kines P, Brazile W, Rosecrance J. Determinants of Safety Climate in the Professional Logging Industry. *Safety*. 2019;5(2) doi:10.3390/safety5020035
6. Lagerstrom E, Magzamen S, Brazile W, Rosecrance J. Active Surveillance of Musculoskeletal Disorder Symptoms in the Development of Safety Interventions for Professional Loggers. *Safety*. 2019;5(2). doi:10.3390/safety5020023
7. Menger-Ogle LM, Pezzutti F, Menger-Ogle AD, Stallones L, Rosecrance J, Roman-Muniz IN. Occupational Safety and Health of Foreign-Born, Latinx Dairy Workers in Colorado. *J Occup Environ Med*. 01 2019;61(1):61-68. doi:10.1097/JOM.0000000000001472. PMCID:PMC7305838.
8. Lagerstrom E, Magzamen S, Rosecrance J. A mixed-methods analysis of logging injuries in Montana and Idaho. *Am J Ind Med*. Dec 2017;60(12):1077-1087. doi:10.1002/ajim.22759
9. Lagerstrom E, Magzamen S, Stallones L, Gilkey D, Rosecrance J. Understanding risk factor patterns in ATV fatalities: A recursive partitioning approach. *J Safety Res*. 12 2016;59:23-31. doi:10.1016/j.jsr.2016.10.004. PMCID: PMC7045363.

Conference Proceedings with Published Abstracts

1. Hobbs-Murphy K, Morris K, Brazile B, Rosecrance J. Respirators, Face Masks, and Diverse Populations: An Analysis of 3D Facial Anthropometrics. In: *Proceedings of 3DBODY.TECH 2021.* 2021:60. doi:10.15221/21.60
2. Masci F, Spatari G, Giorgianni CM, Bortolotti S, Rosecrance J, Colosio C. A Wearable Device to Assess the Spine Biomechanical Overload in a Sample of Loggers. In: Black NL, Neumann WP, Noy I, eds. *Proceedings of the 21st Congress of the International Ergonomics Association (IEA 2021);* Springer, Cham; 2021. doi: 10.1007/978-3-030-74614-8_19
3. Lagerstrom E, Rosecrance J. The Association Between Safety Climate and Musculoskeletal Symptoms in the U.S. Logging Industry. In: Bagnara S, Tartaglia R, Albolino S, Alexander T, Fujita Y, eds. *Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018)*. Springer, Cham; 2019:214-219. doi:10.1007/978-3-319-96080-7_25
4. Masci F, Mandic-Rajcevic S, Ruggeri G, Rosecrance J, Colosio C. Comparing the Strain Index and the Revised Strain Index Application in the Dairy Sector. In: Bagnara S, Tartaglia R, Albolino S, Alexander T, Fujita Y, eds. *Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018)*. Springer, Cham; 2019:261-268. doi:10.1007/978-3-319-96083-8_35
5. Rosecrance J, Lagerstrom E. Injury Claims from Steep Slope Logging in the United States. In: Bagnara S, Tartaglia R, Albolino S, Alexander T, Fujita Y, eds. *Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018)*. Springer, Cham; 2019:277-282. doi:10.1007/978-3-319-96083-8_37
6. Gilkey D, Rosecrance J, Neves H, Lagerstrom E. ATV Safety in Agriculture: Injury, Illness, Analysis and Interventions. In: Stanton N, eds. *Advances in Human Aspects of Transportation. Proceedings of the AHFE 2017 International Conference on Human Factors in Transportation.* Springer, Cham; 2018:227-233. doi:10.1007/978-3-319-60441-1_22.

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

Item 1
Educational aids or curricula
www.hicahs.colostate.edu – the center-wide website includes lay summaries of each project, links to recent publications, and educational resources created by HICAHS and other ag safety partners.

Item 2
Educational aids or curricula
YouTube Videos

- High Plains Intermountain Center for Agricultural Health and Safety. Enhancing Research-to-Practice for Youth Safety in Agriculture. May 7, 2021. https://youtu.be/ElHrKnvVms4

- High Plains Intermountain Center for Agricultural Health and Safety. Humo de los incendios forestales: lo que necesitan saber los trabajadores agrícolas. February 16, 2021. https://youtu.be/24owOcd5dRU
- High Plains Intermountain Center for Agricultural Health and Safety. Paper-based Analytics Device for Detection of PFAS in Agricultural Waters – Ruth Menger. October 12, 2020. https://youtu.be/M64u9qJF5NU
- High Plains Intermountain Center for Agricultural Health and Safety. Study of Environmental Mixtures and Periurban Respiratory Outcomes – Grace Kuiper, MPH. October 12, 2020. https://youtu.be/7LTq2bAzkEM
- High Plains Intermountain Center for Agricultural Health and Safety. Sources of Stress in Hispanic in the I-29 Corridor, South Dakota – Leyby Guifarro. October 12, 2020. https://youtu.be/BgXyDQak5us
- High Plains Intermountain Center for Agricultural Health and Safety. Nasal Swabs Show Promise as a Biomonitoring Tool for Extrathoracic PM Exposure – J. Ramsay. October 12, 2020. https://youtu.be/-H97ZnH03qI
- High Plains Intermountain Center for Agricultural Health and Safety. MLA Emerging Leaders Program – Bryan Lorengo, Montana Logging Association. October 12, 2020. https://youtu.be/wfYV5SloOrE
- High Plains Intermountain Center for Agricultural Health and Safety. Train the Trainer: Building Capacity for Respiratory Protection in Rural Colorado & Utah – T. Walker. October 12, 2020. https://youtu.be/AapWyV1yI3g
- High Plains Intermountain Center for Agricultural Health and Safety. Bringing the "Gear Up for Ag Health & Safety Training" to Colorado Animal Sciences Students. October 12, 2020. https://youtu.be/NcoTZGVGVhU
- High Plains Intermountain Center for Agricultural Health and Safety. Antimicrobial Resistant Genes of Salmonella enterica from Dairy Farm Worker Clothing & Environment. October 12, 2020. https://youtu.be/Ze2W3ShbrP8
- High Plains Intermountain Center for Agricultural Health and Safety. Dairy Worker Perspectives of Performing Euthanasia. October 12, 2020. https://youtu.be/DOc74xr8EB0
- High Plains Intermountain Center for Agricultural Health and Safety. What Agricultural Producers Need to Know About Wildfire Smoke. August 27, 2020. https://youtu.be/mMW_qr__4u0
- High Plains Intermountain Center for Agricultural Health and Safety. What Agricultural Workers Need to Know About Wildfire Smoke. August 27, 2020. https://youtu.be/xBdU9KXy0Ds
- Upper Midwest Agricultural Safety and Health Center. Zoonotic Disease and Livestock Workers. August 19, 2020. https://youtu.be/d33HOFof6PU

C.3. Technologies or techniques

Nothing to report

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

Not applicable

C.5. Other products and resource sharing

Factsheets

- Heat Illness Training Guide (English). Published April 8, 2022. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2022/04/Heat-Discussion-Guide_Colorado-Ver_ENGLISH_final_comp.pdf
- Heat Illness Training Guide (Spanish). Published April 8, 2022. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2022/04/Heat-Discussion-Guide_Colorado-Ver_SPANISH_final_comp.pdf
- Rovai M, Guifarro Rodriguez LS. Keep an Eye on Your Dairy Farm Employee Vision Health. South Dakota State University Extension. Published July 10, 2020. https://extension.sdstate.edu/keep-eye-your-dairy-farm-employee-vision-health
- Recommendations for Prevention: Worker Injuries Caused by Repetitive Motion. Upper Midwest Agricultural Safety and Health Center and High Plains Intermountain Center for Agricultural Health and Safety. Published

June 2020. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/09/prevent-repetitive-motion-dairy-2020.pdf

- Protectión Respiratatoria Durante la Pandemia de COVID-19: Buenas Prácticas para la Comunidad Agropecuraria. High Plains Intermountain Center for Agricultural Health and Safety. Published May 2020. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/05/covid19-respiradores-guia-de-reutilizado.pdf
- Respiratory Protection During the COVID-19 Pandemic: Best Practices for the Agricultural Community. High Plains Intermountain Center for Agricultural Health and Safety. Published May 2020. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/05/covid19-respirator-reuse-guidance.pdf
- Sharing Farm Vehicles During the COVID-19 Pandemic: Best Practices for the Agricultural Community. High Plains Intermountain Center for Agricultural Health and Safety and Colorado State University Extension. Published May 2020. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/04/covid19-and-sharing-farm-vehicles-v4-15.pdf
- Uso Compartido de Vehículos Agropecuarios Durante la Pandemia de COVID-19: Mejores Prácticas para la Comunidad Agropecuraria. High Plains Intermountain Center for Agricultural Health and Safety and Colorado State University Extension. Published May 2020. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/05/covid19-and-sharing-farm-vehicles-spanish.pdf
- Breathe Better with an N95. High Plains Intermountain Center for Agricultural Health and Safety. Published September 2019. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/N95-Respirator-Card-English.pdf
- Respire Mejor Con un Respirador N95. High Plains Intermountain Center for Agricultural Health and Safety. Published September 2019. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/N95-Respirator-Card-Spanish.pdf
- Respire Mejor: Protéjase del humo de incendios forestales. High Plains Intermountain Center for Agricultural Health and Safety. Published September 2019. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2019-Gen-Spanish.pdf
- Breathe Easy: Protect Yourself from Wildfire Smoke. High Plains Intermountain Center for Agricultural Health and Safety. Published August 2019. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2019-Gen-English.pdf
- Colorado: Protéjase del humo de incendios forestales. High Plains Intermountain Center for Agricultural Health and Safety. Published March 2019. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2019-CO-Spanish.pdf
- Dakotas: Protect Yourself from Wildfire Smoke. High Plains Intermountain Center for Agricultural Health and Safety. Published January 2019. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2018-DAKOTAS.pdf
- Wyoming: Protect Yourself from Wildfire Smoke. High Plains Intermountain Center for Agricultural Health and Safety. Published January 2019. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2018-WY.pdf
- Utah: Protect Yourself from Wildfire Smoke. High Plains Intermountain Center for Agricultural Health and Safety. Published December 2018 https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2018-UT.pdf
- Colorado: Protect Yourself from Wildfire Smoke. High Plains Intermountain Center for Agricultural Health and Safety. Published August 2018 https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2018-CO-Eng.pdf
- Montana: Protect Yourself from Wildfire Smoke. High Plains Intermountain Center for Agricultural Health and Safety. Published August 2018. https://vetmedbiosci.colostate.edu/hicahs/wp-content/uploads/sites/17/2020/03/Wildfire-flyer-2018-MT.pdf

D. PARTICIPANTS

Reported in the overall section.

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. This core has translated and amplified center findings and other evidence-based prevention and intervention practices in agricultural health and safety throughout the region. In particular, we have focused on the improvement of training practices for safety and health. This focus on capacity and safety leadership will enable transformation of businesses towards prevention oriented instead of reactionary. This core has supported strong and collaborative relationships that are essential to successful research and outreach and enable the center's future impact.

F. CHANGES

F.1 - Changes in approach and reasons for change, including changes that have a significant impact on expenditures No significant changes
F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them Not applicable
F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents Not applicable

G. Special Reporting Requirements

G.1-3. Not Applicable
G.4. Human Subjects **G.4.a. Does the project involve human subjects?** ☐Yes ☒No *If you selected Yes, answer the following questions:* **Is the research exempt from Federal regulations?** ☐Yes ☐No **If it is exempt, check appropriate exemption numbers(s).** ☐E1 ☐E2 ☐E3 ☐E4 ☐E5 ☐E5 **Does this project involve a clinical trial?** ☐Yes ☐No **G.4.b. Enrollment table attached** **G.4.c. Not Applicable**
G.5 - Human Subjects Education requirement All team members have completed their Human Subjects Education.

G.6. Human Embryonic Stem Cell (hESCs) Not applicable.
G.7 - Vertebrate Animals Not applicable.
G.8 - Project/Performance Sites See overall section.
G.9 - Foreign Component Not applicable.
G.10 Estimated unobligated balance and explanation of balance See FFR for unobligated balance.
G.11 Program Income Not applicable.
G.12 F&A Costs Not applicable.
G.1-12. Not Applicable

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

The Outreach Core has created and disseminated new educational resources to improve the health and safety of workers in agriculture and forestry across the region. Resources were developed on heat-illness prevention, zoonotic disease prevention, respiratory protection, COVID-19, and preventing exposures to wildfire smoke. Many of these resources were created in collaboration with other US Centers for Agricultural Safety and Health (Ag Centers). These collaborations served to synergize Ag Center efforts by reducing duplicative efforts and building the necessary foundation for future partnerships. Through the distribution of $300,000 in small grants, the Outreach Core also enabled partners to create and disseminate resources on all-terrain vehicle safety, cold weather safety, field first aid, logging machinery operation, preventing musculoskeletal stress, proper nutrition, proper use of personal protective equipment, and stress reduction.

A. COVER PAGE: Core-7935

Project Title: Research Core - Pilots and Feasibility Program	
Component Project Lead Information: Pena, Anita Alves	

B. ACCOMPLISHMENTS

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

The major goal of the Pilot/Feasibility Projects Program is to increase research capacity through the development of information and tools by providing seed monies to new investigators and established investigators pursuing a new direction in agricultural and forestry health and safety research. We award 2 to 3 new projects each year (up to $25,000 per project) in order to generate new information and tools with which to improve human health and safety in agriculture and forestry. Historically, this program has been highly successful, leading to the generation of larger-scale federally-funded grants, the development of new educational materials and intervention techniques, the training and mentoring of student and junior investigators, the expansion of professional networks for both new and more established researchers, conference presentations, and peer-reviewed journal articles. Furthermore, we structure our application process to be similar to that of the Small Grants (R03) program administered by the National Institutes of Health (NIH). The use of this system helps familiarize investigators with one of the most common federal grant applications in use today (CDC/NIOSH uses the same system). Our merit review process mimics that of a typical study section review at NIH, for the benefit of both the applicants and the reviewers. Our intent is to foster the development of research capacity by mimicking the grant process within which researchers in the agricultural safety and health field will compete.

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

Across the grant cycle, 32 proposals were received in response to the request for applications to the HICAHS Pilot/Feasibility Project Program and 12 of those were chosen for funding, for a total of $276,880 being distributed 2016-2022.

Junior investigators from the region were encouraged to participate in the application process. Of the funded proposals, principal investigators included junior and mid-career faculty, postdoctoral scholars, and graduate students. Furthermore, past investigators served as reviewers for proposals.

Pilot grant recipients have been productive in sharing their findings through publications (30 manuscript publications, 11 of which published in the 2016-2022 reporting period) and presentations to both scientific and industry audiences. In 2016-2022, 19 presentations have been conducted by pilot awardees (5 international, 5 national/regional, 9 local conferences). Grantees have presented work at annual meetings and conferences including but not limited to the American Thoracic Society (ATS) annual conference, the American Association for Aerosol Research (AAAR) annual conference, the Western States Occupational Network (WestON), the Western Economic Association International Annual Conference, and Western Regional Ag Health & Safety conference.

Two of the main goals of the Pilot/Feasibility Program are to develop and cultivate new partnerships and to build research capacity that serves the occupational health and safety needs of the agriculture and forestry sectors. Developing new partnerships with other academic institutions, state and federal agencies, and private industry has been a hallmark of the HICAHS. Our successful relationship with the dairy industry is an excellent example of how partnership building has enabled the HICAHS to promote agricultural health and safety through applied research. We have also pursued new partnerships by targeting a broader range of applicants for the Pilot/Feasibility Program. During the reporting period, we targeted sponsored programs offices at additional institutions for release of the request for proposals (RFP) at Colorado State University, University of Colorado, University of Wyoming, University of Montana, University of Utah, North Dakota State University, University of North Dakota, South Dakota State University, and University of South Dakota; all six states in Federal Region VIII were represented. We also targeted non-university audiences by releasing the RFP to several listservs and publications including the Occupational Health State Surveillance listserv, the Mountain and Plains Education and Research Center ROADMAP listserv, the Rocky Mountain Center for Occupational and Environmental Health website, and the NIOSH-maintained WestOn listserv.

To further develop research capacity and encourage new collaborations, the Pilot/Feasibility Program partnered with the Evaluation & Planning Core and Outreach Core Teams to host Research Day events in 2019 and 2020. During the Research Day events, presenters shared the methods and findings from their projects that were funded through HICAHS' small grant streams, including the Pilot/Feasibility program. Each Research Day provided professional development opportunities and built new partnerships that led to innovative projects. Due to the COVID-19 pandemic, our 2020 event was fully virtual, which led to greater participation and attendance from researchers and practitioners across the country. In 2020, ten presenters shared their HICAHS-funded work on topics including: agriculture exposure assessment; building safety capacity, and dairy worker health and safety. Attendees who completed the post-event survey reported increasing their knowledge of agriculture exposure assessment, building safety capacity, and dairy worker health and safety. Additionally, they reported that the information presented in the three topics will inform and change their behaviors, practice, and research.

B.3. Competitive Revisions/Administrative Supplements

Not applicable

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

One of the goals of the Pilot/Feasibility Project Program is to expose junior researchers (faculty, postdoctoral fellows, and students) to both the submission and review process (i.e., NIH R03 mechanism) within which they will be competing as their careers develop. As noted above, junior investigators from the region led the majority of proposals received in the application process. Furthermore, several of the reviewers were junior faculty.

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

Pilot grant recipients have been productive in sharing their findings through publications (30 manuscript publications, 11 of which published in the 2016-2022 reporting period) and presentations to both scientific and industry audiences. In 2016-2022, 19 presentations have been conducted by pilot awardees (5 international, 5 national/regional, 9 local conferences). Grantees have presented work at annual meetings and conferences including but not limited to the American Thoracic Society (ATS) annual conference, the American Association for Aerosol Research (AAAR) annual conference, the Western States Occupational Network (WestON), the Western Economic Association International Annual Conference, and Western Regional Ag Health & Safety conference.)

As previously mentioned, HICAHS hosted its Research Day events, which enabled Pilot/Feasibility grantees to disseminate their findings to attendees and in 2020 to a broader audience through social media (see more details in the Administration, Evaluation, & Planning section).

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

This is the final reporting period of the grant cycle.

C. PRODUCTS

Grant Awardee (Year Awarded & PI Last Name)	**Article Citation**
2019 Menger	Menger, R.F., Funk, R., Borch, T., Henry, C.S. (2021). Sensors for detecting per- and polyfluoroalkyl substances (PFAS): A critical review of development challenges, current sensors, and commercialization obstacles. *Chemical Engineering Journal, 417*, 1291332021. doi: 10.1016/j.cej.2021.129133.
2016 Pena	Pena, A. A., & Dixon, B. (2021). Pesticide exposure and the physical and economic health of US crop workers. *Applied Economic Perspectives and Policy*. https://doi.org/10.1002/aepp.13194.
2018 Pandey	Schaefer AL, Ceesay M, Leier JA, Tesch J, Wisenden BD, Pandey S. (2020). Factors contributing to sex differences in mice inhaling asperilligus fumigatus. *Int J Environ Res Public Health, 17*(23), 8851.
2016 Palomares Velosa	Palomares Velosa J.E., Salman M.D., Roman-Muniz I.N., Reynolds S., Linke L., Magnuson R., McConnel C.S., & Rao S. (2016). Socio-ecological Factors of Zoonotic Diseases Exposure in Colorado Dairy Workers. *J Agromedicine, 13,* 1-11. [Epub ahead of print].doi: 10.1080/1059924X.2020.1725700.
2017 Nordgren	Nordgren TM, Bailey KL, Heires AJ, Katafiasz D, Romberger DJ. (2017). Effects of agricultural organic dusts on human lung-resident mesenchymal stem (stromal) cell function. *Toxicol Sci., 162*(2):635-644. doi: 10.1093/toxsci/kfx286.
2014 McConnel	Stenkamp-Strahm C., McConnel C., Magzamen S., Abdo Z., & Reynolds S. (2018). Associations between Escherichia coli O157 shedding and the fecal microbiota of dairy cows. *J Appl Microbiol*., *124*(3), 881-898. doi: 10.1111/jam.13679.
2016 Pena	Pena A.A., & Teather-Posadas E.R. (2018). Field sanitation in U.S. agriculture: Evidence from NAWS and future data needs. *J Agromedicine., 23*(2), 123-133. doi: 10.1080/1059924X.2018.1427642.
2014 Bisha	Chandler JC, Schaeffer J, Davidson M, Magzamen S, Pérez-Méndez A, Reynolds S, Goodridge L, Volckens J, Franklin A, Shriner S, Bisha B. (2017). Method for the improved detection of aerosolized influenza viruses and the male-specific (F+) RNA coliphage MS2. *J Virol Methods, 246,* 38-41. doi:10.1016/j.jviromet.2017.04.004.
2015 Guiberson	Guiberson M, Wakefield E. (2017). A preliminary study of a Spanish graphic novella targeting hearing loss prevention. *Am J Audiol., 26*(3), 259-267. doi: 10.1044/2017_AJA-16-0069.
2014 McConnel	McConnel C.S., Stenkamp-Strahm C.M., Rao S., Linke L.M., Magnuson R.J., & Hyatt D.R. (2016). Antimicrobial resistance profiles in Escherichia coli O157 isolates from Northern Colorado dairies. *J Food Protect., 79*(3), 484-487. https://doi.org/10.4315/0362-028X.JFP-15-321.
2013 Walker & 2013 Farmer	Osborne, P. P., Xu, Z., Swanson, K. D., Walker, T., & Farmer, D. K. (2015). Dicamba and 2,4-D residues following applicator cleanout: A potential point source to the environment and worker exposure. *Journal of the Air & Waste Management Association, 65*(9), 1153-1158. doi: 10.1080/10962247.2015.1072593.
2009 Douphrate	Schall M., Fethke N., Chen H., Oyama S., & Douphrate D. (2015). Accuracy and repeatability of an inertial measurement unit system for field-based occupational studies. *Ergonomics, 59*(4), 591-602. In press. DOI: 10.1080/00140139.2015.1079335.

D. PARTICIPANTS

Reported in the overall section.

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. This core has supported junior researchers and encouraged more senior researchers to expand their focus on agriculture safety and health issues. Pilot funding has enabled researchers to apply for and obtain larger funding for projects that will have a larger impact on public health.

F. CHANGES

F.1 - Changes in approach and reasons for change, including changes that have a significant impact on expenditures Nothing significant to report.
F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them Nothing significant to report.
F.3 - Significant changes to human subjects, vertebrate animals, biohazards, and/or select agents Not applicable

G. Special Reporting Requirements

G.1-12. Not Applicable

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.

Between 2016-2022, the HICAHS Pilot/Feasibility Project Program funded 12 innovative projects for a total of $276,880 being distributed 2016-2022. Principal investigators included junior and mid-career faculty, postdoctoral scholars, and graduate students across the HICAHS region (Federal Public Health Service Region VIII). Pilot grant recipients shared their project findings through publications (30 manuscript publications, 11 of which were published between 2016-2022) and presentations to both scientific and industry audiences. In 2016-2022, 19 presentations have been conducted by pilot awardees (5 international, 5 national/regional, 9 local conferences).

The Pilot/Feasibility Program funded projects that filled identified research gaps and addressed emerging priorities within the agriculture and forestry health and safety sector of Region VIII. Examples of recently identified priority areas that were addressed by Pilot/Feasibility Program grants include mental health in agriculture and farming, wildfire smoke impacts on worker health, and COVID-19 prevention and response.

A. COVER PAGE: Core- Project-7933

Project Title: Intervention (R2) - Occupational Safety Management and Leadership on Large-Herd Dairy Farms
Component Project Lead Information: Douphrate, David Irvin

B. ACCOMPLISHMENTS

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

The U.S. dairy industry has shifted towards a large-herd, mass-production model due to economies of scale. This shift has led to a higher risk of fatalities, injuries and work-related musculoskeletal disorders (MSDs) due to task specialization, increased work demands and hazards. Additionally, dairy owners are increasingly dependent on front-line supervisors to effectively manage a larger workforce comprised primarily of low-literacy, non-English speaking workers with minimal to no experience of working on large-herd farms. Owners are increasingly seeking supervisors who demonstrate effective management and leadership skills, especially in relation to worker health and safety. Much research effort has been put into developing safety management systems for large enterprises, whereas there is a lack of development, implementation and evaluation of safety management systems for small enterprises, especially dairy farming operations. Despite increasing herd sizes with increasing numbers of hired workers, over 95% of dairy farms in the U.S. remain private, family-owned operations. This study builds on extensive HICAHS dairy research and outreach over the past 14 years, and responds to these findings with the development of an integrated safety management strategy that will be operationalized on modern, large-herd U.S. dairy farms. The long-term goal of the project is to reduce or eliminate injuries and fatalities among a vulnerable workforce on dairy farms. This project employs novel and innovative longitudinal data collection and analysis methods which have not been utilized in occupational safety research in agricultural settings.

1) Develop and implement integrated safety management and leadership training intervention for large-herd dairy front-line supervisors. Status: COMPLETED without modification.

2) Evaluate the effects of the safety leadership and management training intervention.
   a) Evaluate the effects of the intervention on front-line supervisor safety leadership and management daily practices. Status: COMPLETED without modification

   b) Evaluate the effects of the intervention on group safety climate and behavior among workers. Status: COMPLETED without modification

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

After COVID-19 delays, the research team resumed training with front-line dairy supervisors and evaluating the effectiveness of the safety leadership and management training intervention for front-line supervisors. During the additional year of funding, enrollment resumed and included a small number of supervisors who served as controls. To date (9/1/2021), 103 front-line dairy supervisors from dairy farms in New Mexico, Texas, Colorado, and Kansas, have been enrolled and 65 have completed the 13-module training intervention program designed during the first year of the project. The team celebrates the high participant retention rate (71%) across the 12-week training course. Dropout was due to lack of interest or motivation, natural employment turnover, farms closing, career changes, migration, workplace conflicts, medical procedures, and sickness absence (e.g. due to the COVID-19 pandemic). The training engages participants in weekly interactive digital lessons and assignments. Extension agents reinforce the management practices introduced in digital lessons during hands-on coaching sessions.

The research team, led by Dr. Douphrate, continued their work on a U.S. Department of Agriculture funded grant building on this project, which educates dairy owners, manager, and workers on COVID-19.

B.3. Competitive Revisions/Administrative Supplements

Not applicable

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

Opportunities for training and professional development provided in this project include graduate students being involved in many aspects of the study which include methodology development, as well as data analysis. No opportunities for field-based data collection existed due to COVID-19 travel restrictions. These experiences still provide valuable experience and learning opportunities which will equip them to be more effective safety researchers and practitioners upon graduation. For example, Dr. Anabel Rodriguez has been involved in this project since its launch and served as a GRA and now Project Manager post-graduation. She accepted a tenure-track position at the rank of Assistant Professor at the UTHealth School of Public Health in San Antonio. She remained on the project. The project has provided Dr. Rodriguez many opportunities to network with dairy owners and workers. This has inspired her to continue her research addressing worker health and safety in the dairy industry. Her dissertation focus was on tuberculosis among dairy workers, as well as Total Worker Health issues. Dr. Rodriguez will serve as a Key Investigator on future Ag Center submissions with Dr. Douphrate.

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

Project team members continue to present the project at dairy industry conferences and training workshops. For example, we did present the project at the 2020 High Plains Dairy Conference in Lubbock TX. We have also presented the project in multiple meetings of the National Milk Producer Federation. We will continue to present findings at the annual U.S. Dairy Education and Training Consortium in Clovis, NM. This six-week training event provides large-herd dairy management training to undergraduate and graduate students from across the country. Presentation feedback from participants suggests the project is enthusiastically welcomed from the industry, as many within the industry have suggested that such a training tool is needed on dairy farms.

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

This is the final reporting period of the grant cycle.

C. PRODUCTS

C.1. Publications, conference papers, and presentations

- Douphrate, D. (2021). Animal agriculture and the One Health approach. Journal of Agromedicine. DOI: https://doi.org/10.1080/1059924X.2021.1849136.
- Driscoll M, Dalton D, Jenkins P, Tinc P, Murphy D, Douphrate D, Sorensen J. (2020). A scoping review of safety and health interventions in the high-risk dairy industry: gaps in evidence indicate a need for rigorous evaluation. Journal of Agromedicine. (8)479. DOI: 10.1080/1059924X.2020.1837703.
- Rodriguez A*, Douphrate, D, Gimeno Ruiz de Porras D, Perez A, Hagevoort R, Nonnenmann M, Prot E. (2020) Bovine tuberculosis case intervention using T.SPOT.TB assay to screen dairy workers in Bailey County, Texas. Frontiers in Public Health. DOI: https://doi.org/10.3389/fpubh.2020.00479. PMID: 33383992.
- Rodriguez A*, Douphrate D, Gimeno Ruiz de Porras D, Perez A, Hagevoort R, Nonnenmann M, Cienega L. (2020) Association of category of cattle exposure with self-reported history of tuberculosis among dairy workers in Bailey County, Texas. Workplace Health and Safety. DOI: 10.1177/2165079920976521.
- Rodriguez A*, Douphrate D, Gimeno Ruiz de Porras D, Perez A, Hagevoort R, Nonnenmann M, Cienega L. (2020) Association of category of cattle exposure with tuberculosis knowledge among dairy workers in Bailey County, Texas. Journal of Agromedicine. DOI: 10.1080/1059924X.2020.1765931. PMID: 32449645.

Manuscripts in development:
1. Longitudinal training effectiveness evaluation of supervisor safety leadership behavior in the dairy industry
2. Effect of large-herd dairy supervisor leadership and management training on workplace safety climate change
3. Research-to-practice in dairy leadership and management training: lessons learned

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

Nothing to report

C.3. Technologies or techniques

Survey instruments
This training intervention project involved the development of novel training delivery techniques using mobile devices, as well as the development of an innovative mechanism of dairy supervisors to report daily safety leadership and management practices using personal mobile devices. These two training delivery and evaluation techniques have yet to be used in safety research in the AgFF sector.

C.4. Inventions, patent applications, and/or licenses
Not applicable

C.5. Other products or resource sharing
Training:
Douphrate D. Dairy farm safety and leadership. U.S. Dairy Consortium Teaching: Advanced Dairy Herd Management. Clovis, NM, June 14-15, 2021.

Non-Peer-Reviewed Trade Publication:
Douphrate D and Rodriguez A. Dairy Farming and COVID-19. New Mexico Dairy Extension E-Newsletter. April 2020.

D. PARTICIPANTS

Reported in overall section.

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.

This project's findings help demonstrate investments in management training and leadership skills that impact safety culture in large-herd dairy operations. The training of front-line managers has increased safety culture, which is potentially transferrable to different agricultural sectors and other industries.

F. CHANGES

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

No significant changes to objectives or scope to report.

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

No significant changes to objectives or scope to report.

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

No significant changes to objectives or scope to report.

G. Special Reporting Requirements

G.1-3. Not Applicable

G.4. Human Subjects

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

If you selected Yes, answer the following questions:

Is the research exempt from Federal regulations? ☐Yes ☒No

If it is exempt, check appropriate exemption numbers(s).

☐E1 ☐E2 ☐E3 ☐E4 ☐E5 ☐E5

Does this project involve a clinical trial? ☐Yes ☒No

G.4.b. Enrollment table attached

G.4.c. Not Applicable

G.5 - Human Subjects Education requirement

All team members have completed their Human Subjects Education.

G.6. Human Embryonic Stem Cell (hESCs)

Not applicable.

G.7 - Vertebrate Animals

Not applicable.

G.8 - Project/Performance Sites

See overall section.

G.9 - Foreign Component

Not applicable.

G.10 Estimated unobligated balance and explanation of balance

See FFR for unobligated balance.

G.11 Program Income

Not applicable.

G.12 F&A Costs

Not applicable.
G.1 -12 Nothing to report.

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

Dairy farming is among the most dangerous occupations and accounts for a disproportionately large percentage of all injuries in livestock-related agriculture. The U.S. dairy industry has shifted towards a large-herd, mass-production model due to economies of scale. This shift has led to a higher risk of fatalities, injuries and work-related musculoskeletal disorders (MSDs) due to task specialization, increased work demands and hazards. Additionally, dairy owners are increasingly dependent on front-line supervisors to effectively manage a larger workforce comprised primarily of low-literacy, non-English speaking workers with minimal to no experience of working on large-herd farms. Owners are increasingly seeking supervisors who demonstrate effective management and leadership skills, especially in relation to worker health and safety. The long-term goal of the project was to reduce or eliminate injuries and fatalities among a vulnerable workforce on dairy farms. We developed and implemented an integrated safety leadership and management training intervention for large-herd dairy front-line supervisors, and evaluated the effects of the safety leadership and management training intervention on dairy supervisor daily leadership and management practices, as well as worker group safety climate and behavior.

A 13-module mobile learning program regarding dairy farm supervisor safety leadership and management was developed and tested in four US states in 2017-2020. We employed a quasi-experimental, pre-post intervention-control study design to evaluate the effects of a training intervention on supervisor safety leadership and management practices. We randomly assigned dairy supervisors to one of two groups: training intervention group, and a non-training, control group. Using an interrupted time-series design, we collected several measurements of outcome variables both before, during and after introduction of the safety leadership and management training intervention. We employed innovative intensive longitudinal data collection and analysis methodology which, to our knowledge, has never been applied in occupational health and safety research or in the agricultural industrial sector. Each supervisor (intervention and control groups) reported their daily safety leadership and management practices using their personal mobile device with a custom application. Researchers monitored and measure over time supervisor safety leadership and management performance as well as intervention effectiveness. There were pre-post increases on reported daily safety leadership and management behaviors among enrolled supervisory participations. The training program appears to be effective in increasing safety leadership and management practices among front-line dairy supervisors.

A pre-post intervention study design was used to evaluate the effects of the program on a 24-item – 8-factor workplace safety climate survey. The training program and pre and post surveys were completed by supervisors, and their workers completed the pre and post survey. There were pre-post increases on all 24 items for both the supervisors and workers. Significant increases were seen on the 14-item supervisor safety climate scale and the 10-item group safety climate scale, as well as subscales regarding safety priority, empowerment and dealing with conflicts. No significant improvements were seen for the factor regarding leaders encouraging workers to report incidents (injury and near-miss), as these were already rated highly. (Conclusions) The training program appears to be effective in improving safety climate. Future studies should evaluate training program sustainability as well as effectiveness in reducing near-misses and injuries on dairy farms.

A. COVER PAGE: Project-7934

Project Title: Translation (R3) - Agricultural Safety Education Initiative
Component Project Lead Information: Pate, Michael Lynn

B. ACCOMPLISHMENTS

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

1) Determine the effectiveness of utilizing an evidence based agricultural machinery safety curriculum to provide "Train the Teacher" programming to secondary agricultural teachers.
2) Assess performance of safety procedures related to agricultural machinery using teacher-led supervised agricultural experiences (SAE).
3) Measure local community adoption of agricultural machinery safety procedures and develop a model for translation using an FFA Award structure (SAE Proficiency Awards) to diffuse student safety education gains.

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

A combination of video conferencing and in-person training workshops were offered to school-based agriculture teachers in Montana, South Dakota, and Utah. Zoom webinar workshops were held with teachers during the COVID-19 Pandemic. The five targeted training topics were 1) Tractor/Equipment Roll-over hazards, 2) ATV/UTV operation hazards, 3) Tractor/Equipment Operation Hazards, 4) PTO/Entanglement hazards, and 5) agricultural machinery transport hazards associated with use on public roadways. The agricultural machinery safety curriculum continues to be provided online training and video tutorials the partnership formed with The Agricultural Experience Tracker. The Supervised Agricultural Experience Safety Award program was launched with Montana, South Dakota, and Utah teachers. SAE Safety Awards were presented during state FFA conferences. Students' safety knowledge data have been collected through the online tool Agricultural Experience Tracker.

B.3. Competitive Revisions/Administrative Supplements

Not applicable

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

In addition to the project workshops, five additional professional development workshops were provided to teachers who were outside the project scope.

Pate, M. L., & Clawson, S. K. (2022, February 4 – 5). Supercharging SAE's with safety [Conference session]. Utah Association for Career and Technical Education Conference, St. George, UT, United States.

Perry, D. K. (2021). Agricultural Education Safety Initiative: Safely Securing and Transporting Equipment. Workshop presented at Montana Association of Agricultural Educator's Summer Update in Deer Lodge, MT.

Perry, D. K. (2021). Safe Tractor Operation. Seminar presented to undergraduate student workers at the Bozeman Area Research and Teaching Farm.

Pate, M. L., Fetzer, L., Ploeckelman, M., Pennington, W., Schossow, M., & Yoder, A. (2020). SAE Safety for All: How to Launch Foundational Safety Programs for Agricultural Education Students. Invited Presentation, *New Jersey Fall FANRE Professional Development Conference Surviving & Thriving in the Virtual World.* Zoom Conference, September 25.

Perry, D. K. *& Arnold, S. (Fall, 2019). Keep their eyes from rolling: Mini tilt-table demonstration. Presented at the 2019 Agricultural Extension Conference. Bozeman, Mt.*

Pate, M. L. *& Perry, D. K. (2019). Agricultural safety education: Efficacy of a train the trainer event. Presented at the International Society for Agricultural Safety and Health Annual Conference, Des Moines, IA.*

Perry, D. K. & Pate, M. L. (2018). Keep their eyes from rolling: Building a mini-tilt table for tractor rollover demonstrations. Workshop presented at 91st annual National FFA Convention in Indianapolis, IN.

B.5. How did you disseminate the results to communities of interest?
The supervised agricultural experience risk assessment tool has been shared with Iowa Department of Education: Agricultural Education Division within Career and Technical Education. Project activities have been shared with State FFA associations for Utah, Montana, and South Dakota. The National SAE for All initiative hosted by The Council for Agricultural Education has incorporated the risk assessment documents within student record keeping. These documents were shared through teacher in-services at local, regional, and national conferences. The SAE safety curriculum materials are hosted on the USDA-NIFA funded Safety in Agriculture for Youth Clearinghouse which is publicly available through eXtension.org

B.6 - What do you plan to do during the next reporting period to accomplish the goals?
This is the final reporting period of the grant cycle.

C. PRODUCTS

C.1. Publications, conference papers, and presentations

Smalley, S. W., Perry, D. K., Shultz, A., Lawver, R. G., Pate, M. L., Hanagriff, R., & Ewell, C. (2022). Assessing Youth Safety Knowledge with the Agricultural Experience Tracker (AET). *Journal of Agricultural Safety and Health*, *28*(2), 87-98.

Lawver, R. G., Pate, M. L., Smalley, S. W., Perry, D. K., & Shultz, A. (2021, July 12 - 16). *Tractor and machinery instructor training: Impact of sequential professional development* [Paper presentation]. American Society for Agricultural and Biological Engineers Annual International Meeting, Virtual (OpenWater Conferencing Service). doi: 10.13031/aim.202100427

Smalley, S. W., Perry, D. K., Lawver, R. G., Pate, M. L., Shultz, A., Hanagriff, R., & Ewell, C. (2021, July 12 - 16). *Assessing youth safety knowledge through the agricultural experience tracker (AET)* [Paper presentation]. American Society for Agricultural and Biological Engineers Annual International Meeting, Virtual (OpenWater Conferencing Service) doi: 10.13031/aim.202100910

Lawver, R. G., Pate, M. L., Smalley, S. W., Perry, D. K., Shultz, A., Clawson, K. (2021). Tractor and Machinery Instructor Training: Impact of Sequential Professional Development. *Proceedings of the Western Region American Association for Agricultural Educators Conference*, Bozeman, MT. September 27-29.

Perry, D. K., Smalley, S. W., & Pate, M. L. (2020). Effectiveness of utilizing an evidence based safety curriculum to increase student knowledge. *Journal of Agricultural Education, 61*(3), 294-307. doi: 10.5032/jae.2020.0300294

Perry, D. K., Smalley, S. W., & Pate, M. L. (2020, July 12 - 15). Utilizing an evidence-based safety curriculum: A review of factors that may influence effectiveness [Paper presentation]. American Society for Agricultural and Biological Engineers Annual International Meeting, Virtual (OpenWater Conferencing Service). doi: 10.13031/aim.202000241

Toft, J. T., Perry, D. K., Shultz, A., & Pate, M. L. (2019). Facilitating Experiential Education through a Multi-State Initiative: An Examination of an Agricultural Safety Training Experience. Presented at the National Agricultural Mechanics Blue Ribbon Research Symposium. Indianapolis, IN. Distinguished Research Paper Award

Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., Stallones, L, & Shultz, A. (2018, July 29 – August 1). Agricultural Safety Education: Formative Assessment of a Curriculum Integration Strategy [Paper presentation]. American Society for Agricultural and Biological Engineers Annual International Meeting, Detroit, MI, United States. doi: 10.13031/aim.201800862

Pate, M. L., Lawver, R. G., Smalley, S. W., Perry, D. K., & Sorensen, T. J. (2017, May 16 - 19). Multi-state supervised agricultural experience safety award program [Poster Presentation]. American Association for Agricultural Educators Conference, San Luis Obispo, CA, United States.

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

Item 1
Educational aids or curricula
https://theaet.com/page.aspx?ID=271
Item 2
Data or databases
https://theaet.com/page.aspx?ID=271

C.3. Technologies or techniques

Nothing to report.

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

Not applicable

C.5. Other products and resource sharing

Nothing to report.

D. PARTICIPANTS

Reported in the overall section.

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. The project demonstrates the value of training veteran teachers and their capacity to transfer agriculture safety knowledge and skills to their students, who are the future leaders in agriculture. Use of virtual classrooms and other technology to share training materials and content virtually has enabled the project's impact to reach students across the United States.

F. CHANGES

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

G. Special Reporting Requirements

G.1-3. Not Applicable
G.4. Human Subjects **G.4.a. Does the project involve human subjects?** ☒Yes ☐No *If you selected Yes, answer the following questions:* **Is the research exempt from Federal regulations?** ☐Yes ☒No **If it is exempt, check appropriate exemption numbers(s).** ☐E1 ☐E2 ☐E3 ☐E4 ☐E5 ☐E5 **Does this project involve a clinical trial?** ☐Yes ☒No **G.4.b. Enrollment table attached** **G.4.c. Not Applicable**
G.5 - Human Subjects Education requirement

All team members have completed their Human Subjects Education.

G.6. Human Embryonic Stem Cell (hESCs)
Not applicable.

G.7 - Vertebrate Animals
Not applicable.

G.8 - Project/Performance Sites
See overall section.

G.9 - Foreign Component
Not applicable.

G.10 Estimated unobligated balance and explanation of balance
See FFR for unobligated balance.

G.11 Program Income
Not applicable.

G.12 F&A Costs
Not applicable.

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

A combination of video conferencing and in-person training workshops on agricultural machinery safety procedures were offered to school-based agriculture teachers in Montana, South Dakota, and Utah. A total of 11 in-person training workshops were offered to teachers. Four online Zoom webinar workshops were held with teachers during the COVID-19 Pandemic. A total of 28 teachers attended four or more workshop offerings. In-person workshops were offered to 176 unique teachers over the course of five years. A total of 26 student submission of the SAE risk assessment form were collected. A total of eight SAE Safety Awards were presented during state FFA conferences for Montana, South Dakota, and Utah. Since May 2019, 32108 safety knowledge tests have been attempted and 2457 received a passing score of 80% or higher. There were 4632 safety test entries that acknowledged having received formal safety training. There have been 1,451 unique students (ages 14-18) participating in safety knowledge assessment representing all states except for Hawaii, Louisiana, Maine, Massachusetts, New Hampshire, Rhode Island, Washington, Wisconsin, West Virginia, and Wyoming.

COVER PAGE: Core-7937

Project Title: Research Core - Evaluation of the effectiveness of a nasal rinse intervention to reduce the pro-inflammatory response in dairy workers exposed to bioaerosols Component Project Lead Information	
Component Project Lead Information: Reynolds, Stephen J	

B. ACCOMPLISHMENTS

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

Aim 1: Evaluate the effectiveness of hypertonic saline nasal rinse for reducing inflammatory response in dairy workers exposed to bioaerosols (n = 96). We will recruit 96 workers on 4 dairies and randomly assign 40 to the treatment (HTS), and 40 to control (NTS) with nasal lavages conducted before and after each work shift for 5 consecutive days. Sixteen controls with no bioaerosol exposure (office) will also undergo NTS lavages.

Aim 2: Characterize and differentiate the nasal microbiome among dairy workers. We will assess the composition of nasal microbiome (16S rRNA gene sequencing) collected from dairy workers receiving nasal lavages using HTS compared to NTS. We will use culture-based methods to evaluate the prevalence of MRSA, including livestock-associated strains.

Aim 3: Evaluate the feasibility and acceptability of a nasal lavage intervention, and collaborate with industry partners on translation of this intervention research to improve workplace health and safety practices. Results from this intervention study will inform HICAHS translational efforts and outreach to the dairy industry. Collaborating with the HICAHS Advisory Board, industry organizations (Dairy Farmers of America, industry conferences, trade publications), and Extension we will communicate research findings to dairy operators. We will assess the feasibility for adoption of this nasal lavage as a work practice. We will also integrate study findings into our HICAHS programs on training, and occupational health and safety management.

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

Across the entire project, we accomplished the following within each of the specific aims:

Aim 1: The team is in the final stage of recruiting dairies to participate in the study. To date, the team has enrolled 45 participants. We have observed that exposures to dust and endotoxin between groups is not statistically significant. Further, no significant differences in inflammatory cytokines were observed between groups or days. Both groups experienced an increase in IL-10 (anti-inflammatory cytokine); however, the treatment group (i.e., those receiving hypertonic saline) demonstrated a more pronounced decrease in IL-6 as compared to the control group. To further evaluate the effectiveness of this intervention, we will utilize a linear mixed effect model that incorporates dust and endotoxin exposures as well as demographic information and interaction effects.

Aim 2:

In addition to a decrease in inflammatory markers when using the nasal rinse, the team has observed the presence of bacterial and viral pathogens in the nose of dairy workers. These pathogens include MRSA, MSSA, influenza A, C, D viruses, and pan-corona virus. Influenza D is of particular interest as a slight genetic mutation in the virus could have public health implications. Further, the presence of these pathogens may be influenced by the diversity of the bacterial communities naturally present in the worker's nose. We have analyzed 237 lavage samples using culture based and culture independent methods (i.e., PCR and DNA sequencing). Using these methods, we determined that

41% of the nasal lavages were positive for influenza D virus, 32% were positive for MSSA, and 11% were positive for MRSA. The remaining analyzed pathogens were present in 1-2% of the nasal lavages. Significant differences in beta diversity of the dairy workers' microbiome were observed between lavages testing positive for MSSA and IAV and lavages testing negative for MSSA and IAV. However, no significant differences in alpha diversity were observed based on presence or absence of targeted pathogens. Significant differences in alpha diversity between participants was observed – suggesting that dairy workers' nasal microbiome is not homogenous. One interpretation of our diversity metrics is that specific bacterial communities in a worker's microbiome may play a protective role against pathogens, while overall species abundance is less important. We also characterized the nasal microbiome in relation to the intervention and no significant microbiome side effects were observed as diversity metrics between and within groups were comparable. Also of note, there appears to be no washout of microbiome diversity observed. However, differences in diversity between pre- and post-shift samples indicate workplace uptake of bacteria.

Aim 3:
Current results indicate that the intervention was handled well by all the workers with no acute adverse effects. We will continue to evaluate the effectiveness using proposed statistical models. After the data analysis is complete, we will collaborate with industry partners on translation of this intervention research to improve workplace health and safety practices.

B.3. Competitive Revisions/Administrative Supplements

Not applicable

B.4. What opportunities for training and professional development did the project provide?
This project continues to help graduate students, undergraduate students, and junior faculty to gain experience on collaborative research and outreach. They have participated in the training for data collection, laboratory assays, human subjects training, and assisted with field and laboratory aspects of the research.

B.5. How did you disseminate the results to communities of interest?
Students have participated in poster and podium presentations at local, regional, and national conferences and meetings to share preliminary findings. We have also published findings in the articles listed below.

B.6 - What do you plan to do during the next reporting period to accomplish the goals?
This is the final reporting period of this grant cycle.
However, team is working to finish the project and. Our plans our outlined by each aim below.
Aim 1: We plan to conduct two more sampling campaigns to increase our sample size. Also, to further evaluate the effectiveness of this intervention, we will utilize a linear mixed effect model that incorporates dust and endotoxin exposures as well as demographic information.

Aim 2: For the samples collected in 2022 campaigns, we will complete gravimetric, endotoxin, and culture-based and culture-independent analyses. Cytokine analysis and 16S rRNA sequencing of nasal lavage samples will also be completed.

Aim 3: We will continue to analyze the data using proposed statistical models to evaluate the effectiveness of the intervention and control. We will collaborate with industry partners on translation of this intervention research to improve workplace health and safety practices.

C. PRODUCTS

C.1. Publications, conference papers, and presentations

Seidel, J., Erlandson, G., Labadie, J. D., Magzamen, S., Sharp, J., Jones, K., ... & Schaeffer, J. W. (2020). JA: 2021-31. Does the Use of a Nasal Lavage Intervention Improve Pulmonary Function for Dairy Workers?. *Journal of Agromedicine*, *25*(3), 255-256.

Erlandson, G., Schaeffer, J., Magzamen S., Reynolds S. (2022) Impacts of a nasal rinse on inflammation and microbiome diversity in dairy workers. *International Society of Exposure Science Annual Meeting,* Lisbon, Portugal.

Seidel, J., Erlandson, G., Leibler J., Schaeffer, J., Reynolds S. (2022) Do certain nasal microbiome characteristics correlate to viral or MRSA susceptibility in dairy workers? *International Society of Exposure Science Annual Meeting,* Lisbon, Portugal.

Erlandson, G., Magzamen, S., Sharp, J. L., Mitra, S., Jones, K., Poole, J. A., ... & Schaeffer, J. W. (2022). Preliminary investigation of a hypertonic saline nasal rinse as a hygienic intervention in dairy workers. (2022). *Journal of Occupational and Environmental Hygiene*, 1-14; https://doi.org/10.1080/15459624.2022.2137297.

Leibler, J. H., Abdelgadir, A., Seidel, J., White, R. F., Johnson, W. E., Reynolds, S. R., Gray, G. C., & Schaeffer, J. W. (2022). Influenza D virus exposure among US cattle workers: A call for surveillance. *Zoonoses and Public Health,* 1-5. http://doi.org/10.1111/zph.13008.

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

Nothing to report.

C.3. Technologies or techniques

Nothing to report.

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

Not applicable

C.5. Other products and resource sharing

Nothing to report.

D. PARTICIPANTS

Reported in the overall section.

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.

Respiratory disease is a significant concern among dairy workers. There is a major void in research on interventions. If successful, this study will lead to the development of a low-cost, easy to use intervention (nasal rinse using either a hypertonic or normotonic saline) that can be administered before and after a work shift to reduce nasal inflammation. This type of intervention may have wide impact beyond the dairy industry with potential application in other environments with bioaerosol exposures.

F. CHANGES

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

We extended our recruitment period and geographic area to enable us to evaluate the effectiveness of hypertonic saline nasal rinse as part of Aim 1 and to achieve the desired sample size. We extended our recruitment efforts to include larger operations that, in turn, have larger workforces.

Changes were made to the consent and IRB approval has been obtained. These changes included the change in timing of collection so that nasal swab samples were collected 1 to 2 weeks before sampling and with the last nasal rinse on day 5 of sampling.

We partnered with Dr. Jessica Liebler at Boston University and pooled our resources to ascertain additional information regarding the stability of the nasal microbiome and to identify perturbations and transient taxa several weeks after administration of intervention.

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

In March of 2020, all research ceased due to the COVID-19 pandemic. This led to a nearly six-month shut down of all but a few essential labs. Once an avenue opened to restart research, our team organized needed materials, including COVID-19 health and safety plans, and applied for Colorado State University's Return to Research approval process. In July/August Colorado State University approved our team to return to research. This approval did not extend to field research due to our need to travel and interact with the population posing a public health risk. Due to this, our sampling was further delayed. Following vaccination of our field research team and approval from Colorado State University, we returned to large operation recruitment.

We extended our recruitment period and geographic area to enable us to evaluate the effectiveness of hypertonic saline nasal rinse as part of Aim 1 and to achieve the desired sample size. We extended our recruitment efforts to include larger operations that, in turn, have larger workforces.

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

Not applicable

G. Special Reporting Requirements

G.1-3. Not Applicable

G.4. Human Subjects

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

If you selected Yes, answer the following questions:

Is the research exempt from Federal regulations? ☐Yes ☒No

If it is exempt, check appropriate exemption numbers(s).

☐E1 ☐E2 ☐E3 ☐E4 ☐E5 ☐E5

Does this project involve a clinical trial? ☐Yes ☒No

G.4.b. Enrollment table attached

G.4.c. Not Applicable

G.5 - Human Subjects Education requirement

All team members have completed their Human Subjects Education.

G.6. Human Embryonic Stem Cell (hESCs)

Not applicable.

G.7 - Vertebrate Animals

Not applicable.

G.8 - Project/Performance Sites

See overall section.

G.9 - Foreign Component

Not applicable.

G.10 Estimated unobligated balance and explanation of balance

See FFR for unobligated balance.

G.11 Program Income

Not applicable.

G.12 F&A Costs

Not applicable.

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

A nasal rinse intervention may provide relief from inflammation experienced by dairy workers that inhale dust, which is loaded with microorganisms (potentially pathogens). Briefly, we observed the presence of influenza D virus and *Staphylococcus aureus* (including strains that are resistant to antibiotics) in the noses of dairy workers. The nose, in general, functions as a key barrier to the external atmosphere. As a result, the nose is host to bacterial communities (microbiome), which may play a role in a person's immune response. Using state-of-the-art methods, we determined that specific bacterial communities in a worker's microbiome may play a protective role against pathogens, while overall species abundance is less important. By using a saline rinse before and after the work shift, the concentration of inflammatory markers decreased. This decrease may be enhanced by using a highly concentrated saline solution. Further, the nasal rinse does not wash out the microbiome from a worker's nose. Current results indicate that the intervention was handled well by all the workers with no acute adverse effects. This nasal rinse may be a low burden intervention that can be implemented in the workplace. After data analyses are finalized, we will work closely with partners on best practices based on our results.

A. COVER PAGE: Project-7726

Project Title: Project Intervention (R1) - Development of Engineering Controls to Reduce Foldable ROPS Overturn Fatalities	
Component Project Lead Information: Ayers, Paul	

B. ACCOMPLISHMENTS

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

The specific goal of this project is to develop and test new and retrofit mechanical lift assists for foldable ROPS that can be operated from the tractor seat and meets ergonomic standards and generate guidelines for implementing these engineering controls on various size tractors/ROPS combinations. To meet this goal the following specific tasks are identified.
1) Develop and test a sensor to measure the actuation forces and angles for foldable ROPS.
2) Determine the actuation forces and angles on foldable ROPS of various sizes and compare to theoretical values to define both the theoretical and frictional forces.
3) Based on the actuation forces and location of the foldable ROPS with respect to the seat reference point, design and develop new and retrofit mechanical lift assist mechanisms operable from the tractor seat for various size ROPS.
4) Evaluate the mechanical lift assist to determine the forces and movement required by the operator to meet appropriate ergonomic standards.
5) Generate guidelines that can be used to aid the development of mechanical lift assists for foldable ROPS.

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

Click here to enter text.Universal initial lift assist design was used on all 4 tractor foldable rollover protective structure (ROPS) selected. A design was generated that could be retrofit to existing ROPS and did not compromise the structural integrity of the original ROPS. The design includes a rotating disk and extendable lever arm (Figure 1).

Using the developed operator force sensors, the lift assist design was evaluated to meet ergonomics engineering standards [SAE J898 (ISO 6682) and SAE J1814 (ISO 1814)]. Operating in the zone of reach and comfort, and less than the 100 N maximum allowable.
The 4 tractor ROPS tested are shown in Table 1. The lifting forces for the foldable ROPS were measured (Figure 2).
Table 1: Summary information of 4 ROPS tested

ROPS Manuf	Model	Serial	Fits	Max vehicle weight (lb)	Standard	Size	Vertical SRP- top (cm)	Vertical SRP-Pivot (cm)	Transerve SRP-Pivot (cm)	Outside Lateral SRP-pivot (cm)	Outside ROPS width (cm)	ROPS angle at 70 cm above SRP (degrees)
Deere	S el 0095	544	Deere 4120, 4320, 4520, 4720	3860/8820	SAE J2194 OSHA	2 - 3 - 0.180	118	56	30	45.5	91	11
FEMCO	301013466		Deere 2210,2305	2403	OSHA 1928	2 - 2 - 0.175	103	57	28	41	82	10
Laurin	255	1679188	MF 255, 265	9600	OSHA 1926, SAE J1194	2 - 5 - 0.300	100	28	29	43	86	16
Exmark	109-6908		Laser Z mid-mount ZTR	1568	OSHA 1928	2 - 2 - 0.115	97	23	0	41.5	83	30

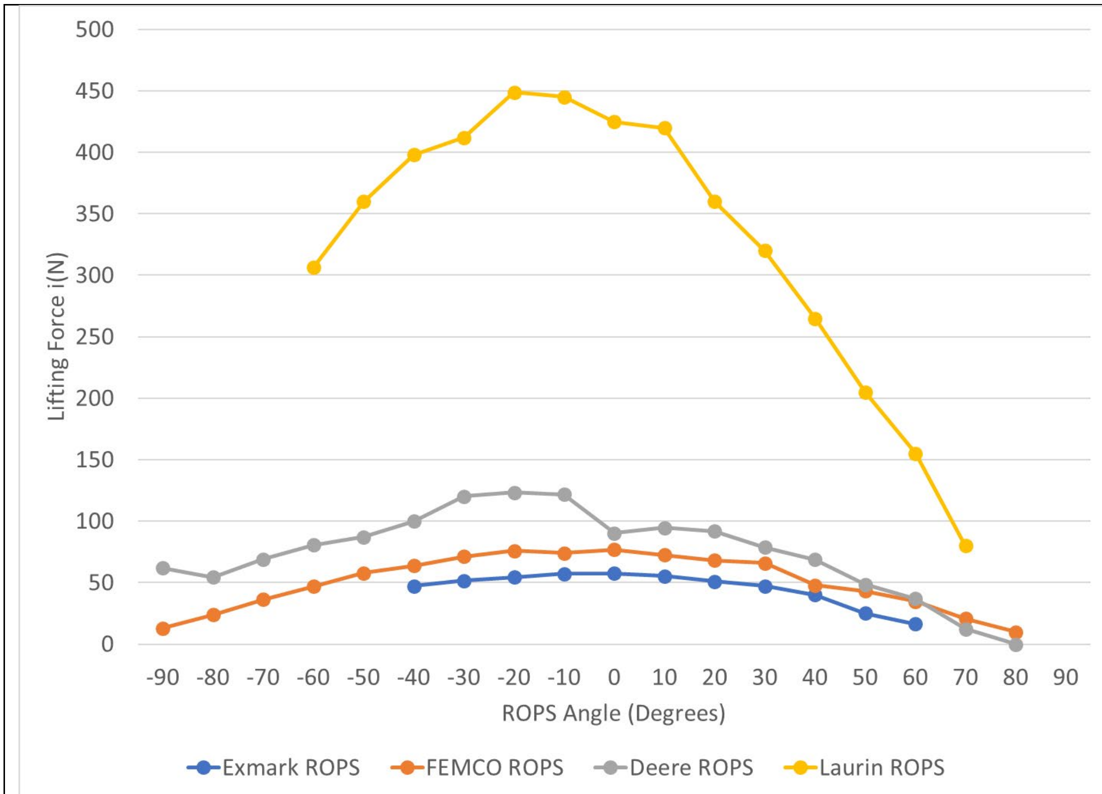

Figure 3: Lifting force for each ROPS with universal lift assist

The Universal foldable ROPS lift assist uses a pivoting disk and sliding lift arm to fit any size foldable ROPS. It attaches at the pivot bolt so does not modify the ROPS structure (Figure 3).

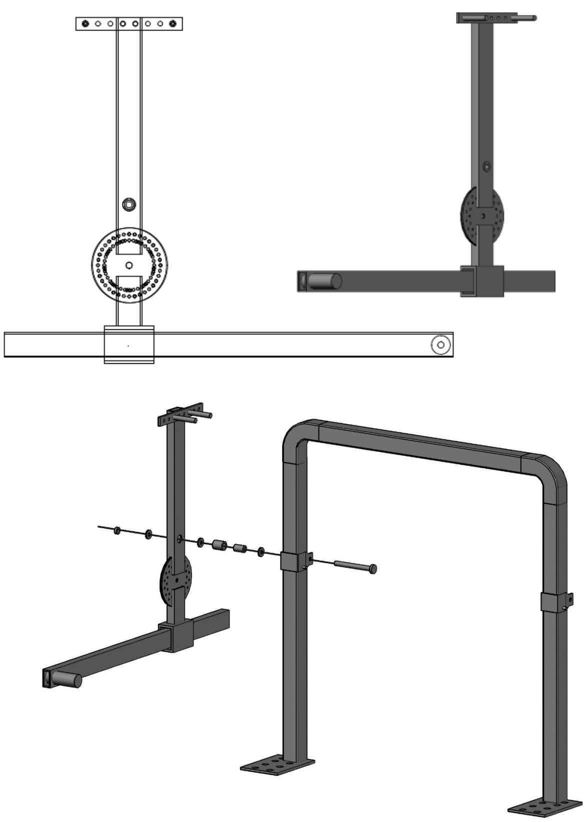

Figure 1: Universal initial lift assist design.

Figure 2: Universal lift assist design mounted on a ROPS.

Due to the high weights of the Deere and Laurin ROPS, a torsion spring integrated stop bracket (Figure 4) was used to reduce the operator actuation forces.

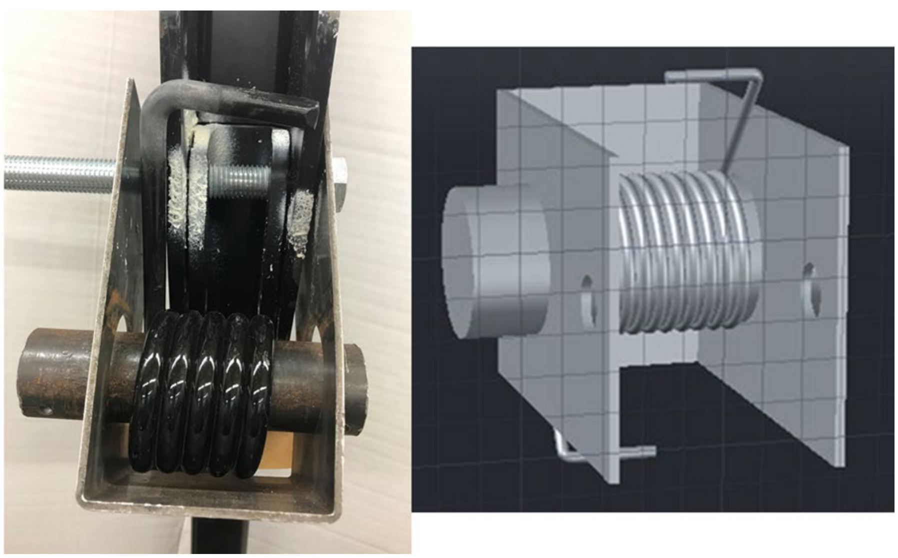

Figure 4: Torsion spring and initial drawing added to universal lift assist.

With the torsion spring the foldable ROPS handle forces are lowered significantly (Figure 5).

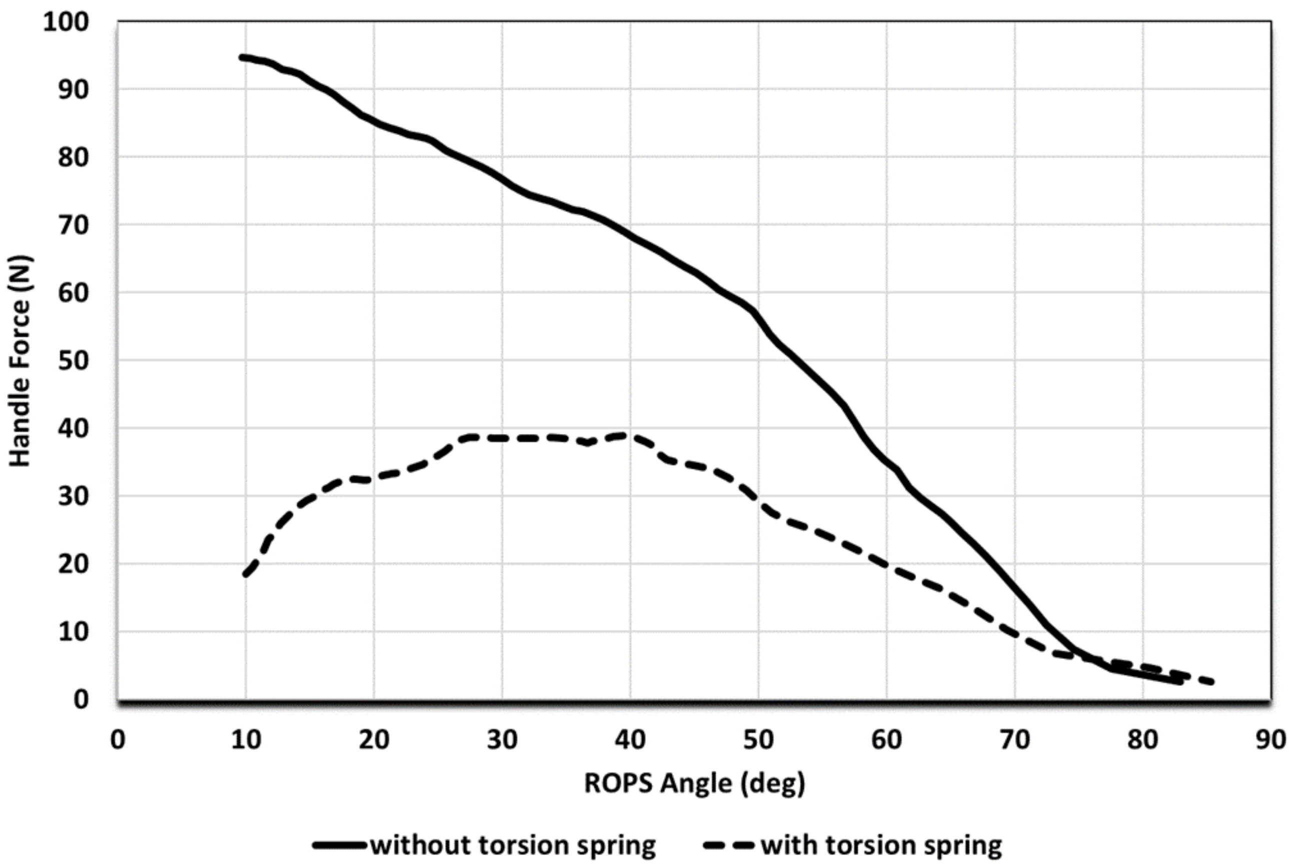

Figure 5: Lifting force for ROPS with and without addition of torsion spring to the universal lift assist.

B.3. Competitive Revisions/Administrative Supplements

Not applicable

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

A graduate student worked on this project and it informed their ongoing work in the field.

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

Project information has been disseminated at national safety meetings, HICAHS advisory meeting, MS 23/2/2 ROPS committee meeting and to the project advisory committee. The ROPS design has been shared on through HICAHS social media channels and the HICAHS website.

B.6 - What do you plan to do during the next reporting period to accomplish the goals?
This project ended 9/14/19 and this is the final reporting period of the center grant cycle.

C. PRODUCTS

C.1. Publications, conference papers, and presentations

Foldable rollover protective structures: Universal lift-assist design
PD Ayers, FK Khorsandi, MJ Poland, CT Hilliard. *Biosystems Engineering* 2019, 185: 116-125.
ROPS Designs to protect operators during agricultural tractor rollovers
P Ayers, F Khorsandi, X Wang, G Araujo. *Journal of Terramechanics* 2018. 75: 49-55.

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

The website with the design for the universal lift-assist lever:
https://www.dropbox.com/sh/uul9xna3wehlbne/AACGc-api865FWyKKJuljgnra?dl=0

C.3. Technologies or techniques

Drawings for the Universal FROPS lift assist design have been developed and presented at national meetings and in journal publications.

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

Not applicable

C.5. Other products and resource sharing

Nothing to report.

D. PARTICIPANTS

D.1. What individuals have worked on the project? Please include calendar, academic, and summer months.
Reported in the overall section.

D.2 Personnel updates, if applicable
No changes.

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.

The impact of this research is the demonstration that a feasible solution exists for tractor operators to actuate a foldable ROPS from the operator seat within the ergonomic force and location requirements. This eases the ROPS folding operation and provides the opportunity for the ROPS to be in the upright position in the event of a tractor rollover. The design has also proven to be retrofitted on existing tractor ROPS and does not affect the structural integrity of the ROPS. A Universal FROPS lift assist design has been developed that fits most foldable ROPS designs and locations with respect to the operator seat. Torsion spring designs were utilized to provide lift assist forces to accommodate heavier FROPS. The design meets the ergonomics design features for lever operation based on engineering standards [SAE J898 (ISO 6682) and SAE J1814 (ISO 1814)].

F. CHANGES

F.1 - Changes in approach and reasons for change, including changes that have a significant impact on expenditures
N/A

F.2 - Actual or anticipated challenges or delays and actions or plans to resolve them
N/A

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

No changes.

G. Special Reporting Requirements

G.1-3. Not Applicable

G.4. Human Subjects

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

If you selected Yes, answer the following questions:

Is the research exempt from Federal regulations? ☐Yes ☐No

If it is exempt, check appropriate exemption numbers(s).

☐E1 ☐E2 ☐E3 ☐E4 ☐E5 ☐E5

Does this project involve a clinical trial? ☐Yes ☐No

G.4.b. Enrollment table attached

G.4.c. Not Applicable

G.5 - Human Subjects Education requirement

All team members have completed their Human Subjects Education.

G.6. Human Embryonic Stem Cell (hESCs)
Not applicable.

G.7 - Vertebrate Animals
Not applicable.

G.8 - Project/Performance Sites
See overall section.

G.9 - Foreign Component
Not applicable.

G.10 Estimated unobligated balance and explanation of balance
See FFR for unobligated balance.

G.11 Program Income
Not applicable.

G.12 F&A Costs
Not applicable.

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

Foldable rollover protective structures (ROPS) are a popular addition to mowers and tractors used on orchards that have been shown to lower rollover fatalities. The foldable ROPS for tractors allows the ROPS structure to be lowered for ease of maneuvering under trees and other low clearance structures. However, these devices usually require many steps to raise and lower, and thus they often remained lowered. Once lowered, the ROPS cannot protect the operator in the event of a tractor rollover.
For this project, Paul Ayers developed a universal lift assist lever that allows the operator to raise and lower a foldable ROPS from the operator seat. Using this device reduces the effort required by the operator to raise/lower the ROPS, and thus aims to decrease the amount of time the operator leaves the device in the lowered (unprotected) position. Once developed, the design was tested to determine if the universal lift assist lever met appropriate ergonomic standards for operator required force and comfort. This was achieved by measuring the required force to lift the ROPS in to place while using the lift assist lever and establishing the zone of comfort and the zone of reach for its use on three different ROPS devices. With the addition of a torsion spring for heavy foldable ROPS models, the lever met all the ergonomic standards.
The impact of this research is the demonstration that a feasible solution exists for tractor operators to actuate a foldable ROPS from the operator seat within the ergonomic force and location requirements. This eases the ROPS folding operation and provides the opportunity for the ROPS to be in the upright position in the event of a tractor rollover. The design has also proven to be retrofitted on existing tractor ROPS and does not affect the structural integrity of the ROPS. A Universal FROPS lift assist design has been developed that fits most foldable ROPS designs and locations with respect to the operator seat. Torsion spring designs were utilized to provide lift assist forces to accommodate heavier FROPS. The design meets the ergonomics design features for lever operation based on engineering standards [SAE J898 (ISO 6682) and SAE J1814 (ISO 1814)].