



**RECOMMENDATIONS TO REDUCE SEMI-TRACTOR TRAILER
INCIDENTS ON INDIANA'S MAJOR ROADWAYS**

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Executive Summary

The following analysis summarizes research and recommendations regarding the importance of safety associated with drivers utilizing Indiana's major roadways, specifically, drivers operating semi-tractor trailers. This 34-page analysis including references, has been compiled over the course of one semester and details extensive themes related to the overall well-being of semi-tractor trailers.

Based on extensive research, the following items are recommended to reduce semi-tractor trailer accidents on Indiana's major roadways:

- Install ignition interlocks on semi-tractor trailers
- Implementing cable barriers is a cost-effective method to eliminate the risk of cars crossing the centerline while driving
- Encourage the Indiana Department of Transportation (INDOT) and its partners to conduct research on where to place cable and steel barriers
- Create speed restrictions in non-interstate highways for vehicles with a gross weight greater than 26,000 pounds (lbs.) to improve the safety of rural roadways
- Increase the width of these roadways will decrease the possibility of vehicles departing the road
- Create situational speed restrictions for the counties listed in the "Other Restrictions Regarding Semi-Tractor Trailers" section
- Post speed limit and no passing zone signs in regular intervals with proper placement in rural areas where vehicles may attempt to pass local vehicles, including farm equipment, with limited knowledge of the architecture of the roadways
- Consider advocating for rest areas to be implemented on U.S. state roads in addition to interstate roadways
- Construct additional rest areas on I-69 near Petersburg, IN and on I-70 in either Vermillion or Gibson County
- Expand upon the rest area in White County to resolve issues of capacity and safety

The transportation infrastructure continues to be a vital instrument for the Crossroads of America. As a global center of transportation and logistics, the economy of Indiana relies heavily on freight movement (INDOT, n.d.). Freight movement will continue to aid the State of Indiana in competitive advantage compared to other states. By 2040, the expected increase of freight flow is 60 percent (INDOT, n.d.). The work behind this analysis directly supports the expansion of freight mobility while promoting Indiana as a leader in prioritizing driving safety.

Introduction

Graduate-level students embarked upon a semester-long research project at Indiana University Purdue University Indianapolis (IUPUI) to further understand highway safety and the imposed risks of semi-tractor trailers, while also studying the safety initiatives across the State of Indiana. This study seeks to scientifically and statistically provide practical recommendations for the Indiana University Police Department (IUPUI) and the Indiana State Police (ISP) to mitigate and curtail semi-tractor trailer accidents on Indiana's major roadways.

A myriad of assumptions and misconceptions exist regarding the causes of accidents involving semis, with one common assumption being that drivers of semi-tractor trailers are the source of many roadway incidents. Many believe that semi drivers purposefully disregard laws such as speed limit restrictions, weigh station check-ins, and electronic logbook regulations. Common assumptions emerge due to the perception of crashes involving semi-tractor trailers and the impact that they have on families, communities, and society. Our analysis intends to investigate these assumptions and detect the accuracy of these claims in order to provide a meaningful response.

The following recommendations are presented to Chief Doug Johnson, IUPD and ISP in an effort to reduce the likelihood that semi-tractor trailers will be involved in an accident, while maintaining endeavors that further promote the safety of all drivers. The Indiana University Public Policy Institute (2018) estimates there were 219,112 collisions in Indiana involving a commercial vehicle in 2017, of which 834 resulted in fatalities. Successful implementation of recommendations may help to effectively reduce this number and prevent the loss of innocent life within the State of Indiana.

The National Scope of Semi-Tractor Trailer Accidents

“Semiochophobia” or the “fear of semi-trucks”, faces everyday people when they are commuting on the roads, highways, and/or interstates of the United States (U.S.). While this may be mere fallacy that is based upon the nervous tendencies of drivers across the country, it is possible that this fear can be supported by actual statistics and scientific data. Semi-tractor trailers are visible anywhere you go in the country, as they are a necessity for transporting goods and services, which means that they are not at risk of becoming limited on roadways (Delchamps, 2019).

Drivers of these large trucks (and other commercial vehicles) are certified to drive with a Commercial Driver’s License (CDL), but this requirement does not prevent them from making the same mistakes that are made by other drivers. As made evident by the various mistakes of semi drivers, accidents involving these vehicles can be more destructive and more devastating than those caused by the average Toyota Prius. Based upon the scope of semi-tractor trailer accidents and the common themes that surround the issue, semiochophobia may actually prove to be justified rather than unfounded fear.

Although the presence of semi-tractor trailers is large, they only constitute 4.3 percent of all highway vehicles and only ten percent of total highway miles traveled. The difference between these vehicles and others is their size and weight, which makes them exceedingly more dangerous than the average commuter vehicle. Additionally, it is recorded that semi-tractor trailers are involved in only 2.4 percent of all vehicular accidents, which means that they are approximately three times (3x) less likely to be involved in an accident than their counterparts (FaceTheFacts, 2013).

Based upon observed data, seventy-five percent of accidents involving commercial vehicles are not the fault of the commercial driver; which actually happens only sixteen percent of the time. The severity of semi-tractor trailer accidents can be traced to the fatality statistics that correspond with occurrences. Ninety-eight percent of all trucking accidents result in the drivers of other vehicles being killed; therefore, leading to the statistic of someone being killed every sixteen minutes in a trucking-related crash within the U.S. (TruckInfo.net, 2019).

Expanding further on the scope of semi accidents, sixty-eight percent happen in rural areas and seventy-eight percent of accidents happen over the course of the weekend. Between the years of 2016 and 2017, reported data of semi-tractor trailer crashes saw an increase of 9 percent. Although many of these accidents may appear to be similar, there are many reasons for these fatal wrecks, including: environmental conditions, commercial vehicle driver impairment, and passenger vehicle error and/or impairment. However, placing emphasis on commercial vehicles and their drivers, reveals an interesting perspective on why these large/oversized vehicles can become deadly under certain circumstances (FMCSA, 2019).

According to a study performed in 2007 by the Federal Motor Carrier Safety Administration (FMCSA), there are three primary causes of fatal accidents - the driver, the vehicle, and the environment. Driver causation consists of four sub areas: non-performance, recognition, decision, and performance; which comprise up to eighty-seven percent of all causal factors. The other two causes of fatalities, vehicular and environmental factors, are fairly self-explanatory with regard to their involvement and/or causation in an accident.

In order to successfully focus on drivers, the causal factors must be reviewed in more depth on an individual basis. The first of these factors, non-performance, refers to drivers and any physical impairments that may be impacting their ability to drive, such as: excess fatigue,

heart problems, and/or stroke/seizures. Non-performance impairments and their influence, while not always the direct responsibility of the driver, represent roughly twelve percent of all accidents. The recognition category stands for distractions from internal and external sources, (or the observation of activities happening around the vehicle) and result in twenty-eight percent of accidents.

The third subcategory of driver causation, performance, represents the smallest subcategory (only 9 percent) and relates to poor judgement and/or an overreaction to incidents on the road. In contrast, the top subcategory of decision-making, represents a staggering thirty-eight percent of driver-related accidents. This area is the most crucial, as it pertains to the decision-making of speed, vehicle following distance, relation to other vehicles on the road, and navigation around others.

Along with an in-depth view of causal factors, the study by the FMCSA listed the top ten reasons for a fatal accident with a semi-tractor trailer. Among these reasons, the top three are (in order): 1. brake problems; 2. traffic flow interruption (congestion, previous crash); 3. prescription drug use. Surprisingly, even though truck drivers are made to work long shifts and may drive many hours without pause, fatigue is ranked at the bottom of the list of ten (FMCSA, 2019).

Semi accidents, despite being quite small in number, account for the majority of vehicular deaths. While semi-related fatalities and wrecks may be associated with many factors and/or concerns, they are largely correlated with the sheer size and weight that these vehicles transport on a daily basis. Although it can be presumed that the majority of these wrecks are caused by vehicles attempting to drive around semi-tractor trailers, it is clear that there is a large

proportion of these accidents that may be avoided if extra control and monitoring is implemented effectively.

Ultimately, when it comes to truck drivers and the surrounding causal factors, many accidents relate to decision making and the ability to pay attention to surrounding activities and/or environmental elements. Successfully preventing accidents will depend upon how certain actions are addressed and how safety measures are implemented around the State of Indiana. Alleviating this issue will involve interpretation of passenger vehicle actions, the training of daily commuters in trucking/driver safety, and the evaluation of semi driver alertness and decision making. While in-depth training may be necessary to ensure improved future decision making, addressing the everyday commuter may be most effective in securing better highway safety.

Major Road Configurations Throughout Indiana

When addressing the issues of major road configurations and major roadways that have the highest number of semi-tractor trailer accidents, there are many contributing factors beyond geographic designation(s). As acknowledged during research on the topic, it is considered a great deal of arterial roads that are vital to the state; these include the major interstate highways: I-65, I-70, I-74, I-80/90, I-265, and I-465. However, more than half (fifty percent) of fatal trucking accidents occur on major roads and thoroughfares that are not classified as interstates or major highways - only around one-third occur on interstates and freeways (secondary to other major roadways).

Major projects, such as "Next Level Roads" by Indiana (IN) Governor Eric Holcomb, have targeted several miles of road north of I-465 and I-65 that have required repair after years of winter road damage. Additionally, this project also has involved the repair of guardrails,

concrete overlay on bridge decks, and the replacement of light bulbs with light-emitting diode (LED) lights. Although the closure has been frustrating for a large number of commuters, it has been an extremely safe and efficient road project (Hwang, 2019).

Shutting down individual sections of the roadway and only focusing on one part at a time, has allowed workers to operate quickly and safely around the clock with completion in a shorter span of time. This has been extremely beneficial in comparison to shutting down multiple lanes for months; therefore, creating severe traffic issues and excessive safety concerns. According to the Indiana Department of Transportation (INDOT) (2019), their agency is “committing around \$150 million across the state to clean-up interstates and state roads after multiple hard winters,” including the tasks of: resurfacing, pothole patching, and bridge repair.

Craig, Kelley & Faultless, LLC (2018) stated that the most dangerous highways in Indiana include: I-90 (the Indiana Toll Road), I-65, and I-70; furthermore, due to the high volume of semi-tractor trailer traffic throughout Indiana, these highways are considered some of the most dangerous in the country. Since I-90, the Indiana Toll Road (ITR), connects the state with Illinois and Ohio, semi-tractor trailers frequent this highway daily. In most instances, interstates that merge with other interstates and/or freeways present a higher risk to all drivers, which includes: I-70, I-74, I-65, and I-465 in Indiana. INDOT has also noted that construction zones present a higher risk to drivers due to rear-end collisions that result from: following too closely, unsafe lane movement, improper lane changes, unsafe speed, and various other factors.

Statistics from 2010-2014, stated that I-65, I-80, I-90, and I-94 were the deadliest interstate roadways within Indiana (Faultless et al., 2018). The first interstate observed on the national ranking list was Interstate 65, which came in at number six and federal highway U.S. 421, at number ten. Focusing on semi-tractor trailer statistics from the Northwest Indiana Times,

fifty fatal crashes have been recorded in the I-80, I-94, and I-90 corridor (thirty-three of which involved semi-tractor trailers); I-65 had thirteen fatal motor vehicle crashes, with semi-tractor trailers involved in 5; and U.S. 421 had no reporting of semi-tractor trailer fatalities.

Additionally, from the time frame of 2013-2017, interstate collisions with commercial vehicles had jumped from 3.7 percent to 9 percent of all accidents, but fatal crashes decreased by 5 percent (Nunn, 2018).

Regulations Regarding “Over the Road” Commercial Truck Load (CTL) Nationwide

When addressing the importance of regulations nationwide, it is important to understand the size and weight standards for all semi-tractor trailer drivers, including those drivers traveling internationally. According to the Indiana Title 9, there are several size and weight standards semi drivers must comply with in order to ensure safety when traveling nationwide, as well as, specifically along Indiana roadways (INDOT, 2019). For example, the weight of a single axle cannot exceed 20,000 pounds, the weight of a maximum tandem axle cannot exceed 34,000 pounds, and a maximum tri-axle cannot exceed 50,000 pounds. In addition to the size and weight standards, drivers need to be aware of bridge restrictions nationwide. According to INDOT (2019), drivers must obtain approval from the municipality before traveling the routes with bridge restrictions. It is the responsibility of the driver, including those driving internationally, to understand the size and weight standards as well as further restrictions when traveling.

When citizens of other countries (such as Mexico and Canada) are entering the United States as a commercial truck driver, there are set expectations, as well. Foreign citizens must have proof of residence in a foreign country without intention of abandoning their country (CBP, n.d.). Although the U.S. does not require Canadian residents to provide a passport or visa upon entry, photo-identification is required. However, citizens from Mexico are required to present a

valid passport or non-immigrant visa. All foreign citizens must return to their countries at the end of the authorized period of temporary admission (CBP, 2019).

Drivers from other countries, such as Mexico and Canada, can deliver a shipment from Mexico or Canada to one or more U.S. locations, however, drivers are unable to deliver to an unaddressed U.S. location, or reposition an empty trailer between two points in the U.S. (DHS, 2012). International drivers are unable to transport hazmat materials, including explosives, unless drivers have undergone a thorough background check (DHS, 2012). Background checks for international drivers mimic those required for U.S. drivers regarding hazmat endorsement. These materials include, but are not limited to, Additionally, drivers are scanned thoroughly by the Customs and Borders Protection (CBP) in order to ensure their trailer belongs to them and does not show any signs of tampering. Additionally, CBP agents are responsible for ensuring semi-tractor trailers are properly screened at borders.

In addition, the United States and Canada have worked closely to develop uniform inspection procedures and safety standards. This uniformity allows trucks to travel unrestricted from Canada into the U.S. Furthermore, inspections of trucks at the border of the U.S. and Canada are not required. In contrast, trucks entering the U.S. from Mexico are inspected at 28 border crossings and are limited to where they can travel within the U.S. (Weintraub, 1998). One important safety requirement to note is that all commercial vehicles entering the U.S., and otherwise, are subject to vehicle safety inspections at least once every 12 months (FMCSA, 2019). The Electronic Code of Federal Regulations (eCFR) details the requirements for trucks entering the U.S., as well as the trucks in the U.S., in general. Safety inspections appear to be rather thorough throughout the eCFR (eCFR, 2019). Therefore, all drivers, including

international drivers, must carry their vehicle inspection report with them in case they are questioned about the safety of their vehicle.

According to the U.S. Department of Transportation (USDOT), there are specific hours of service allowed for individuals to drive trailers. Drivers of other countries, such as Mexico and Canada, may also operate under similar regulations. For example, Mexico recently changed their hours of service procedures in order to make the roads safer. With these regulations, drivers will be less likely to be in accidents related to fatigue and falling asleep when driving. Due to drivers participating in long rides internationally, there is a greater chance for this. Further, there are several checkpoints and places for these drivers to stop and make sure they are logging their hours correctly. Mexico and Canada share this regulation with the U.S. Additionally, specific regions throughout other countries may not be safe to drive in hours of darkness. Therefore, these regulations do their best to keep all drivers and surrounding communities safe.

[Semi-Tractor Trailer Speed Limit Restrictions](#)

Indiana is consistently within the top five states with the busiest commercial vehicles' interstate and intrastate. Due to constant efforts of political lobbyists to increase speeds to deliver goods quicker and other lobbyists' concerns with fuel and pollution as environmental awareness as it regards to speed, there are a tremendous number of factors that contribute to speed limits. In fact, some argue safety may not always be at the forefront of those concerns. However, Indiana has made significant strides in order to promote safety throughout the state. One of the most significant contributions that Indiana has implemented regard the cable barrier systems. Additionally, the reduction of speeds in congested areas are based upon determined periods that overall affect outcomes of safety. For example, the input of congestion times and the education of vehicle operations along with the focus on minimizing human error, increasing safety alone

with the efficiency of transportation of goods and people is vital. Implementing the reduction of speeds at interchanges and other congested areas are based upon the times and conditions of the day as well as the conditions of the interstates accounting for higher accident rates among semi-tractor trailers while keeping in mind the issue may be bigger and will take more than just speed reduction.

“Each year, 724 million tons of freight travel through Indiana, making it the fifth busiest state for commercial freight traffic,” (IN.gov, 2019). One example is I-70 with speed limits of 65 miles per hour (mph) for trucks over a certain weight limit and 70 mph for the rest of those vehicles traveling. There are set speeds for the State of Indiana with rural interstates set at 65 mph, urban interstates at 55 mph and other limited access roads at 40 mph (Schubert, 2018). Despite the speed limits, semi-tractor trailers may present a danger to everyday drivers, regardless. In 2016, there were 3.63 million registered trucks (OOIDA, 2017) and 264 million registered cars (Hedges & Company, 2019). This considers roughly 1.35 percent of vehicles on the road were semi-tractor trailers. In 2017, there were 219,112 roadway accidents and 911 fatalities; large trucks contributed to 14,877 of those crashes causing 125 fatal crashes (Hwang, 2019). In 2017, 6 percent of overall crashes included trucks while 13 percent of crashes involved a semi tractor-trailer.

The National Motorists Association (2019) discusses various frequently asked questions in regard to speed limit policy on a "speed limit fact sheet." Although the National Motorists Association does not assume slower driving always means safer driving, individuals would not necessarily drive faster if speed limits were increased. Further, most accidents are not directly caused by speeding. A study by the University of Arkansas (2006) revealed that "different speed

limits for cars and large trucks on rural, interstate highways lead to greater speed variation and a higher number of vehicles passing each other, thus compromising safety."

Like previously stated, there is more to making roads safer other than focusing on improving speed limits. For example, increased damage to roadways and bridges is a product of higher rates of speeds, specifically when observing large trucks. It has been determined that for every 10 percent increase in vehicle weight, damage to highways are increased by 40 percent. This statistic considers that speed continues to be a constant while the weight considers to be a variable. Therefore, regulating speeds should be as commonplace as regulating the weight vehicles. By imposing restrictions to semi-tractor trailers on urban interstates and other limited access roads, there would be several benefits for vehicles on the roadways that are used every second of every hour. If a semi-tractor trailer has a gross weight of 40,000 pounds or more, they should be limited to 5 mph below the posted speed limits. This regulation would complement vehicle weight regulations and create safer roads in Indiana. Indiana State Police (ISP) has illustrated a crash risk map that entails risks for crash increase in urban areas. This reiterates why speed restrictions should be considered for urban interstates.

Although speed alone is not the primary reason for semi-tractor trailer accidents, there still needs to be some sort of regulation regarding speed limits increasing, decreasing, or staying the same. It is recommended to place restrictions for night driving as well as for high traffic times such as rush hour. If restrictions were in place to reduce semi-tractor trailers driving during rush hour times between the hours of 4 and 6 p.m., there would be a significant decline in accidents involving semi-tractor trailers. There should be one adjustment to the speed limits of Federal interstates and State roads. This recommendation addresses the speed limit of semi-tractor trailers to not exceed 60 mph. If semi drivers are caught speeding, there should be harsher

fines (with a limit of two fines) before the CDL is revoked and the driver loses their license. By implementing some of these restrictions, it may reduce the likelihood of semi-tractor trailer involved accidents occurring.

It is clear that major roadways do not uphold "so favorable" conditions for semi-tractor trailers. Due to this, it is hard to determine speed limit restrictions for every vehicle utilizing the roadways in Indiana. However, by decreasing speed limits throughout urban areas by a minimum of 5 mph, there may be a difference in traffic accidents, specifically those with semi-tractor trailers. Targeting speed limits by introducing speed limits posted specifically for trucks, similar to other states, or establishing a law enforcement unit specifically assigned to certain posts to work traffic control could be beneficial to reducing speeding amongst all drivers, specifically semi drivers. Another recommendation includes ensuring law enforcement, including ISP, continues to carefully collaborate with other local law enforcement to ensure an increase in manpower with both, influences to decrease in speeding amongst all drivers.

Further, regulations should focus on the spacing between semi-tractor trailers and other vehicles on the road. If spacing is improper, drivers may forget limits and may begin to follow the flow of traffic, rather than the speeds that are legally enforced. Indiana should post limits every few miles and make sure that sufficient signage is provided for any upcoming speed changes, such as a significant increase or decrease that may require semi-tractor trailers to adjust stopping distance. According to Mayyasi (2017), the team in Michigan "want[ed] to set the speed limit so that 15 percent of drivers exceed it and 85 percent of drivers drive at or below the speed limit." This provides less variability among driving speeds and has been shown to decrease the number of accidents that occur. While empirical data would be needed to determine what these speed limits would be in the State of Indiana, this method should be utilized to provide limits that

are not extreme in either direction and provide the most improvement regarding the safety of the public and drivers who are traveling throughout the state.

Other Restrictions Regarding Semi-Tractor Trailers

Implementing general or situational speed restrictions on roadways can improve safety. General speed restrictions for large trucks are common throughout the country. The stopping distance for large trucks is significantly greater than regular vehicles. This stopping distance is outlined by the Utah Department of Transportation (UDOT). According to UDOT, a semi-tractor trailer traveling in ideal conditions at 65 mph needs up to 525 feet of braking distance to come to a complete stop (Utah Department of Transportation, 2019). If the speed is reduced to 55 mph, the braking distance is still 335 feet. This distance can increase given driver reaction and weather conditions. According to the Federal Motor Carrier Safety Administration (FMCSA) in 2015, a report indicated 25 percent of accidents involving large trucks were influenced by adverse weather conditions. Along with adverse weather conditions, speed was a contributing factor to these accidents (FMCSA, 2015). FMCSA suggests that speeds be reduced by one-third during rainy conditions and one-half during snow conditions.

Certain counties in Indiana have a disproportionate rate of accidents. Speed restrictions for these counties should be explored to mitigate accidents and fatalities. These restrictions should consider weather trends, average annual daily traffic (AADT) counts, and the geography of both rural and urban roadways. The common characteristics of these counties is their low population base. The specific Indiana Counties identified in this section are Posey, Pulaski, White, Vermillion, Parke, Gibson, Rush, Carrol, Switzerland, Spencer, Adams, Miami, and Dearborn.

A report titled Posey County, Indiana Long Range Transportation Plan, compiled by the Evansville Metropolitan Planning Organization, details accident statistics between 2007 and 2009 in Posey County. According to the report, there were 1,326 crashes reported in this county between 2007 and 2009. Of those crashes, approximately 47.7 percent occurred on locally maintained roads, 41.2 percent occurred on state-maintained roads and 9.8 percent occurred on federally maintained roads (Evansville Metropolitan Planning Organization, 2010, p. 30). Furthermore, 350 people were injured, and 8 people were killed in these accidents.

The majority of the roads where accidents occur in Posey occur on two-lane roadways. These roadways should utilize legible traffic signs, lane delineation, and adequate lane widths to mitigate accident potential. Speed restrictions should also be considered for these roadways and are addressed in the Posey County Transportation Plan (2010). It is recommended that the speed limit should not exceed 55 mph on two-lane roadways during the hours of darkness or during or after a major weather incident (Evansville Metropolitan Planning Organization, 2010, p. 57). Architectural hazards associated with the roadways are also identified in this plan. Over half of the roadways are less than 18 feet wide and do not meet Federal width recommendations. Increasing the width of these roadways will decrease the possibility of vehicles departing the road.

A common characteristic of roadways in these counties are that they are rural. Average annual daily traffic (AADT) counts on these roads suggest that they might be used to bypass traffic congestion on busier roads, such as the interstate system. The increased traffic on these roads can cause problems because rural roads contain undefined intersections, unreported road hazards, and unfamiliar terrain. This is a common occurrence in the counties of Pulaski and White due to U.S. 35 and U.S. 421 running perpendicular to I-65. To mitigate the potential for

accidents, it is important that speed limits are posted in regular intervals and that no passing zones are properly placed since cars or trucks may attempt to pass local vehicles, including farm equipment, with limited knowledge of the roads' architecture. Counties should utilize the Indiana Department of Homeland Security Snow Emergency System as a tool to regulate speeds in adverse weather conditions (Indiana Department of Homeland Security, 2019). Combining this system with mandated 20 mph speed restrictions during snow events can improve safety by cautioning drivers of hazards.

Speed restrictions in rural areas are outlined by Indiana legislation and are supported by crash statistics. Crash statistics, outlined by Indiana University Public Policy Institute publication titled, *Indiana Crash Facts 2017*, reveal drastic differences between accidents in rural and urban areas. In 2017, the rate at which fatal accidents occurred on rural roads was 7.8 per 1000 accidents, compared to 2.2 in urban areas (Sapp, Thelin, & Nunn, 2017, p. 42). This disproportionality is profound by both the accidents and the population density of these areas. The publication goes on to reveal that 22 percent of fatal accidents in rural areas were due to excessive speeds. These statistics support the need for speed restrictions in rural areas.

Indiana legislation has addressed the need for speed restrictions in rural areas, however, it is recommended that further speed restrictions for large trucks are implemented. Chapter 5 of IC 9-21 regards speed limits. Section 2 of IC chapter 5 outlines specific restrictions for vehicles, with a gross weight greater than 26,000 pounds, that are traveling in rural areas. The speed limit for these vehicles is 65 mph on national interstate systems and 60 mph on highways not designated as a national interstate system (Indiana General Assembly, 2019). Furthermore, section 5 specifically restricts oversized vehicles from traveling faster than 55 mph. This 55 mph restriction should also apply to vehicles with a gross weight greater than 26,000 pounds. These

restrictions would be implemented on highway systems not designated as national interstate systems in rural areas to facilitate safer roadways and combat the disproportionate fatal accident rate.

Alcohol and Drug Related Problems Amongst Semi Drivers

Alcohol and drug abuse amongst semi drivers are an unfortunate reality when looking at the causes of semi-tractor trailer accidents. Many of these drivers are on the road for hours on end with little to no sleep. For many, between the road and other factors, alcohol and drugs are an outlet drivers depend on. Unfortunately, what has been set in place to prevent semi-tractor trailer drivers from operating on the road under the influence of alcohol or drugs has not had much attention in the recent years. Although the data on semi-tractor trailer drivers under the influence of alcohol or drugs may be the causes of accidents on major highways, it is important to identify the recommendations on how to implement certain practices to prevent drivers from getting on the road under the influence of alcohol or drugs. The following information highlights research regarding the reduction of incidents caused by semi-tractor trailer drivers driving impaired by alcohol or drugs.

Semi-tractor trailer drivers are held to a higher standard on the roads due to the capacity of shipments being transported. For some, it is products or materials being carried from one business to another, whether traveling from state to state or from one country to another. Therefore, it is important that semi-tractor trailer drivers be held to a higher standard when it comes to the use of alcohol and/or drugs. According to Kirchner (2017), drug and alcohol abuse in the trucking industry is all too common. The findings indicated the most common substances semi-tractor trailer drivers use include alcohol, amphetamines, cannabis and cocaine. Additionally, young drivers and those taking longer trips are at the greatest risk for drug abuse

amongst semi drivers. Further, another factor associated with substance abuse relies on the amount of pay that truck drivers receive based on their productivity; this factor indicates the likelihood semi-tractor trailer drivers will participate in drug usage. Additionally, the faster a semi driver delivers their cargo to their destination, the more money that will be made. It is assumed that drivers may skip extra sleep and instead, use illegal and ill-advised methods to help stay awake.

The FMCSA states that a driver cannot consume alcohol within 4 hours of operating a commercial vehicle (CDL Jobs, 2019). Drivers with a CDL are held to a much higher standard than regular motor vehicle drivers and can receive a DWI if their alcohol blood concentration (BAC) is at 0.04 percent (CDL Jobs, 2019). When observing accidents that are caused by drivers under the influence of alcohol or drug consumption, experts believe that there are at least 200,000 semi-tractor trailer drivers on the road with substance abuse problems (Arnold & Itkin, 2019). At least 12.5 percent of truck drivers tested positive for alcohol abuse worldwide in 2013 while the average rate of amphetamine use amongst semi drivers was around 8 percent (Arnold & Itkin, 2019).

Due to the overwhelming number of semi-tractor trailer accidents, it is hard to thoroughly understand the causes of drivers' accidents. For example, according to the latest data analyzed by the National Highway Traffic Safety Administration (NHTSA), in 2010, approximately 80,000 people were injured in crashes involving large trucks and another 3,675 people killed (Kirchner, 2017). However, the latest, Large Truck Causation Study by the FMCSA found that in crashes involving large trucks, driver behavior was 10 times (10x) more likely to be at fault than other conditions such as bad weather or road situations (Kirchner, 2017).

While this might be true, it is important to note that the data can shift. Overwhelmingly, what was found in earlier research was that truck driving accidents were mostly caused by issues on the road among passenger vehicles. It is also important to note that many common medications and over-the-counter medications that drivers, including semi-tractor trailer drivers, take on a regular basis have warnings about driving when taking them. Some of the medication semi drivers take in order to help them stay awake or get rid of a cold or flu can have the opposite side effects. The medications listed that prove this include stimulants, sedatives, antidepressant medications, medications to prevent seizures, antihistamines and decongestants, sleep-aid medications, medications to reduce anxiety, narcotic analgesics, diet pills and natural weight loss supplements, energy drinks, high blood pressure pills, or even medications containing Naproxen (Brauns, 2019).

The recommendations that were found to reduce alcohol abuse and drug abuse includes stricter driver implementations. According to the DOT, strengthening impaired driving laws and enforcement efforts, educational awareness campaigns and the use of technology (e.g. ignition locks) to prevent drivers from operating vehicles is beneficial (U.S. Department of Transportation, 2019). In New Mexico, when implementing impaired driving programs, high visibility enforcement efforts to reduce these incidents found that alcohol-involved crashes decreased by 36.5 percent in those participating in the program (U.S. Department of Transportation, 2019). Ultimately, what it concludes with refers to trucking companies being more involved and providing the tools to prevent drivers from being on the road under the influence of alcohol or drugs. This can include installing ignition interlocks in truck drivers' vehicles. This means, before they put their vehicle in drive, the ignition interlocks would

measure the alcohol on the breath of the driver and keep the vehicle from starting if the driver's BAC is above, for example, 0.02% (CDC, 2016).

Further, when combating alcohol or drug problems associated with semi-tractor trailer drivers, it is vital for companies to consider pre-employment testing, post-accident testing, random testing, reasonable suspicion testing, return testing, and follow up testing, stipulated by Title 49: Transportation of the Electronic Code of Federal Regulations (eCFR, 2019). When drivers are in accidents, regardless of the causes, companies should intervene and determine whether or not their drivers are at fault or whether alcohol or drug use was the cause.

The Importance of Steel and Cable Barriers

Through extensive research regarding steel and cable barriers in several counties in Indiana, there has been little evidence to show the implementation of these safety precautions on roads and highways. The Indiana Department of Transportation (INDOT) highlights the benefits of cable barriers and reports they have been proven to avoid median-crossover crashes, reduce disabling injuries, fatalities, and crash costs (2019). In addition, the Federal Highway Administration (FHWA) emphasizes roadway departures or when cars cross edge and center lines in their report (USDOT, 2017). In their examination of accidents per year, they estimate 23 percent of crashes involve crossing a center line or median. These types of crashes also account for more than half of highway fatalities in the United States (USDOT, 2017). This type of infrastructure is innovative and can help mitigate accidents on major roads. The Minnesota Department of Transportation (MnDOT) (2019) states these barriers are made of steel cables that allow for shock absorption when a car hits them; this allows for easier car repair and quick cable replacement. Water-filled barriers are also used in areas, too; these barriers are designed to protect employees from the dangers of working closely to roadways. These are used for

temporary work zones, stadiums, road blocks, and public work projects (National Trench Safety, n.d.). There are multiple types of barriers that can be installed to heavily trafficked roads and interstates. A notable benefit of these barriers is their cost. Cable barriers cost roughly one-third of the total cost of concrete barriers installments per mile (MnDOT, 2019). These barriers can save lives through an adaptable traffic device suited for use in existing medians to prevent crossover crashes (AASHTO, n.d.). These barriers and their innovative nature can provide a cost-effective answer to fatal car accidents.

In the last several years, INDOT has been testing a system of cables to prevent fatal accidents on a large stretch of an Indiana interstate. This thirteen-mile project is located on I-69 between Noblesville and Anderson (Kooi Law, 2018). Prior to the integration of this project, INDOT estimated 12 fatal crashes, 11 serious injury accidents, and 69 accidents involving an injury. Following months after the installation of these barriers, the same 13-mile stretch has had 0 fatal crashes, 5 serious accidents, and 13 accidents involving injury. This project reported a reduction of 84 percent in fatalities and accidents involving injury. In addition, these cable barriers installed on this section of I-69 have stopped 100 percent of vehicles crossing the center median, including at least one semi-truck trailer. Through the success of this project, INDOT wishes to increase the number of cable barriers throughout the state (Kooi Law, 2018). With the installation of this in a heavily trafficked area in Indiana, it could be expected this development could be followed by other departments to increase safety on busy highways.

Throughout research, it was found that many counties do not have cable or steel barriers installed on major roadways throughout the state. Heavily populated areas were researched, and little evidence existed to show there are safety measures put into place on interstates to eliminate cars crossing the medians. States are reporting their fatality rates as reduced by roughly 90

percent when there are cable barriers present; however, there are many highly populated areas of road with little to no protection (INDOT, 2019). Major state roads in Indiana, SR 129, SR 25, SR 16, SR 18, SR 19, SR 1, SR 46, SR 48, SR 56, SR 62, SR 148, SR 124, and others, all are lacking proper protection against cars crossing the center median. These are all state roads across Indiana, some more heavily driven than others. Cable barriers are scarce and difficult to locate. Many of them are located on parts of major interstates, mostly used near entry and exit ramps (MnDOT, 2019). In addition, many of these state roads are very narrow with nothing but grass to separate the two opposing sides of the road; making travel very dangerous.

In other areas across the state, steel barriers exist, but they primarily are installed in bridges and on the sides of roads next to ditches to prevent drivers from sliding off the road. Installing steel barriers on Indiana's major roadways is beneficial for all players. It provides increased safety for those who are working near these places, driving through them, and for law enforcement responding to the scenes. The steel barrier system has demonstrated it saves lives, and evidence can be found in Indiana. Roads and Bridges (2017) stated that the steel barrier system installed on I-69 in a highway construction zone saved two construction workers' lives when a dump truck lost control of the vehicle and collided into the steel barrier. The implementation of steel barriers should be greatly considered, especially in highway construction zones.

It is recommended for the roads lacking in protection to provide additional measures to ensure safety for those traveling along the roadways. Fatal accidents and the use of cable barriers were investigated in Dearborn County. The results of this research showed the specific roadways with the highest number of accident fatalities did not have cable barriers installed (Perleberg, 2019). Examples of these included SR 48 and US 50. More research should be conducted similar

to the INDOT project on I-69 in order to better understand the causes of these fatal accidents, and if cable or steel barriers would reduce such incidents (Kooi Law, 2018). If cross-over accidents are found to be the leading cause of the accidents, cable or steel barriers should be installed to reduce those crashes. It is essential to determine if these items have a positive effect on one another, or if they are simply correlated in order to provide accurate recommendations for the implementation of cable and steel barriers in Indiana's major roadways.

Through extensive research, it has been shown there is little emphasis placed on highway safety in regard to fatal crashes by crossing the median. Cable and steel barriers have the potential to mitigate this issue by installing protective efforts on major roadways. It may not be feasible to install barriers on each major road; however, the major roads need to take precautions and protect those who are using the roads. The need exists for the installation of cable and steel barriers across the state, but it is important that more research be conducted to determine where exactly to install such cable and steel barriers. From a public safety perspective, there are more roads lacking protective equipment than there are ones protected. This is a reasonable measure that could be implemented onto the highway system to protect humans, cars, trucks, and trailers.

Rest Areas in Indiana

The Indiana Department of Transportation (INDOT) is responsible for operating rest areas throughout the state. According to Lisa Macabasco, the official purpose of a rest area regards safety and convenience, as stipulated in the Federal Aid Highway Act of 1956, which created the national interstate system (2015). Currently, INDOT operates 17 rest area locations, with 28 separate rest area facilities on Indiana's interstate highways (INDOT, n.d.). These rest areas are utilized by semi-tractor trailers, busses, recreational vehicles (RVs), and automobiles.

According to federal policy, there should be a place for drivers to take a break every half-hour of driving (Macabasco, 2015). However, these regulations do not address state-run rest stops specifically. For example, commercial rest stops, and regular city exits are considered areas for drivers to rest while traveling. Due to this statistic as well as the consideration of the road configurations of Indiana, no wonder more state-run rest stops do not exist throughout Indiana. For example, state-run rest stops are only located on the interstate system. In Indiana, most road configurations are considered highways or state routes.

The importance of operating more state-run rest stops throughout Indiana is vital regarding the safety of all drivers on the road, including drivers of semi-tractor trailers. According to INDOT (2019), the rest area on I-74 near Batesville, IN is currently under construction. It is clear the question of additional rest stops as well as the option to modernize rest stops has become a priority for INDOT. Further, extensive research has provided thorough recommendations regarding the installation of several areas for rest stops throughout the state. To begin, the area of Petersburg, IN, along I-69, is considered a reasonable location to install a rest area due to its low population and low levels of traffic. Low levels of traffic will lead to lower accidents amongst semi-tractor trailers as these vehicles are merging on and off the interstate. A second recommendation recognizes I-70 in Vermillion County and Gibson County as a potential rest area component. Due to accident statistics regarding I-70, more rest areas on this interstate may be beneficial. A third location recommended includes an expansion rather than a new area. The rest area in White County is small and often full, which means an additional row of semi-tractor trailer parking would provide a safer rest area for drivers.

If the rest area mission was reimagined, it may reduce the number of accidents that occur when drivers become fatigued. As previously mentioned, rest areas are coordinated on

interstates through the work of INDOT and the Federal Highway Administration. If the decision was made to install more rest areas on highways and state roads, the Crossroads of America would benefit tremendously. Not only should the locations be reimagined, but the idea of installing new rest areas should be targeted to reduce the likelihood of accidents associated with semi-tractor trailers as they are merging back onto the roadways from areas they chose to rest.

Tire Safety

Although safety is always an important factor, it is especially important to consider tire safety as it is essential for all drivers on the road, regardless if the individual in question is a truck driver, or the driver of a passenger vehicle. If law enforcement officials began paying increased attention to the condition of tires, it may begin to help mitigate the rate of accidents on our roads. This is especially important among semi-tractor trailers, because of extended driving that is placed upon tires, the conditions that tires are forced to endure, and due to the number of tires utilized on each vehicle.

Tire condition and safety are part of a comprehensive inspection of commercial and private vehicles; however, most law enforcement authorities and weigh stations are not required to check tire wear or perform extensive inspections. While they do measure a number of factors that may impact tire safety; such as: overloading a vehicle for commercial or private purposes, they fail to account for all issues that could lead to failure and/or a fatal accident. According to the United States Department of Transportation (USDOT), the factor of overloading a commercial vehicle can cause excessive heat to build up, which can lead to internal structural damage and tire failure (USDOT, n.d.).

In the State of Indiana, commercial vehicles must stop at weigh stations if they have a gross weight in excess of 10,000 pounds (5 tons). It is vital for these vehicles to stop at the

nearest weigh stations when required, so accidents caused by vehicle weight and/or related issues can be significantly reduced. In addition to the commercial vehicle requirement, weigh stations may also be implemented for overloaded private vehicles to ensure that safety is not being compromised for convenience. In the United States, the maximum weight of a loaded truck, regardless of ownership, that is permitted on roadways is 80,000 pounds (or 40 tons) (Blake, 2018).

It is very important that all vehicles (and their corresponding parts) are thoroughly checked, as many are driven faster than legal limits and in excess of their original design capabilities. For example, most semi drivers within the United States drive faster than 75 miles per hour (mph) - more than their tires are designed to handle; which is a practice that has been linked to wrecks and tire blowouts. Unfortunately, this misuse has largely escaped the attention of highway officials across the nation and continues to be unaddressed by legislative officials and private executives.

According to the Federal Motor Carrier Safety Administration (FMCSA) (2014), from 2009 to 2013, there were approximately 14,000 fatal crashes in the United States involving heavy trucks and buses, resulting in the deaths of almost 16,000 individuals. Of the accidents reported, semi-tractor trailer tires were considered a contributing factor in 198 accidents and in 233 deaths. However, if proper attention was given to semi maintenance and vehicle condition, these fatalities and occurrences could have been prevented.

In 2013, Jim Park wrote an article regarding the “5 Deadly Tire Sins” and how they relate to vehicle incidents and corresponding deaths. In the article, Park stated that negligence and apathetic attitudes consign more tires to an early demise than all other road hazards combined. An inspection of most tire scrap piles will exhibit that a majority of expired tires resulted from

the neglect of their owners, or the neglect of the responsible corporation. Neglectful conditions, such as: irregular wear, mechanical problems, mis-matched dual tires, or abnormal inflation pressure(s) across two tires in a dual assembly, all possess telltale signs; however, those signs are often ignored until it is too late for repair or salvage. Park also advised that under- or over-inflation has one of the most significant effects on highway safety, because, as Decker stated, “you don’t go from properly inflated to a blowout...unless you hit something on the highway” (2013). It is estimated that about 80 percent of blowouts could be prevented if tires were kept properly inflated.

Finally, the common causes of over or under-inflated tires and tire negligence, are due to lack of basic vehicle maintenance. Tire pressures should be checked on a weekly basis, even if the vehicles are part of hidden company fleets around the country. In any instance, an on-board tire inflation system on semi-tractor trailers, or in commercial vehicles, will increase tire drive life, raise fuel economy, and reduce vehicle maintenance costs; all while improving safety (Park, 2019).

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