

# Occupational Injury Epidemiology

## Highlights of research and training at the UMN

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# Outline

- Brief overview: public health burden
- Breadth of Occ Inj Research at UMN
  - Faculty Research
    - Agricultural Injuries
    - Workplace Violence
    - Trauma and PTSD
  - Doctoral Student Research
    - Janitor Study
    - Driving studies
    - Older workers

Employed  
Americans  
spend about  
6 hrs/day  
working

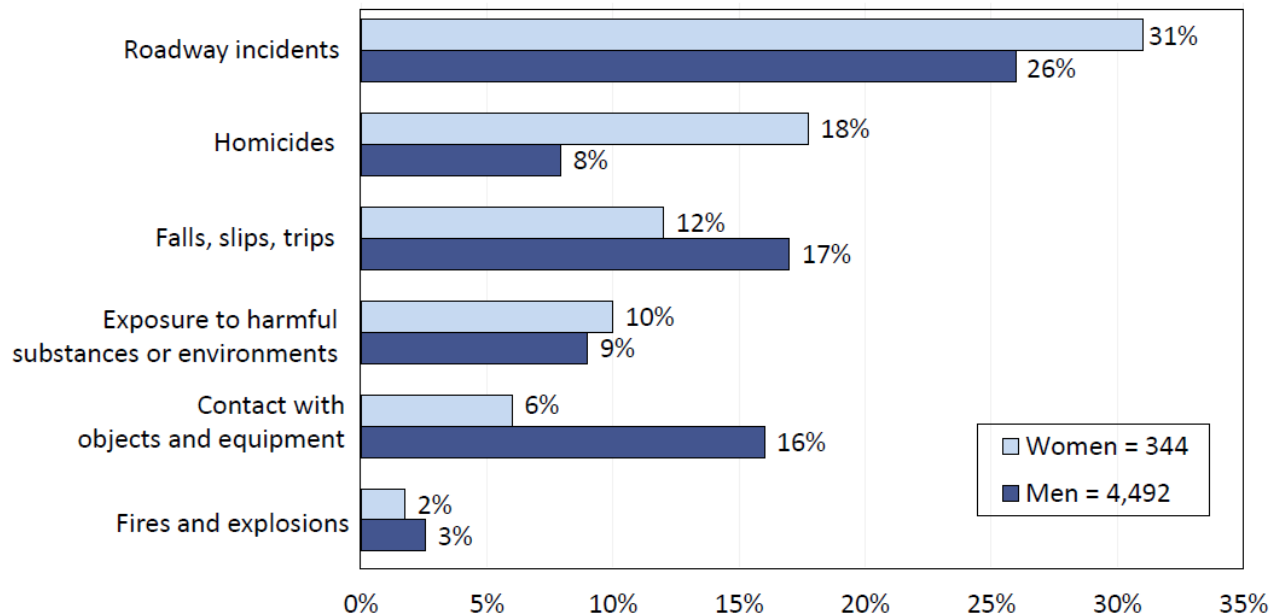
# Occupational injuries account for 30-40% of all injuries to Americans

- ✓ Among all working-age populations (ages 18 to 64) in the US, 28.6% of all injuries occur while working
- ✓ Among working-age men, 37.5% occur while working
- ✓ Among working-age women, 20.5% occur while working

Smith et al., 2005

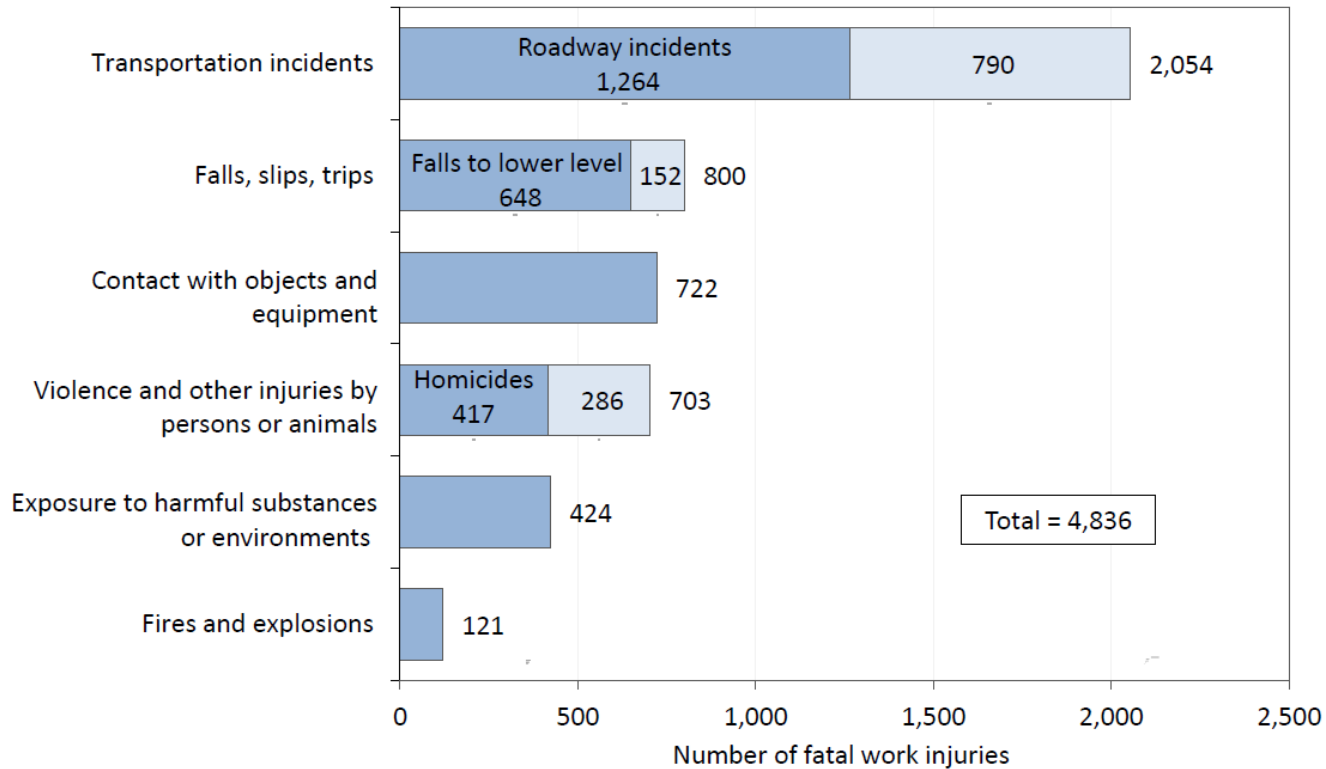
Data source: National Health Interview Survey

# Distribution of fatal injury events by gender of worker, 2015



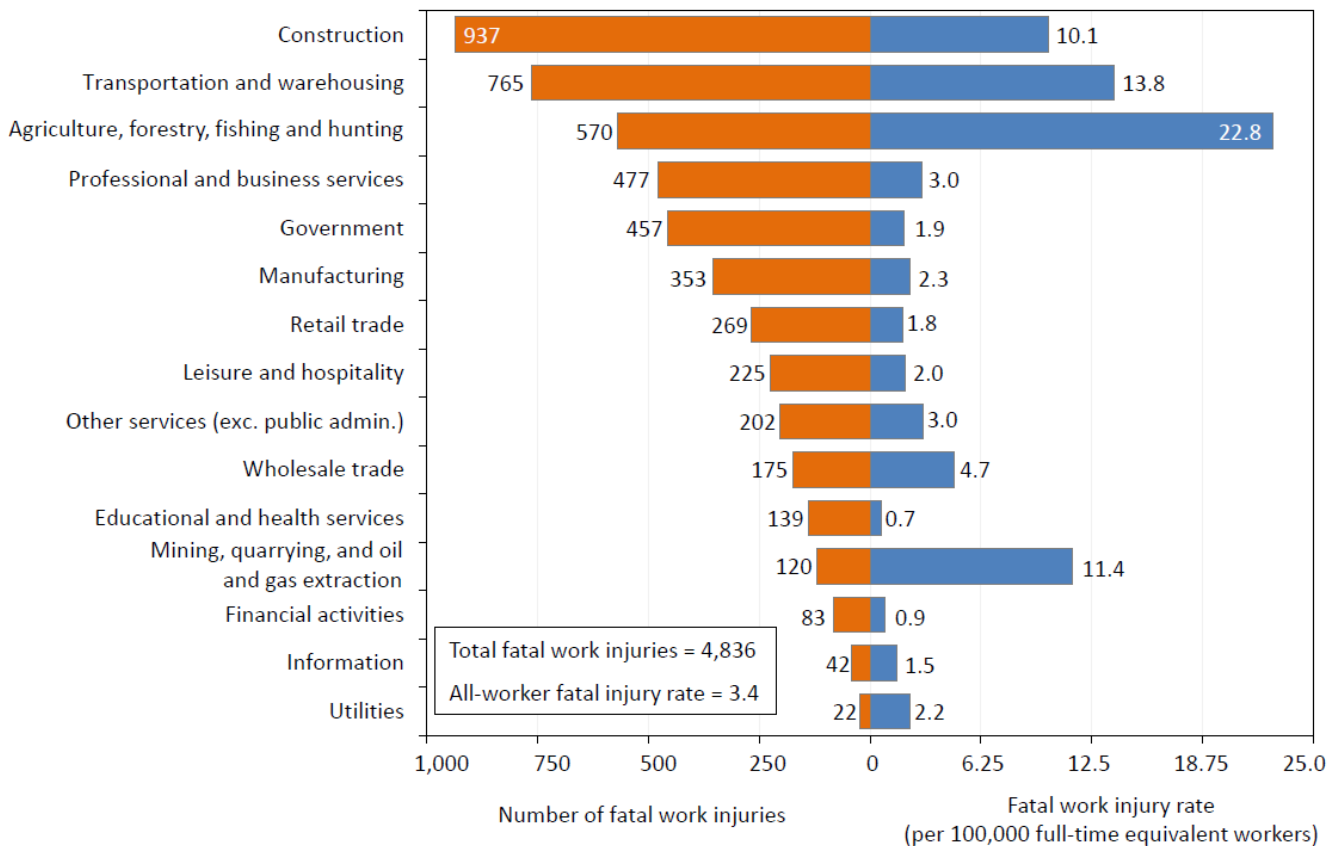
Women experienced a higher proportion of fatal injuries due to roadway incidents and homicides relative to men. Men incurred a higher proportion of injuries from falls, slips, and trips and contact with objects and equipment. Men and women experienced similar proportions of fatal injuries from exposure to harmful substances or environments and from fires and explosions.

## Fatal occupational injuries by major event, 2015



More fatal work injuries resulted from transportation incidents than from any other event in 2015. Roadway incidents alone accounted for about one out of every four fatal work injuries.

# Number and rate of fatal work injuries by industry sector, 2015



Private construction had the highest count of fatal injuries in 2015, but the private agriculture, forestry, fishing and hunting sector had the highest fatal work injury rate.

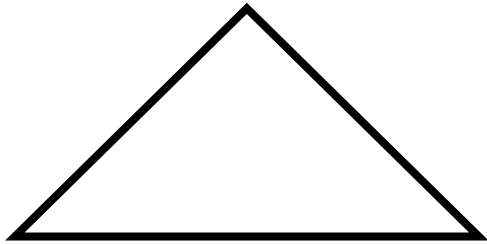






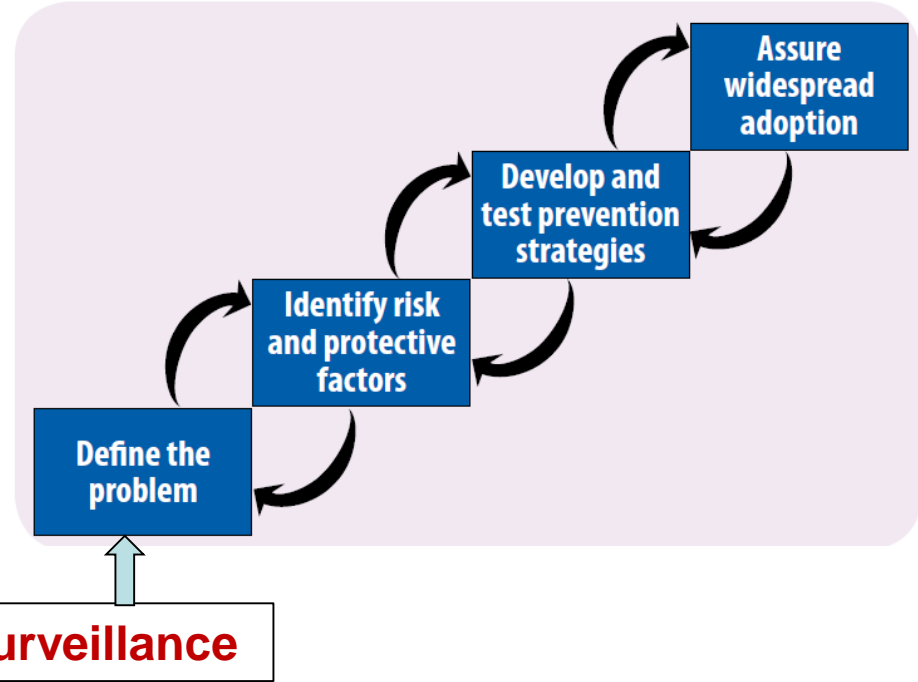
# Epidemiologic Approach to Occupational Injury Prevention

**Host**



**Agent**

**Environment**





# Injuries in Swine Workers



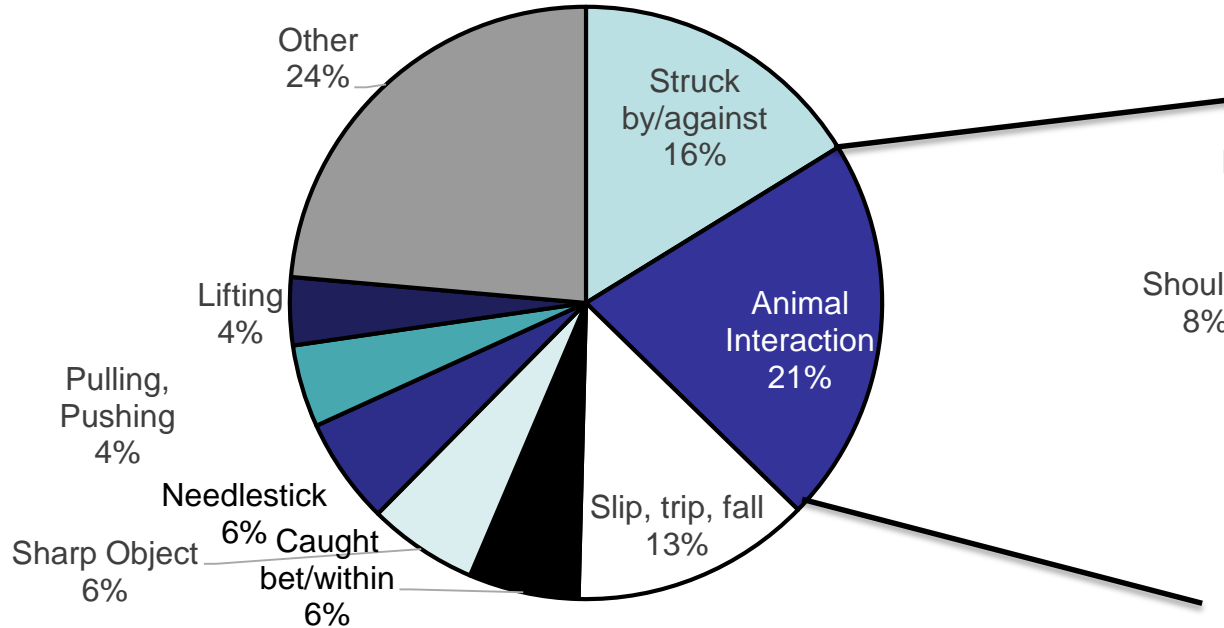
- Ag workers ~8x more likely to die on the job than all other workers; 40% higher rate of non-fatal injuries
- Animal agriculture workers have higher rates of injury than other ag workers 6.7 vs 5.5 injuries/100 workers (BLS)



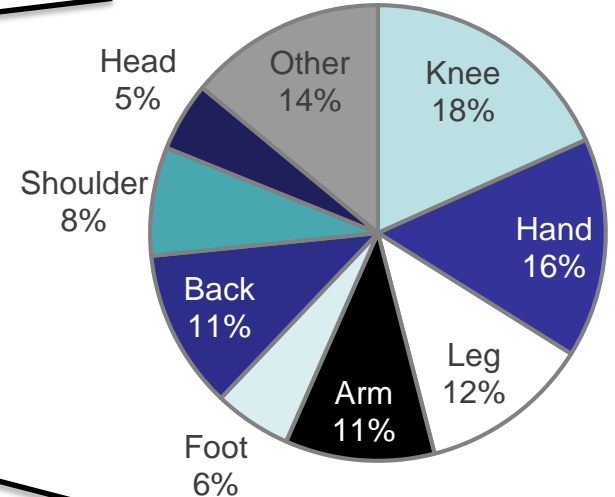
Evaluated worker's compensation and OSHA data from swine operations in 3 states

# Characteristics of Injuries in Swine Production

## Cause of Injury



## Body Part Injured



# Misclassification of animal interactions?

VIOLENCE AND OTHER INJURIES BY PERSONS OR ANIMALS include all intentional injuries; injuries involving weapons regardless of intent; & injuries involving direct physical contact with persons, animals, or insects regardless of intent.

	Report only	Medical	Indemnity	Total
Original Coding	577	304	267	1148
Study reclassification	514	253	179	946
Percent agreement	89.1%	83.2%	67.0%	82.4%



*Susan Gerberich  
Professor, EnHS  
Director, MCOHS*

# Violence against teachers: Etiology and Consequences

- K-12 MN educators identified from MN Dept of Ed; Mail questionnaires
- Rates:
  - physical assault: 5.3/100,000
  - Non-phys assault: 26.4/100,000
- Risk factors: special education vs. standard class, worked in public/alternative vs. public school

# Violence against Nurses

Gerberich et al., 2005

- Case control study ~1200 MN nurses fr. licensing database
- Incidence of assault: 13.2/100 per year
- Risk/Protective Factors:
  - nursing homes/long-term care (OR=2.6; 95% CI =1.9-3.6)
  - emergency departments (OR=4.2; 95% CI =1.3-12.8)
  - psychiatric departments (OR=2.0; 95% CI=1.1-3.7)
  - poorly lit environments (OR=2.2; 95% CI=1.6-2.8)
  - increased shift hours (OR=1.05; 95% CI=0.99-1.11)
  - carrying cell phones/alarms (OR=0.3; 95% CI=0.2-0.7)

# World Trade Center Studies

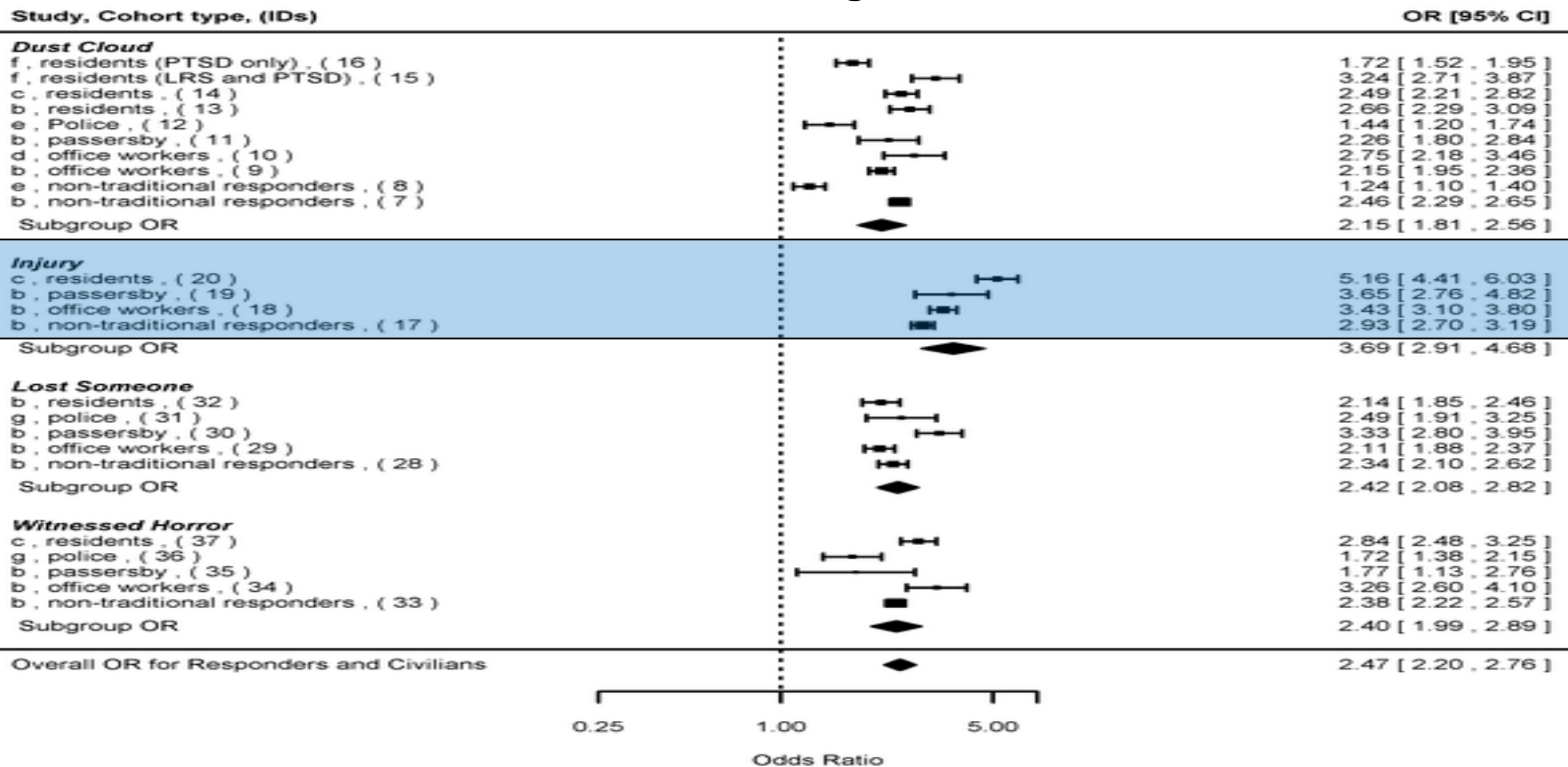
## Evaluating health impacts



*Hyun Kim*  
*Assistant Prof, EnHS*



# Meta analysis of PTSD risk among WTC exposed. Having injury from WTC attack was the strongest risk factor for PTSD



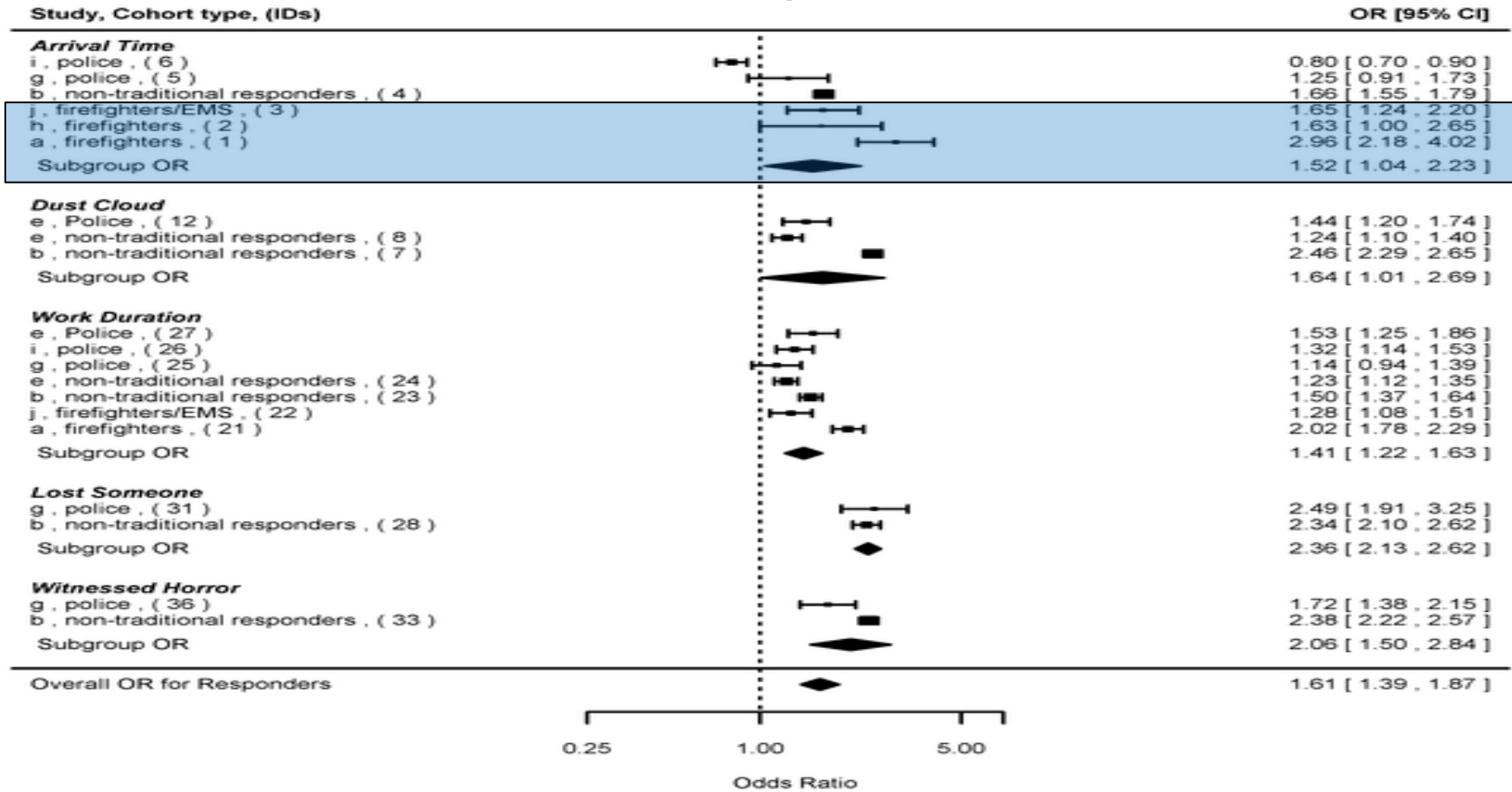
Liu B, Tarigan LH, Bromet EJ, Kim H (2014) World Trade Center Disaster Exposure-Related Probable Posttraumatic Stress Disorder among Responders and Civilians: A Meta-Analysis. PLOS ONE 9(7): e101491.

<https://doi.org/10.1371/journal.pone.0101491>

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0101491>



# Among the responders, firefighters who arrived at the Ground Zero had twice higher risk of PTSD



Liu B, Tarigan LH, Bromet EJ, Kim H (2014) World Trade Center Disaster Exposure-Related Probable Posttraumatic Stress Disorder among Responders and Civilians: A Meta-Analysis. PLOS ONE 9(7): e101491.

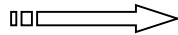
<https://doi.org/10.1371/journal.pone.0101491>

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0101491>

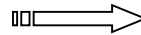
# Farm Equipment Roadway Study, 2011-16

M Ramirez, C Peek-Asa (U Iowa), D McGehee (U Iowa)

Surveillance  
(Crash data, 2005-2014)

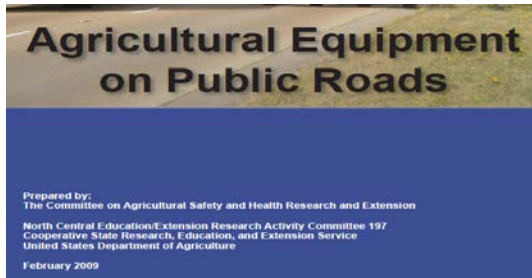


Risk Factor  
Analyses



Policy Evaluation

**Effectiveness of lighting and marking laws on reducing  
crash rates involving farm equipment**

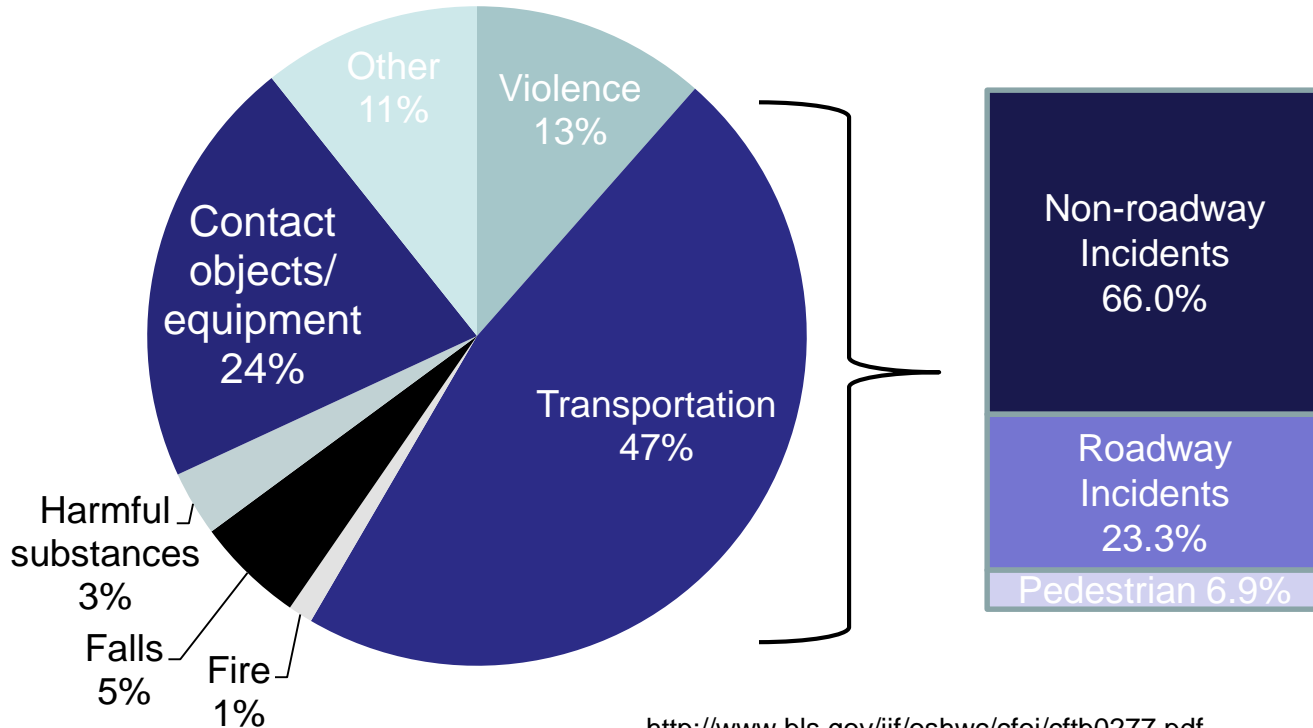


“Research is needed to assess the understandability, effectiveness and best use practices of lighting and marking agricultural equipment on public roads”

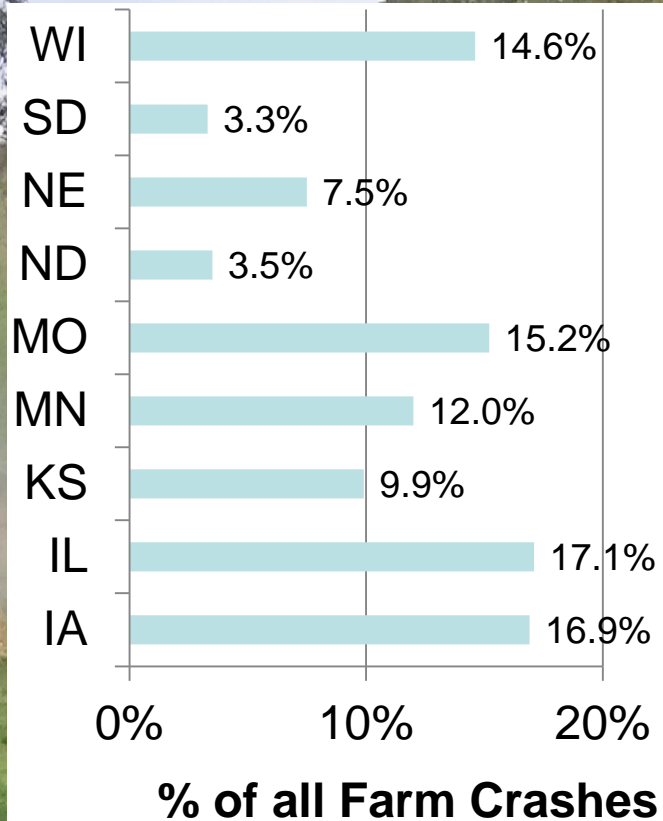


**achelor' Chris Soules formally  
arged with felony hit-and-run after  
al Iowa crash**

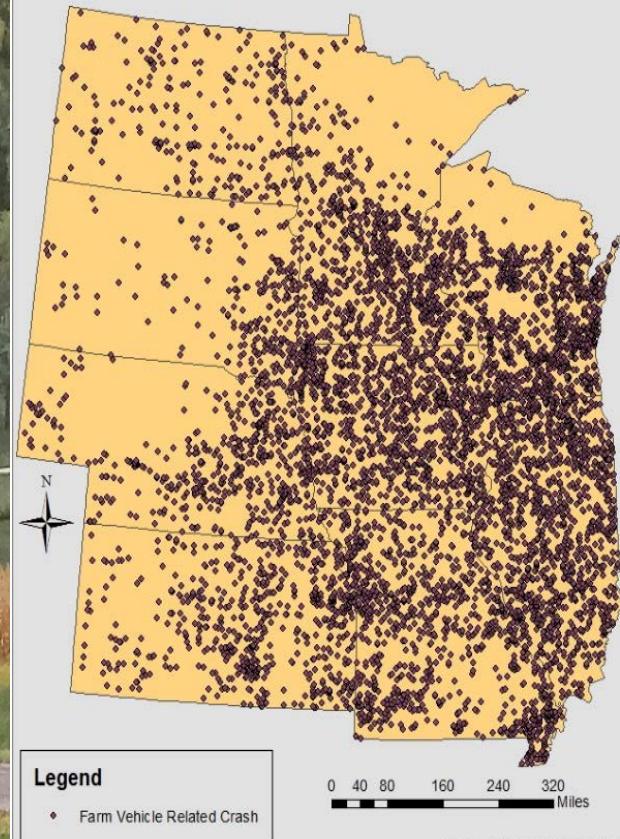
# Burden of Transportation-Related Deaths among Agricultural workers U.S. 2013



7,094 crashes  
12,938 vehicles/drivers  
14,842 persons



Nine State Farm Vehicle Related Crashes  
(2005 - 2010)





## Policy Evaluation:

***Do states with stricter policies on lighting and marking have lower crash rates?***

*Methods: collecting and coding laws*

- ✓ LexisNexis search
- ✓ Compare laws to standards offered by the American Society for Agricultural & Biological Engineers (gold standard)

*Methods: Analysis*

- ✓ Generalized Linear Models with Generalized Estimating Equations
- ✓ Controlled for population size, cultural tightness of a state, % GDP from Ag



# Policy Evaluation Form used for Screening State Codes

Policy Questions	Iowa	Kansas	Society for Agricultural and Biological Engineers – Standard
<i>How many headlights are required on tractors and self-propelled agricultural equipment ?</i>	1	2 ✓	2
<i>Are taillights/flashers/ reflectors required to define outer extremities of the unit?</i>	No	Yes, reflectors ✓	Yes, reflectors
<i>Are turn signals required on tractors and self propelled ag equipment?</i>	No	No	Yes



**Generate compliance score as the sum of compliance to each item**

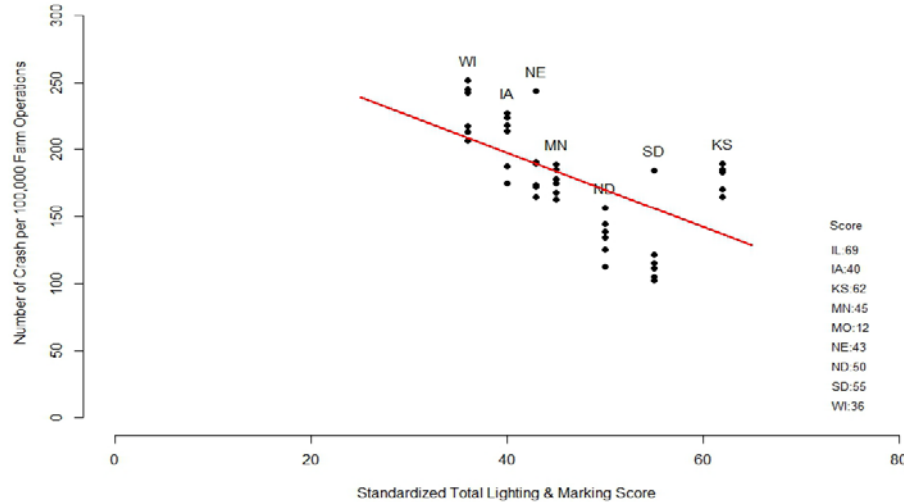
# Compliance Scores

State	Level of Compliance with ASABE Standards	Lighting Score	Marking Score
Illinois	69	73	59
Kansas	62	62	59
South Dakota	55	54	59
North Dakota	50	58	45
Minnesota	45	46	41
Nebraska	43	50	36
Iowa	40	50	27
Wisconsin	36	42	27
Missouri	12	15	5



# Associations between Compliance Score and Crash Rates

Figure 2. Scatter Plot of Farm Equipment Crash Rate by The Policy Compliance Score for 9 States, 2005 - 2010



	Composite Score	Lighting Score	Marking Score
<b>Rate Ratio (95% CL)</b>	<b>0.80 (0.75, 0.85)</b>	<b>0.77 (0.60, 0.98)</b>	<b>0.93 (0.89, 0.97)</b>

Generalized Linear Model fit with GEE, negative binomial link function  
Rescaled for every 5 unit increase in compliance

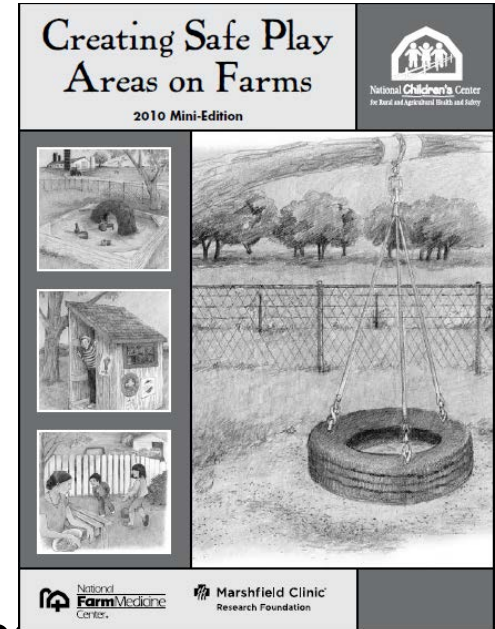


# Safe Play Areas: A Process Evaluation

M Ramirez<sup>1</sup>, E Fisher<sup>2</sup>,  
T Ellis<sup>3</sup>, R Rautiainen<sup>4</sup>,  
M Robertson<sup>1</sup>,

Parent-based educational  
intervention

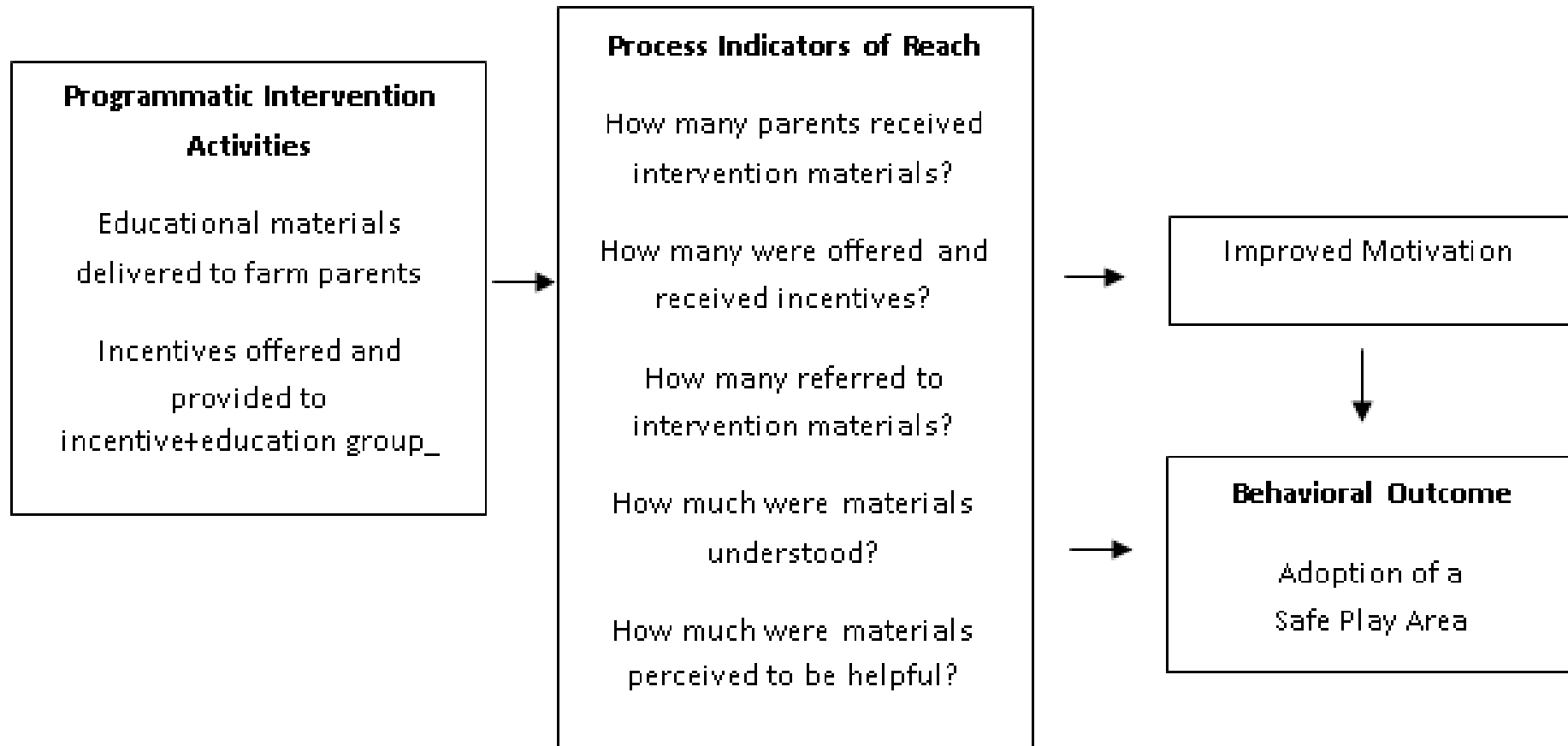
RCT among 450 farm families  
with children <7 from MN, SD,  
WS, NE, MO, IA



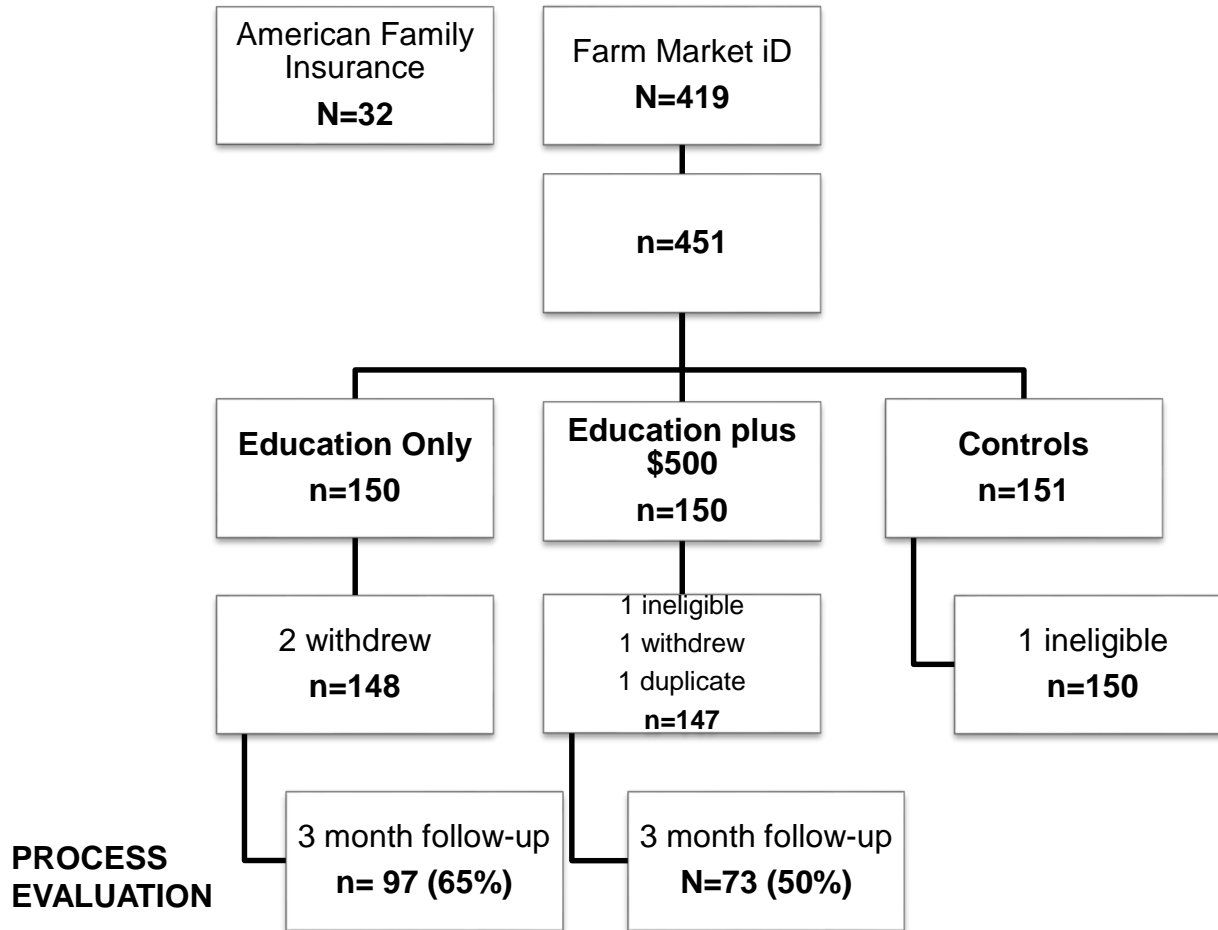
1 UMN, 2 University of Iowa, 3 National Farm Medicine

Center, 4 University of Nebraska Medical Center

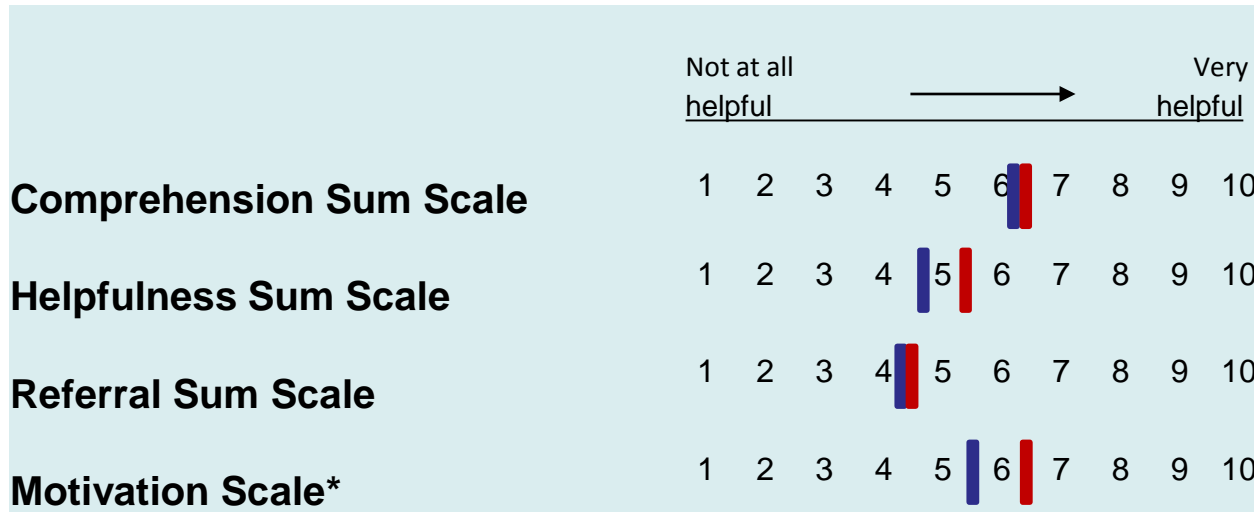
# ***Logic Model for evaluating Safe Play Areas on the Farm Intervention***



# Study Sample



# ***Intervention uptake and motivation by randomized group***



\* significant difference at  $\alpha \geq 0.05$   
Wilcoxon rank-sum test

Education only      Education + incentive

## ***How do intervention and uptake materials impact motivation?***

	<b><math>\beta</math> (95% CI)</b>
<b>Education Plus vs. Education Only</b>	<b>0.89 (0.05, 1.74)</b>
<b>Helpfulness</b>	<b>0.67 (0.52, 0.83)</b>
<b>Referred</b>	<b>0.26 (0.14, 0.39)</b>
<b>Comprehension</b>	<b>0.21 (0.03, 0.40)</b>

Show Deirdra's Video

# HIGHLIGHTS OF UMN TRAINEES

# Janitor Injury Burden



*Deirdre Green  
OIPRT Trainee*

- Janitors incur **46,000 work-related injuries** resulting in days away from work (US BLS, 2012) **16<sup>th</sup>** highest in all occupations (n=~800)

- STUDY AIMS

- Determine injury incidence and severity in Janitors and associated risk factors
- Examine relation between workload and injury through sleep quality

- Study Population

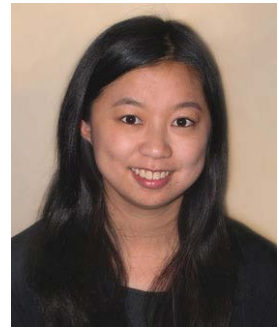
- Service Employees International Union
- Twin Cities: 4000 Members (60% Spanish, 20% Somalian)



# Janitor Study

- Cross-sectional survey to ~4000 union members, at baseline and follow-up
- 1 month workload direct sampling to obtain full shift workload exposure (steps taken, active minutes, floors climbed, heart rate, sleep duration/quality)





# Transportation-Related Research: High-Risk Rural Intersections & Intervention efficacy

*Disi Tan, OIPRT Trainee*

## STUDY AIMS

- Identify the magnitude of and risk factors for rural intersection-related crashes and the severity of injuries
- Evaluate an intelligent rural intersection collision warning system (RICWS)



# A Driving Simulator Study for Evaluating the Effectiveness of RICWS Signs at Rural Thru-STOP Controlled Intersections



## Findings:

- The sign intervention demonstrated the most safety potentials for experienced, middle-aged drivers.

*HumanFIRST Partial Motion-based Driving Simulator Set Up and Smart-Eye Pro Eye Tracking Camera*



# ASSOCIATION BETWEEN WORK-RELATED CHARACTERISTICS AND INJURIES AMONG THE AGING US WORKFORCE

- By 2020, 25% of US workforce will be aged 55+ years

**Overall aim:** Longitudinally analyze work-related characteristics, including work-related psychosocial characteristics causally associated with injuries

**Study setting and sample:** A cohort of 7,212 adults aged 50+ years from the Health and Retirement Study (HRS)

*Navneet Baidwan  
OIPRT Trainee*

**Physical work demands (yes/no)**

Demographic factors  
Health conditions & Lifestyle factors

Work-related characteristics  
Previous history of injuries

**Work-related injuries (counts)**

2004



2006

2008

2010



2014

# Final Remarks

- Rigorous epidemiologic approaches needed in occupational injury prevention
- Training the next generation of occupational injury epidemiologists



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