Episode Title: Research Spotlight: Farm Vehicle Crashes on Public Roads

Summary: This episode is part of our "Research Spotlight" series, where we talk about recent research in the field of agricultural safety and health. Research can help identify hazards, understand outcomes, and determine if interventions are helpful in reducing injuries and illnesses. In this episode, we hear from Matt McFalls and Dr. Marizen Ramirez from the University of Minnesota, who recently published a paper titled "Farm vehicle crashes on public roads: Analysis of farm-level factors." We discuss their study examining risk factors for rural roadway crashes and why research is important to gather information we can use to develop prevention programs. A link to the paper is included in the episode resources.

Expert: Marizen Ramirez and Matt McFalls

Episode Quote:

"This study gives us an opportunity to look at these factors that are influential to crashes, and then ask, 'What can be modified at the farm level? What can be changed to prevent crashes?'"

– Matt McFalls, PhD student, University of Minnesota

Transcript

00:04 K. Crawford

Welcome to the FarmSafe Podcast brought to you by the Great Plains Center for Agricultural Health. Today we have a special episode to highlight recent research in the field of agricultural safety and health. Research is an important piece of what we do to try and reduce injury and illnesses in agricultural communities. Research can help identify hazards, understand outcomes, and determine if interventions are helpful in reducing injuries and illnesses. My guests today are Matt McFalls and Dr. Marizen Ramirez from the University of Minnesota. They recently published a paper titled, "Farm vehicle crashes on public roads: Analysis of farm-level factors," which describes their study examining risk factors for rural roadway crashes.

Thank you both for being here today. Can you introduce yourselves to our listeners?

M. McFalls

I'm Matt McFalls. I'm a fourth year PhD student in the occupational injury prevention research training program at the University of Minnesota.

M. Ramirez

I'm Marizen Ramirez. I'm a professor of Environmental Health Sciences at the University of Minnesota School of Public Health. I also direct the Midwest Center for Occupational Health and Safety. It's a training center funded by the Centers for Disease Control and Prevention, really focused on preparing, training the next generation of occupational health safety professionals in our field.

I'm really delighted to join you today to speak about this project but to also really talk about this larger scope of work, looking at farming equipment roadway crashes. You know when we think about occupational health and safety in general, we know that transportation is a significant external cause for morbidity and mortality. And in farmers and agriculture, specifically, we know that, again, transportation, is one of those important hazards that we as a public health community must face.

We know very little about the characteristics of roadway crashes on public roads, involving agricultural equipment and we really have started to really think about prevention because really that's where the buck is. The efforts in prevention are really important. That's what our calling is in public health.

K. Crawford

Dr. Ramirez, could you give us a little background on this work?

M. Ramirez

When I was at the University of Iowa, I was part of the Great Plains Research Center, and this was one of three large projects that was funded by the center under CDC to study this problem of roadway crashes. And we actually looked at data from nine Midwest states to understand the epidemiologic trends of these crashes. We examined crash and roadway data in in the state of Iowa. We utilized geographic information systems to look at geographic characteristics of where in these nine states did these crashes occur, what kinds of environments urban and rural, what types of roadways. Curved roadways, straight roadways, roadways with gradient, roadways without gradient, roadways with increased traffic density. And finally, we engaged in surveys with farmers to understand what their experiences of crashes on public roadways looked like. And so, again, large body of work we've done, and years of research in this area.

And then, at the University of Minnesota, when I had moved there, we had this existing data that I found to be quite important for training students like Matt in occupational health and safety, specifically roadway crash injuries. So, you know as we talk today, I think we'll learn more about the work that Matt has done, and certainly I would love to speak to sort of the bigger impact of this research, because it is an area that had been previously understudied.

K. Crawford

I'm looking forward to hearing more about this. In this podcast we talk about different hazards and try to provide recommendations for reducing injuries resulting from exposure to those hazards. But with this episode, I think we have an opportunity to talk about how we even get the information we need to make those recommendations in the first place.

This paper lays out some background information about how there are higher crash fatality rates on rural public roads than compared to other roadways, AND that when agricultural equipment is involved, those rates are even higher. So, it sounds like what you're saying is, this is a clear problem, but more research is needed to understand why this is happening. In your study, you're pulling together a ton of data describing the circumstances of these crashes and you're talking to farmers about their experiences with vehicles on the road, all so you can get a better idea how to recognize what's leading to those crashes? Because we can do more to prevent them if we know what is causing them, right? Is that the goal?

M. Ramirez

Absolutely. And when we think about roadway crashes it's been well established that rural roadways are much more hazardous than other types of roadways and there's many reasons for that, including uncontrolled speed, there's lack of traffic controls. You also don't see divided lanes, or highways, so often these conditions really lead to an increased risk for crashing on roadways.

Particularly in urban settings, we would often encounter these large farm equipment vehicles, that size differential is a critical issue. Speed differential is another one because these are slow moving vehicles. So, when you have slow moving vehicles, large sized tractors or farm equipment, and then we have smaller sized high speed passenger vehicles, those interactions, as well as that rural roadway, kind of lead to a perfect storm of potential crashes.

We do know that crashes involving farm equipment tend to be severe, especially for those that are in the passenger vehicles. And again, a lot of this is due to size and speed differential. So, when you think about the physics of crashing, you've got a large equipment crashing with a small passenger vehicle. So, the injuries and deaths are higher in passenger vehicles versus farm equipment vehicles. So, it's really an interesting scenario here where we're sharing the roadway, and we're wanting to think about prevention efforts where farmers and other roadway users can use safe driving strategies, safe vehicle operating strategies, in order to create a safe roadway environment for everyone.

And Matt, I don't know if you would like to just chime in. I know that you've been looking at this research as part of your training, and maybe you could speak to some of the other background literature that you found in this area?

M. McFalls

Yeah, I think one of the things that was surprising when I was starting this out was just how few surveys of farmers have been done in general. And there really was more of a reliance on motor vehicle crash reports, which is where we learned a lot of these things that Dr. Ramirez has been highlighting. I think that was perhaps the main surprise for me was that at some point in doing this analysis—I

jumped on the project sort of midway–was just it resonated with me, just how many farmers from how many states this survey made up, and that I was working with some data that was kind of rare.

K. Crawford

Yes, I'm glad you brought that up. The survey piece is interesting, especially if most of what we know about these incidents comes from crash reports. Can you talk a little bit about what you're getting from the surveys that you can't get from these crash reports?

M. Ramirez

As Matt had mentioned a lot of the existing studies, particularly traffic studies, really focus on crashes. So, you know, you get a collection of crash reports, often from law enforcement, and fortunately at the state and national level, there are efforts to collect this information that has been extremely valuable for research, really informative. But what they tell us is only the characteristics of the crashes after they happen. So, we don't really know very much about risk factors which means you really want to know about behaviors and characteristics of drivers and farm vehicle operators who crash and don't crash, so that you can look at what factors actually increase their probability of crashing. And that's a really key thing because that tells us about prevention.

The body of work that exists has been extremely valuable because they tell us the characteristics of those crashes, but we want to step back and say, "Okay, what are those risk factors?", so that they can tell us who is at most risk for crashing because those are the answers that really help inform prevention.

Matt, do you want to delve into the actual survey items and maybe some of the unique questions that we had asked?

M. McFalls

The survey was really in two parts. Every farmer who took the survey was basically asked about their farming operation, size of the farm, they filled out a vehicle matrix of the types of vehicles and the mileage and the seasonality of driving those vehicles.

And then there was a point in the survey where a question was asked of "Have you ever had a crash with equipment from your farm, and at that point, there were some questions [if] they responded, "Yes", asking them to recall the crash. When it happened, time of year, who was driving, passengers are in the vehicle or not. Some of the conditions, the behaviors of the drivers, was anyone distracted? Daylight, nighttime? And also, if there was any report of the crash to law enforcement, or who was at fault.

Anything about the size of the farm and their operation that wouldn't be on a crash report. And really those questions would complement a lot of what we can learn from crash reports, where there's overlap and where there's not. And that would help us corroborate our findings, based on what we know from crash reports, what we know farmers are reporting from the survey, and look for any kind of overlap or any differences. So really, there was potential with this, to learn some things that wouldn't be found in a crash report.

M. Ramirez

Thanks Matt and I would just want to add, you know, a couple of additional thoughts here. This survey also asked about near misses which often don't end up in the crash report. And when you think about it some of even the more minor crashes, sometimes don't end up in a crash report. So, this is an opportunity to obtain that. Another piece of data that we were able to collect–Matt, you talked about that earlier and I just want to emphasize why it's important–is how many vehicles are being operated on the road, how [many] miles are they used on the road, all of that, what we call exposure data, is really important because that gives us a frame of the frequency of driving on roads and that will ultimately, tell us what we call denominator data, which, you know, again, the case data, the crash data are numerator data, the exposure, how much time you spend on the road is your denominator data, and you need these two estimates, in order to understand really what is the risk and what's the probability of crashing.

Sorry to get technical there, but it's such an important piece when you're trying to understand, again, who's at risk. Is it people who are driving more? You want to account for how much people are on roads to understand what are the risks for crashing.

K. Crawford

Interesting. So, the numerator and denominator are how you're look at the outcome, or crashes, compared to the exposure, or time on the road. And one crash reported by a farm with one vehicle that is rarely on the road may be a different story than one crash from a farm with a ton of vehicles frequently on the road?

M. Ramirez

Yes, yes, Kate thanks, thanks for expressing that. Yes, and you're able to account for those differences. So, somebody who drives more frequently versus those who drive less frequently, then you're able to understand, okay, why is there a higher risk in one group than the other, and account for that.

K. Crawford

Matt, for this project, you were doing the analysis and took all this information describing farms, vehicles, and crashes and then developed a predictive model. Can you talk a little about that?

M. McFalls

The basic idea behind a predictive model is to look at combinations of factors that may be important to an outcome. So, we weren't trying to model a cause to say that this factor is causing crashes. It was instead all of these factors in combination. So, there were a fair number of items on the survey related to the farm, the operation, demographics of the farmer that we considered including in the model. And then there's ways to check is the model working well with these characteristics? Should we leave them in the model? Take them out? And at the end of the day, we come up with a model that we can test how well it's working, and get these sort of crash probabilities, based on factors and combinations. So, a combination for instance, a farm that drives high mileage, uses crops, has a high number of vehicles, perhaps a small farm, place those in combination, you get a probability, which could be useful. There's somewhat of a limit to predictive ability for something like crashes that are influenced by so many factors. We simply couldn't collect all the factors in a survey to create a model. So, we tried to come up with something that was kind of simple and a little bit intuitive, when we looked at the sectors and combination and tried to explain the results.

M. Ramirez

Yeah, and you know I think what Matt had really pursued is a really important approach of studying a problem that we know very little about. So, you kind of explore the data, and say okay of all of these factors that we've collected, what's driving crashes? Because we didn't know. And often in other studies where you've got sort of a body of research you might have one question and you're able to delve in and say, I want to know is factor A increasing your risk of crashing. But again, we just didn't know, especially since no really extensive surveys to this level had been previously conducted. So, you're really trying to get the data, use these data and try to explore and find what together are the profiles of crashes. What profile of farmers and farm operations have a higher probability of crashing?

K. Crawford

So, what did you find? What type of operations have the highest probability of crashing based on your research and this analysis?

M. McFalls

When we were compiling the results and sort of creating these profiles of farms, we zeroed in on the size, whether or not a farm is crops or, as opposed to a livestock farm or some farms were involved with both, high vehicle mileage, high number of vehicles. So, across any of those factors, there was a trend. Any farm driving a high number of vehicles would overall have a higher probability of crash in comparison to other farms of similar size driving fewer vehicles for instance. So, really at the top of the whole thing, the largest farms driving the most vehicles with the highest mileage and crops in their operation, would have a higher crash probability than farms that weren't driving as often.

K. Crawford

When I read your paper, it also said that most crashes were happening during the day and during clear weather right? I thought that was interesting, maybe surprising to me, because it seems sometimes, we only tell people to be careful when driving in the dark or on ice. Does that tie back into exposure and that there's just most people on the road on clear days?

M. McFalls

I think it could reflect when the work is being done. In a lot of ways, I think that past research has considered this type of finding of most crashes happen during the day, during clear weather, during the seasons of summer, the harvest season in the fall when most activity on the road is happening. If we were to talk about what surprised us about the research, I think in some ways just how much it lined up with what we know from research from crash reports, asking farmers of their experience with crashes, asking them to remember something that may have happened while ago, as opposed to an officer filling out a crash report on the day of the crash. It was surprising just how much some of the findings lined up.

K. Crawford

What's the next step? You've identified this group of factors that contributes to a higher probability of crashes, so what do you do with that information?

M. Ramirez

That's the kind of exciting stuff that Matt was able to come up with those profiles and say, okay, there is a group or a type of farm that have a greater risk of crashing. And then from a prevention standpoint, and we'll get into that, that's where we can really focus our efforts, because if you only have so many resources for prevention, we want to prioritize to begin with some of our efforts in prevention in characteristic operations that are at higher risk of crashing.

M. McFalls

I think it was also a useful approach in our situation having a lot of factors that maybe at the end of the day, aren't going to be modified: the size of a farm, how often someone drives. The whole operation is not going to change based on crash risk. So, it really gives us these profiles to zero in on and ask well what can be modified within the space of a large productive operation? So, what this study gives us an opportunity to do is look at these factors that are influential to crashes and then ask questions of what can be modified at the farm level. What can be changed? What can we look more into to prevent crashes?

M. Ramirez

Developing interventions in partnership with these large farm operations would be a really logical next step. It is key that when we think about developing these programs of intervention that that we design them together with our large farm operators, and obviously the impacts could be really great because we can learn from each other, we can implement interventions within their settings, and then really think about the "4 E's" of prevention: education enforcement engineering and economics because we want to look at the cost effectiveness of the programs that one might be implementing, and certainly I think that bottom dollar is really important for our farm operators and their businesses.

K. Crawford

Matt, any other thoughts on your findings or next steps?

M. McFalls

I think I'd emphasize as well, the importance of passenger vehicles and their involvement in the crash. Findings from our survey, past studies, has been that often the crash is the result of the passenger vehicle driver or the fault of the passenger vehicle driver. So, I think a forward-thinking statement here would also be to–especially with urbanization, we know that the rural/urban interface is weaving together more or growing together–just to consider that for education of passenger vehicle drivers, as well, who may be entering into a rural area rarely, or for the first time, or who may have been driving in rural areas their whole life. I think that would be an important takeaway to consider for education.

M. Ramirez

Matt, that's a really good point. And, you know, I think with these large farm operators, and all farm operators in general, those coalitions and partnerships with their local communities can really, really move things forward. I know that you all have another project at the Great Plains Center focused on educational campaigns and communities and I think that's a really wonderful next step

that you know these campaigns can be also implemented in partnerships with the, with these large farming operations. So that might be another area for the future.

I also want to sort of speak to some of the other work that we've done on lighting and marking of farm equipment. Our research found that these policies that include stricter laws or guidelines on marking and lighting of vehicles, has been found to be protective against crashing. So, I think that's another space in which yes, the other passengers on the roadway are often at fault. And that also our farm operators play a really, important role in prevention by marking and lighting their vehicles to the best, best levels as possible.

K. Crawford

I think that's a great point. We did an episode on lighting and marking and talked about the lighting and marking makes it easier to see these vehicles when you come up on them, especially at night. We also talked about educating the community and passenger vehicle drivers about those size and speed differentials you mentioned earlier and how those emblems are meant to alert you to those situations.

As we wrap up today, do you have any final thoughts?

M. Ramirez

Well, I just want to say that again, we're really grateful for the opportunities to be able to continue this research and to bring it full circle is that my role is to also train you know future prevention specialists, like, Matt, to research on areas that are of great importance to the agricultural community, and the occupational community. So, I'm grateful for that opportunity to bring this knowledge and to also bring new people like Matt into the field, for Matt to be able to sort of explore the data in innovative ways because the newer generation of researchers are coming up with better techniques, innovative techniques that I think we want to apply in our field. So, it's been really just a wonderful process.

K. Crawford

Thank you both for being here and I appreciate taking the time today to talk with us today and telling us about your project. As I said earlier, we talk a lot on this podcast about hazards and prevention strategies but it's interesting to hear about the research that goes into that and helps us get the information we need in the first place to understand those hazards and develop prevention strategies.

M. McFalls

Listen in to the FarmSafe podcast to join in the conversation about keeping safe on the farm and on the road.

K. Crawford

Check out the links provided in the episode resources section of our website which include links to the GPCAH's resources on rural roadway safety and a link to the paper that Matt and Dr. Ramirez talked about today.

We want to hear from you. Share your stories about health and safety issues on the farm, about injuries that made you change the way you work, or about the ways you keep yourself and others safe on your farm. Also let us know if there are any topics that you want to hear about on the air. You can visit our website at gpcah.org or email us.

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Episode Resources

- GPCAH Rural Roadway Safety Resources
- Farm vehicle crashes on public roads: Analysis of farm-level factors
- Community campaigns for roadway safety

Photo