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Assessing the Role of Distance to Level I Trauma Units on ATV Rollovers, Tractor Rollovers, and Machinery Entanglement Outcomes

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Abstract

All-Terrain Vehicle (ATV) rollovers, tractor rollovers, and machinery entanglements cause traumatic injuries to agricultural workers. Response time of first responders combined with travel to trauma units can take a significant amount of time in rural areas, potentially leading to an increased risk of fatal outcomes for those involved in these incidents. The aim of this study is to determine if distance to a level I trauma unit is a factor in the outcomes of these incidents. ATV rollovers, tractor rollovers, and machinery entanglement injuries and fatalities, collected from a 7-state Midwestern region were entered into a GIS system along with locations of level 1 trauma units. Distance from trauma units was compared between victim outcomes (fatality versus injury), as it was hypothesized that increased distance to trauma unit is associated with poorer outcomes. Results demonstrated no statistically significant difference in distance to trauma units between injury incidents versus fatalities. When comparing outcomes between demographic variables, the data demonstrated a significant association with age ($p=0.006$). The median age for those who were injured was lower at 46.0 years compared to 58.0 years in those who died. Strategies to engage and accommodate aging agricultural workers should be researched and implemented.

Chapter 1 – Project Description

Specific Aims (Figure 1)

Determining the cause of agricultural injuries and fatalities is one aim of the Central States Center for Agricultural Health and Safety (CS-CASH) (University of Nebraska Medical Center, 2023). CS-CASH is one of 12 Agricultural Safety and Health Centers across the U.S. These centers are funded by the National Institute for Occupational Safety and Health (Center for Disease Control, 2023). CS-CASH was founded in 2011 and serves a 7-state region including North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, and Missouri. The Center's mission is to work with agricultural communities in the Central States through conducting research, intervention, education, and outreach activities to discover mechanisms of injury and illness, and to develop, implement, and evaluate prevention strategies that measurably improve the health and safety of members of the agricultural community. In support of their mission and as part of a surveillance project, CS-CASH collects and analyzes news clipping data on agricultural injuries and fatalities within their service region. News clipping data from 2012-2022 were mapped using ArcGIS as part of my APEX project in 2022. This mapping is used to determine the need for training, outreach, research and to recognize emerging issues within the CS-CASH region. Mapping allowed visualization of the considerable number of all-terrain vehicle (ATV) rollovers, tractor rollovers, and machinery entanglements. My Capstone research further explores these incidents.

Aim 1: Merge multiple datasets using ArcGIS to create a final analytic dataset.

The purpose of Aim 1 was to combine datasets with different location data and create a new analytical dataset using GIS software. The new dataset had a new variable, distance to level 1 trauma unit, created using measuring features present in the GIS software.

Aim 2: Use SAS software to examine the relationship between accident outcome and distance to trauma unit, as well as demographic variables.

From the analytical dataset created in Aim 1, statistical software was used to examine relationships between variables. The output of this analysis was used to create a discussion around the safety and health of farmers, ranchers, and producers in the CS-CASH 7-state region.

Chapter 2 – Significance and Background

As of 2021, the fatality rate for agriculture was alarmingly high at 20.0 per 100,000 workers, whereas all other industries combined had an average fatality rate of 3.6 per 100,000 workers (NIOSH, 2023). Tractor rollovers and machinery entanglements are two common types of incidents that can occur when working in agriculture. Tractors are a primary source of occupational fatalities in agriculture. In fact, tractor rollovers account for up to 76% of all tractor-related fatalities (Reynolds & Groves, 2000). Despite the Occupational Health and Safety Administration's (OSHA) rollover protection structure (ROPS) requirement for all tractors built after 1976, there are many older tractors still in use today that do not have ROPS installed. Of the 4.8 million tractors estimated to be in use in the United States today, 2.8 million are pre-ROPS tractors (Ayers, 2021). There are many factors that contribute to tractor rollovers, including high centers of gravity, rear wheel drive, narrow front ends, excessive speed, improper loading, and operation on uneven terrain (Reynolds & Groves, 2000).

Machinery entanglements are also a significant risk for operators in the agriculture industry. Entanglements occur when a body part or piece of clothing is caught in a moving part of equipment, such as the power take-off (PTO) shaft, the belt or chain drive, or the rotating parts of the implement. According to Thomas and Buckmaster, PTO drivelines are responsible for 2,000 incidents among farmers annually in the United States, resulting in severe injuries such as death, amputation, and fractures (Thomas & Buckmaster, 2003). PTOs can rotate at speeds between 540 and 1,000 rpm, which can draw a victim up to four meters into and around a shaft in less than one second. Adding to the danger, farmers and other workers often operate machinery alone, suggesting that if they become caught in the machinery, there is no one around to stop it or call for emergency assistance. Age

may play a part in the substantial number of entanglements. The average age of farmers in the United States is 57.5 years, which is significantly older than the average age of workers in other industries, making them potentially more vulnerable to accidents (USDA NASS, 2019). Agricultural workers may lack access to safety training or may not be aware of safety regulations, which can contribute to incidents. A case study in Iowa reported by the National Institute for Occupational Safety and Health (NIOSH) illustrates the severity of these incidents. *“The victim was found wrapped around the unshielded PTO shaft powering the elevator, with obvious severe injuries to one arm, leg, and his chest. After rescue crews arrived, the victim was transferred to a local hospital, where he was pronounced dead.”* (NIOSH, 2005). Education and the implementation of measures designed to prevent tractor rollovers and entanglements is crucial to protecting the safety of producers and farm workers.

Another commonly used machine in agriculture is the all-terrain vehicle (ATV), which can also be subject to rollover incidents. According to the Consumer Product Safety Commission, there were 2,211 deaths associated with off-highway vehicles (OHV) between 2016 and 2018. ATVs made up nearly three quarters of those deaths (Consumer Product Safety Commission, 2021). Risk factors for ATV-related injury and fatality include lack of formal training, lack of crush protection devices, driving up or down hills, and traversing hills (Neves et al., 2018). Investigators identified that 59% of occupational ATV-related injuries and 65% of all occupational ATV-related deaths occurred in the agricultural sector (Neves et al., 2018). ATVs have been in use for more than four decades, but there have been minimal engineering improvements in safety controls. Meyers estimates that over a ten-year period, use of crush protection devices (CPD) would result in saving lives, reducing injuries, and lowering the economic impacts of these rollover events. If CPDs

were installed on all ATVs, the social benefit of injuries averted would equate to \$3,943 per ATV over a 10-year period (Myers, 2016). Overall, rollovers present a significant risk for ATV operators, like tractor operators.

With tractor rollovers, entanglements and ATV incidents being a primary source of injuries and fatalities in agriculture, it is important that rural communities and first responders are prepared to respond to these types of incidents. There are several roadblocks that first responders may face when responding to an emergency on a farm or in a rural area. These can be grouped into the “triad of T’s”. Excessive **time** until treatment, excessive **trash** or wound contamination, and excessive **trauma** to tissues and organs (Donham et al., 2016). Preplanning is a crucial step in keeping responders safe and reducing the amount of time it takes them to respond to an accident. However, most rural emergency responders do not have right-of-entry to private farms to map them for future emergencies, leading them to not knowing whether hazards are present at the scene of the incident (Minor, 2013). Weichelt et al. notes that farms are one of the most visited rural job sites by emergency responders. They also state that most first responders are volunteers, and the number and significance of calls to farms, compounded by the rurality and geographic distance from healthcare facilities, increases the pressure on these first responders (Weichelt et al., 2018). Longer response times of emergency medical services (EMS) translates to prolonged time without treatment, which increases the risk of mortality (Adeyemi et al., 2022). Another unique roadblock for first responders is **trash**, or wound contamination. Agriculture has a working environment that can include soil, manure, petrochemicals, fertilizers, and pesticides, all of which have potential to contaminate a wound (Donham et al., 2016). Agriculture environments contain a high microbial load. Agger et al. observed that 89% of agricultural wounds had bacterial growth, compared to

63% of factory wounds. The agricultural wounds also had 4 times as many species of bacteria in them compared to factory wounds (Agger et al., 1986). The **trauma** portion of the triad is another roadblock first responders and EMS may encounter. Most agricultural traumatic injuries occur during interactions with machinery, especially tractors (Runyon, 2003). Grandizio et al. observed that injuries sustained in agriculture were consistently more severe and frequently required multiple procedures to repair the sustained damage (Grandizio et al., 2018). The trauma associated with these incidents can profoundly impact the physical health of the injured person. Traumatic injuries sustained in agriculture can be particularly devastating as they often involve amputations, crush injuries, and other types of severe trauma that can result in permanent disability and disfigurement. First responders in rural areas face several challenges in the form of excessive time, trash, and trauma. I hypothesize that these factors create a situation where victims of these types of incidents may have worse outcomes depending on the distance to level 1 trauma unit.

The literature lacks information pertaining to distance from trauma units and outcomes of ATV rollovers, tractor rollovers, and equipment entanglement incidents. The proposed study aims to bridge this gap. CS-CASH will use the information obtained from this project to identify needs for healthcare facilities and emergency response training in their 7-state region. These data can be used to create information campaigns and serve as initiative to provide direction for rural EMS training. It will also highlight the need for quick response times in the rural areas, especially when these injuries can be so severe and life threatening.

Chapter 3 – Methods

The general methodology for creating this analysis lies in four steps: Data collection and preparation, mapping and examination, generation of dataset for statistical analysis, and statistical analysis (Figure 1).

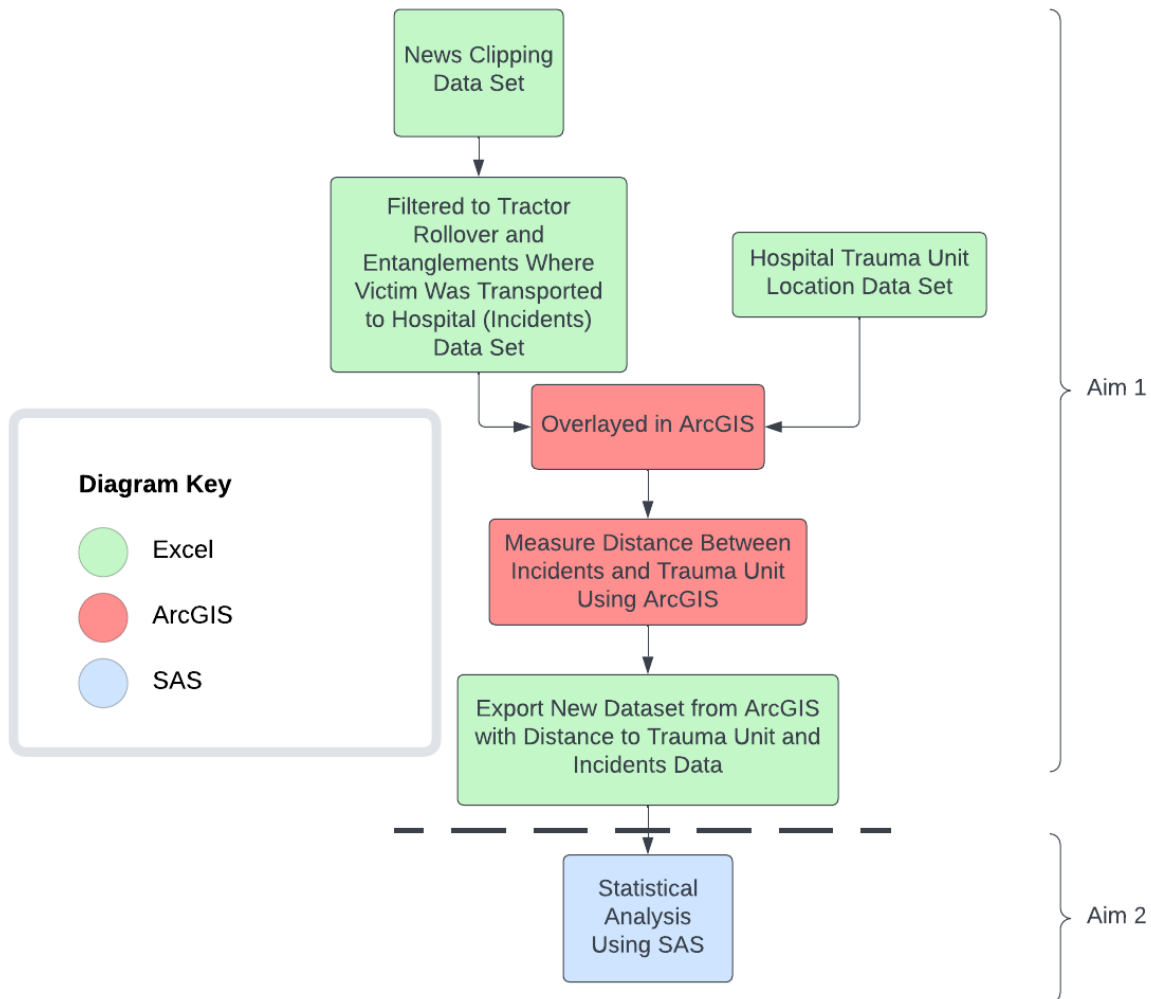


Figure 1. Flow chart of Specific Aims for Capstone Project, denoting the process by which Microsoft Excel, ArcGIS Pro, and SAS OnDemand was used for analysis.

Data Collection and Preparation. ATV and tractor rollover, and machinery entanglement incidents were collected from a larger dataset that contained agricultural injury and fatality news clipping data from incidents occurring in the CS-CASH 7-states region from 2012-2022. News clipping data was collected for CS-CASH by contract with Mr. Murray Madsen and from the Ag Injury News database (Ag Injury News, 2023).

Mapping and Examination. As part of my APEX project, I compiled the data into a mappable database. From this dataset, tractor rollovers, ATV rollovers, and machinery entanglements were filtered into a new data set and mapped in ArcGIS.

Generation of Dataset for Statistical Analysis. All incidents where the victims were dead at the scene were removed from the dataset. A dataset containing level 1 trauma units were mapped in ArcGIS. These data are located in ArcGIS Hub (Davis, 2023). The distance to closest level 1 trauma unit was measured using distance tools in ArcGIS, creating a new variable, distance to level 1 trauma unit from incident location. This new variable, along with incident data, was exported from ArcGIS to create a new data set that was analyzed in SAS OnDemand (SAS Institute Inc., 2022).

Statistical Analysis. The data were analyzed state by state and across the CS-CASH 7-state region. Normality testing was used to assess the distribution of distance to level 1 trauma units. The data was analyzed using a Wilcoxon Rank Sum test, as the data appeared to be non-normally distributed. The independent variable was distance to level 1 trauma unit from accident location. The dependent variable was accident outcome, listed as either injury or fatality. The distance was further categorized based on the distribution of the data using quartiles, and further analyzed using the Chi-Square test. Distribution of incident outcome categories (injury versus fatality) were also compared between demographic variables, age, and gender. Additionally, distance to level 1 trauma unit

between states was also compared using the Kruskal-Wallis test while stratifying by incident type. Logistic regression analysis was performed to assess the role of distance to level 1 trauma units on injury and fatality outcome while adjusting for age and state. Kansas was excluded from this portion of the analysis because they had one reported fatality.

Chapter 4 – Results

There were 308 incidents that were classified as either injury or fatality (Table 1). Injuries made up 78.3% of the dataset, whereas fatalities made up 21.7%. Of the 308 incidents, 304 reported gender. Of the incidents reporting gender, 89.5% of the incidents were male, while 10.5% were reported as female. The median age of the study cohort was approximately 51 years. Minnesota had 24.7% while South Dakota had the lowest percentage 3.6%. Median distance to a level 1 trauma unit was 70.8 miles.

Table 1. Descriptive statistics for the ATV rollovers, tractor rollovers, and equipment entanglements dataset. Age, gender, number of incidents by states, distance to level 1 trauma unit, and number of incidents described below.

Table 1: Dataset Descriptives	
Age	Measure
Mean (SD)	45.9 (23.5)
Median (IQR)	51.0 (38.0)
Gender (n,%)	
Female	32 (10.5%)
Male	272 (89.5%)
State Incidence (n, %)	
Iowa	70 (22.7%)
Kansas	19 (6.1%)
Minnesota	76 (24.7%)
Missouri	64 (20.8%)
Nebraska	40 (13.0%)
North Dakota	28 (9.1%)
South Dakota	11 (3.6%)
Distance to Level 1 Trauma Unit (miles)	
Mean (SD)	85.7 (58.3)
Median (IQR)	70.8 (45.2)
Outcome (n, %)	
Injury	241 (78.3%)
Fatality	67 (21.7%)

The distance to level 1 trauma unit (miles) was determined to be non-normally distributed, therefore, the data was analyzed using the Wilcoxon Rank Sum test. Overall and state by state, there was no significant difference in median distance to level 1 trauma unit between injuries and fatalities (Table 2). The p-value for distance to level 1 trauma unit for Kansas could not be calculated due to only one fatality incident that met the criteria for this dataset. After exploring differences in distance to level 1 trauma unit between states, significant differences were found. However, distance to level 1 trauma unit had no impact on incident outcome.

Table 2. Distance to Level 1 Trauma Unit by Outcome, analyzed as a whole dataset and state by state. Wilcoxon Rank Sum used due to nonparametric data.

Table 2: Distance to Level 1 Trauma Unit by Outcome					
Region/State	Injury		Fatality		p-value*
	N	Median (IQR)	N	Median (IQR)	
Overall	241	70.8 (46.3)	67	73.8 (50.8)	0.54
Iowa	46	65.8 (28.7)	24	68.8 (27.2)	0.68
Kansas	18	59.3 (50.8)	1	245.9 (-)	-
Minnesota	66	68.9 (40.6)	10	61.9 (38.5)	0.95
Missouri	49	53.4 (32.4)	15	59.7 (44.1)	0.96
Nebraska	33	155.1 (151.4)	7	122.0 (112.5)	0.32
North Dakota	22	86.9 (84.9)	6	139.1 (71.1)	0.22
South Dakota	7	183.5 (79.1)	4	214.4 (93.3)	1.00

*Wilcoxon Rank Sum p-value

When comparing outcomes between demographic variables, the data demonstrated a significant association with age ($p=0.006$). The median age for those who were injured was lower at 46.0 years compared to 58.0 years in those who died (Table 3). There was not a significant difference in the distribution of gender between those who were injured or fatally wounded ($p=0.38$). After categorizing distance to level 1 trauma units by the distribution of the data, there was no significant difference in the distribution of distance between injury

incidents and fatalities ($p=0.38$) (Table 3). A multivariable logistic regression analysis confirmed that distance to level 1 trauma unit is not a predictor of outcome after adjusting for state and age ($p=0.74$). Age and state are associated with outcome ($p=0.01$, $p=0.01$), however, age is evenly distributed across distance to level 1 trauma unit. The differences in outcome between states may be attributed to variations in number of incidents across states.

Table 3. Comparing Age, Gender, and Categorical Miles by Outcome. Wilcoxon Rank Sum used due to nonparametric data.

Table 3: Comparing Age, Gender, and Categorical Miles by Outcome					
Variable	Injury		Fatality		p-value
	N	Median (IQR)	N	Median (IQR)	
Age	169	46.0 (36.0)	65	58.0 (31.0)	0.006*
Gender	N	%	N	%	0.38^
Female	23	9.7%	9	13.4%	
Male	214	90.3%	58	86.6%	
Categorical Miles					0.38^
0-49.99	66	27.4%	12	17.9%	
50.00-74.99	69	28.6%	24	35.8%	
75.00-99.99	50	20.8%	13	19.4%	
100+	56	23.2%	18	26.9%	

*Wilcoxon Rank Sum p-value

^Chi Square p-value

Chapter 5 – Discussion

This project aimed to characterize differences between injuries and fatalities caused by ATV rollovers, tractor rollovers, and machinery entanglements, with a particular interest in distance to level 1 trauma units. It was hypothesized that incidents with a further distance from level 1 trauma units would have worse outcomes than those closer to these trauma units. However, the data demonstrated no significant difference in distance to level 1 trauma unit between injury incidents and fatality incidents both at the state level and for the entire region ($p=0.54$), which could indicate that local EMS teams have proper training to deal with these incidents that are highly traumatic. Another factor to take into consideration is the nature of agricultural work. A 2011 study conducted by McLaughlin and Mayhorn stated that farmers spend nearly 60% of their time working alone (McLaughlin & Mayhorn, 2011). When an incident occurs, it may be hours or days before the victim may be found, which contributes negatively to the survivability of these incidents.

Age was found to be a factor associated with incident outcomes. There was a significant difference in the age of the victims that were injured compared to victims that had fatal outcomes ($p=0.006$). The average age of those injured in incidents was 47 years, while victims of fatal accidents had an average age of 58 years. The USDA reports an average age of 57.5 years for farmers, ranchers, and producers, with 34% being age 65 years and above (Halvorson, 2023). McLaughlin and Sprufera noted that older farmers tend to suffer injuries more frequently than younger farmers and the injuries they suffer are more likely to be fatal (McLaughlin & Sprufera, 2011). These factors coincide with the findings of this study.

There was no significant association between gender and outcome ($p=0.38$). Males accounted for almost 90% of those involved in incidents, while females only accounted for

10%, which was similar between outcome groups. This falls in line with a study conducted by Horst and Marion, in which 86% of farm owner-operators were male and 14% were female (Horst & Marion, 2019). However, this is different than USDA demographics collected in 2017. The USDA reported that 64% of U.S. producers were male, and 34% were female (USDA NASS, 2019). Being male was found to be associated with increased odds of being injured in a systematic review by Jadhav et. al., The odds of a male being injured are 1.68 times that of females (Jadhav et al., 2015).

No significant association was found between categorical miles to level 1 trauma unit and incident outcome ($p=0.38$). This does not support the hypothesis that incidents with further distance to level 1 trauma units would have worse outcomes than incidents closer to these trauma units. Although this study does not support the hypothesis, other studies did find an association between distance and survival outcome. Nicholl et al., found that increased distance from hospitals was associated with an increased risk of death (Nicholl et al., 2007). Jarman et al. found that there was an 8% increase in odds of death for every 5-mile increase in distance to the nearest trauma center (Jarman et al., 2018).

Limitations

There were several limitations to take into consideration for this study. The first is that the primary data source for the incidents was newspaper articles. The depth of reporting varied from news article to news article. Also, there could be some subjectivity in what is considered news. Larger population centers may not see a tractor rollover as worthwhile news, while smaller population centers may focus on these events that impact their community. Some smaller and remote communities may not have news outlets to report fatalities and injuries. Follow ups for these incidents also varied.

Another limitation was the size of the dataset. There were only 308 incidents over a ten-year period (2012-2022) that fit the criteria for this dataset. Accounting for fatalities that did not make it to the hospital greatly reduced the sample size. Kansas only had one fatality that met the criteria set forth in this project, making a statistical comparison impossible. A larger, more robust dataset could give greater clarity to what is happening in these rural areas and potentially allows the differences in distance to level 1 trauma units between injuries and fatalities become more apparent, as the literature suggests.

No publicly available database contains information on injuries in agriculture, and thus the reason news articles were relied upon for this research. The United States Bureau of Labor Statistics lumps farmer incidents into the much broader category of Agriculture, Forestry, Fishing, and Hunting. This makes comparisons particularly challenging, if not impossible.

Finally, one important factor not discussed in this study is the severity of injury relative to distance to level 1 trauma unit. Injuries that result in amputation or paralysis may be impacted by the distance to trauma units. These injuries can be life altering and may severely impact the ability of these farmers to live the life they did prior to injury. Death does not always need to be the only call for action, thus future studies may benefit from investigating injury severity relative to level 1 trauma units.

Chapter 6 – Conclusions

Although there were no significant differences found in this study comparing distance to level 1 trauma units between injury incidents and fatality incidents, trends were seen in the data. A larger more robust dataset may be able to characterize these differences better. A dedicated database created for agricultural incidents would help pinpoint areas of need and further provide data to help the effectiveness of organizations like CS-CASH. It could also create a standard of reporting, thus being more consistent than newspaper articles. Age continues to be a factor in incident outcomes and will likely continue to be as our farmer population continues to age. Strategies to engage and accommodate aging agricultural workers should be researched and implemented.

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Foundational Competencies

MPHF3 - Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming, and software, as appropriate.

This competency will be integrated twice in this project. The data will first be compiled into ArcGIS for initial analysis, then from the dataset generated from ArcGIS, SAS Studio will be used to look for statistical significance in the data. The data that will be analyzed is both quantitative and qualitative. Interpretation of this analysis will help CS-CASH determine which communities are in need of intervention and how their region might be better served.

EOHMPH7 Employ measures to control workplace injury and illness including engineering, education, regulations, incentives, and best practices.

This competency is integrated with this project through the outcomes that are expected to be seen from the statistical analysis. Education on tractor rollovers and entanglements to communities in need will help bring awareness of these accidents, as well as providing additional training to first responders and EMS teams to provide better outcomes for those involved in tractor rollovers and entanglements.

EOHMPH8 Examine information sources and public health indicators in occupational and environmental health.

This competency is integrated through the initial data collection step. The information source that will be used to generate a map and then final dataset is newspaper clippings. These newspaper clippings are a valuable public health tool, as they can help researchers determine what is happening in areas that do not receive much media coverage. They can be used as a source to identify trends or outbreaks in smaller, rural communities.

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EDUCATION

- MPH** University of Nebraska Medical Center Expected Summer 2023
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Environmental, Agricultural and Occupational Health
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 - Biostatistics I
 - Principles of Toxicology
 - SAS Programming
- BS** University of Nebraska at Kearney, Biology May 2016
Minor in History
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 - Genetics

PROFESSIONAL EXPERIENCE

- Conagra Brands: Omaha, NE** April 2023-Present
Associate Microbiologist
- Whole Genome and 16S Sequencing
 - Performing shelf-life and challenge studies
 - Development of procedures for laboratory function
- Conagra Brands: Omaha, NE** Aug 2021-April 2023
Laboratory Technician II
- Media preparation
 - Preparation and maintenance of cultures for target microorganisms
 - Detecting, enumerating, and identifying microorganisms of concern within RQI samples
 - Documentation management and procedure conduction in accordance with ISO 17025
- University of Nebraska Medical Center: Omaha, NE** April 2019-July 2021
Research Technologist I
- Culturing monocytes to differentiate into human monocyte derived macrophage
 - Data processing from a variety of laboratory instruments using software such as Excel and universal protein databases
 - Tryptic digest of proteins for analysis by high pressure liquid chromatography combined with mass spectrometry
 - Analysis of proteins using immunohistochemistry combined with fluorescent microscopy

- Digestion of formalin-fix paraffin embedded (FFPE tissue for analysis by Western Blot and high-pressure liquid chromatography combined with mass-spectrometry
- Training of graduate students and other technicians on proteomic procedures
- Responsible for the purchase and organization of over \$75,000 worth of laboratory supplies and equipment

Ward Laboratories: Kearney, NE

May 2017-April 2019

Laboratory Technician

- Testing the organic content of soil
- Fat, starch, dry matter, and non-protein nitrogen analysis on feed samples
- Ammonium, dry matter, and ash analysis on manure and manure slurry samples
- Dry matter and nitrate analysis on plant samples
- Total suspended solids, total dissolved solids, biological oxygen and chemical demand analysis on water samples
- Phosphorous, sulfur, and specific gravity analysis on fertilizer samples

Institute of Environmental Health: Grand Island, NE

Oct 2016-May 2017

Laboratory Technician

- Utilization of Polymerase Chain Reaction (PCR) techniques to test meat samples for bacterial contamination
- Knowledge and utilization of both quantitative and qualitative tests to test samples for a range of microorganisms
- Media preparation and sample plating

ADDITIONAL SKILLS AND EXPERTISE

- | | |
|---|---|
| <ul style="list-style-type: none"> • Media preparation and sample plating • Microorganism enumeration and identification • 16S and Whole Genome Sequencing (WGS) • Aseptic technique skills • Water activity and pH analysis • Laboratory equipment calibration and validation • Operation and maintenance of laboratory equipment | <ul style="list-style-type: none"> • Organization of laboratory samples and procedures from current and previous lab members • Utilization of different laboratory procedures to produce results for a variety of samples and diverse food matrices • Development and refinement of new and existing laboratory procedures • Computer skills: proficient in Microsoft Excel, PowerPoint, and Word |
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PUBLICATIONS

Grabowska, K., Macur, K., Zieschang, S., Zaman, L., Haverland, N., Schissel, A., Morsey, B., Fox, H. S., & Ciborowski, P. (2022). HIV-1 and methamphetamine alter galectins-1, -3, and -9 in human monocyte-derived macrophages. *Journal of Neurovirology*, 28(1), 99–112.

Peterson, B. C., Koupal, K. D., Schissel, A. K., & Siegel, C. M. (2015). Longevity of mineral supplements within the soil and associated use by white-tailed deer.

Pending Publications

Macur, K., Schissel, A., Yu, F., Lei, S., Morsey, B., Fox, H., & Ciborowski, P. (2023). HIV Infection and Methamphetamine Response Exposure Change Histone H3 Lysine 14 Acetylation Stoichiometry in Human Monocyte Derived Macrophages as Determined by MS-based Absolute Targeted Quantitative Proteomic Approach. *Journal of Proteome Research*.

Biography

Andrew Schissel grew up in rural Northeastern Nebraska, where he was actively involved in the farming community. Between 4-H, FFA, and working on a farm, Andrew saw many different facets of agriculture. This fueled his desire to pursue an MPH, where he could give back to the community that ignited his passion. Andrew is currently employed as a Food Microbiologist with Conagra Brands and currently lives in Omaha with his wife, two dogs, and cat. He also makes frequent trips to his family's farm where cover crops and conservation capture his current interests.