Are Individuals with Arthritis More Likely to be Involved in a Crash?

Authors: Mohammed Almannaa, Max Bareiss, Luke Riechinger & Feng Guo, Virginia Tech University

Arthritis causes stiffening and pain, which worsens with age and can limit a person’s range of motion and ability to drive safely. Because of the prevalence of arthritis among U.S. drivers, understanding its impact on driving could assist in the development of systems to improve safety. This study investigated the differences in driving between individuals with and without arthritis to compare their crash risk. Using the Strategic Highway Research Program Naturalistic Driving Study (SHRP-2 NDS) dataset provides unique insights into the natural driving behavior of the subjects by recording key vehicle information such as speed, braking and steering wheel angle, as well as video recordings of the driver and surroundings. Anonymized data for trips involving experienced drivers with and without arthritis who were and were not involved in crashes were examined. Seventy-eight drivers out of 3,563 had severe arthritis and were involved in 414 out of 1,641 crashes. The main factors analyzed were crash risk, secondary task engagement and driver strength. The analysis found a significant relationship between arthritis and crash risk with an odds ratio of 1.72, which indicates that individuals with arthritis are 72 percent more likely to be involved in a crash than non-arthritic drivers. After controlling for the potential confounding effects of age, we concluded that arthritis is associated with higher crash risk and special assistance systems can potentially improve safety for these drivers.

MyMobility Plan: Helping Older Adults Remain Safe, Mobile & Independent

Authors: Laurie Beck, Gwen Bergen, Briana Moreland, Bethany West & Ann Dellinger, The Centers for Disease Control & Prevention (CDC)

Driving helps older adults stay mobile and independent, but they are at an increased risk of being injured or killed in a crash due to frailty and underlying health problems. Declines in vision and cognition (the ability to reason and remember), and physical changes might also affect driving. In addition, physical changes associated with aging can change the way the body reacts to medicines, potentially causing more side effects including the ability to concentrate and drive safely. The good news is that there are steps older adults can take today to improve their mobility and maintain their independence tomorrow. The CDC’s planning tool, MyMobility Plan, can help older adults prepare for possible mobility changes in the same way they plan financially for retirement. The tool has three sections — MySelf, MyHome and MyNeighborhood — designed to help older adults (or their family members or friends) — develop a personal plan to meet the challenges that might come with age so they can stay safe, mobile and independent as long as possible.
Poster 3

Developing an Optimal Traffic Signal Control Algorithm with Pedestrian Priority at Signalized Intersections Under Connected Vehicles Environment

Authors: Amirreza Nickkar & Seyedehsan Dadvar, Morgan State University

Connected vehicle technology is able to consider both vehicle and pedestrian movements in an integrated framework to avoid possible collisions at intersections. The current research aims to provide an optimal algorithm for optimizing traffic signal control at an isolated signalized intersection under a connected vehicles environment. The proposed algorithm has two innovations that distinguish it from past studies: first, this algorithm considers pedestrian priority at the intersection and, second, it also includes a developed traffic signal optimization model for both vehicle and pedestrian demands that considers the geometric status of the road and crosswalk. Results show that the amount of vehicle traffic, as opposed to the number of pedestrians, is what influences the total delay time at an intersection.

Poster 4

Capturing Road Users’ Traffic Safety Knowledge Retention Using an Audience Response System Program

Authors: Rebecca Liller, Jason Jackman, Pei-Sung Lin & Siwon Jang, University of South Florida, Center for Urban Transportation Research

WalkWise Florida provides interactive presentations and safety information to the public to increase their knowledge of appropriate safety measures identified by the Florida Department of Transportation (FDOT). The program began in 2010 as WalkWise Tampa Bay and was expanded statewide. Since 2013, WalkWise Florida has reached groups in more approximately 15 of Florida’s high crash counties. Certain demographic groups are threatened by this safety problem more than others because pedestrian fatalities and injuries do not impact all people equally. Therefore, the primary target audience for these presentations was high-risk populations identified by FDOT crash data. An Audience Response System (ARS) was used before and after the WalkWise presentations to assess attendees’ short-term knowledge retention and understanding of correct pedestrian and bicyclist safety practices. The results indicated that knowledge retention increased immediately following the presentation and further indicated through an online survey, which was conducted two weeks later.

Poster 5

Georgia’s 2018 Pedestrian Fatalities: A Preliminary Description

Authors: Charles Warnock & Carol P. Cotton, University of Georgia

Rising pedestrian fatalities are a worrisome trend in Georgia. As the number of overall yearly traffic fatalities stabilizes, the number of pedestrian fatalities and the proportion of traffic fatalities that are pedestrians has increased every year since 2014 both statewide and nationally. Understanding the characteristics of pedestrian fatalities allows for the development of successful evidence-based interventions and life-saving roadway and pedestrian engineering efforts. This poster preliminarily describes pedestrian fatalities in Georgia in 2018 using data from the Georgia Electronic Accident Reporting System (GEARS).
**Poster 6**

**How Do e-Bikes Affect Bikeshare Systems?**

**Authors:** Mojdeh Azad & Christopher R. Cherry, University of Tennessee-Knoxville

Bikeshare raw Global Positioning System data were analyzed to compare the behaviors of traditional bicycle riders’ and electronic bicycle (e-bike) riders and e-bike riders with different bikeshare membership types. Using data collected from the Baltimore Bikeshare system in November 2016, 4,384 trips (40% via e-bikes) completed by 1,393 users were analyzed. We visualized geographical distribution of all trips to identify the segments used by riders and the segments with larger differences in speed. This led to the creation of a map of speed differences between e-bikes and traditional bikes. We also studied and compared trip characteristics and safety behaviors among riders using e-bikes versus traditional bikes and among riders with different types of bikeshare membership.

**Poster 7**


**Authors:** Nitesh Shah & Christopher R. Cherry, University of Tennessee-Knoxville

According to the 2017 National Household Travel Survey, bicycles accounted for only 1% of mode share in the U.S., despite the promotion of bicycling as a means to build livable communities and streets, reduce congestion and create an active lifestyle. Past studies have cited safety among the reasons not to bicycle, yet this factor is often overlooked in disaggregate route choice modeling. Fatal and incapacitating bicycle crashes were used as a proxy of perceived safety to evaluate the route choice for regular and casual bicyclists. Global Positioning System (GPS) data for 9,101 trips made by 1,866 users from November 2014 to May 2015 for Grid Bike-share in Phoenix, Arizona were used to compare the actual route with four alternative routes using a path size logit model. The results found that crash history negatively influences bicyclists’ route choice, which implies that people perceive these serious crash locations as dangerous and tend to avoid them. This preference was found predominant for regular bicyclists versus their casual counterparts. These findings can be used to increase ridership by strategically investing limited resources at the locations and routes perceived safer by bicyclists.

**Poster 8**

**Bicycle Safety Education Project: Driving Change in Grand Rapids**

**Authors:** Chelsea Maupin, Güd Marketing; Suzanne Schulz, City of Grand Rapids; & Mike Smith, Michigan Department of Transportation

Grand Rapids’ ratio of fatal crashes involving people riding bicycles was 50% higher than the statewide average prior to the Driving Change program. Recognizing the need to address this problem, the City working with Güd Marketing developed a multi-faceted initiative for a long-term safety program to save lives and change minds. The comprehensive, research-based approach included crash data analysis, the identification of communication best practices, survey research to understand audience perceptions and behavior, and focus groups to test messaging. From this research, a public education campaign was developed and implemented to promote awareness of new city ordinances, communicate rules to both motorists and bicyclists and help “drive change” in the community that builds a culture of respect between all drivers (bicyclists and motorists) on the road. After conducting the campaign during three summers, a post-campaign survey showed a significant impact on understanding, perceptions and behavior change among Grand Rapids residents. In particular, there was double-digit growth in understanding of specific rules of the road, as well as growth in the key campaign success measures of perceptions of respectful riding behavior, campaign awareness and message recall. Most importantly, during this three-year period Grand Rapids’ bicycle-involved crashes fell to a record low.
**Poster 9**

**Identifying Vulnerable Road Users’ Crash Correlates Along Street Corridors**

**Authors:** Farah J. Al-Mahameed & Xiao Qin, University of Wisconsin-Milwaukee

Crashes involving pedestrians and bicyclists, commonly referred to as vulnerable roadway users (VRU), have been increasing at an alarming rate in recent years, and are strongly correlated with roadway, environment and socioeconomic factors. However, specific variables representing these factors are often correlated, making it difficult to accurately characterize relationships between individual variables and pedestrian and bicyclist safety. Our study used the structural equation model (SEM) technique to overcome this problem. We collected more than 60 explanatory variables for 200 highway corridors in Wisconsin. Since VRU’ variables are continuous in space (e.g., percentage of the corridor length with median, side-path, bike lane), results from a corridor-specific study are expected to be more informative. This research will provide a better understanding of the intricate relationships between the factors that contribute to VRU road crashes, especially at the corridor-level.

**Poster 10**

**Advocating Complete Street Policy for Pedestrian Safety**

**Authors:** Istiak Bhuyan & Dr. Celeste Chavis, Morgan State University

In the U.S., 5,987 pedestrians and 840 bicyclists were killed in vehicular crashes in 2016, a 9% and 1.3% increase, respectively, compared to the previous year. In addition, 70,000 pedestrians and 45,000 bicyclists were injured in traffic crashes in 2016. The first step in understanding where these crashes occur is to employ strategies such as Hot Spot Analysis and Kernel Density Estimation (KDE). This spatial statistical analysis can help to identify priority locations and the appropriate traffic safety countermeasures. The analysis takes this a step further to identify features of the environment that attract roadway users and can act to hinder or support pedestrian, bicyclist and motorist safety. The Hot Spot Analysis aggregates the crash locations into weighted features, produces a roster of statistically significant hot and cold spots using the Getis-Ord Gi* statistic and the KDE represents the probability of crash occurrence based on the variables. For crash incidents (point occurrences), KDE is more suitable as it considers both individual locations and density of points at a given location, while hot spot analysis considers only values (positive/negative z-scores) of crash incidents. To identify road segment or intersection, a KDE might be more applicable, while hot spot analysis can be useful for zonal studies (block groups/tracts) as it takes into consideration mode, along with people and the environment. Upon identifying the severe locations, changes in road design such as converting them into complete streets should improve safety for pedestrians and bicyclists. This study evaluates the successful implementation of a complete streets policy to reduce crashes and improve traffic safety.

**Poster 11**

**Distraction-Colored Glasses: How We Report Distracted Driving Affects How Much of It We See**

**Authors:** Lila Ralston, MPH, Traffic Safety Research and Evaluation Group & Shiwei Tang, MPH, Department of Epidemiology and Biostatistics, College of Public Health, University of Georgia

Allocating resources and evaluating countermeasures to address distracted driving require accurate data that reflects the prevalence of the problem along with its effects on crashes, injuries and fatalities, and changes over time. Although it is often difficult for the reporting officer to determine whether distraction was a factor in a crash, in Georgia, as in many states, the crash report is the only data source available. Beginning in July 2017, Georgia law enforcement agencies transitioned to a new crash report form which has more options for reporting distraction as a contributing factor. This introduces a potential bias in reporting the prevalence of distraction as a factor in crashes, which prompted our research to account for the effects of the change due to the new crash report form. Why does this matter? The State Legislature is assessing the impact of the Hands-Free Georgia law, which took effect in July 2018, and considering possible amendments. Using all fatal and injury crashes (injury code K, A, or B) reported via the Georgia Electronic
Accident Reporting System in January-April 2017 (n=13,262) and January-April 2018 (n=12,382), we examined the following variables: year, agency, accident report version, date last modified, and proportion of crashes with distraction reported as a contributing factor. We found that officers using the new form are more likely to include distraction as a contributing factor, which may be mistaken for evidence of an increase in distracted driving. In addition to ensuring that policymakers take this into account, our findings will be used to educate law enforcement about the role of distraction in crashes so they report it appropriately; to seek funding for well-designed observational studies of distracted driving, detailed crash analysis, and other methods for more accurately assessing its role in crashes; and to monitor the effect of changes in the reporting method on the reported prevalence of distracted driving.

Poster 12

Deterring Distractions & Aggressive Driving Behavior Using a Smartphone App: What Difference Does it Make?

Authors: Sirajum Munira, Texas A&M University & Russell Henk, Texas A&M Transportation Institute

Distraction and other risky driving behaviors are the leading causes of fatal crashes involving teen drivers. Using data obtained from a smartphone app developed for the Safest Young Driver Contest operated by the Texas A&M Transportation Institute’s Teens in the Driver Seat® program, our research investigated the nature and prevalence of distracted driving under real-world conditions and whether real-time feedback provided by the app and the opportunity for reward resulted in teens curtailing risky driving behavior. The app was made available to everyone but only users 15 to 24 years of age were eligible for prizes. An analysis was conducted on three months of data that accounted for 8,111 trips logged from 138 teen users. The app detected the car driver’s phone use while driving along with other aggressive driving events including harsh acceleration, hard braking, and cornering. Statistical analysis to investigate the difference in driving behavior between the teen drivers’ first and last 10 trips were performed. We found that feedback and incentives resulted in a significant decrease in phone use while driving among female users and users age 15 to 17. This research adds valuable insights into the scope and characteristics of distracted drivers and innovative solutions for addressing the problem.

Poster 13

Stay Alert & Get Home Unhurt: Preventing Drowsy Driving Among Maryland Healthcare Providers

Author: Susanne Ogaitis-Jones, MSPH, CHES, CPST/I, Maryland Institute for Emergency Medical Services Systems

In 2017, the Maryland Highway Safety Office (MHSO) received a grant from the Governor’s Highway Safety Association and the National Road Safety Foundation to create a drowsy driving prevention campaign for Maryland healthcare providers. The MHSO partnered with the Maryland Institute for Emergency Medical Services to develop a campaign to reach Emergency Medical Service (EMS) and hospital personnel across the state. Health care providers were chosen as studies indicate that 10% of all crashes involve a drowsy driver, that shift workers are a high-risk group and many EMS providers say they are fatigued and/or sleep-deprived increasing their risk of crashing. The campaign used research and informal surveys to create targeted educational materials to help educate this population about drowsy driving and prevent the behavior. Products that were produced and disseminated to 25 hospitals and EMS companies included: two, 30-second Public Service Announcements, a website, 14 social media messages, six table tents with eye-catching messages, a magnet and hot cup holder with the logo and website URL, PowerPoint presentations, ready-to-use press materials, and on-line training. Examples of these materials are provided. Feedback from campaign implementers was used to determine next steps for preventing drowsy driving.
Poster 14  
**Occupant Protection for Children Track**

**From Research to Practice: Assessing Community Child Safety Seat Use. Data Collection Recommendations from the Native Children Always Ride Safe Study (Native CARS)**

**Authors:** Nicole Smith, Tam Lutz & Candice Jimenez, Northwest Portland Area Injury Health Board; & Jodi Lapidus, Oregon Health & Science University

Do you use data to identify groups at risk for riding unrestrained? To tailor messages to specific audiences? To allocate your funding more efficiently? To demonstrate need for a grant application? We do, too. After doing extensive research documenting how children ride in motor vehicles, we developed a data collection method that is easy to use, collects key risk factor information and requires no statistical software or expertise. Everything you need to collect community child passenger safety data is available at nativecars.org. See Module 4 for copies of the data collection tool and to download the Excel file for data entry and automatic analysis.

Poster 15  
**Occupant Protection for Children Track**

**Occupant Restraint Checkpoints: Collecting & Comparing Child Restraint Use Data**

**Authors:** Rebekah Abangan & Andrea Tsatoke, Indian Health Service, U.S. Public Health Service; and Patsy Sneezy, Ignacio Sneezy & Jeralie Crowe, San Carlos Apache Police Department

From 2016-2018, Division of Environmental Health Services, Indian Health Services staff coordinated occupant restraint checkpoints with the San Carlos Apache Police Department and the Community Health Representative (CHR) program. The checkpoints provided a way to collect and compare estimates for child restraint (CR) use and correct CR use. An occupant restraint measurement process was developed and used at three checkpoints. The police department addressed on-site traffic safety considerations and communicated the reason for the checkpoint to each stopped driver. Vehicles with unrestrained children, children with suspected incorrect CR use, or children whose parents wanted a CR checked were diverted to an adjacent area where child passenger safety technicians were staged to assess CRs. The occupant restraint checkpoints incorporated data elements for both CR use/non-use and correct/incorrect CR use. This method provides more representative data because it includes a sample of the child population randomly captured in the checkpoint. In addition, use of this method and the resulting data can provide for local comparison over time. The CR use/non-use findings for the 2016-2018 checkpoints indicated a 17% increase in restraint use and a 7% increase in correct usage.

Poster 16  
**Pedestrian/Bicyclist Track**

**Driving in the Danger Zone: Parking Lot Safety**

**Authors:** Stephanie Bridges, Andrea Tsatoke & Robert Morones, Indian Health Service, U.S. Public Health Service

Unintentional injury was the leading cause of death in Arizona for American Indians/Alaska Natives (AI/AN) for all ages from 1999-2016. Among Arizona AI/ANs in 2016, the pedestrian fatality rate was 9.05 per 100,000, three times higher than the statewide rate. In 2017, unsafe vehicle and pedestrian parking lot conditions, which could lead to injuries among pedestrians and motorists, were identified at a commercial complex on an Arizona Indian Reservation. Issues identified included no marked parking spaces or traffic lanes, no marked crossing areas, no fire lanes, and no separation between vendor and parking areas. A traffic count assessment, based on the Manual of Uniform Traffic Control Devices, was used to quantify the amount of vehicle and pedestrian traffic within the commercial center and confirm the need for traffic control measures. A report of the findings was shared with key partners resulting in the passage of tribal resolution in August of 2018 to address the safety issues. Significant improvements to the center included marking all vehicle traffic lanes, parking spaces, fire lanes, and pedestrian crossing locations, as well as several other key improvements.
Poster 17  
**Infant Car Seat Challenge. What’s All the Fuss About?**

**Authors:** Ariel Burton, Angela Rowlett & Danielle Brown, Schneck Medical Center

The purpose of a car seat safety challenge is to promote the safe transport in motor vehicles of all at-risk infants leaving the facility where they were born. This population includes infants less than 37 weeks gestation being discharged on cardiac or apnea monitors, infants with medical conditions and infants weighing less than 2,500 grams with maternal opioid use. Evidence-based knowledge on improving car seat safety for at-risk infants is discussed as well as the guidelines and process for conducting a car seat challenge.

Poster 18  
**Evaluation of Safety Enhancements in School Zones with Familiar & Unfamiliar Drivers**

**Authors:** Maria Rojas, Didier Valdés & Benjamin Colucci, University of Puerto Rico-Mayaguez; & Michael Knodler, University of Massachusetts at Amherst

Working collaboratively, we investigated the safety and operational aspects of school zones when driven by motorists familiar and unfamiliar with their surroundings. Driving simulators were used to analyze driver responses to changes in roadway configuration, school zone speed limits and roadway signage. A comparison between familiar and unfamiliar drivers’ behavior was performed. In terms of speed compliance, the effectiveness of the enhanced traffic control devices with Spanish-text was greater for familiar drivers when compared to unfamiliar drivers. This finding might be indicative of the consideration for the use of symbols rather than text messages in areas with the propensity to have unfamiliar drivers on the road.

Poster 19  
**Building a Child Passenger Safety Technician Network**

**Authors:** Fara Smith, Jennifer Northway & Andrea Morales Swindler, University Health System

Even though there are more than 100 child passenger safety technicians in the area, it seems like the same 10 participate in community events and update classes. In an effort to increase engagement and improve technical skills, as well as reduce last minute sign-off requests and lapsed certification renewals, Safe Kids San Antonio launched Tech Network. The initiative targeted technicians within the University Health System’s trauma service area, which includes San Antonio (Bexar County, TX) and its contiguous counties. Through monthly meetings, the Tech Network provides continuing education and works to create a community of practice. Successes to date are highlighted including increased engagement at events, on-going skill development and reduced requests for last minute sign-off.

Poster 20  
**Motor Vehicle Collisions Among Emergency Medical Services (EMS) Providers: Policy Solutions for a Growing Problem**

**Author:** Jeffrey Rollman, UCLA Fielding School of Public Health

Emergency Medical Services (EMS) providers play a critical role in ensuring that those involved in motor vehicle crashes are transported to medical facilities to receive appropriate care. These first responders, however, are two to five times more likely than the general worker population to be injured or killed in a transportation-related incident. Most of these fatalities occur during lights and sirens use. The hierarchy of controls was used to analyze EMS motor vehicle collisions and potential solutions. The most effective control, elimination, is unlikely to be feasible, while the second, substitution, is the most appropriate opportunity to intervene. Sufficient evidence is available to suggest that substituting lights and sirens usage with non-emergency driving can lead to dramatic decreases in EMS motor vehicle collisions without negatively impacting patients’ health outcomes. Yet this risky practice largely continues. Simple regulatory changes to address lights and sirens could yield positive benefits without any apparent unintended consequences.
Laws Against Alcohol Discount Tactics & Fatal Vehicle Crashes: Protocol for an Empirical Study

Authors: Victor Puac-Polanco & Charles Branas, Columbia University

Every 50 minutes a person died in an alcohol-related motor vehicle crash in the U.S. in 2016. Drunk driving continues to be the most significant contributor to fatally-injured drivers in the U.S. Despite more than three decades of policies and programs aimed at deterring alcohol-impaired driving concurrent with new vehicle technologies and restraint systems, in 2017, a total of 10,874 lives were lost in alcohol-related crashes on the nation’s roadways. These preventable deaths represent almost a third of all fatally-injured crash victims. We can do better. Our research examines how alcohol policies might affect the alcohol consuming behavior of people involved in alcohol-related crashes. Our aim is to produce evidence that gets us a step closer to eliminating alcohol-related fatal injuries.

Alcohol Consumption & Driving: Facts, Perception & Simulation

Authors: Yindhira Taveras & Didier Valdés, University of Puerto Rico-Mayaguez

Road crashes related to alcohol consumption claim thousands of lives around the world. This poster presents the results of three related studies to determine the factors that influence the Blood Alcohol Concentration (BAC) in a group of drivers in Puerto Rico. Our research goal for the first study was to identify the factors that influence BAC for drivers with different characteristics. The second study examined drivers’ perceived ability to drive after consuming alcohol and their actual BAC levels. In the third study, driving simulation was used to show the effects of alcohol consumption in participants’ decreased driving abilities.

Preventing Road Traffic Injuries in Jamaica: Gap Analysis & Recommendations

Authors: Andrea Gielen, Keshia Pollack Porter & Sung Huang, Johns Hopkins Bloomberg School of Public Health; & Trevor Wrobleski, Tsinghua University

The Johns Hopkins Center for Injury Research and Policy (JHCIRP) was asked by the National Road Safety Council of Jamaica (NRSC) to conduct a gap analysis and produce recommendations for programming, policy and/or research to reduce traffic-related crashes, deaths and injuries in that nation. Six overarching priorities consistent with the Safe Systems approach were identified by the research team and NRSC: structural (enforcement and engineering), cultural/educational, vehicle accessibility, data, emergency response, and electronic surveillance. Best practice recommendations to address these priorities were culled from the research literature and international organizations. A total of 24 best practice recommendations were identified to address these priorities.

Evaluations of Low-Cost Countermeasures for Preventing Wrong-Way Driving Incidents: Two Before-and-After Case Studies in Alabama

Author: Qing Chang, Auburn University

Before and after analyses were conducted at two exit-ramp terminals of partial cloverleaf interchanges (I-65 Exit 284 and I-65 Exit 208) in Alabama that were identified as high-risk locations for Wrong-Way Driving (WWD). Alabama Department of Transportation regional engineers have implemented low-cost countermeasures to mitigate the WWD activities at these two locations including: new double yellow lines and left-turn skip strips on the crossroad, a yield line for the right turn lane and a stop bar for left turn lane at end of the exit ramp for Exit 284; and a raised-curb channelized island to reduce the width of the ramp for Exit 208. There is little documentation on the effectiveness of these types of low-cost countermeasures in reducing WWD incidents. WWD incident data were collected at these two locations before...
and after the countermeasures were implemented. Following installation of the countermeasures, WWD incidents at Exit 284 declined 65% overall and 89% at night. The latter is the result of drivers following left-turn skip strips more closely during nighttime than the daytime hours. At Exit 208, installation of the channelized island resulted in an 80% increase in WWD incidents. Additional signage and pavement markings need to be improved along with the channelized island to achieve better effectiveness in preventing WWD incidents at this location.

**Poster 25**
**Evolving Safety Priorities & Solutions Track**

**Modeling the Risk of Wrong-Way Driving at the Exit Ramp Terminals of Partial Cloverleaf Interchanges**

**Authors:** Md Atiquzzaman & Huaguo Zhou, Auburn University

Partial cloverleaf (parclo) interchanges are susceptible to wrong-way driving (WWD) due to the presence of closely spaced parallel entrance and exit ramps. In this study, a logistic regression model was developed to predict the risk of WWD at the exit ramp terminals of parclo interchanges based on geometric design features, wrong-way (WW) related traffic control devices (TCDs), area type (urban/rural), and Annual Average Daily Traffic (AADT) on exit ramp, entrance ramp, and crossroad. The developed model was used to conduct a network screening for 38 exit ramp terminals of parclo interchanges in Alabama. The top 10\% high-risk locations (i.e., four exit ramp terminals) identified by the model were further verified by 48-hours (Friday, 5 PM to Sunday, 5 PM) WWD incident data at each location. Results suggest that two out of four locations had more than 10 WWD incidents during a typical weekend. Given the rareness of WWD events, it can be concluded that the developed mathematical model can effectively identify the high-risk exit ramp terminals for improvements even without crash history. Transportation agencies can use this mathematical model for initial identification of high-risk exit ramp terminals within their jurisdictions and verify the high-risk locations by field WWD incident data.

**Poster 26**
**Evolving Safety Priorities & Solutions Track**

**Traveler-Involved Traffic Crashes as a Negative Externality of Tourism**

**Authors:** Amin Mohamadi Hezaveh, Candace Brakewood & Christopher R. Cherry, University of Tennessee-Knoxville

Although it is well established that travelers have a higher risk of injury in traffic crashes compared to non-travelers, less is known about the magnitude of traffic crashes involving travelers and the negative externality of travelers’ crashes (NETC) imposed on non-travelers. In this note, we relied on the U.S. Travel Association’s definition of a traveler to conduct an empirical analysis focusing on the state of Tennessee, which defines travelers as those who travel more than 50 miles from home or have a home-address outside of Tennessee state. We found that 19.2\% (127,031 out of 694,276 from 2014-2016) of traffic crashes in Tennessee involve a traveler. The injury cost of non-traveler crashes due to a crash with a traveler (i.e., monetized value of NETC) exceeds $7.6 billion, or 12.3\% of tourist expenditures between 2014-2016. Analyzing the net impact of travel (tourist expenditures minus NETC) at the county level reveals that the NETC exceeds tourist expenditures in 19 of 97 counties (or 20\%) in Tennessee. The results of this analysis reveal that an overlooked negative externality of tourism is traffic crashes involving travelers, which warrants further study and potential policy remediation.

**Poster 27**
**Evolving Safety Priorities & Solutions Track**

**Work Zone Safety**

**Authors:** Farzaneh Azadi, Praveen Edara & Yaw Adu-Gyamfi, University of Missouri-Columbia

Two work zone safety projects are presented. The first discusses a reference sheet, the outcome of a project sponsored by the Federal Highway Administration to develop guidelines for using crash modification factors (CMFs) to assess the potential effect of a work zone countermeasure. Two examples are presented to illustrate how work zone countermeasures are evaluated using CMFs. The second project explores the utility of SWiZApp, a smartphone app developed to address the lack of reliable work zone information. The app collects accurate data related to speed limits, traffic conditions, lane activity, and positive protection such as barriers and vehicle arresting systems. Workers can use the app to automatically geolocate the work zone location and add condition information that can be used by
departments of transportation, traffic management centers and contractors. This app may also have utility for third parties such as travelers who could use this information to plan trips or navigate safely through work zones.

Poster 28  
**Evolving Safety Priorities & Solutions Track**  
**Intelligent Transportation System Approach on Freeway Secondary Crash Identification & Mitigation**  
**Author:** Armana Huq, Florida International University

Secondary crashes (SCs) usually occur due to non-recurring congestion or other prior incidents. SCs are increasingly spotted as a major issue on freeway traffic operations leading to reduced capacity, extra traffic delays and increased fuel consumption and emissions. The USDOT estimated that SCs alone are responsible for approximately 18% of all traffic fatalities and 20% of all crashes. Further, compared to primary incidents, SCs have significant impacts on traffic management resource allocation. For these reasons, prevention of SCs has been highlighted as a high priority task for traffic incident managers. In fact, the FHWA uses the reduction of SCs as one of the performance measures for state incident management systems. Previous studies have reported that the risks of SCs can be reduced by improving the incident management process to warn about prior incidents ahead of time. A method for identifying SC’s is one of the critical challenges for the transportation industry. Researchers are also struggling to define SCs, so traffic safety practitioners must identify a holistic way to define them. Though Connected Vehicle technology is the advanced method of mitigating SCs, there are some significant limitations that still need to be addressed.

Poster 29  
**Evolving Safety Priorities & Solutions Track**  
**Influence of Adverse Weather Conditions on Crash Clearance Time**  
**Authors:** Henrick Haule, Priyanka Alluri, Thobias Sando & Md Asif Raihan, Florida International University

Crashes are a major cause of traffic delays on freeways. It is essential to clear crashes as quickly as possible irrespective of the weather conditions. However, rainy conditions could impact crash clearance duration. The goal of our study was to estimate the duration of rain within the crash clearance time and evaluate the impact of crash-related attributes on the clearance time during rainy conditions. Crash and rain data (2014-2016) were extracted from the SunGuide® and National Oceanic and Atmospheric Administration (NOAA) databases, respectively, for a network of freeways in Jacksonville, Florida. The study estimated the rain duration within the crash clearance time and used hazard-based models to investigate factors that influence the crash clearance time as a result of the weather. The results indicated that crash severity, the extent of rain duration, time of day, day of the week, area type, and involvement of Emergency Medical Services significantly impacted the crash clearance time during rainy conditions. The study results can assist incident management agencies in advancing strategies to reduce crash clearance time during adverse weather conditions.