



GREAT PLAINS
Center for Agricultural Health

Great Plains Center for Agricultural Health Longitudinal Evaluation Report

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contact information, and center activities.**

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Great Plains Center for Agricultural Health: Longitudinal Evaluation Approach

This report summarizes a center-wide evaluation of the 2016-2022 cycle of the Great Plains Center for Agricultural Health (GPCAH), a center funded by the National Institute for Occupational Safety and Health (NIOSH). The GPCAH mission is to prevent agricultural injury and illness and to improve the safety and health among agricultural communities.

The GPCAH was formed in 1990 and accomplishes its mission by advancing knowledge through scientific research and who prevents agricultural injury and illness through education, outreach, and intervention programs.

A comprehensive evaluation report was generated to address the key question: *What is the impact of GPCAH on the health and safety of agricultural workers in our region?*

The approach for this evaluation differed between Research Projects (Air Quality Improvements in Livestock buildings; Roadway Safety Interventions; Surveillance) and the Outreach Core activities (focusing on the Core Course). Because activities conducted in the 2016-22 cycle were built on knowledge developed in previous cycles, this evaluation considered longitudinal impact of the Center's activities from previous cycles to evaluate the impact of the GPCAH's research and outreach portfolios. A multimodal approach was taken to evaluate the GPCAH impact. The approach and methods for the research and outreach activities were analyzed separately.

The evaluation team obtained documentation from investigators, reviewed annual reports, and conducted interviews with project team members to evaluate the impact of efforts conducted by the GPCAH on its mission to reduce injury and illnesses in its region's agricultural communities.



Great Plains Center for Agricultural Health: Evaluation Approach for Research Core

The evaluation of the research portfolio drew upon two theory-based frameworks – Contribution Analysis (CA) and Translational Research Staging (TRS). CA emphasizes the importance of assessing a program as an influencing factor in the theory of change. TRS framework was used to assess the temporal movement from research to practice over time. The NIOSH translational research process comprises the following stages, mapping to the figure below:

Stage 0: Hazard/Problem Identification - Needs assessments or basic/applied research studies that show the existence and significance of a problem. The findings of these studies become the focus in Stages 1-4 of the translation research framework.

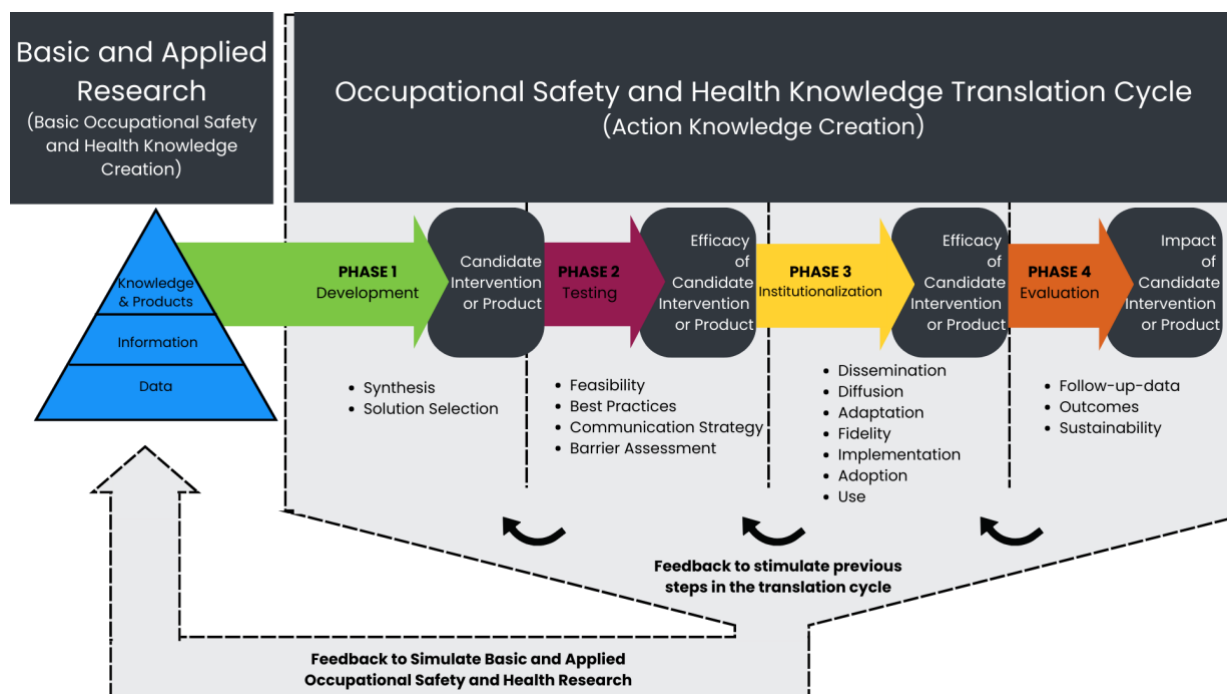
Stage 1: Development - Small pilot-testing on a limited proof-of-concept basis to develop a solution to a hazard or problem

Stage 2: Testing - Assessing the efficacy and potential value of a new finding, invention, process, training program, or intervention for larger-scale occupational safety and health application

Stage 3: Institutionalization - Demonstrating that an intervention or recommendation works and that it can be integrated into a broad range of workplace or community settings

Stage 4: Evaluation - Demonstrating “real world” health, safety, economic, and well-being impacts of integrating these new discoveries and interventions into large scale practice

The evaluation team examined research project records to identify *evidence of research output adoption*. Specifically presented in this report is adoption evidence that includes training, strengthened partnerships, and the adoption of lessons or projects made into broader education and outreach activities adopted beyond the funded research project aims and activities that were originally funded.



Research Core Evaluation: Air Quality Projects

The GPCAH is home to large animal feeding operations, which are associated with persistent respiratory symptoms that represent a lasting disease burden throughout the GPCAH nine-state region. Addressing *inhalation hazards in swine confinement* has been a priority topic for many cycles. In the 2016-22 cycle, researchers have developed and tested cost-effective devices to help reduce respiratory ailments among swine workers as well as reduce bioaerosol concentrations to lead to an improvement in both worker and pig health. This work built on previous study findings, as illustrated.

Stage 0
Hazard
Identification

2006-2011 (O’Shaughnessy): NEEDS ASSESSMENT

CONFIRMED
Elevated levels of CO₂, dust, and endotoxin in all aspects of swine farming



RECOMMENDED
Respirator use among hog workers



BUT...

- Low adoption of respirators unless mandatory
- Respirator use requires ongoing education
- Respirator use does not prevent inhalation of gases

Stage 1
Development

2011-2016 (Anthony): INDUSTRIAL FILTRATION

DEMONSTRATED
EFFICACY of Recirculating Ventilation System (RVS) in reducing dust, CO₂, endotoxin, NH₃ and H₂S in swine farrowing

THIS MATTERS BECAUSE RVS:

- Does NOT rely on voluntary respirator use
- Does NOT negatively impact pig health
- Is cost effective \$\$\$

RECOMMENDATION
Vented Heaters



Air Cleaners with Recirculating Ventilation Heater

BUT...

- RVS not tested in commercial swine farms: “Will it work in real life?”
- Study did not develop a “product” for swine producers

Stage 1 & 2
Development
and Testing

2016-2022 (Nonnenmann): FILTRATION + UVC DISINFECTION

DEVELOPED
A trailer-based RVS (tRVS) that integrates air filtration **AND** ultraviolet light (UVC) radiation

DEMONSTRATED
EFFICACY of tRVS in controlling dust **AND** bioaerosols

THIS MATTERS BECAUSE tRVS:

- Found to be effective in a commercial swine operation
- Reduces bioaerosols (in addition to dust), which improves BOTH worker and pig health, leading to cost savings for producers



tRVS: New duct work for air filtration (L)
UVC treatment in duct work (R)

BUT...
External trailer-based technology requires complicated building ductwork

Next...(2022-2027):
Test miniaturized RVS (+UVC) installed inside swine farms based on producer input

Stage 1,2,& 3
Development,
Testing, &
Institutionalization
(2022-2027)

Evidence of research output adoption includes:

- Training:** The project trained multiple health and safety professionals. For example, one postdoctoral researcher developed skills in industrial hygiene method development, equipment and sampling media preparation, field data collection, sample analyses, electronic data collection and analyses, and report writing.
- Partnerships and Presentations:** The project strengthened collaborations with the National Pork Board and local swine producers. These relationships have facilitated input in new RVS designs and a focus on research questions most relevant to producers.
- Education and Outreach:** The project findings were incorporated in the GPCAH Core Course curriculum for agricultural safety and health professionals. Workers were trained at the study site. Lessons learned to conduct this project included the development of new lab techniques for virus aerosolization, sampling, and infectivity assays, which were then used to inform hospital-based COVID research in 2020 and additional airborne virus studies now being conducted in other settings.

Research Core Evaluation: Roadway Safety

Throughout the GPCAH region, roadway crashes continue to be an important cause of severe traumatic injuries to farmers as well as other roadway users. *Preventing farm equipment crashes* has been a long-term research priority for GPCAH to achieve our mission of injury reduction. The main objective during the current grant cycle is to develop a “We’re on This Road Together” Toolkit and training module. The train-the-trainer approach will be used to disseminate the campaign to Extension Educators who would then implement the toolkit into their communities directly.

2011-2016 (Ramirez/Peek-Asa): NEEDS ASSESSMENT

Farm-vehicle crashes endanger agricultural **AND** non-agricultural workers

DEMONSTRATED

- 30% of farm equipment crashes occur in **urban areas**
- **Non-ag vehicle** most frequently at fault
- **Stricter laws on lighting and marking** may lead to lower crash rates

BUT...

- Little understanding of **specific driver behaviors** behind crashes
- Need to address driving behaviors of both **ag and non-ag** vehicle operators
- Adoption of stricter laws on lighting and marking require **advocacy** for full effect



2016-2022 (Hamann/Peek-Asa): DRIVING BEHAVIORS (PHASE 1)

DEVELOPED

- **SaferTrek**: a device to collect driving data on farm- and non-farm vehicle interactions
- Algorithms to analyze **SaferTrek** data

USING SaferTrek, IDENTIFIED

- Unsafe driving behaviors in non-farm vehicles
- Passing
- Speeding
- Leaving headway space



SaferTrek Mounted on Rear of Farm Vehicle



Example of a Video Snapshot from SaferTrek

What **SaferTrek REVEALS** about farm-vehicles:

- Time on the road
- Routes frequented
- Frequency of encounters with other vehicles



2016-2022 (Hamann): COMMUNITY INTERVENTION (PHASE 2)

ENGAGED a **Community Advisory Board**

DEVELOPED a **Community Campaign**

“WE’RE ON THIS ROAD TOGETHER”

- “Slow Down”
- “Leave More Space”
- “Avoid Passing”



Community Campaign in Action: 4th of July Parade, Williamsburg IA

SURVEY on PASSING BEHAVIOR & CAMPAIGN REACH

- 10% perceived farm equipment as a top road safety concern
- Males more likely to pass farm equipment
- 60% recalled campaign
- 75% recalled campaign location
- 53% recalled messaging content
- 9% increase in exposure to road safety info from baseline to post-period

SCALING

How can we enable other communities to implement their **own** roadway safety campaigns?

Next... (2022-2027)

Partner with **Cooperative Extension System** to implement campaigns in multiple communities



Evidence of research output adoption includes:

- **Training:** The project cross-trained multiple individuals in public health techniques. PhD students in Civil Engineering devised algorithms and approaches to analyze *SaferTrek* data. MS students assisted in the analysis of survey question responses and manuscript preparation. Undergraduate students worked on video review and annotation.
- **Partnerships and Presentations:** Strengthened collaboration between Iowa State University and University of Iowa. Information was shared with Iowa Department of Transportation.
- **Education and Outreach:** Study findings were incorporated into GPCAH Core Course curriculum for agricultural safety and health professionals. In addition, GPCAH representatives continued to share information on farm vehicle lighting and marking and farm shows. The Roadway Safety webpage became one of the most visited pages on the GPCAH website. Tools developed in this study led to development of a process for analyzing naturalistic data on vehicle exposure and driving behaviors using the *SaferTrek* device, developed with funding from this project; this tool has been adapted for use in other studies, including one examining bike safety and injury prevention, subsequently funded by the CDC.

Research Core Evaluation: Surveillance

Due to limited surveillance for agricultural injuries throughout the GPCAH region, surveillance projects have been funded to *identify what systems can be used to identify and eliminate critical health and safety hazards injuring the region's farmers and farm workers*. In addition, a goal of this project was to identify trends to evaluate center performance and identify emerging issues in need of response. Some important aims of this project were to provide Center partners with information about trends and characteristics of agricultural traumatic fatalities and injuries in the GPCAH region to help prioritize interventions and measure effectiveness of interventions underway.



2011-2016 (Peek-Asa/Ramirez): NEEDS ASSESSMENT

Conduct ongoing surveillance using multiple regional and state databases to identify the burden of injury to agricultural producers

- Fatality/Assessment and Control Evaluation (FACE)
- Census of Fatal Occupational Injury (CFOI)
- Newspaper Clipping Services
- Iowa's State Trauma Registry

BUT...

- Newspaper clippings too inconsistent for research purposes
- Need to find reliable information sources for non-fatal injuries for 9-state region



2016-2022 (Ramirez/Casteel)

Partnered with industry **to analyze** worker's compensation data

- 2/3 of claims medical only
- 1/3 of claims death/disability
- **Yielded unique data** about the immediate cost of injuries

Compared Iowa trauma registry (ITR) data to Iowa workers' compensation (WC) data, but found very little overlap

Cause of injury	ITR	WC
Roadway crashes	>25y	<25y
Cut/pierce, struck by	>45y	<45y
Falls	>62y	<62y

Overall trends

Cause of injury	ITR	WC
Older workers	X	
Young workers		X
Machinery	X	
Fire/Burns		X

Nationwide



2016-2022 (Ramirez/Casteel)

Developed hazard surveillance checklist and **converted** it to an app

- Tested on 103 row crop farms
- Piloted training module with Ag safety and health professionals
- Trained users enter data from farms
- Data available for researchers to use

Hazards assessed:

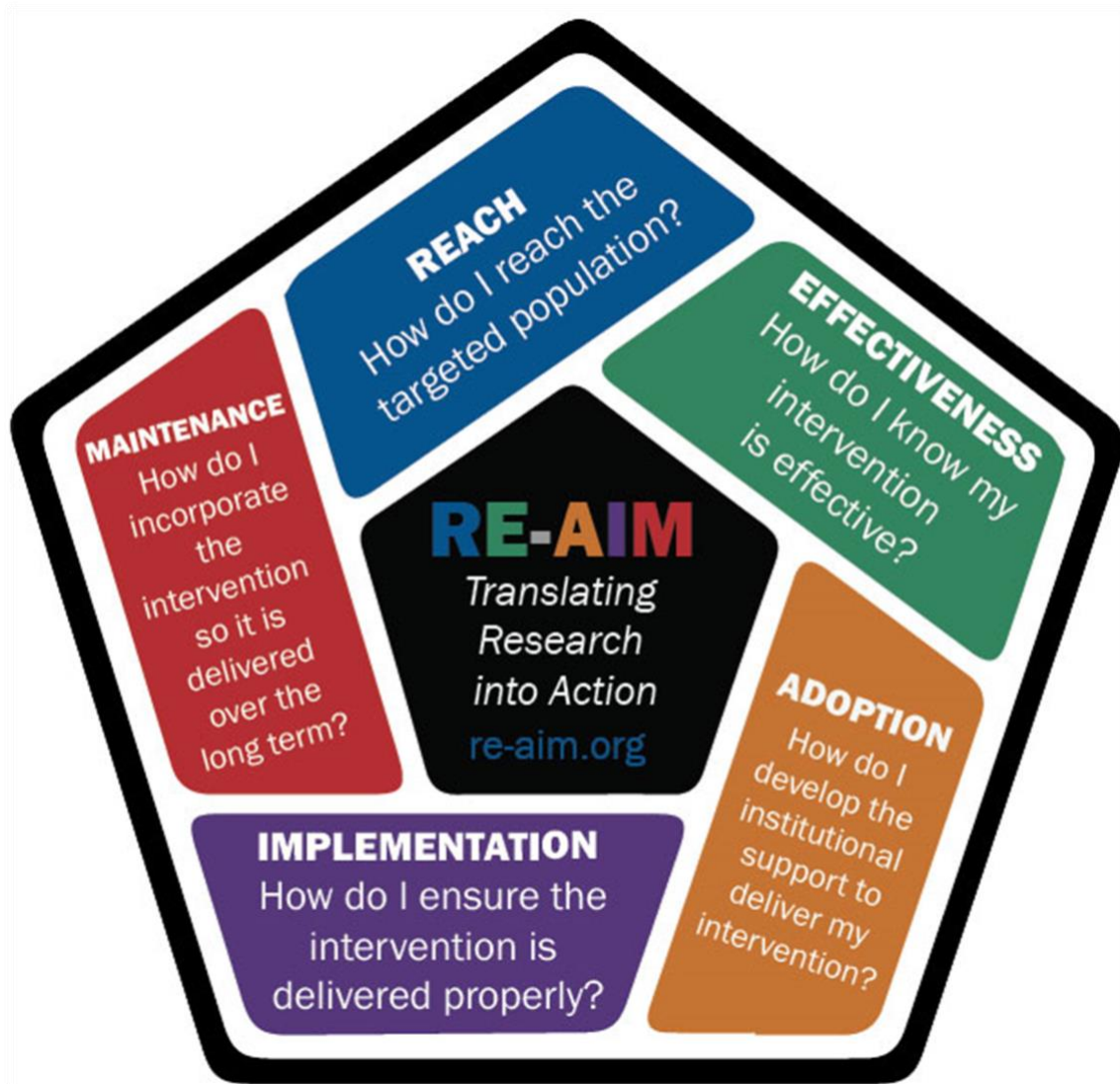
- Self-propelled vehicles
- Pulled implements
- Fixed machinery & equipment
- Buildings & structures
- Fall prevention & ladders
- Safety Training & written policies
- Worker injury history

Evidence of research output adoption include:

- **Training:** Five PhD students and 2 MS students were involved in collecting field data, examining linkages between databases, and analyzing the checklist tool.
- **Education and Outreach:** The project converted the newly developed “checklist” into a web-based application, then developed and provided training at an online skills-development workshop. This included a 60-minute asynchronous training to understand the app and its scoring, then a synchronous 90-minute session to apply the checklist to videos collected on the farm. Iowa trauma registry findings have been shared with outreach personnel and ag educators to communicate on-farm risks and injuries using cases relevant to the region's farmers.

Great Plains Center for Agricultural Health: Evaluation Approach for Outreach Core

We focused on the “Educate” aim of the *Outreach Core* and assessed the impact of the *Agricultural Safety and Health: The Core Course* using the **RE-AIM** framework. The *Core Course* aims to develop agricultural safety and health competency among multiple segments of the rural and agricultural community and motivate these influences to intervene and promote prevention messages directly to farmers. The elements of the RE-AIM framework (**Reach**, **Effectiveness**, **Adoption**, **Implementation**, and **Maintenance**) have been used to evaluate the *Core Course* for internal and external validity, simplified with the image below.



Outreach Core Evaluation: The 40-hr Core Course

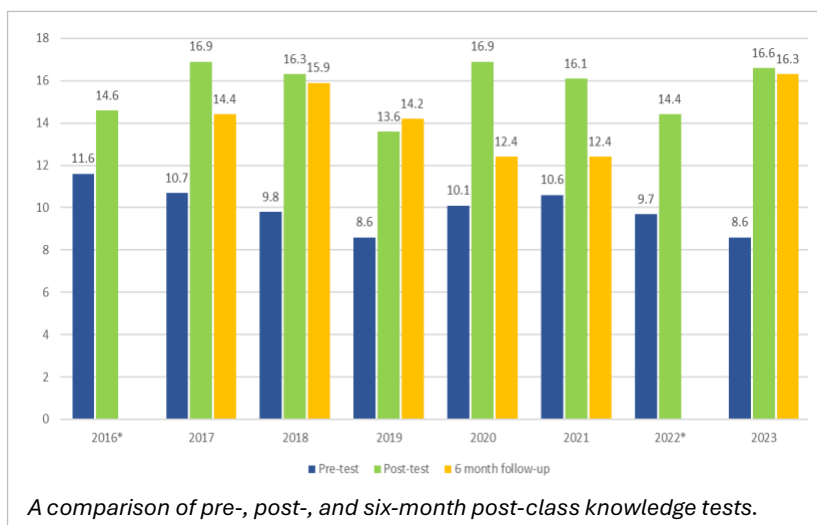
Reach: The course has trained 210 participants from 2016-2023, with an average of 26 participants per year.

- In the previous cycle, men comprised 30%-45% of course participants. Since 2018, women now comprise about 65%-85% of participants.
- Participants range in age from 20-70 years.
- The majority of participants were students or healthcare providers. Other groups included veterinarians, health and safety professionals, and government representatives.
- In recent years (2019-2022) 30%-50% of participants were outside of the GPCAH nine-state region, identifying increased reach beyond our region.

Effectiveness: The Core Course measures change in knowledge through pre- and post-tests.

(Max score =21 for every assessment)

- Average *pre-test* score *decreased* from 11.6 to 8.6, potentially reflecting the diversity of participants registering for the course.
- The average post-test score *increased* from 14.6 to 16.6 in 2023.
- Overall, the average difference in pre-post scores across all eight years (2016-2023) was an *increase of 5.7 points*.
- Results from the six-month follow up test reflects substantial *retention of knowledge gained* from this class, long after the course ended.



Adoption: Organizations have adopted GPCAH course materials for similar class offerings.

- During the 2016-2022 project cycle, the Core Course was delivered to graduate and undergraduate students at three new sites: University of Missouri, Kansas City (School of Pharmacy); Dordt University, Sioux Center, Iowa; and Dalhousie University, Nova Scotia, Canada.
- The Core Course continues to be offered consistently by partners in Nebraska and Texas.

Implementation: Course satisfaction by 2016-23 participants is high:

- 94% rated the course *organization* as “good” or “excellent”
- 97% rated the *value of interdisciplinary approach* as “good” or “excellent”
- 90% rated *course resources* (binder and electronic resources) as “good” or “excellent”
- 95% rated the *depth/level of information* as “appropriate”
- 96% rated the course *overall* as “good” or “excellent”

Maintenance: The 2016-22 project period developed 12 online training modules to enhance sustainability.

- Online educational training modules from the Core Course are now included in the SAY National Clearinghouse.
- This last project cycle, GPCAH translated key classroom curriculum topics into asynchronous online training modules. Several Core Course sites now use online modules to deliver portions of this course. The web-based digital learning platform is expected to increase access to and sustainability of agricultural health and safety content offered by the course. As of September 2024, courses have been completed 2415 times across the 12 online modules developed during the 2016-22 project period.

The GPCAH Core Course materials have been adopted across the US and beyond. Digital educational materials have expanded our reach and helps build the capacity of agricultural safety and health expertise across our region and beyond.