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# Toward a Rural Vision Zero

A Qualitative Exploration of Bicyclist and Pedestrian Traffic Fatalities in Small-Town and Rural Nebraska

#### Daniel Piatkowski, Justin McCully, and Melissa Piatkowski

ABSTRACT—Walking and bicycling are dangerous activities in small-town and rural America. People walking or bicycling (socalled vulnerable road users, or VRUs, are at greater risk of death in rural communities than in cities. But research is lacking to understand the specific dangers facing VRUs in rural settings, and how to best address these dangers. This research questions the assumption that some (or most) fatal car-on-VRU crashes in rural areas are accidental events in which no one is at fault (rather than crashes in which blame can be assigned) and seeks to understand how rural communities can become safer for walking and bicycling. In recent years, "Vision Zero," the movement to eliminate all traffic fatalities, has gained traction internationally and in many US cities. This movement emphasizes an approach to safety in which all traffic fatalities can be avoided through a combination of planning, policy, and engineering. But Vision Zero is primarily an urban movement and has not generally been pursued in rural communities. In this study we use a combination of fatal crash records from rural areas in the state of Nebraska from 2008 to 2019 and their associated legal filings, as well as contemporaneous news sources, to develop an understanding of VRU fatalities in rural communities. We then establish a research and policy agenda to guide the creation of a "Rural Vision Zero" movement.

Key Words: bicycle and pedestrian safety, driver negligence, vulnerable road users

#### Introduction

There is a growing epidemic of fatal car-on-bike and car-on-pedestrian crashes in the United States, but this epidemic is preventable. Bicyclists and pedestrians are vulnerable road users (VRUs) who lack many of the protections afforded to individuals in a car, and frequently lack access to adequate infrastructure to safely reach their destinations. Media coverage of crashes involving VRUs illustrates a societal bias against such users as unwelcome (at least) and at fault (at most) (Scheffels, Bond, and Monteagut 2019). Moreover, transportation professionals accept that our transportation system is inherently dangerous, and even in the best circumstances, some crashes are inevitable (Dumbaugh and Gattis 2005).

In recent years, the Vision Zero movement has gained acceptance internationally and in many US cit-

ies. Vision Zero seeks to reduce traffic fatalities to zero. The first step in doing so is a paradigm shift in traffic safety, namely, refuting the idea that some traffic fatalities are random accidents and instead recognizing that all fatalities be treated as preventable crashes.

In the United States, Vision Zero is primarily an urban phenomenon and has not generally been pursued in rural communities. Unfortunately, safety problems for VRUs are most severe in rural areas and in small towns in rural areas. Drivers in these places tend to engage in more risky driving behaviors than urban drivers, and provisions for bicyclists and pedestrians are especially lacking (Rakauskas, Ward, and Gerberich 2009). Because of long distances between destinations, poor driver behavior, insufficient VRU infrastructure, and high vehicle speeds, when car-on-VRU crashes occur in rural places they tend to be deadlier than in urban areas (Carter and Council 2007). Despite the myriad potential factors contributing to VRU fatalities, there is a dearth of research into understanding the specific safety problems and circumstances that lead to rural VRU fatalities.

This research posits that for rural communities to

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adopt a Vision Zero approach to safety, we must first understand the context leading to VRU fatalities, as well as how the existing transportation and legal systems address these fatalities. To do this, our research begins by exploring the practical distinction between a "crash" in which the driver is considered at fault and an "accident" in which no party is to blame in rural areas. Understanding this distinction then allows us to establish the type of VRU fatalities that are considered acceptable in the transportation system, and as such, reflect a social norm around that accepts certain types of road fatalities as features of our transportation system. Then, by defining this societal norm for when a VRU death is deemed a "crash" versus an "accident," we can question whether this is acceptable, and if not, what can be done about it.

In the absence of high-quality quantitative data on rural VRU safety, we have compiled qualitative data from a number of sources to better understand fatal car-on-VRU crashes in rural areas and small towns in rural areas. The data for this research comes from fatal car-on-bicycle and car-on-pedestrian crashes in rural counties in the state of Nebraska, United States, between 2008 and 2019 (n = 67). Each crash record is supplemented with Google Street View imagery, contemporaneous news sources, and legal records. Findings from this work are used to identify gaps in the transportation and legal systems that lead to some crashes being characterized as accidental, and how this can inform Vision Zero practice in rural communities. This research is an exploratory approach to understanding the unique safety challenges facing pedestrians and bicyclists in rural contexts, and proposing a path forward to develop a "Rural Vision Zero."

# Background Road Safety, Road Design, and Rural Areas

There is a misconception that bicycling and walking are rare in rural areas and small towns. Bicycling rates for exercise and transportation are actually comparable across urban and rural areas (Tribby and Tharp 2019). While residents of small towns may walk substantially less for transportation, they walk substantially more than urban residents for recreation (Stewart et al. 2016). But walking and bicycling in rural areas are much more dangerous than in urban areas. In 2018 in the United States, bicyclist fatalities rose 6.3% and pedestrian deaths rose 3.4% since the previous year (NHTSA 2019). One quarter of these deaths occur on rural highways (Carter and Council 2007). Vehicle type, alcohol, pedestrian age, and nonintersection location all contribute to rural pedestrian crashes (Carter and Council 2007). While pedestrian crashes are more common in urban areas, they are more deadly in rural areas (Carter and Council 2007).

Tragically, the specific dangers facing vulnerable road users in rural areas today can be traced back to bicycle advocacy efforts begun over 100 years ago. Much of rural America was settled prior to the automobile era, with planning and design reflecting the transportation of the time, including travel by foot, by horse (and buggies), and often connected regionally by river or rail. In the late 19th century, roads were generally in poor condition, and while urban roads were built and maintained using city taxes, no such system existed for rural roads. Rural roads were the responsibility of the farmers who owned property next to the roads (Guroff 2016). These roads were unpaved and typically impassible in rain or snow (Longhurst 2015).

Recognition of the poor condition of most roadsparticularly rural roads lacking the congestion of urban areas-coincided with the rising popularity of bicycling among middle- and upper-class men (many of whom were politically engaged). These new road users, desirous of high-quality roads for bicycling, established an advocacy movement, the Good Roads Movement, to press for state and federally supported road design, construction, and maintenance (Longhurst 2015). Most notably, their efforts led to then-president Wilson signing the Federal Aid Road Act (1916). The act initially helped to fund and build infrastructure enjoyed by bicyclists, but it also paved the way for our current automobilecentered transportation system, including the Federal Highway Administration, state departments of transportation, and gas taxes (Bopp, Sims, and Piatkowski 2018). Since the start of the 20th century, as the automobile has become ubiquitous in American life, the US transportation system has responded accordingly. A century of institutional and policy development has led to a system singularly focused on meeting the demand of drivers to travel by car, thereby inducing driving by neglecting other modes of transportation (Piatkowski and Marshall 2018).

Today, adequate walking and bicycling infrastructure is rare in American cities, but particularly so in rural areas and the small communities in these areas (Carter and Council 2007). There are many reasons for this, stemming from a historical bias toward investing in automobility in the US (Norton 2007) and a "passive safety" roadway design paradigm. The theory behind passive safety is that crashes will always occur, so engineers can only reduce crash severity. This is done through long sight-distances, wide lanes, medians, and shoulders. Unfortunately these approaches also increase speeding, reduce driver attentiveness, and increase fatality risks, particularly for VRUs (Dumbaugh and Gattis 2005). Outsize rates of VRU fatalities are the most problematic outcome of an automobile-centered transportation system, but this bias has also helped to establish a social and policy context that favors drivers over other road users. This context is biased not only against VRU safety (Ralph et al. 2019) but also against consequences for drivers who hit and kill VRUs, resulting in a propensity to victim-blame VRUs in car-on-VRU crashes (Magusin 2017; Bond 2018).

Most roadway design in rural areas follows passive safety recommendations. High design speeds (and high speeds resulting from design) are common, signalized intersections are scarce, and provisions for VRUs are rare or nonexistent (Carter and Council 2007; Rakauskas, Ward, and Gerberich 2009; Bagdade et al. 2012). Rural drivers also exhibit a distinct "rural safety culture" characterized by riskier behaviors than urban drivers (e.g., speeding, not wearing a seatbelt, and drinking and driving) and associated with reduced perceptions of risk (Rakauskas, Ward, and Gerberich 2009). Enforcing traffic laws is challenging over large areas (Bagdade et al. 2012), and rural residents have especially negative perceptions of the utility of traffic law enforcement (Rakauskas, Ward, and Gerberich 2009).

#### The Movement to Address VRU Safety

The Vision Zero movement has emerged to address the epidemic of VRU fatalities globally. Vision Zero as a movement arose to prominence in concert with the growing body of evidence rejecting the passive safety paradigm in favor of creating streets that are safe for all road users, regardless of mode. Vision Zero explicitly rejects the notion that accidents are a feature of our transportation system, treating crashes as avoidable and advocating a holistic approach to doing so. The Vision Zero approach is based on five core tenets with an additional nine components for an effective Vision Zero framework:

#### Vision Zero Core Tenets

- 1. Traffic deaths are preventable. Essentially, accidents do not exist and all crashes can be prevented.
- 2. Integrate human failing in approach. Humans are fallible and transportation systems and policies should be designed with this in mind.
- 3. Prevent fatal and severe crashes. If crashes do occur, their severity can be mitigated and fatalities prevented.
- 4. Take a systems approach. Eliminating traffic fatalities requires a comprehensive process involving design, education, enforcement, and policy.
- 5. Saving lives in not expensive. Eliminating traffic fatalities does not require costly infrastructure investments and can be accomplished cheaply.

#### Nine Components for an Effective Vision Zero Framework

- 1. Political commitment. Highest-ranking local officials make public commitments to Vision Zero goals, and establish a timetable for doing so.
- 2. Multidisciplinary leadership. A Vision Zero task force involving high-ranking officials from all applicable public services.
- 3. Action plan. A plan must be created within one year of an initial commitment to Vision Zero.
- 4. Equity. Equity should be reflected in the stakeholders involved and in the metrics for successful outcomes.
- Cooperation and collaboration. All stakeholders are committed to meaningful engagement and cooperation.
- 6. Systems-based approach. City leaders commit to systems-based approaches and messaging that emphasize that all traffic losses are preventable.
- 7. Data-driven. Stakeholders are committed to an evidence-based approach, including data collection and data sharing.
- 8. Community engagement. A range of opportunities for engagement are created and community representation on the taskforce is prioritized.
- 9. Transparency. The process is transparent to all and includes at least annual reporting by the task force.

The Vision Zero core tenets and framework for effectiveness are meant to first shift the ways in which policymakers and community members think about safety—namely, from an individual behavior issue to a problem requiring action from the entire transportation system. Vision Zero is also founded on the idea that "everyone has the right to move safely in their communities, and that designers and policymakers share the responsibility to ensure safe systems for travel" (https:// visionzeronetwork.org).

Vision Zero originated in Sweden in the late 1990s. Since that time the commitment to end traffic fatalities the movement espouses has been adopted across the US in dozens of cities, but is conspicuously absent in smaller rural communities (i.e., communities <50,000 population). In our research, we have identified only a few smaller communities publicizing Vision Zero initiatives (e.g., Harrisburg, PA, population 49,3229; Columbia, MO, population 123,180). These few examples suggest smaller communities are utilizing traffic calming measures, building bicycle and pedestrian infrastructure, and developing "complete streets" (i.e., streets for all users), but these approaches differ little from those in larger cities.

While many departments of transportation in largely rural states recognize safety, and particularly VRU safety as a priority (see, for example, North Dakota's statewide Vision Zero strategy at https://visionzero.nd.gov), these organizations tend to follow federal guidelines that do not adequately operationalize Vision Zero tenets. For example, the Federal Highway Administration (FHWA) makes the following recommendations to "make local and rural roads safer for pedestrians and bicycles":

- Educate pedestrians to walk against, not with, the flow of traffic and to stay off the travel lane.
- Encourage pedestrians and bicyclists to wear reflective or brightly colored clothing to improve their conspicuity.
- Educate school-aged children on safety practices that they should follow while waiting for the bus (e.g., stay out of the road, limit horseplay, be aware of traffic, etc.).
- Involve the community in improving pedestrian and bicycle safety by establishing advocacy or advisory groups, including those focused on children, older adults, and individuals with disabilities.
- Provide enforcement to target speeding and aggressive driving maneuvers in strategic locations with a high concentration of pedestrians and bicyclists, such as school zones.

The above recommendations fall short of the systems approach advocated by Vision Zero, and instead prioritize individual responsibility. For example, VRUs are directed to avoid travel lanes and wear bright colors, implying that safety is a personal responsibility and cannot be guaranteed by the transportation system. Furthermore, enforcement is prioritized to curb speeding and dangerous driving, while a Vision Zero approach might address roadway design elements that make dangerously high speeds possible. In sum, the existing approach advocated at the federal level ignores the ethical imperative that all users should have the ability to move safely in their communities. Existing design guidance provided by FHWA reflects the flawed passive safety paradigm (e.g., increasing sight distance and reducing roadside barriers) that has been proven to increase vehicle speeds and reduce VRU safety (Dumbaugh and Gattis 2005).

Our literature review reveals a disconnect in rural VRU safety. There is widespread recognition of the problem but a lack of appropriate solutions. Vision Zero offers an alternative to the standard approach to VRU safety but has not gained traction in rural areas. It may be that "urban" solutions to VRU safety advocated by Vision Zero are *actually* inappropriate in rural contexts, or that they are only *perceived to be* inappropriate in rural contexts. In either case, this research seeks to inform both possibilities and present a path forward to fostering rural VRU safety.

#### Data and Methods

The goal of this research is to better understand fatal car-on-VRU crashes in rural areas in order to inform a research and policy agenda to increase VRU safety. To do this, we require high-quality data on crash outcomes, crash frequency, where and when crashes are occurring, and any additional factors that may be related to VRU crashes. Unfortunately, VRU crash data is lacking in the US. The Fatality Analysis Reporting System (FARS), operated by the National Highway Traffic Safety Administration, collects data on all fatal crashes in the US annually. But fatal crashes are rare (only about 2% of all crashes are fatal). The reporting system focuses on auto crashes, only including information on where, when, and who was impacted by a crash, without details on how the crash occurred, or any associated legal consequences. Because of poor data, engineers lack

vital Safety Performance Functions, which are used to predict safety risks on roads, for modes other than cars (Gibson et al. 2016).

Nebraska is primarily a rural state, with a population of 1.9 million, more than half of whom live outside the state's two major metropolitan areas (i.e., the Lincoln and Omaha region). The next largest city in Nebraska is Grand Island, with 48,520 people (2010 census). Beyond these cities, Nebraska is home to hundreds of cities, towns, and villages ranging from a few people to ~25,000 people. Despite having bicycle and pedestrian laws similar to other states (e.g., a 3-foot passing law when a car overtakes, pedestrian priority in crosswalks, and laws against generally negligent driving behavior), the state was recently ranked 49th in the League of American Bicyclists' "Bicycle-Friendly-State Ranking," attributed to a lack of infrastructure and planning (https://bikeleague.org).

Data for this study was provided by the Nebraska Department of Transportation's fatal crash database, which includes the date, location, and name of driver for all fatal car-on-bicycle and car-on-pedestrian crashes in the state since 2008. The dataset was then divided into "rural" and "urban" crashes based on county, wherein all crashes occurring in counties with fewer than 100,000 people were considered "rural" (defined as excluding Douglas, Lancaster, and Sarpy Counties, which include the cities of Lincoln and Omaha and surrounding suburbs).

We then conducted Web searches on each crash record, including via the State of Nebraska's online documentation portal (nebraska.gov), to identify contemporaneous news articles regarding specific crashes, related legal charges, and access to court documents. The name of the driver in each crash was entered into the system to identify applicable criminal and civil filings, including affidavits, criminal charges, probation orders, civil filings, and case notes. We found multiple incomplete records, and cases with some details (e.g., local news sources) but no documented legal filings. In these cases, we assume county prosecutors did not pursue legal consequences for the driver (because criminal or civil filings, if they had been submitted, would be present in the state's online documentation portal).

We evaluated each of the 67 fatal bicycle and pedestrian crashes in our sample to find any additional information available that could elucidate the context and consequences of each crash, including location and VRU mode (Table 1). We determined time of day

Ta	bl	e 1.	Cras	hes	by	location	and	user	type.	
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Crash location (by population)	Pedestrian	Bicycle	Unknown
Rural area	7	4	
<1,000	3	1	
1-4,999	6		
5-24,999	12		3
25-50,000	3		1
Unknown			27
Total	31	5	31

(when available in crash records, case notes, or news reports) and used Google Street View to specify if the crash occurred in a town or in a rural area, as well as the roadway type (e.g., number of lanes, and highway, street, or rural road). Of the 31 confirmed pedestrian crashes, 28 included crash locations, and we identified associated news stories for these 28 crashes. In total, 25 records included both crash locations and contemporaneous news articles, and in 13 cases criminal, civil, or both types of charges were brought in the case. Of the five confirmed bicycle crashes, we found crash locations for all, and news articles on four crashes. In two of the five bicycle crashes, legal consequences were pursued. Note that while much of the source data used in our analysis is publicly available (e.g., local newspaper articles published online), we are required to omit names, dates, and specific locations of individual crash records to comply with Institutional Review Board protocols.

We analyze the data using qualitative, inductive content analysis (Elo and Kyngäs 2008). This involves a systematic, descriptive review of the data (in all its forms), with the goal of reducing the data to concepts that describe the phenomenon being studied. This method has been used in related research on bicycle and pedestrian crash reporting (Ralph et al. 2019). Content analysis is well suited to a range of data sources and can be applied either inductively or deductively. We use inductive content analysis to describe the phenomenon of fatal car-on-bike and car-on-pedestrian crashes in rural areas. Inductive content analysis begins with preparation, then proceeds to organizing and reporting. Preparation is simply collecting the data. With inductive content analysis, organizing the data includes coding and categorizing the data to then develop concepts. It is crucial that researchers clearly report the research process to ensure readers are able to follow how results are generated (Elo et al. 2014). In this research, we first illustrate "codes" in our data as a typology of fatal crashes. We then develop a conceptual model specifying our theoretical understanding of the process leading from the context of a crash to the decision to pursue driver consequences. Finally, we present our results as research directions to better understand and quantify VRU safety in rural areas.

# Findings 1: Typology of Crashes

We identify three types of fatal car-on-bike and car-onpedestrian crashes in rural areas and non-urban small towns: (1) crashes in which the driver is determined to have acted negligently, (2) crashes where neither the driver nor the VRU was considered at fault, and (3) crashes that place responsibility for the crash on the VRU. Fatal crashes in the dataset occur in a range of physical settings, across all types of infrastructure, including gravel roads, state highways, small-town main streets, suburban-style roads, and even neighborhoods (Fig. 1). But data limitations do not allow for a quantitative evaluation of crash frequency across locations.

#### *Type 1: Establishing Driver Negligence*

Type 1 crashes illustrate situations of, or involving, clear driver negligence. These cases illustrate a practical standard by which punitive consequences are sought against the driver. Examples of clear driver negligence include failure to obey traffic laws, impairment (e.g., drugs or alcohol), and distracted driving (e.g., an admission of distraction or evidence of texting and driving). In legal terms, these reflect "public welfare offenses," wherein we seek to penalize offenses without regard to the intent of driver, but with the goal of addressing avoidable forms of neglect (Dressler 2014). Under Nebraska law, impairment is treated as additional to negligence, meaning a driver was not only negligent but also took an additional risk in driving while impaired. Fleeing the scene is also within this category of crashes and, in Nebraska, doing so is a distinct criminal act.

The crashes in this category range in circumstances. In one case the local news reported a crash involving a 24-year-old man who passed out from using inhalants while driving his pickup and struck and killed a woman gardening in her yard. The man was sentenced to 8–15 years in prison. In another case, case notes state a 17-year-old told police he had been "looking at a field" while driving his pickup, and did not see the bicyclist that he drifted across the road and hit. The driver was sentenced to 30 days in jail, in addition to restitution, community service, and other fines. In a third case, case notes from a crash in which a 26-year-old woman killed a pedestrian crossing a three-lane street (one lane each way and a center turn lane) at an "unmarked cross walk" describe the driver as "engaging in flirtatious texts at the time," further noting that "an eyewitness at the crash verified that [driver] had time to see the pedestrian."

Victim characteristics do not appear to play a role in the determination of driver negligence, but they raise safety concerns that require further study. For example, we find evidence of fatalities among aging and disabled VRUs in rural areas and small towns. This finding coincides with demographic statistics indicating an outsize aging population in rural areas (Thiede et al. 2016). One crash involved a 54-year-old man in a wheelchair who was killed in the evening along a two-lane paved state highway on the outskirts of a small town. Two other crashes involve older victims (one a 73-year-old female pedestrian killed by an 18-year-old male driver, the other a 79-year-old male pedestrian killed by a 64-year-old male driver). Both crashes occurred in the street in small towns. In the former, case notes state the pedestrian was in a marked crosswalk, while the latter only states that the victim was killed on the downtown main street, but both indicate a failure-to-yield on the part of the driver.

Crashes in this first typology suggest that alcohol or drug use, distraction (including texting), and disobeying traffic laws (including failing to yield and fleeing the scene of the accident) all justify consequences for the driver. Victim status or behavior does not appear to factor into this process if driver negligence is present.

#### *Type 2: No Fault Crashes*

This category includes "accidents" in which neither the driver nor the VRU victim is considered at fault. We use two criteria to establish no fault: first, no record of charges in the statewide database. Second, we consider the crash an "accident" if there is no mention of consequences in local news sources, or sources explicitly state no punitive action was pursued. We find "accidental" crashes involving pedestrians of all ages in our sample, but none involving bicyclists.

Aging victims and insufficient pedestrian infrastruc-



Rural road: center painted line, no shoulder, no bicycle or pedestrian infrastructure



Gravel road in rural area: No markings, no bicycle or pedestrian infrastructure



Small-town main-street: on-street parking, intersection signage, crosswalks, no bicycle infrastructure

Fig. 1. Example physical context in small towns and rural areas. *Top*: Photo by Ken Lund, https://www.flickr.com/photos /kenlund/5810965067/, used under Creative Commons BY-SA 2.0. *Middle*: Photo by Carol M. Highsmith, https://www.loc.gov /item/2016630572/. *Bottom*: Photo by North Dakota Department of Transportation, https://www.loc.gov/item/2016630572/.

ture are common themes in this category of crashes. In one case, a 55-year-old male pedestrian was killed by a 72-year-old male driver in the early evening while crossing a T-intersection of two, two-lane paved rural highways. Similarly, another crash involved a 23-year-old male driver killing a 67-year-old male pedestrian as he tried to cross a two-lane paved rural highway, also in the early evening. Neither case offers clear evidence for why no fault was determined, other than the absence of obvious driver negligence.

Crash records also highlight the importance of a driver's conduct after the crash. One example is an earlymorning crash in which a 33-year-old male driving a pickup hit and killed a 55-year-old man who was jogging along a two-lane paved rural road (with a center yellow stripe). A county sheriff reported that "the driver of the vehicle said he just didn't see him" and also immediately stopped to call 911 and render aid.

Frequently, incomplete reporting of complex situations makes it impossible to determine why no fault was assigned. In one instance, just before 7:00 on a summer morning on an isolated two-lane paved rural highway, a car with multiple passengers hit a deer. That car stopped (or was disabled), and over an unknown period of time additional vehicles stopped at the scene. At some point an occupant of the original vehicle exited the car and was hit and killed by a third vehicle. Case notes cite visibility issues for all parties but lack the clarity necessary to understand what exactly occurred. Another crash in the early evening involved a mother pushing a stroller (along a paved two-lane rural highway with no shoulder) and a 25-year-old female driving a sport utility vehicle. Case notes do not specify if the driver hit her from behind or not, but do note a suspicion that the driver was "accessing her Facebook account when she struck the mother killing her and seriously injuring the infant." There is no record of civil or criminal action or out of court settlements in this case. Both of these examples underscore the challenges in understanding exactly what occurred, given current reporting standards.

Under the framework of "public welfare offenses," we seek to penalize individuals who fail to act responsibly under the theory that this will better protect society at large from negligent conduct. However, these crashes illustrate that without clear evidence of negligence, we lose the rationale for punishing drivers as a deterrent.

#### *Type 3: The Role of the Victim*

Portrayals of victims (from contemporaneous media and case notes) illustrate ways in which a driver may be absolved of fault and the victim blamed in fatal crashes. For example, in one crash, local news reported that at 7:30 a.m., a 52-year-old man was jogging when he was hit and killed by a 54-year-old man driving a pickup in a rural area on a gravel road. There are no legal records associated with the crash, and the sheriff's office was quoted as saying that "[the victim] cut in front of a pickup approaching behind him" and that the "the driver was preparing to pass the victim when the victim suddenly turned in front of the driver's truck." This underscores the one-sided nature of crash reporting, in which the victim's perspective will never be known, and the assumption that VRUs are inherently unpredictable.

Another example, a 58-year-old man was riding a recumbent bicycle, and local news reported the bicycle had an 8-foot flag extending from it. The victim was hit from behind and killed by an 84-year-old woman driving a minivan. There is a record of civil action against the driver and an out-of-court settlement, but the county attorney was quoted as saying he "didn't find evidence a crime occurred" and had spoken to other motorists who "had encountered [the victim on the road] previously and had trouble viewing it." The county attorney further stated "it just was not a safe place to be on that type of contraption." These quotes blame the VRU when the victim was, by accounts, obeying the law and using an eight-foot flag to signal to drivers. We lack data on the time of day the crash occurred, vehicle speed, the aging driver's competency, or direct witness quotes.

We also find a disturbing subset of crashes in which children are killed in or near the street and no driver fault is assigned. One crash involved a 37-year-old male driving a pickup killing a 10-year-old boy on a bicycle while exiting a private driveway on a gravel road in an isolated area. Two other cases occurred on low-speed (25 mph posted) residential streets in small towns. In the first, a 69-year-old male driving a pickup hit and killed a seven-year-old girl who was crossing the street in front of her house. The second involves a 55-year-old male driving a pickup running over and killing an eightyear-old boy. Local news reports the boy was "laying on his stomach on a skateboard" in front of his house. In



Fig. 2. Context-to-consequences conceptual model.

both cases local news explicitly labeled the crashes "accidents," stating alcohol, drugs, or vehicle speed were not factors, and that no citations were issued. These examples reflect the troubling reality that, in the absence of obvious negligence, crashes are considered accidental and victims may be blamed for their own death (even if the victim is doing their best to be visible, or is a child). That is, our transportation system allows for certain types of fatalities to occur, indicating a systemic failing requiring a systems approach advocated by Vision Zero.

# Findings 2: Context-to-Consequences Conceptual Model

We use the findings from above to develop a contextto-consequences conceptual model. The purpose of the model is to specify where systemic failings in the transportation system are occurring (Fig. 2). Each circle is a variable identified from our analysis as a key component in a fatal car-on-VRU crash, beginning with societal values and ending with the driver consequences. Squares represent the ways the variables can be operationalized and measured (actual or hypothesized), and arrows indicate relationships between variables and process flow.

Crashes in our sample are occurring in the absence of VRU infrastructure, or in the absence of adequate VRU infrastructure. The built environment in turn impacts the potential for a fatal crash, moderated by both driver and pedestrian behavior. (Note: the model formulation also assumes an interaction between driver behavior and the built environment as well as pedestrian behavior and the built environment.) The relationship between crash risk and potential VRU fatality is beyond the scope of this research but is included in the model for completeness. The context of a VRU fatality, moderated by social context, determines driver consequences in the process model.

From the proposed model, we operationalize the crash process within a larger context (i.e., system): a transportation system in the US that is historically automobile-centric. This context has then helped to establish a societal consensus that favors drivers and moderates consequences for drivers. In turn, societal values have significantly impacted how we invest in infrastructure, creating a national transportation system designed around automobile users and a policy context prioritizing the driver's perspective.

106

Our model illustrates the narrow set of circumstances in which our system addresses the VRU fatalities. Essentially, there is a legal framework for determining individual responsibility (either driver or VRU) and then applying punitive measures. This process is unable to account for (or address) systemic issues, such as roadway design, that play key roles in the process leading to a fatal collision between a car and VRU. While this finding is instructive in demonstrating the gaps in our current system for addressing VRU safety, it is not specific enough to provide practical directions for research and practice. To inform next steps in improving rural VRU safety, we next turn our attention to the specific limitations of our current system: understanding the distinction between a "crash" and "accident" (i.e., the decision to seek consequences against drivers in fatal rural VRU crashes).

### Findings 3: Driver Consequence Threshold

Understanding when a driver is considered "at fault" in fatal rural VRU crashes exposes the limitations of our transportation and policy system to adequately address VRU safety. As illustrated in the conceptual model (Fig. 2) determining consequences for a driver in a fatal rural VRU crash is moderated by societal values regarding the distinction between a crash in which a party is determined to be at fault and an "accident" which is deemed unavoidable (and no fault is assigned). Our analysis suggests three standards for assigning consequences to the driver in a fatal car-on-VRU collision.

- The assumption is that VRUs are inherently unpredictable and frequently do not belong on roads. The status of the victim does not appear to factor into the threshold for driver consequences (regardless of whether they be young children, aging individuals, or those with disabilities). Victim characteristics appear to serve two purposes in our findings. First, they can serve to absolve the driver of guilt through victim-blaming. Second, they can serve to absolve the transportation system of responsibility for VRU safety.
- 2. Motive matters, and a driver's actions after a crash are a factor (e.g., a driver who remains on the scene and renders aid is cast as virtuous, while one who flees the scene is guilty).

3. The operational standard for safe driving is to not use alcohol or drugs, and to pay attention (i.e., do not text and drive). A driver's cognitive or physical abilities (e.g., aging drivers) are not taken into consideration when determining driver negligence.

These standards reflect societal norms around what is appropriate (versus negligent) driver behavior. The distinction between a crash and an accident reveals the limitations of our existing transportation system to prevent crashes, and the limitations of our legal system to assign fault. Our findings raise troubling questions around VRU safety and driver responsibility. For example, should a driver be held accountable for hitting and killing a child who was "playing in the street" (i.e., unaware of the potential risks)? Or should an aging driver, who may not even be aware of any age-related driving impairments, be sent to prison for accidentally hitting and killing a bicyclist? These questions require solutions that transcend the decision of whether or not to bring consequences against a driver.

# Discussion: Implications and Research Needs

Because this is a qualitative study with a small sample size, research findings should not be treated as generalizable, but as directions for a research and policy agenda to guide the creation of a rural Vision Zero. In this section we first synthesize our findings to present specific takeaways from the research. Next, we discuss the findings in the context of the five core tenets of Vision Zero and the unique challenges and opportunities for operationalizing an effective Rural Vision Zero.

The research process demonstrates numerous data limitations that must be addressed to improve rural VRU safety. Our work was helped by an advocacy organization and a collaborative relationship with the state Department of Transportation, but the majority of data collection (e.g., case filings and news stories) was done through case-by-case Web searches requiring agency authorizations, data sharing agreements, and legal expertise. Even with this effort, we found only a modest number of cases to analyze. Addressing the practical challenges of determining what data is required to address rural VRU safety, institutionalizing data collection processes and portals for sharing is critical, moving forward. Despite data limitations, we offer below our exploratory findings (with directions for additional research):

- VRU fatalities occur in all contexts, from main streets and neighborhoods in small towns in rural areas, to isolated gravel roads and paved highways. More research (and higher-quality data) are necessary to understand crash and fatality risk across these disparate settings.
- VRU fatalities may be occurring at higher rates among already vulnerable populations. Aging adults, children, adults with children, and people with disabilities are all represented in our study, but we require better data to understand the equity implications.
- Dangerous driving, large vehicles, and high speeds are a fatal combination. These factors require more study (and better data) in rural areas.
- Driver punishment is meant to deter specific dangerous behaviors (e.g., drinking and driving). Our transportation system lacks the capacity to address situations in which there is no obvious behavior to deter.
- Victim-blaming of VRUs in rural areas perpetuates the misperception that these users do not belong in rural areas, and normalizes VRU fatalities as accidents, rather than as a feature of the transportation system.

Our exploratory findings highlight specific challenges and opportunities to develop a Rural Vision Zero. The core tenets of Vision Zero state that traffic deaths are preventable, and addressing them requires integrating human failings, preventing fatal and severe crashes, using a systems approach, and recognizing that solutions are not expensive. Furthermore, the components of an effective Vision Zero framework emphasize political commitment and collaboration, engagement and equity, and data-driven decision-making to inform a systemsbased approach (see literature reviewed in the "Background" section).

Developing a Rural Vision Zero also means changing perceptions of VRUs in rural areas, specifically, the propensity to blame victims rather than the transportation system that has failed to accommodate all members of the community, regardless of mode. Other research has demonstrated that VRUs, especially cyclists, are demonized for their perceived "scofflaw" behavior on roads (Marshall, Piatkowski, and Johnson 2017) and are the subject of consistent victim-blaming in the media (Ralph et al. 2019). Our work is the first to suggest this is pervasive in rural contexts as well. Future research is needed to determine whether anti-VRU biases are more extreme than in urban areas or whether advocacy efforts, such as Safe Routes to Schools programs, face greater challenges because VRUs are perceived as secondary road users.

The negative framing of VRUs is a symptom of a larger transportation system in which VRU fatalities are an accepted feature, not a random occurrence. This requires a systems approach. The consequence threshold, we suggest, in which obvious driver negligence must be present to necessitate a policy response (i.e., laws and punishment), leaves a great deal of opportunity for so-called accidents in our transportation system. Addressing these accidents requires integrating design and engineering, in addition to education and enforcement into a systems approach to rural VRU safety. It has taken time for Vision Zero to make the case for systems thinking in cities. Our findings suggest rural areas are no different. Time will tell, as Rural Vision Zero efforts are undertaken outside urban areas.

#### Conclusion: Toward a Rural Vision Zero

We suggested above two possibilities regarding barriers to a Rural Vision Zero: (1) Vision Zero approaches are either perceived to be inappropriate in small towns and rural areas, or (2) Vision Zero approaches are actually inappropriate for rural areas and small towns in rural areas. The Vision Zero framework is city-centric, and to apply it to rural areas means broadening its scope to accommodate the extreme physical, social, and demographic differences across rural America. For example, rural areas face unique equity issues, and ensuring safe transportation for all road users can be difficult when considering aging populations, immigrant and refugee groups, seasonal workers, and tribal communities. Capacity to enact policies in these contexts can depend on jurisdictional authority and community engagement, and collaboration can require partnerships across local, county, state, and tribal organizations. Identifying the appropriate parties to create a multidisciplinary leadership team can be difficult, as can overcoming the practical challenges of holding regular meetings and ensuring a transparent process.

Design and infrastructure are central to an effective Vision Zero, and bicycle and pedestrian infrastructure, such as sidewalk repairs or painted bicycle lanes, are very inexpensive when compared to road construction

GREAT PLAINS RESEARCH VOL. 31 NO. 1, 2021

projects. While street space is at a premium in many cities, rural areas typically feature an abundance of space and a dearth of traffic. This means rural areas present unique opportunities for walking and bicycling. For example, in Nebraska many small towns were founded along rail corridors prior to the automobile era, and were therefore initially intended multiple road users, including pedestrians, bicyclists, horses and buggies, and even early public transit (e.g., streetcars or trolleys). This pedestrian-centered design can be seen in the historic main streets of most small towns. But the automobile era, and funding for roads, led to a shift in infrastructure priorities, connecting small towns by road rather than rail. Rural roads are designed using highway design standards, and can include wide vehicles lanes, shoulders, and medians. At a minimum, vehicle lanes are typically 11-12 feet wide.

Highway design standards have historically been maintained when state roads pass through small towns, cross-cutting historically walkable places with oversized auto infrastructure. But small towns can take advantage of an abundance of road space and very little traffic using the evidence-based design approaches currently advocated by Vision Zero. That is, safer crossings, protected bike lanes, and reduced vehicle speeds are effective in any community, regardless of size. These approaches to safety are aimed at creating "Complete Streets" (i.e., streets for all users (more information on complete streets can be found at www.smartgrowthamerica.org). Modest efforts to improve the pedestrian environment can also help to normalize walking and cycling, thereby reducing stigma and building popular support for future policy and infrastructure investment.

Rural areas between small towns present unique challenges for a Rural Vision Zero. The fact that rural areas are auto-centric, characterized by miles of roads with no bicycle or pedestrian accommodations, can reinforce the perception that VRUs are impractical and do not belong. As our research illustrates, this line of thinking results in tacit acceptance of VRU fatalities in all instances lacking clear driver negligence. But simple and low-cost options, such as rumble strips, can be easily added to existing roads. With improved data we can determine if pairing approaches can yield significant gains. For example, what is the impact of reducing driving among aging populations (e.g., improved paratransit and aging driver's-license policies), and installing rumble strips on VRU safety in rural areas?

A Rural Vision Zero will necessarily begin with modest approaches to build consensus around the rights of all individuals to move safely in their communities. But a Rural Vision Zero is also an opportunity to question fundamental assumptions about daily transportation and recreation in rural areas and small towns in rural areas. Rural roads and rural lifestyles are auto-centric because of a long history of federal funding prioritizing high-speed, long-distance auto travel over all other uses. The roads built with this funding feature design characteristics that lull drivers into a false sense of security that they should not expect any other users, and lead to higher speeds. Because of this, quiet small towns or isolated country roads with very little traffic are deadly environments. A crucial first step in Rural Vision Zero is building consensus and visioning around what people living in rural areas and small towns in rural areas want their community to look like, and how their infrastructure can serve that vision.

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