



A Tier-1 University Transportation Center

Mixed Method Approach to Develop a Framework for Adoption of Intelligent Speed- Assist Technology (ISAT)

**July
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A Report From the
Center for Pedestrian and Bicyclist Safety

Bruce Appleyard

Megan Honey

Madison Cranford

Gianna Salazar

San Diego State University

Anurag Pande

California State University San Luis Obispo

Sahar Ghanipoor Machiani

Arash Jahangiri

Nusheen Baradaran

San Diego State University

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16. Abstract Speeding remains a leading contributor to roadway fatalities in the United States, playing a role in approximately one-third of all deaths on US roads. Vulnerable Road Users (VRUs), particularly pedestrians and cyclists, face disproportionate risks due to vehicle speed and design. Traditional methods of speed control, such as roadway design modifications and law enforcement, have notable limitations. This study analyzes speeding-related fatalities with a focus on understanding risks to VRUs and the potential for Intelligent Speed Assist Technology (ISAT) to mitigate these harms. Analysis of 2012-2022 federal Fatality Analysis Reporting System (FARS) data shows that 5.1% of all speeding-related fatalities involve pedestrians and cyclists. Most vehicles were traveling well above posted speed limits between 20 and 40 mph, the average speed in pedestrian deaths on 25 mph roads being 122% over the limit. Heavier vehicles such as SUVs are also overrepresented in fatal crashes. This report evaluates the cost-effectiveness of ISAT at various levels of implementation. At 90–100% effectiveness, ISAT could prevent over 95,000 deaths and generate up to \$1.5 trillion in societal benefits. Additional interventions, including speed cameras, design changes, and dynamic speed limits, are also reviewed as essential complements to ISAT in advancing traffic safety goals.					
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A Center for Pedestrian and Bicyclist Safety Research Report

October 2025

Bruce Appleyard

San Diego State University

Megan Honey

San Diego State University

Madison Cranford

San Diego State University

Gianna Salazar

San Diego State University

Anurag Pande

California State University San Luis Obispo

Sahar Ghanipoor Machiani

San Diego State University

Arash Jahangiri

San Diego State University

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Acronyms, Abbreviations, and Symbols

BCR	Benefit-Cost Ratio
EXP	Examples
FARS	Fatality Analysis Reporting System
FHA	Federal Highway Administration
ISAT	Intelligence Speed Technology
NHTSA	National Highway Traffic Safety Administration
UCR	Uniform Crash Report
VRU	Vulnerable Road Users
TIMS	Transportation Injury Mapping System
SWITRS	Statewide Integrated Traffic Records System

Abstract

Speeding remains a major contributor to traffic fatalities in the US and poses heightened risks for vulnerable road users (VRUs). This paper presents an analysis of speeding-related collisions in the US between 2012 and 2022, finding that speeding was consistently involved in roughly 30% traffic fatalities every year, with about 6% of victims being pedestrians or bicyclists. Strikingly, 65% of speeding-related pedestrian fatalities occur in 25-40MPH posted speed limit zones with drivers far exceeding the posted limits and killing pedestrians at average speeds 176% (44 MPH) higher than the 25 MPH limit. The trends demonstrate failure of the existing speed enforcement paradigm and potential benefits that are on the table with ISAT (Intelligent Speed Assistance Technology) overall, as well as in specific contexts (e.g., roads with lower speed limits and pedestrian activity). The paper briefly discusses legal, technological, and societal challenges associated with ISAT implementation. We quantify the benefits of reducing speeding-related crashes in two ways. First, we vary the effectiveness of ISAT from 20% to 100% to reflect a range of potential real-world outcomes, finding savings ranging from \$291 billion to \$1.5 trillion annually, based on the value of lives saved alone. Second, we disaggregate by context, recognizing that public acceptance of continuous speed monitoring with technology varies, ranging from high support in urban freeways or construction zones to lower acceptance in rural areas. Metropolitan areas with pedestrian activities, construction zones, and urban freeways are identified as contexts where ISAT implementation may be more politically feasible yet still impactful.

Keywords: Speeding-related fatalities, Intelligent Speed Assistance Technology (ISAT), Fatality Analysis Reporting System (FARS), Speed management, Transportation safety policy, Speed impact severity, Crash data analysis, Vision Zero

Executive Summary

This report presents an in-depth analysis of the relationship between speeding and traffic safety in the United States, with a particular emphasis on pedestrian and bicyclist safety. Utilizing data from the Fatality Analysis Reporting System (FARS) from 2012 to 2022, the report investigates patterns and trends in speeding-related collisions, identifies vulnerable populations most at risk, and evaluates policy and technological interventions designed to reduce traffic violence. The overarching goal is to assess how Intelligent Speed Assist Technology (ISAT) and other speed reduction measures can help prevent fatalities and injuries, particularly in urban environments where multimodal transportation is growing.

The findings are clear: speeding remains one of the most prevalent contributing factors in fatal crashes across the country. Over the ten-year period analyzed, approximately one-third of all traffic fatalities involved excessive speed. The risks posed by speeding are not distributed evenly. Pedestrians and bicyclists, especially in lower-income neighborhoods and communities of color, face disproportionately high fatality risks (Schneider & Sanders 2020). The probability of death rises dramatically with impact speed; a pedestrian hit by a car traveling at just 20 mph has only a 5% chance of being killed, while someone traveling 40 mph faces an 85% risk of death (Tefft 2013). This exponential increase in lethality we believe has much to do with how we have evolved as a species to survive head trauma below the fastest speeds we can run (around 25 MPH) and therefore underscores the need for aggressive speed management interventions.

The data also reveal troubling vehicle type disparities. Larger vehicles such as SUVs and light trucks are overrepresented in fatal pedestrian collisions, largely due to their elevated front-end geometry, mass, and larger blind zones. The problem has worsened in recent years, as the national vehicle fleet continues to shift toward heavier models. Additionally, despite temporary reductions in vehicle miles traveled during the COVID-19 pandemic, speeding-related fatalities spiked, a trend attributed to emptier roads, reduced enforcement, and behavioral risk-taking.

In response to these findings, the second half of the report evaluates a suite of speed-reduction interventions, with a focus on Intelligent Speed Assist Technology (ISAT). ISAT employs GPS-linked speed databases and on-board camera recognition to notify drivers of posted speed limits or, in more stringent systems, actively prevent drivers from exceeding them. Empirical evidence from the European Union, where ISAT has been mandatory in new vehicles since 2022, projects a 30% reduction in collisions and a 20% decrease in traffic fatalities (European Transport Safety Council 2022). U.S.-based pilots, such as New York City's 2023 deployment in municipal fleets, yielded similar outcomes, including a 64% reduction in speeding and a 36% decrease in hard braking events. (New York City Department of Citywide Administrative Services 2023)

Legislative momentum around ISAT is building. States like New York, Virginia, and Washington have introduced or passed bills mandating ISAT installation in vehicles operated by habitual speeders or drivers convicted of extreme speeding offenses. However, public acceptance remains contingent on key design features: driver override capabilities, system reliability, and data privacy

protections. Survey research included in this report confirms that while the public largely supports ISAT for repeat offenders and high-risk areas like school zones, there is discomfort with non-overrideable mandates and concern over the use of personal driving data.

Beyond ISAT, the report also assesses traditional and hybrid speed reduction strategies, including speed limit reductions, automated enforcement (speed cameras), dynamic speed harmonization, and physical traffic calming measures such as raised crosswalks and mini-circles. These strategies often demonstrate high benefit–cost ratios (BCRs), with many exceeding 4:1, and in some cases, returning \$40 or more in societal benefit for every \$1 spent (FHA 2018). When deployed strategically, particularly in high-fatality corridors, they offer substantial gains in roadway safety at comparatively low cost.

This report argues that speed reduction is not merely a behavioral issue, but a systemic planning and policy imperative. Reducing vehicle speeds through targeted technological, regulatory, and infrastructural strategies is among the most effective and equitable tools available to address the U.S. traffic safety crisis. To achieve this, policymakers must integrate data-driven decision-making with public engagement and commit to redesigning road systems and vehicle technologies that currently normalize dangerous speeds. ISAT and complementary interventions offer a pathway toward Vision Zero goals and a safer, more inclusive transportation future.

Introduction

Speeding remains a persistent and deadly problem on U.S. roadways, contributing to roughly one-third of the more than 44,000 traffic fatalities each year (NHTSA, 2023). Despite decades of enforcement-based deterrents like speeding tickets and license suspensions, traditional methods have proven insufficient to reduce speeding at scale or protect road users. Analysis of data from the Fatality Analysis Reporting System (FARS) from 2012 to 2022 reveals that road users face significantly higher fatality risks as speed increases, with the likelihood of death increasing exponentially with impact speed. A pedestrian struck at 20 mph has only a 5% chance of being killed, while at 40 mph the risk rises to 85% (Tefft, 2011). Appleyard and Appleyard 2021 inquire about this leap in fatality risk, above 20 MPH, arguing that it might relate to our physiological limits of our species to being able to withstand head trauma at the fastest speeds we can run, about 20 MPH. Consequently, VRUs may be impacted by even speeds that are at or lower than the speed limit. Therefore, addressing the speeding issue through enforcement of existing traffic speed limits may be of marginal benefit to these users and may require infrastructure-based changes and broader lowering of speed limits (20's Plenty for Us, n.d.). These facts point to the fact that enforcing existing speed limits and the success of future implementation of speed limits inspired by campaigns such as 20isplenty requires policymakers to explore options beyond the current speed enforcement regimes.

This paper focuses on the promise of Intelligent Speed Assistance Technology (ISAT) as a proactive solution to curb excessive speeding and improve roadway safety. ISAT uses GPS, onboard sensors, and digital speed maps to warn drivers or automatically limit vehicle speed in accordance with posted limits. Unlike traditional enforcement, ISAT functions continuously and without the need for police presence and dangerous interactions with road users. Results from recent pilots, such as New York City's 2023 municipal fleet trial, are encouraging: ISAT-equipped vehicles showed a 64% drop in speeding, a 36% reduction in hard braking, and 99% compliance with speed limits (City of New York, 2023). This paper draws on FARS data, benefit-cost analyses, and real-world ISAT outcomes to assess its potential effectiveness. The analysis underscores ISAT's potential as a scalable, evidence-based intervention and offers strategic guidance for policymakers considering its broader deployment.

Literature Review

Speeding and Safety: Evidence from Literature

Speeding is a primary contributor to both the likelihood and severity of traffic collisions. Approximately one-third of all traffic fatalities in the United States involve excessive speed, making it one of the most persistent and deadly behaviors on the road (NHTSA, 2023). Decades of empirical research confirm that higher travel speeds increase crash risk by narrowing a driver’s visual field, reducing reaction time, and lengthening stopping distances (Litman, 2021). Figure 1 shows the proportion of speeding-related traffic fatalities, and this proportion is remarkably consistent over 2012 through 2022. It shows that the existing enforcement regime has not made a meaningful difference in reducing these fatalities.

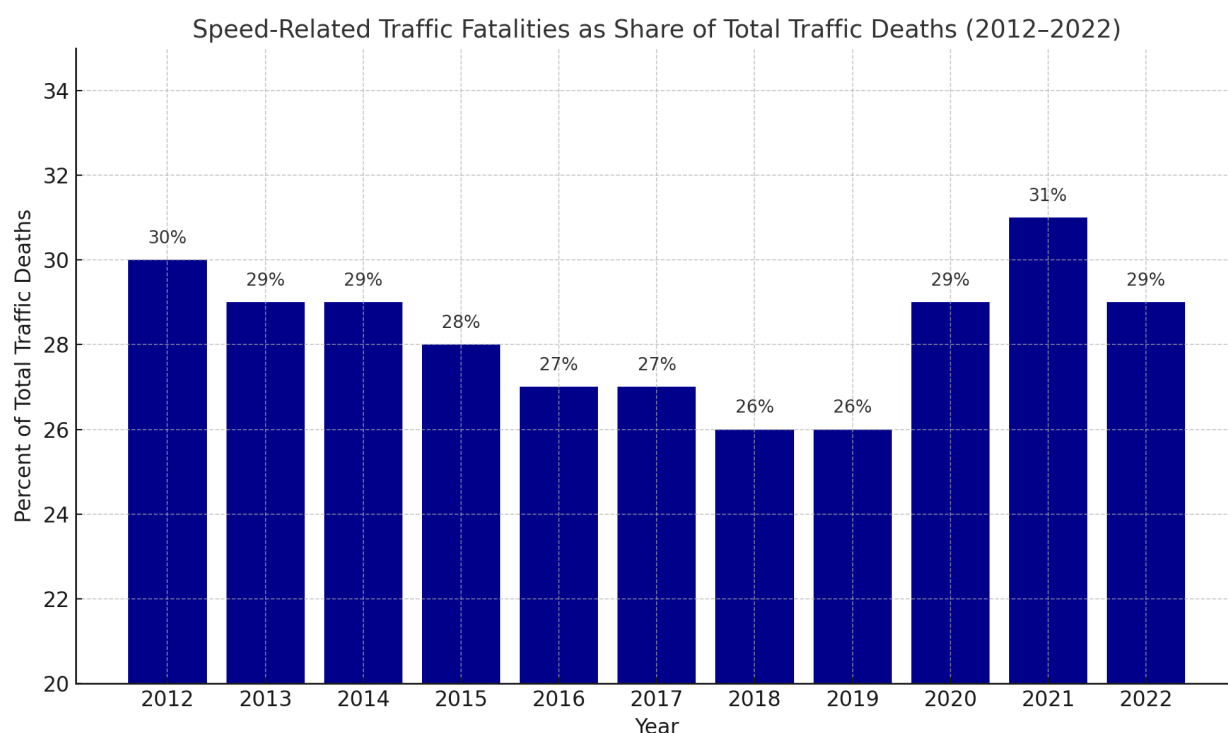


Figure 1. Speed-Related Traffic Fatalities as a Share of Total Traffic Deaths (2012–2022)
(Source: FARS 2025)

Once a crash occurs, speed magnifies the force of impact, increasing the probability of serious injury or death. This relationship is not linear; small increases in speed result in disproportionately severe outcomes. Tefft (2013) found that a pedestrian’s risk of death is just 10% at 24 mph, but rises to 50% at 40.6 mph and 90% at 54.6 mph. As discussed above, this pattern of dramatic increase around 25 MPH speaks to our physiological limits (Appleyard and Appleyard, 2021). Similar patterns are observed for severe injuries, which escalate sharply above 30 mph. Vehicle type compounds these risks: pedestrians hit by SUVs and trucks are significantly more likely to be

killed than those hit by passenger sedans, even at the same speed (Tefft, 2013). Figure 2 shows these findings visually.

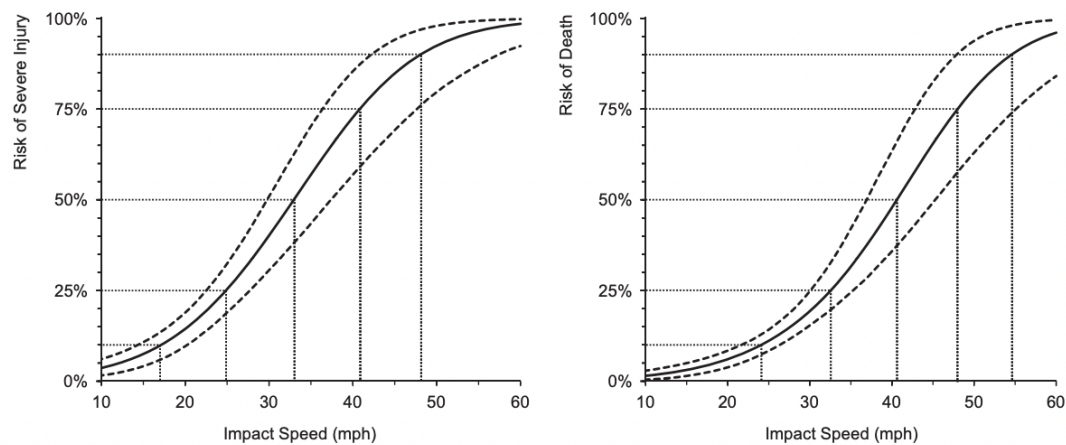


Fig. 1. Risk of severe injury (left) and death (right) in relation to impact speed in a sample of 315 pedestrians aged 15+ years struck by a single forward-moving car or light truck model year 1989–1999, United States, 1994–1998. Risks adjusted for pedestrian age, height, weight, body mass index, and type of striking vehicle; standardized to the population of pedestrians struck in the United States in years 2007–2009 with respect to pedestrian age and type of striking vehicle. Dotted lines represent point-wise 95% confidence intervals. Severe injury is defined as AIS score of 4 or greater and includes death irrespective of AIS score.

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B.C. Tefft / Accident Analysis and Prevention 50 (2013) 871–878

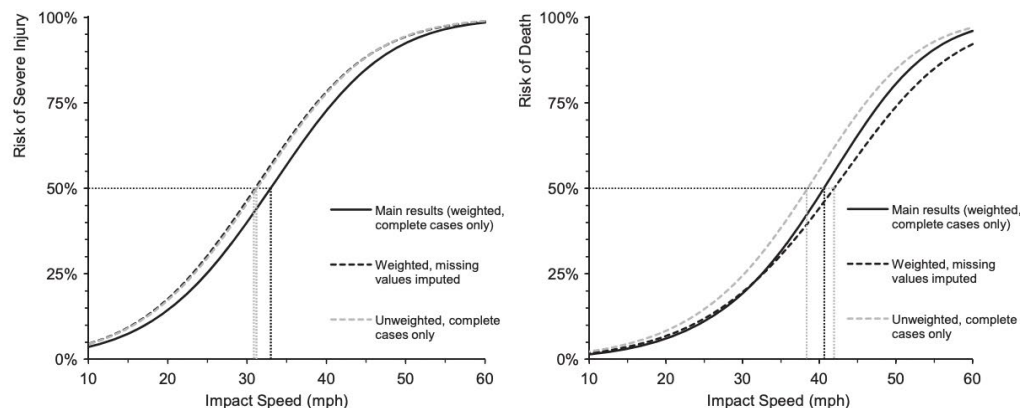


Figure 2. Risk of Severe Injury (left) and Death (right) in Relation to Impact Speed (Tefft 2013)

These risks are particularly acute for vulnerable road users (VRUs), including pedestrians and bicyclists, who lack the structural protections afforded to vehicle occupants. Between 2010 and 2019, urban pedestrian fatalities rose by 42%, with speed playing a key role in both fatal and injury crash rates (AAA Foundation for Traffic Safety, 2022). In California, unsafe speed is consistently identified as a leading primary collision factor in fatal and injury crashes (California Office of Traffic Safety, 2022). Research shows that underserved communities, particularly low-income neighborhoods and communities of color, are disproportionately affected by speed-related fatalities due to a combination of poor street design, wider roadways, and limited traffic-calming

infrastructure (Schneider & Sanders, 2020). These patterns demonstrate that addressing speed is central to advancing not only roadway safety but also reducing disparate outcomes related to transportation injury.

A particularly dangerous subset of speed-related behavior involves "super speeders," drivers who repeatedly and significantly exceed posted speed limits. According to recent enforcement data from New York City, vehicles with 20 or more speed camera violations were five times more likely to be involved in crashes resulting in injury or death (NYCDOT, 2024). Though they comprise only 5% of drivers, superspeeders are involved in over one-third of fatal crashes. Traditional enforcement methods such as fines, points systems, or license suspensions often fail to deter this high-risk group. In fact, up to 75% of drivers with suspended licenses continue to drive illegally (Spectrum News, 2025), underscoring the need for interventions that bypass voluntary compliance altogether. Putting restrictions on these superspeeders has precedent from the restrictions put on drivers convicted of repeated DUI offenses.

Intelligent Speed Assistance Technology (ISAT) offers a system-level solution to address these challenges. ISAT uses GPS and digital speed limit maps to alert drivers when they exceed speed limits, or in more advanced configurations, automatically limit vehicle acceleration. Unlike conventional enforcement, ISAT ensures continuous, equitable, and real-time speed regulation. A 2023 pilot in New York City demonstrated that ISAT-equipped vehicles reduced speeding by 64%, hard braking by 36%, and achieved 99% compliance with posted speed limits (City of New York, 2023). These findings suggest that ISAT not only reduces speed but also moderates driving behavior overall, lowering crash severity and improving outcomes for VRUs. Reduction in hard braking suggests that lowering speeds reduces crash likelihood, as literature shows that hard braking events are predictive of crash frequency at roadway locations (Pande et al., 2017).

Given the strong evidence linking higher speeds to increased crash lethality and the limitations of existing enforcement, ISAT represents a promising tool within the Vision Zero and Safe System frameworks. Its application to repeat offenders mirrors existing policy precedents such as ignition interlock devices for DUI drivers, offering a scalable, non-discretionary mechanism for preventing traffic crashes. In sum, ISAT directly targets one of the most dangerous and under-regulated contributors to fatal crashes: excessive speed.

The Role of Speed in Crash Risk and Frequency

Higher vehicle speeds pose the greatest risk to road safety by compromising driver performance and magnifying crash forces. As speed increases, a driver's visual field narrows, known as "tunnel vision," while reaction time shortens and the capacity to take evasive or corrective action diminishes, as shown in figure 2. These physiological limitations are further compounded by increased braking distances, all of which drastically reduce a driver's ability to avoid a collision once a hazardous situation arises (Litman 2021, Figure 3). The consequences of speeding are not only more frequent collisions but also far more severe outcomes, particularly for vulnerable road users such as pedestrians and cyclists (Blincoe et al. 2023).

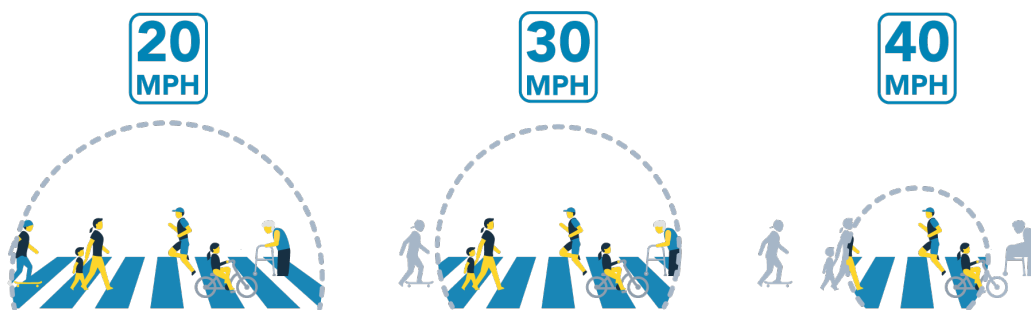


Figure 3. NACTO Urban Street Design Guide (2013)

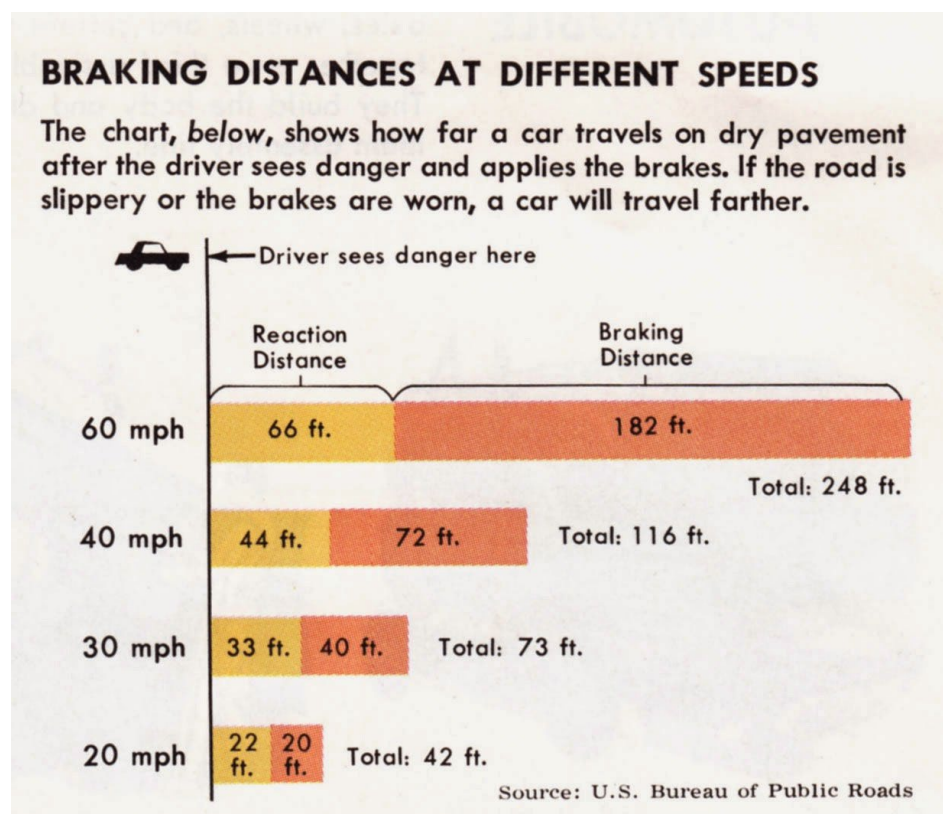


Figure 4. Litman, T. (2021). Not so fast: Better speed valuation for transportation planning (Figure on stopping distance and speed-related effects). Victoria Transport Policy Institute. Retrieved from <https://vtpi.org/nsf.pdf>

The risk posed by speeding is especially acute for pedestrians. Research from the National Highway Traffic Safety Administration (NHTSA 2023) demonstrates that even small increases in vehicle speed dramatically reduce pedestrian survival rates. A pedestrian struck at 20 mph has roughly a 90% chance of survival, but this drops precipitously to just 10% at 40 mph. These

statistics reflect the exponential relationship between speed and kinetic force upon impact, a dynamic that becomes fatal quickly even at relatively modest increases in speed.

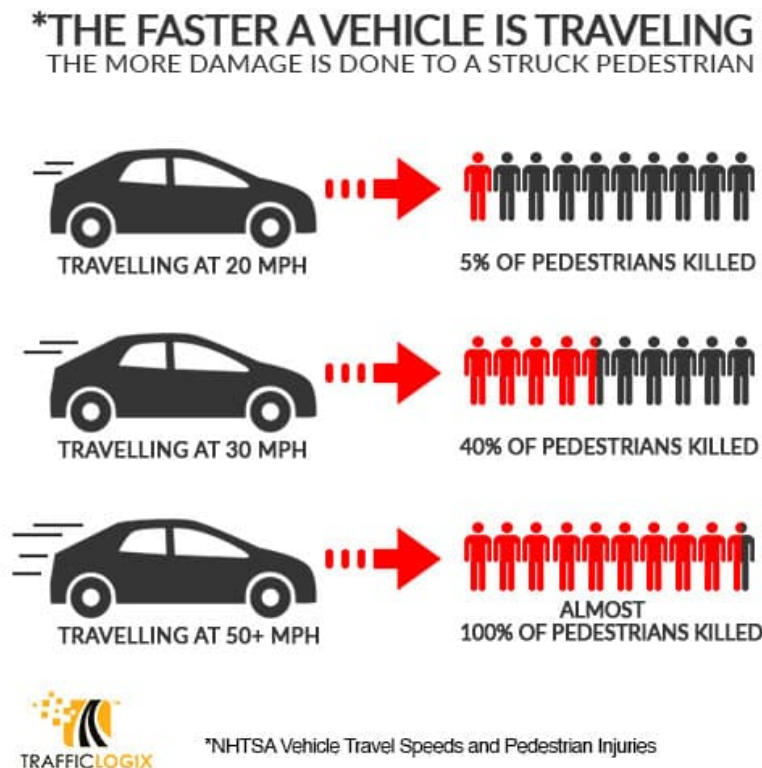


Figure 5. Vehicle Travel Speeds and Pedestrian Injuries (NHTSA 2023)

International health organizations have further quantified this relationship. The World Health Organization (*Road traffic injuries*, n.d.) reports that for every 1% increase in average vehicle speed, the risk of a fatal crash increases by 4%, while the risk of a serious injury rises by 3%. Nilsson’s power model, a widely used framework in traffic safety analysis, supports these findings while Aarts and van Schagen (2005) showed that each 1% increase in average speed leads to a 2% increase in the likelihood of minor injuries, a 3% increase in serious injuries, and a 4% increase in fatal crashes. This model underscores how changes in speed do not result in linear shifts in outcomes but rather disproportionately increase the likelihood of catastrophic consequences.

Supporting these conclusions, Bédard et al. (2002) conducted a multivariate crash analysis and found that drivers traveling above 111 km/h (69 mph) were 2.64 times more likely to be involved in a fatal crash than those traveling below 56 km/h (35 mph). Even those traveling between 96 and 111 km/h (60–69 mph) faced a 1.68 times greater risk. Similarly, Doecke et al. (2020) found that critical speed thresholds for serious injury vary by crash type, with head-on collisions resulting in serious injuries at speeds as low as 28 km/h (17 mph), and side impacts causing harm at 51 km/h (32 mph). These thresholds demonstrate that injury risk is not confined to high-speed roads but also prevalent on urban streets with moderate speed limits.

In addition to absolute speed, speed variance, the difference in speeds between vehicles on the same roadway, has been shown to increase crash risk. When drivers travel significantly faster or slower than the average traffic speed, the unpredictability disrupts traffic flow and increases the likelihood of collisions (Aarts & van Schagen 2005). Roads posted at 35 mph are particularly vulnerable to this dynamic, as they often exhibit design inconsistencies that confuse driver expectations. According to the Foundation for Traffic Safety (2022), these roads experience disproportionately high rates of speed-related crashes and fatalities, despite their moderate speed limits. This paradox highlights the need for speed management policies that address not only posted speed but also design speed, enforcement practices, and vehicle behavior.

Together, these findings confirm that speeding is a critical factor in traffic fatality risk and that even incremental increases in speed yield severe and often fatal consequences. Reducing speed limits and improving compliance through technology, enforcement, and roadway design is essential to achieving substantial gains in traffic safety, especially for non-motorized road users.

Demographic Factors and Speeding Behavior

Demographic variables such as age and gender significantly affect the likelihood of being involved in speeding-related crashes. Young drivers, particularly males, exhibit a higher propensity for speeding and are disproportionately represented in severe crash statistics (NSC, 2024). Drivers aged 20 and younger traveling at speeds above 111 kph (69 mph) were 2.64 times more likely to be fatally injured compared to those traveling below 56 kph (35 mph) (Bédard et al., 2002).

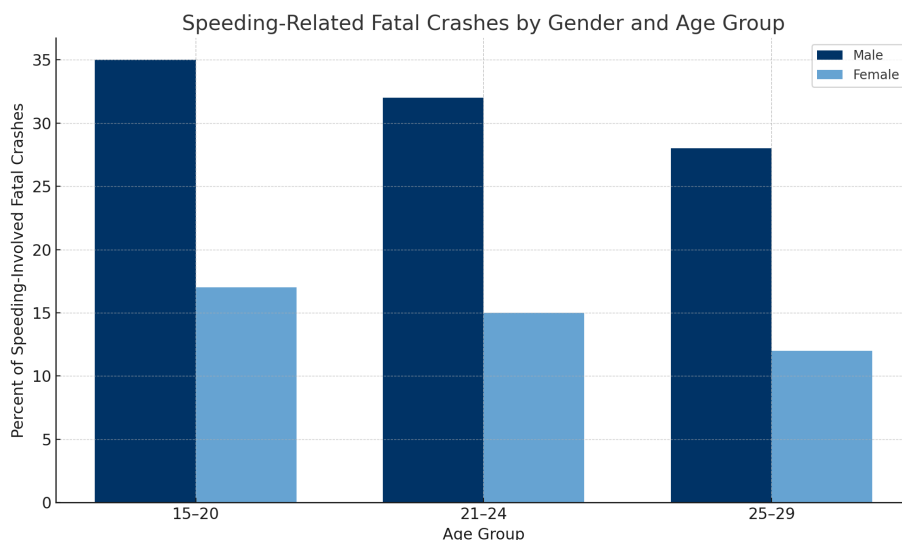


Figure 6. Speeding-Related Fatal Crash Involvement by Gender and Age Group (Ages 15–29, U.S.) (2022)

Super Speeders

A disproportionate number of speeding related collisions have been found to involve repeat offenders known as “super speeders” defined as drivers who consistently engage in dangerous driving behavior (Brooklyn Paper, 2025). To address this threat, policymakers are exploring to mandate ISAT as a penalization and requirement for repeat speeding offenders, with some exploring its mandatory integration in all newly manufactured cars. This shift represents a proactive, evidence-based system designed to use mechanical restrictions to prevent speeding-related crashes before they occur. Use of ISAT for repeated “super speeders” may also be more politically palatable due to precedent set by use of Ignition interlock devices (IIDs) to address driving under the influence by repeat offenders. While laws around IID requirements vary in states based on offense severity, blood alcohol concentration (BAC), and prior convictions; the precedent they provide for restriction in the use of an automobile may pave the way for ISAT to be used as a speed control technology.

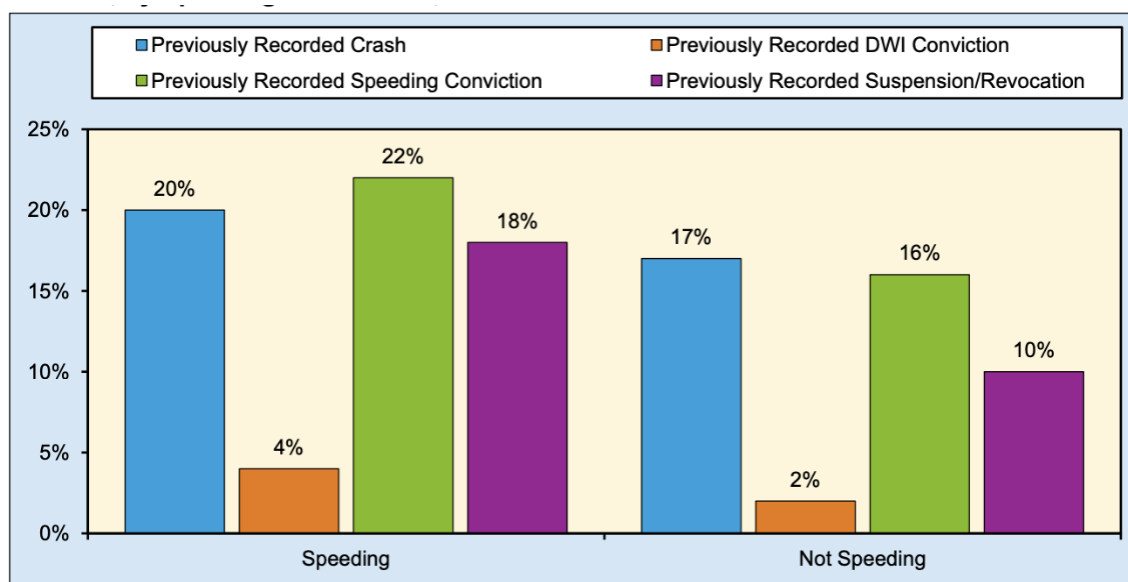


Figure 7. Percentages of Previous 5-Year Driving Records of Drivers Involved in Fatal Traffic Crashes, by Speeding Involvement, 2022. from Traffic Safety Facts: 2022 Data – Speeding (Report No. DOT HS 813 582), National Highway Traffic Safety Administration, 2022

Data from New York City’s automated enforcement program highlights the danger posed by this high-risk group. Vehicles that received 20 or more speed camera violations were found to be five times more likely to be involved in crashes resulting in injury or death. Strikingly, though super speeders account for just 5% of all drivers, they are involved in more than one-third of fatal crashes (NYCDOT, 2024). Traditional penalties, such as fines, license suspension, or points systems, have shown to have low, insufficient, or only temporary efficacy when concerning high risk individuals and repeat offenders (NHTSA 2023) Studies even show that 75% of drivers with suspended licenses continue to drive (Spectrum News, 2025), indicating the need for a mechanical intervention that bypasses voluntary compliance.

Economic and Social Costs of Speed-Related Crashes

The repercussions of speeding-related collisions extend far beyond individual injuries and fatalities; they represent a profound economic and social burden on both national and global scales. According to the Centers for Disease Control and Prevention (CDC 2024), motor vehicle crashes in the United States cost over \$430 billion in 2022 alone. These costs include direct medical expenses, emergency response, legal and court costs, property damage, lost productivity, and the statistical valuation of lives lost. Speeding is a contributing factor in nearly one-third of these crashes, indicating that a substantial portion of these costs could be mitigated through effective speed management interventions.

Globally, the World Health Organization (WHO 2023) estimates that road traffic collisions cost most countries approximately 3% of their gross domestic product (GDP), with low- and middle-income countries bearing the greatest burden relative to their economic output. In the U.S., the National Highway Traffic Safety Administration (NHTSA 2023) reported that in 2021 alone, speeding-related crashes accounted for 12,330 deaths and an estimated \$52 billion in economic loss. These figures do not account for the long-term societal costs such as chronic disability, mental health impacts on survivors and families, and broader community disruptions.

Research has also emphasized the indirect social costs of traffic violence, including diminished neighborhood cohesion, reduced access to safe public spaces, and decreased property values in areas with high crash rates (Litman 2021). Communities most affected by traffic-related harm often coincide with historically underserved neighborhoods, where infrastructure investments are lacking and enforcement practices may disproportionately penalize certain populations. These disparities underscore the need for systemic, technology-based interventions such as Intelligent Speed Assistance, which can reduce harm while minimizing biased enforcement outcomes.

A cost-benefit analysis by the Federal Highway Administration (FHWA 2021) found that many speed reduction measures, including automated enforcement and urban speed limit changes, generate benefit-cost ratios (BCRs) well above 2:1, meaning that for every dollar spent, more than two dollars are saved in avoided crash costs. When scaled to the national level, widespread implementation of such measures could save billions annually. Additionally, traffic calming interventions, such as road narrowing, speed humps, and raised intersections, are not only cost-effective but also yield measurable improvements in quality of life, access to mobility, and air quality, particularly in urban and suburban settings (Ewing & Dumbaugh 2009).

The economic rationale for addressing speed-related crashes is clear; from a policy perspective, investments in speed management technologies and infrastructure redesign represent fiscally imperative strategies with high returns in public health, safety, and social welfare.

Policy Implications and Countermeasures

The literature clearly demonstrates that mitigating speeding-related fatalities and injuries demands a multifaceted policy approach that combines legislative reform, physical infrastructure design, behavior modification, and vehicle technology. No single measure alone is sufficient to

meaningfully reduce the toll of speed-related crashes; rather, an integrated strategy that targets both driver behavior and the built environment is paramount.

Lowering posted speed limits, particularly in high-risk or pedestrian-dense areas, has been shown to significantly reduce the frequency and severity of crashes (Foundation for Traffic Safety 2022). Urban speed reductions, when paired with appropriate enforcement, can dramatically improve survivability for vulnerable road users. Complementary infrastructure-based interventions, for example, Edge Lane Roads and traffic-calming measures including speed humps, roundabouts, narrowed lanes, raised crosswalks, and pedestrian safety zones, help reinforce lower speeds through street design, making it physically and psychologically more difficult for drivers to speed (Litman 2021). These interventions also enhance public space usability and walkability.

Public education and targeted enforcement remain necessary components, particularly for addressing high-risk populations such as younger drivers and habitual speeders (NSC 2024). However, traditional enforcement alone has limitations, including potential concerns about enforcement disparities in over-policed communities. In this context, Intelligent Speed Assistance Technology (ISAT) presents a powerful, system-level tool to reduce driver speed in a consistent and non-discriminatory manner.

ISAT encompasses a suite of in-vehicle technologies designed to inform, warn, or physically intervene when a driver exceeds the posted speed limit. Its three primary modalities, Advisory, Differential, and Mandatory ISAT, range from simple alerts to active speed control. When paired with digital speed maps and GPS technology, ISAT can deliver real-time speed data, correcting for inconsistent signage, variable speed zones, and driver distraction. The potential benefits are especially relevant in areas where traditional signage may be missing, obscured, or subject to frequent change, such as construction zones, rural corridors, and school zones (Broekx et al. 2007; Elvik & Vaa 2004). Recent research further supports ISAT's capacity to reduce crash rates, enhance driver awareness, and strengthen compliance with speed regulations (Johansson et al. 2023).

Mandating ISAT in newly manufactured vehicles represents a forward-looking, evidence-based policy intervention that aligns with national safety goals such as Vision Zero. As part of a broader speed management strategy, ISAT can fill critical enforcement gaps, reduce speed variance, and significantly lower the risk of fatal and serious injury crashes. Taken together, these measures provide a strong foundation for a public policy agenda aimed at reducing preventable roadway deaths as a result of speeding, improving transportation safety and access, and protecting users of the roadways.

Data and Methodology

Methods

Data Sources

To evaluate the potential of Intelligent Speed Assistance Technology (ISAT) in reducing speeding-related fatalities, this report analyzes ten years of national crash data (2012–2022) from the Fatality Analysis Reporting System (FARS). FARS provides detailed information on all fatal crashes involving motor vehicles on public roadways in the U.S. Key variables used in this analysis include estimated travel speed, crash-level speeding indicators, and vehicle-level designations of speeding involvement. While estimates of travel speed may rely on judgment from reporting officers, the dataset offers a robust foundation for understanding how excessive speed contributes to fatal outcomes, particularly for pedestrians and bicyclists. The analysis focuses on identifying trends in speed-related collisions by posted speed limit and user vulnerability. To assess the economic feasibility of ISAT deployment, the paper applies cost estimates from the National Safety Council (NSC), which capture both direct (e.g., medical, legal, and property damage) and indirect (e.g., pain and suffering, lost productivity) consequences of crashes. Using NSC’s 2021 valuations—\$13.7 million per fatal crash and \$1.1 million per disabling injury, among others—the analysis models avoided societal costs based on projected reductions in crash rates under ISAT scenarios. These benefits are estimated using the U.S. Department of Transportation’s Value of a Statistical Life (VSL) as a benchmark. While the methodology offers a rigorous, data-driven approach to estimating ISAT’s potential impact, limitations remain—particularly in accounting for behavioral changes, enforcement dynamics, and unquantified social harms such as trauma and disparate outcomes among different groups.

Fatality Analysis Reporting System (FARS) Data

FARS is a dataset compiled by the National Highway Traffic Safety Administration (NHTSA). For each year since 1975, the NHTSA collects detailed information on all qualifying traffic fatalities (defined in the FARS manual as a crash involving, “a motor vehicle traveling on a trafficway customarily open to the public, and must have resulted in the death of a motorist or a non-motorist within 30 days of the crash”). The FARS data contains a myriad of variables, split into different levels (i.e. crash level, vehicle level, and person level).

The travel speed variable is an estimate of how fast each vehicle was traveling before a fatal crash. This may be based on subjective judgment, as it relies on an estimate from the investigating officer in a crash. According to the FARS manual, this variable, “[...] is often a judgment, rather than a measurement.” Additionally, we used the “A_SPCRA” and “SpeedRel” variables, which marks if a crash (A_SPCRA) or a vehicle (SpeedRel) was designated as speeding-involved.

We evaluated 10 years of FARS data from 2014-2023 using the national dataset, which includes all 50 states and the District of Columbia, but excludes Puerto Rico, Guam, U.S. Virgin Islands, American Samoa, and Northern Mariana Islands.

Results

Fatality Analysis Reporting System Results

Speeding and Fatal Crashes

Speeding-Related Crashes

Speeding-related crashes are defined as collisions in which at least one driver was either exceeding the posted speed limit or driving too fast for prevailing road or weather conditions. To identify these incidents, we utilized the A_SPCRA variable from the FARS Accident Auxiliary File, which flags crashes determined to involve speeding as a contributing factor.

Speeding's Impact on Pedestrians and Cyclists

Data for this analysis was collected and analyzed using the 2012-2022 FARS database, including the Accident Auxiliary File and the Vehicle File. Speeding-involved crashes were identified using the A_SPCRA variable from the Accident Auxiliary File, which flags incidents in which speed was a contributing factor.

Vehicle-level data were extracted from the Vehicle File, specifically the travel speed (in miles per hour) variable. However, it is important to note that travel speed data are only available for approximately 40% of vehicle entries, as this information is frequently unreported or missing in crash records.

According to the FARS Analytical User's Manual, travel speed is defined as "the speed the vehicle was traveling prior to the occurrence of the crash as reported by the investigating officer" (NHTSA, 2023, p. 145). Additionally, the analysis incorporated the "Speedrel" variable, which identifies which vehicle(s) in a given crash were determined to be speeding at the time of the incident.

Table 1. Share of speeding-involved crashes involving fatalities, nationwide, 2012-2022.
(Source: FARS)

	Total Crashes involving Fatality	Percent of total Fatalities	Speeding-Involved Fatalities	Total Percentage Fatalities Related to Speed	Average Travel Speed (mph)	Estimated Cost
Pedestrian-Involved Crash	67,831	18.2%	5,087	7.5%	40.04	\$929.27 Billion
Cyclist-Involved	8,189	2.9%	721	8.8%	39.73	\$112.19 Billion
No Pedestrian or Cyclist Involved	298,321	79.7%	96,059	32.2%	45.29	\$4.09 Trillion
Total Crashes	374,341	100%	104,188	27.8%	44.47	\$5.13 Trillion

The FARS crash data reveals a stark disparity in fatality outcomes between different types of road users and points to a strong relationship between higher travel speeds and fatal crashes. Roadway fatality data reveals a strong association between higher travel speeds and crash severity, particularly for vulnerable road users. Although pedestrian-involved crashes represent a smaller portion of total collisions, they result in a disproportionately high share of fatalities—accounting for 18.2% of all traffic deaths. This is a significantly higher fatality burden relative to cyclists, who account for 2.9%. These trends highlight the inherent vulnerability of pedestrians and the severe consequences of collisions involving unprotected road users. The data also underscores how street design and vehicle-centric infrastructure continue to fall short in protecting those on foot, particularly in urban environments where walking is often the only viable transportation option for many residents.

The economic toll of these crashes is staggering. When applying the U.S. Department of Transportation’s estimated value of a statistical life, \$13.7 million per fatality, the cost of pedestrian-involved fatal crashes alone exceeds \$929 billion, while cyclist-involved crashes total approximately \$112 billion. Crashes that involve only motor vehicles, which account for the majority of incidents, carry the highest total estimated cost: \$4.09 trillion. Altogether, the estimated cost of all fatal crashes reflected in this dataset is over \$5.13 trillion. These figures demonstrate that beyond human tragedy, fatal crashes impose a profound economic burden on society (USDOT, n.d.).

Speeding emerges as a central factor in the severity and distribution of these crashes. Of the 104,188 speed-related crashes recorded, 92% (96,059) occurred between motor vehicles without involving a pedestrian or cyclist. These vehicle-only crashes also had the highest average travel speeds at 45.29 mph, compared to 40.04 mph for pedestrian crashes and 39.73 mph for cyclist crashes. This difference is not incidental; it reflects how roadway environments shape the types of crashes that occur. Pedestrian and cyclist crashes are more likely to happen in lower-speed, mixed-use environments, such as residential neighborhoods, urban centers, and intersections, where non-motorized users are present. Vehicle-only crashes are concentrated on higher-speed roadways such as arterials, highways, and suburban corridors where pedestrians and cyclists are either rare or effectively excluded by design (FHWA 2021; NHTSA 2020). Furthermore, it is easy to see from these statistics that while automobile travelers can survive crashes at higher speed, fatal crashes have lower average speeds when pedestrians and bicyclists are involved.

When looking at crash types, speed-related incidents were most prevalent in vehicle-only collisions, where 32.2% were attributed to speeding, compared to just 7.5% for pedestrian-involved crashes and 8.8% for cyclist-involved crashes. This pattern highlights two key dynamics: non-motorized users like pedestrians and cyclists face a high risk of death even at lower speeds, while drivers are more likely to speed on roads that are designed for fast travel—such as wide arterials or highways, where there are often few physical or legal measures in place to discourage speeding (NHTSA 2020). With the average travel speed across all crash types averaging at 44.47 mph, it's clear that even relatively moderate increases in speed can dramatically influence the risk and severity of crashes, especially for vulnerable road users, i.e., pedestrians and bicyclists.

Taken together, this data strongly supports a shift toward policies and infrastructure strategies that actively reduce vehicle speeds, especially in areas with vulnerable road users. Tools like traffic calming measures, reduced speed limits, automated enforcement, and ISAT can all significantly reduce crash rates and fatality risks. The findings reinforce the need for a systems-level approach to road safety, one that treats speed not as an individual driver decision, but as a structural factor shaped by land use, street design, enforcement, and policy priorities. Addressing speed holistically is essential to protecting vulnerable road users, saving lives, and reducing the multi trillion-dollar cost burden these crashes place on society.

Total Fatalities by Posted Speed Limit

Fatal crash data broken down by posted speed limits highlights the critical link between speed and crash severity (See Figure 8). Roads with posted speed limits of 55 mph or higher accounted for a majority of fatalities, with over 170,000 deaths, representing 51.7% of all fatalities during the 2012–2022 period. This suggests that higher-speed crashes continue to be a primary driver of traffic-related death, even as vehicle safety standards improve; roads with a posted limit of 55 mph alone accounted for 94,097 fatalities, the largest single category in the data set.

At the lower end of the spectrum, roads with posted limits between 5 and 25 mph accounted for over 17,000 fatalities. While this is a smaller portion of the total, it is significant given the

expectation that these environments, often residential areas or downtown zones, should be among the safest. The percentage shown in the graph (Figure 9) represents how much higher the average speed in a speeding related crash was compared to the speed limit.

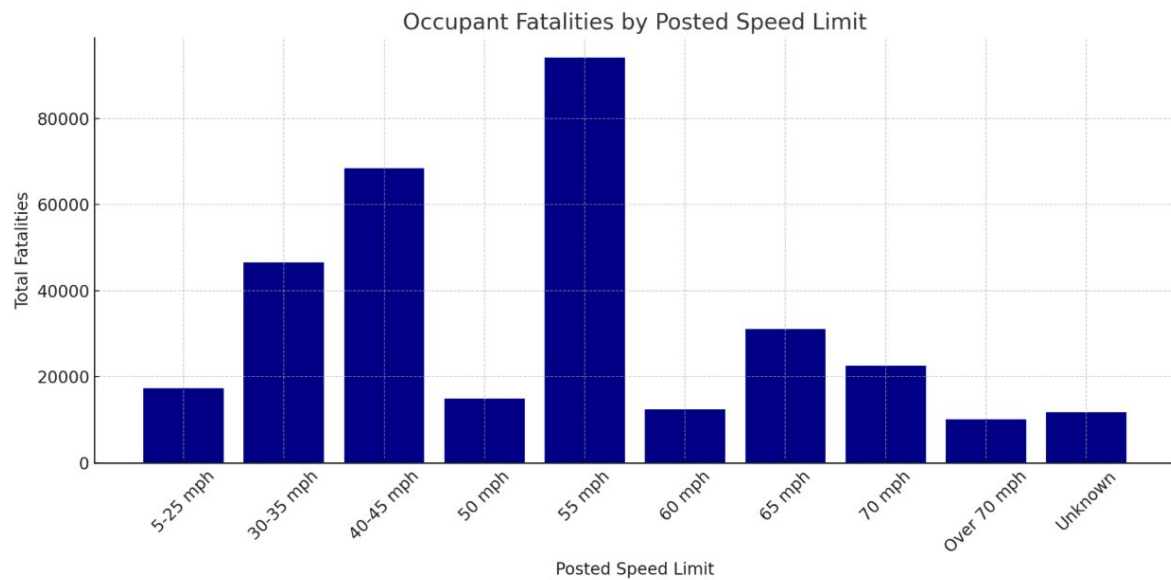


Figure 8. Motor Vehicles and Occupants Involved in Fatal Crashes by Posted Speed Limit, 2012-2022 (FARS 2025)

Table 2. Motor Vehicles and Occupants Involved in Fatal Crashes by Posted Speed Limit, 2012-2022 (FARS 2025)

Posted Speed Limit	Total Fatalities	Total Fatal Collisions related to speed	Percentage of total Fatal Collisions related to speed	Average travel speed for non-speeding related fatalities (MPH)	Average travel speed for speeding related fatalities (MPH)	% Difference in Speed
5	92	50	54.30%	14.7	46.6	-
10	277	127	45.90%	14.3	40.4	-
15	1,204	734	61%	16.5	45.6	-
20	1,377	2,656	192.90%	20.4	51.5	-
25	36,887	21,549	58.40%	20.9	56.4	225.60%
30	36,853	22,136	60.10%	25.1	61.3	204.33%
35	74,309	47,307	63.60%	28.9	62.9	179.71%
40	46,442	29,041	62.50%	30.9	66.7	166.75%
45	84,619	54,418	64.30%	35.9	68.7	152.67%
50	26,475	16,237	61.30%	37.7	73.4	146.80%
55	151,897	87,241	57.40%	45.2	71.3	129.64%
60	22,638	13,267	58.60%	44.9	76.4	127.33%
65	53,654	30,401	56.70%	48.9	76.1	117.08%
70	33,592	19,714	58.70%	49.3	77.6	110.86%
75	11,747	8,289	70.60%	45.9	80.3	107.07%
80	1,527	1,210	79.20%	60	79.6	99.50%
85	8	8	100%	Unknown	Unknown	-
Unknown	36,961	10,571	28.60%	Unknown	Unknown	-
TOTAL fatalities	621838					

Motor Vehicles and Occupants Involved in Fatal Crashes by Posted Speed Limit

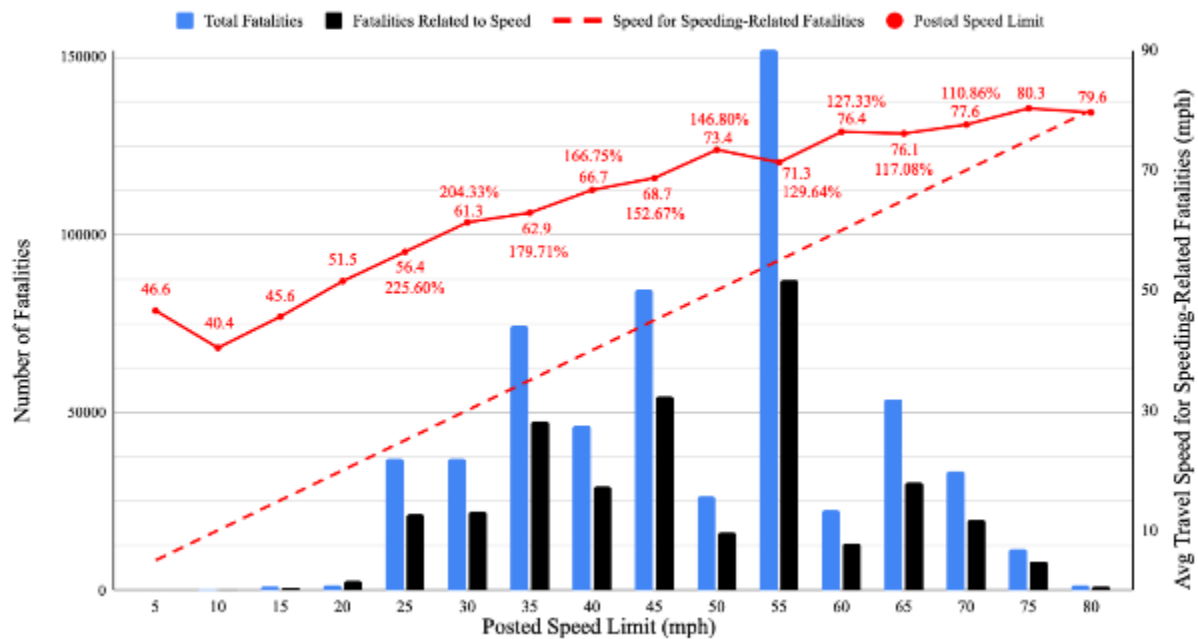


Figure 9. All Speeding-related Fatal Collisions by Posted Speed Limit (2012-2022) (FARS 2025)

In the next section, data specific to pedestrian and bicyclist crashes are analyzed. Figures 10 and 11 show the same relationship specific to pedestrian and bicyclist crashes, respectively. In Figure 10, one observes that in 20 MPH speed limit roads, the average travel speed of vehicles involved in speeding-related fatal crashes is more than 245% (49.1 MPH in 20 MPH zone; See Figure 10) higher than the speed limit.

Table 3. Pedestrian Fatal Crashes by Posted Speed Limit, 2012-2022

Posted Speed Limit	Total Pedestrian Fatalities	Total Pedestrian fatalities related to Speed	Percentage of fatalities related to speed	Average travel speed for non-speeding related fatalities (MPH)	Average travel speed for speeding related fatalities (MPH)	% Difference in Speed
5 mph	45	-	-	11.7	-	-
10 mph	77	6	7.8%	10.9	10	-
15 mph	205	19	9.3%	10.8	32.7	218.00%
20 mph	250	41	16.4%	19.3	49.1	245.50%
25 mph	5,531	724	13.1%	19.9	44.3	177.20%
30 mph	5,269	630	12%	26.6	48.8	162.67%
35 mph	11,296	1,116	9.9%	32	52.1	148.86%
40 mph	8,416	609	7.2%	36	55.6	139.00%
45 mph	12,525	665	5.3%	40	59	131.11%
50 mph	3,167	171	5.4%	41.7	63.9	127.80%
55 mph	9,083	620	6.8%	45.8	62.8	114.18%
60 mph	2,421	178	7.4%	42.7	65	108.33%
65 mph	5,792	656	11.3%	50.4	68.4	105.23%
70 mph	3,063	226	7.4%	50.7	72.3	103.29%
75 mph	918	74	8.1%	45.3	71.9	95.87%
80 mph	96	11	11.5%	42.5	61.7	77.13%
TOTAL Pedestrian fatalities	68,152	5,366	100%		54.41	

Pedestrian Fatalities by Posted Speed Limit, 2012-2022 (FARS 2025)

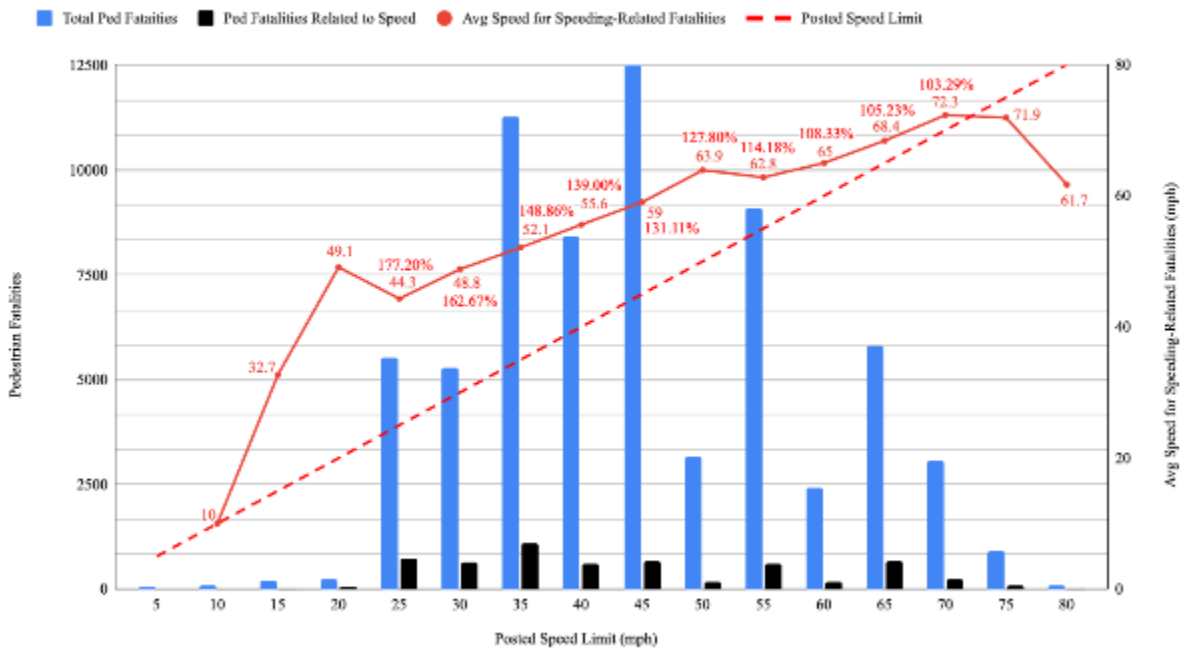


Figure 10. Average Travel Speed in Speeding-Related Pedestrian Fatalities Compared to Posted Speed Limits (2012–2022)

Posted speed limit zones of 25 mph to 45 mph also show high speed percentage differences, notably the average speed of vehicles involved in speed-related fatalities (depicted with red dots and a line) frequently exceeds posted limits by as much as 177.2% in 25 mph zones. This trend reveals that even at relatively low speed limits that are expected to be safer for pedestrians, more speeding-related pedestrian fatalities occur more regularly in these speed limit zones than in high-speed limit zones. The data underscores the lethal impact of speed, particularly in speed limit zones with moderate posted limits where pedestrian activity is higher. While streets posted at 5 to 20 mph collectively account for less than 1% of pedestrian fatalities, a dramatic increase in the number of fatalities occurs at 25 mph; at 25 mph, fatalities jump to 5,531, 8.12% of the total. This pattern continues as speeds increase: 35 mph accounts for 11,296 fatalities (16.57%), 40 mph for 8,416 (12.35%), and 45 mph for 12,525 fatalities holding the highest share at 18.38%. This highlights the need for robust enforcement mechanisms in urban areas to succeed, and that the current enforcement mechanisms are not up to the task even if one is able to reduce the speed limit. A similar issue persists on streets that have speed limits from 25-40 MPH, even though the difference is not as high as that corresponding to 20MPH.

This dataset reinforces the urgent need for systemic speed management reforms. The correlation between posted speed and fatal crash outcomes is not abstract, it is visible, measurable, and deadly.

Reassessing speed limits, particularly on urban corridors, and pairing those reductions with infrastructure that prioritizes pedestrian safety, will be critical to reversing these trends.

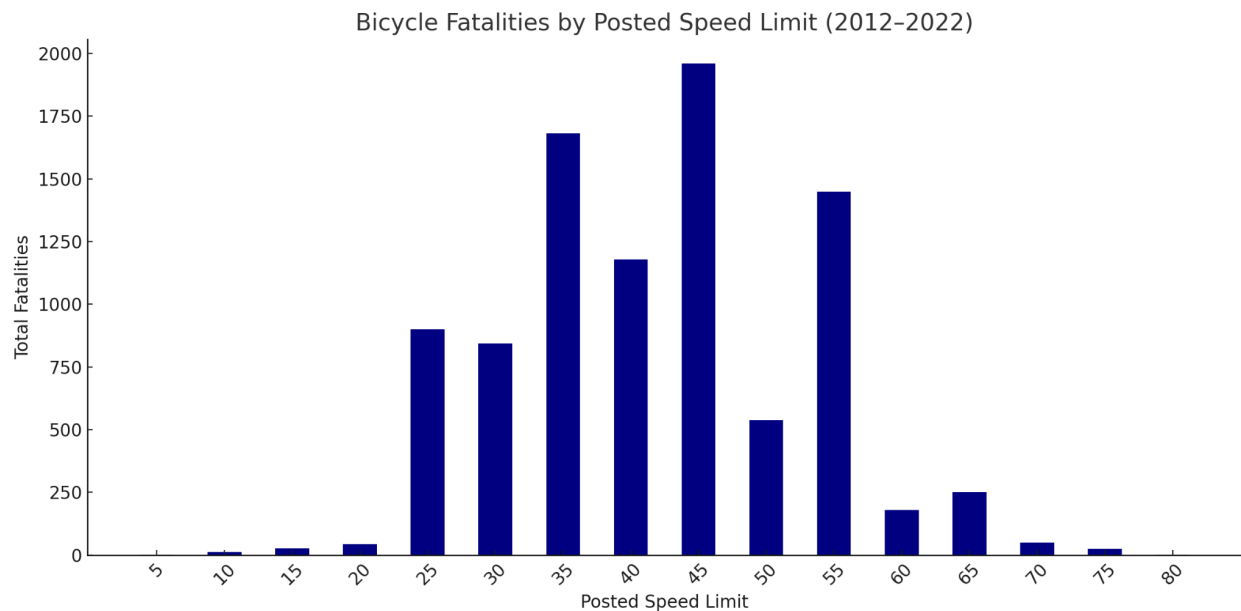


Figure 11. Bicycle Fatalities by Posted Speed Limit (2012-2022) (FARS 2025)

Table 4. Bicycle Fatal Crashes by Posted Speed Limit, 2012-2022 (FARS 2025)

Posted Speed Limit	Total Fatalities	Total Fatalities related to Speed	Percentage of speeding related fatalities	Average travel speed for non-speeding related fatalities (MPH)	Average travel speed for speeding related fatalities (MPH)	Percentage Difference in Speed
5 mph	2	-		5	-	-
10 mph	11	-		8.1	-	-
15 mph	26	4	15.4%	8.6	30	-
20 mph	44	5	11.4%	18.3	51.3	-
25 mph	901	85	9.4%	19.4	47	188%
30 mph	843	89	10.6%	26	52	173.33%
35 mph	1,681	197	11.7%	31.4	55.1	157.43%
40 mph	1,178	116	9.8%	35.2	53.8	134.50%
45 mph	1,959	137	7.0%	40.9	59	131.11%
50 mph	538	39	7.2%	45.4	61.7	123.40%
55 mph	1,448	128	8.8%	51	57.5	104.55%
60 mph	180	13	7.2%	55	65	108.33%
65 mph	250	13	5.2%	59.1	70	107.69%
70 mph	49	8	16.3%	58.9	70	100%
75 mph	24	3	12.5%	59.5	75	100%
80 mph	1	-		70	-	-
85 mph	-		-	-	-	-
TOTAL Bicycle fatalities	9,135		100%		57.49	

Bicyclist Fatalities by Posted Speed Limit, 2012-2022 (FARS 2025)

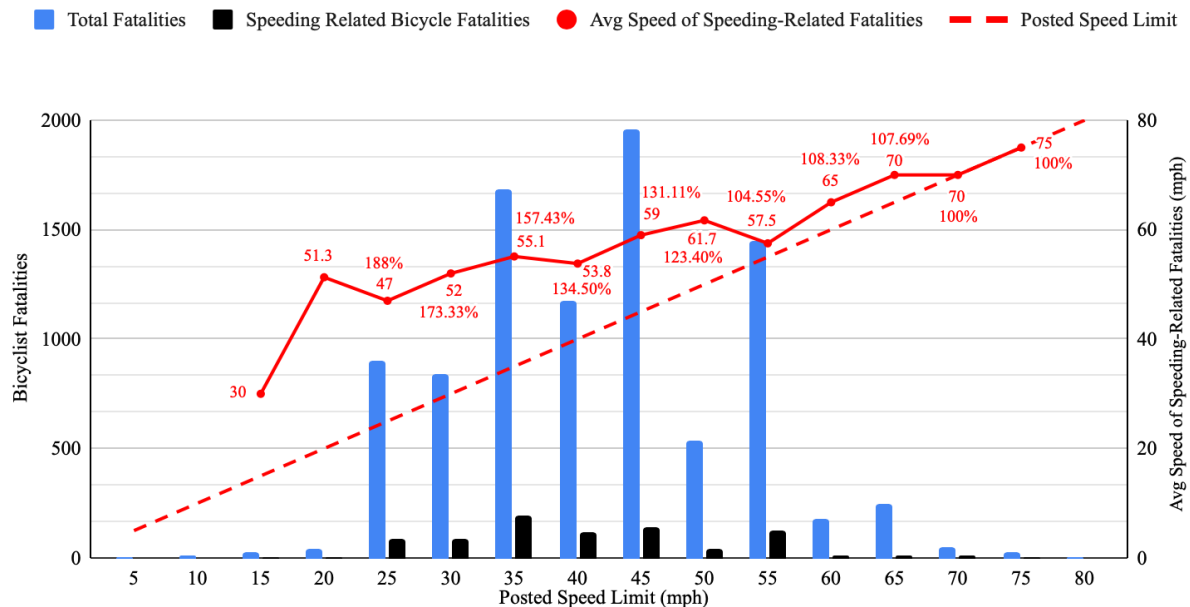


Figure 12. Average Travel Speed in Speeding-Related Bicyclist Fatalities Compared to Posted Speed Limits (2012-2022)

Figure 12 presents bicyclist fatalities by posted speed limit from 2012-2022, with a focus on the role of speeding. Similar to Figure 10, the difference remains significant even at moderate speeds (e.g., 157.4% at 35 mph), suggesting that actual travel behavior in these zones is substantially riskier than what the speed limit implies. Unlike pedestrian fatalities, which decrease more sharply at higher speed zones, bicyclist fatalities taper more gradually, with notable deaths still occurring up to 65 mph zones. The chart underscores the vulnerability of bicyclists on roads with moderate posted limits, where both speeding and exposure are high, emphasizing the need for infrastructure and enforcement interventions to reduce speeds and protect cyclists.

Speeding Data for California

According to Caltrans, more than 3,600 traffic fatalities and 13,000 serious injuries occur in California each year (Caltrans 2022). Approximately 34% of these fatalities and serious injuries are related to speeding and aggressive driving (Caltrans 2022). The University of California at Berkeley's Transportation Injury Mapping System (TIMS) provides data on vehicle-related deaths and injuries in California, both on state and county levels. Based on fatalities alone for the state of California between 2015-2024, the state faces an average of 1,045 speeding-related fatalities each year. Adding serious injuries into the criteria increases the number to a 5,251 yearly average over the same time frame (UC Berkeley, n.d.). Unsafe speed was the most common primary crash factor in speeding-related FSI crashes in 2021 making up 71.4 percent, followed by driving or bicycling

under the influence of alcohol or drugs (15.4 percent) and improper turning (4.8 percent). Hence, controlling speed has the potential to address a large majority of crashes that are due to unsafe speeds. UC Berkeley's Safe Transportation Research and Education Center (SAFETREC) summarized that 35 percent (or 1509) of all motor vehicle fatalities in California in 2021 were speeding-related, while 29 percent (or 12330) of all motor vehicle fatalities nationwide were speeding-related (UC Berkeley, 2023). 76% of speeding-related crashes in California in 2021 occurred in urban areas.

Top 5 Crash Factors in Speeding-Related Fatal and Serious Injury Crashes (California, 2021)

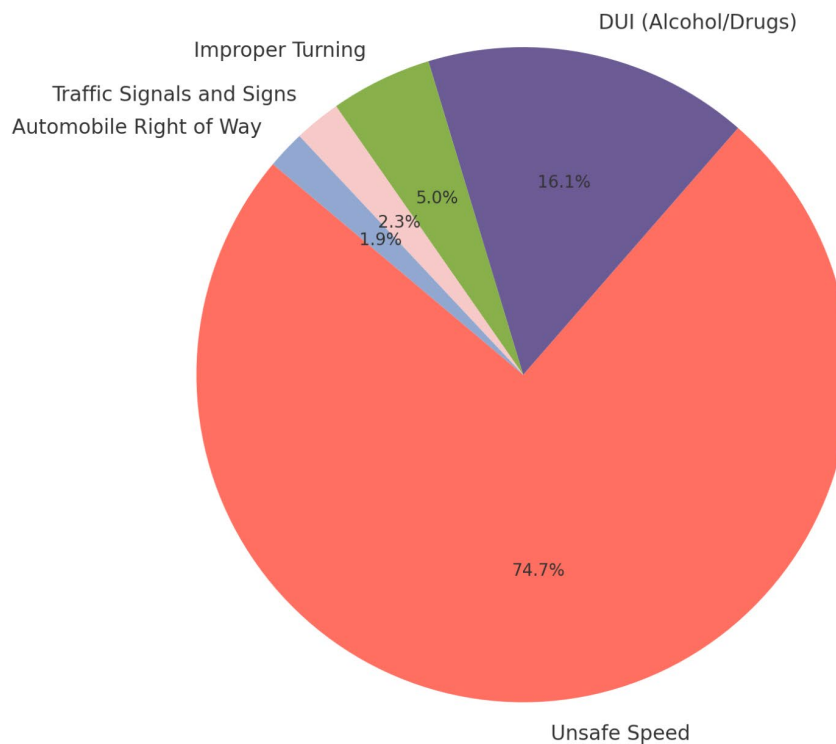


Figure 13. Top Five Primary Crash Factors of Speeding-Related Fatal and Serious Injury Crashes in California (2021)

Table 5. Share of speeding-involved bicycle collisions and fatalities in California by posted speed limit, 2011-2022

Posted Speed Limit	Bicycle Collisions		Bicycle Fatalities Related to Speeding		Collisions Resulted in Fatalities	Cost of Fatalities
	Count	Percent	Count	Percent	Percent	
5	1	0.00%	-	0.00%	0.00%	
8	16	0.02%	-	0.00%	0.00%	
10	2	0.00%	-	0.00%	0.00%	
15	134	0.13%	-	0.00%	0.00%	
16	1	0.00%	-	0.00%	0.00%	
20	313	0.31%	-	0.00%	0.00%	
25	84,143	82.48%	1,118	77.96%	1.33%	\$15.32 billion
30	3,207	3.14%	23	1.60%	0.72%	\$315.1 million
35	5,398	5.29%	45	3.14%	0.83%	\$616.5 million
40	2,905	2.85%	52	3.63%	1.79%	\$712.4 million
45	2,695	2.64%	66	4.60%	2.45%	\$904.2 million
50	927	0.91%	34	2.37%	3.67%	\$465.8 million
55	914	0.90%	44	3.07%	4.81%	\$602.8 million
60	70	0.07%	8	0.56%	11.43%	\$109.6 million
65	1,257	1.23%	43	3.00%	3.42%	\$589.1 million
70	38	0.04%	1	0.07%	2.63%	\$13.7 million
Total	102,021		1434		1.41%	\$1.40 trillion

% of Bicycle Collisions Resulted in Fatalities per Posted Speed Limit (California, 2011-2022)

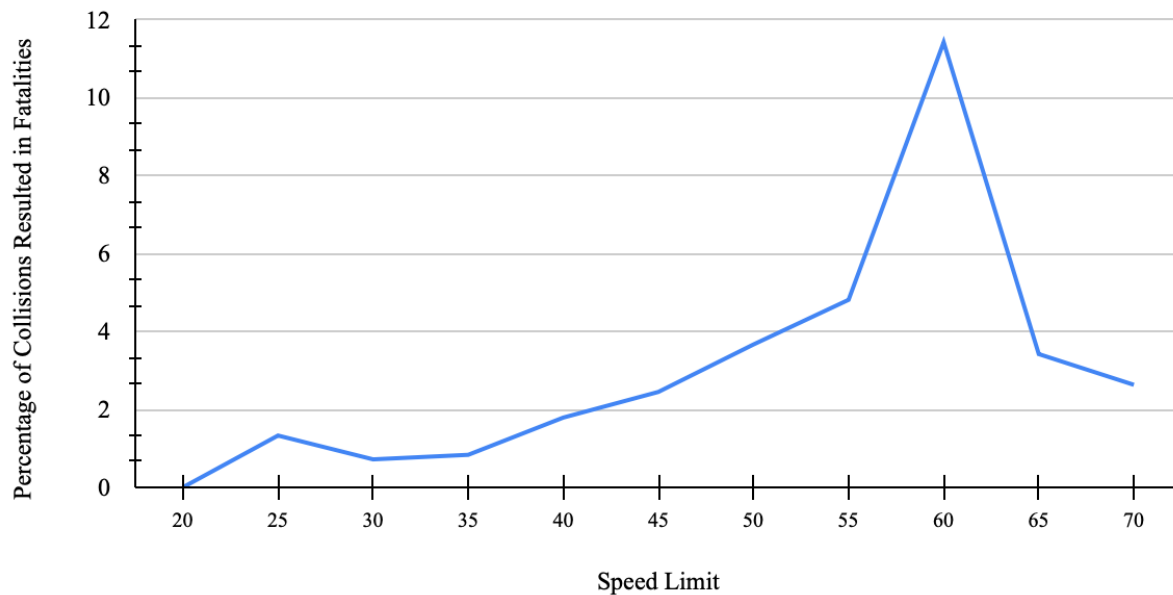


Figure 14. Percent of Bicycle Collisions Resulted in Fatalities per Posted Speed Limit (California 2011-2022)

This dataset presents bicycle collision and fatality data broken down by posted speed limits, revealing clear relationships between speed environments, collision frequency, fatality rates, and economic costs. A total of 102,021 bicycle collisions were recorded, resulting in 1,434 fatalities, an overall fatality rate of 1.41%. When these fatalities are evaluated using the U.S. DOT's value of a statistical life (\$13.7 million), the total estimated societal cost exceeds \$1.40 trillion.

The majority of bicycle collisions (over 82%) occurred on roads with a posted speed limit of 25 mph, accounting for 84,143 crashes. Despite this concentration, the fatality rate at this speed was relatively low, 1.33%, resulting in 1,118 fatalities. This accounts for 78% of all bicyclist deaths in the dataset. While this initially appears counterintuitive, it likely reflects greater exposure rather than greater risk: roads with 25 mph limits are typically urban or residential, where more people bike and interact with vehicle traffic. The cost of these fatalities is substantial, totaling \$15.32 billion.

Although fewer crashes occurred at higher posted speed limits, the likelihood that a crash would be fatal increased significantly. For example:

- On roads with speed limit 45 mph, the fatality rate was 2.45% with 66 fatalities.
- On roads with speed limit 50 mph, it rose to 3.67% with 34 fatalities.
- On roads with speed limit 55 mph, it climbed further to 4.81% with 44 fatalities.

- The most extreme fatality rate occurred on roads with speed limit 60 mph, where 11.43% of bicycle collisions resulted in death, despite there being only 70 crashes at this speed.

This trend demonstrates the substantial increase in fatality risk as speeds rise, a finding that aligns with existing research showing that the survivability of crashes sharply decreases as impact speeds exceed 35 mph (Tefft, 2011). The total cost of fatalities escalates accordingly, with segments like 40 mph and 45 mph accounting for \$712.4 million and \$904.2 million, respectively.

Although the fatality risk of each individual crash is higher on high-speed roads, the overall impact of bicycle fatalities is most severe in 25 mph zones due to the sheer number of crashes (and bicyclists that use these facilities) that occur there. These lower-speed environments, typically urban and residential areas, see far more interactions between cyclists and vehicles, which drives up the total number of deaths despite the lower per-crash severity. In contrast, higher-speed zones account for a smaller share of total crashes but pose a significantly higher risk when crashes do occur. For example, while only 914 crashes were recorded at a posted speed limit of 55 mph, the resulting fatalities carried an estimated economic cost of \$602.8 million, nearly 4% of the total cost from less than 1% of crashes.

The data clearly supports the case for targeted speed management as a critical strategy in reducing bicyclist fatalities. As speed increases, so does the fatality rate, with even modest rises in posted speed limits correlating with significantly higher crash lethality. However, volume also plays a major role. Streets with lower speed limits but high volumes of bike-vehicle interactions can produce the highest absolute number of fatalities. The increase of per-crash lethality at high speeds and associated increase in total fatalities at lower-speed high-volume locations points to the need for comprehensive policy intervention. The societal cost of these fatalities, totaling \$1.40 trillion, further reinforces the urgency of addressing the problem.

The intersection of travel speed and fatality risk for bicyclists is both clear and urgent. This analysis demonstrates that meaningful reductions in traffic fatalities will require more than just addressing the most dangerous roads; it also demands action in the everyday spaces where most crashes happen. Lower-speed streets, by virtue of their high usage, still carry a heavy burden of harm. Reducing this burden will require a systems-level approach to speed management, one that integrates infrastructure design, enforcement, public engagement, and emerging vehicle technology to create safer streets for all users.

Pedestrians

This dataset provides a detailed breakdown of speeding-involved pedestrian collisions and fatalities across different posted speed limits in California from 2011 to 2022. The data highlights a stark relationship between posted speed limits, the volume of pedestrian collisions, and the fatality outcomes of those crashes. In total, 142,305 pedestrian collisions were recorded, resulting in 9,771 fatalities. Using the U.S. Department of Transportation's value of a statistical life (\$13.7 million), the total estimated economic cost of these pedestrian fatalities exceeds \$133.85 billion.

Table 6. Share of speeding-involved pedestrian collisions and fatalities in California, 2011-2022

Posted Speed Limit	Pedestrian Collisions		Pedestrian Fatalities		Percentage	Cost
	Count	Percent of Collisions	Count	Percent of Fatalities	Percentage Collisions Resulting in Fatalities	Estimated cost for total fatality
5	1	0.00%	-	0.00%	-	-
8	7	0.00%	-	0.00%	-	-
10	3	0.00%	1	0.01%	33%	13.7 million
15	83	0.06%	2	0.02%	2.41%	27.4 million
17	1	0.00%	-	0.00%	-	-
20	750	0.53%	16	0.16%	2.13%	\$219.2 million
25	119,945	84.29%	7,167	73.35%	5.98%	\$98.19 billion
30	3,897	2.74%	127	1.30%	3.26%	\$1.74 billion
35	6,596	4.64%	394	4.03%	5.97%	\$5.40 billion
40	3,460	2.43%	282	2.89%	8.15%	\$3.86 billion
45	2,292	1.61%	276	2.82%	12.04%	\$3.78 billion
50	854	0.60%	163	1.67%	19.09%	\$2.23 billion
55	955	0.67%	253	2.59%	26.49%	\$3.47 billion
60	85	0.06%	34	0.35%	40%	\$465.8 million
65	2,978	2.09%	902	9.23%	30.29%	\$12.36 billion
70	398	0.28%	154	1.58%	38.69%	\$2.11 billion
Total	142,305		9,771		6.87%	\$133.85 billion

% of Pedestrian Collisions Resulting in Fatalities per Posted Speed Limit (California, 2011-2022)

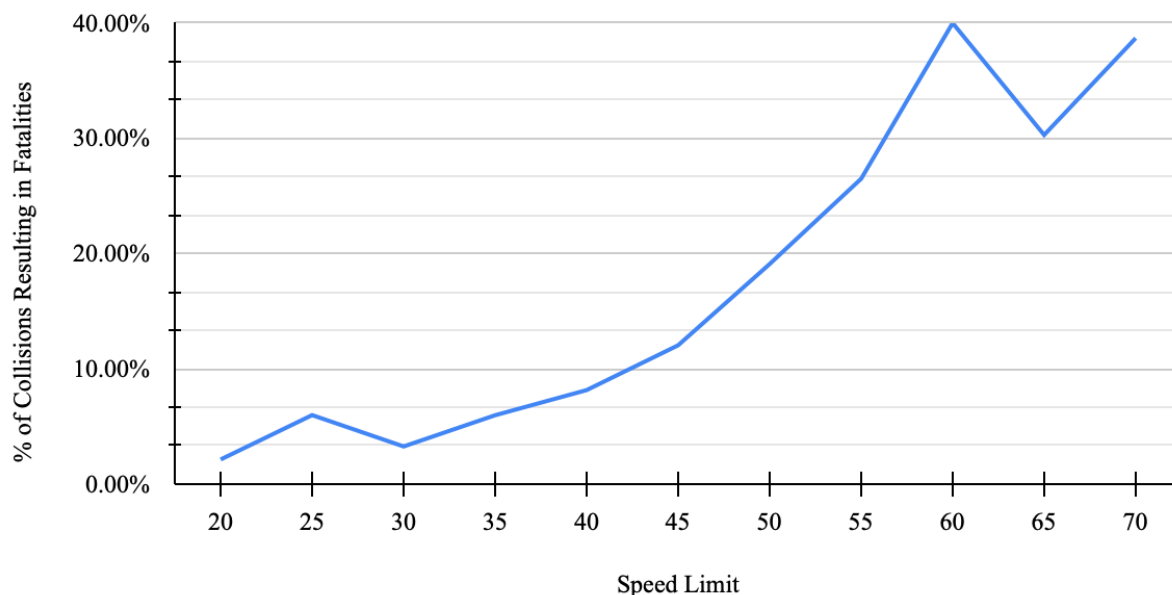


Figure 15. Percent of Pedestrian Collisions Resulted in Fatalities per Posted Speed Limit (California 2011-2022)

The overwhelming majority of collisions occurred on roads with a posted speed limit of 25 mph. These accounted for 119,945 crashes, or 84.29% of all incidents, and resulted in 7,167 pedestrian fatalities, representing 73.35% of all pedestrian deaths in the dataset. The estimated economic cost of these fatalities is \$98.19 billion, by far the highest among all speed categories. This concentration of collisions and fatalities at 25 mph suggests not only the ubiquity of this speed limit in urban areas, but also the high exposure of pedestrians in such environments. While the per-crash fatality risk may be lower at this speed compared to higher-speed zones, the sheer number of pedestrian interactions with traffic at 25 mph generates the greatest total harm.

Higher-speed zones, although associated with fewer total collisions, show a consistent pattern of increased lethality per crash. At 35 mph there were 6,596 pedestrian crashes resulting in 394 fatalities, a fatality rate of approximately 5.97%- the same as the rate observed at 25 mph (7,167 fatalities from 119,945 crashes). However, as speeds increase further, the fatality rate climbs sharply. At 50 mph, 854 crashes resulted in 163 fatalities, meaning that nearly 1 in 5 crashes (19.09%) at that speed were fatal. The pattern is even more pronounced at 65 mph, where 2,978 collisions led to 902 fatalities, a fatality rate of 30.28%, the highest across all posted speed categories. Although crashes at 65 mph made up just 2.09% of all pedestrian collisions, they accounted for 9.23% of total pedestrian deaths, with an estimated societal cost of \$12.36 billion.

This disproportionate outcome underscores the deadly consequences of high-speed pedestrian impacts and the need for interventions that reduce vehicle speeds on major roadways.

Notably, even small increases in posted speed limits appear to drastically elevate fatality risk. At 40 mph, 3,460 crashes resulted in 282 deaths, while at 45 mph, 2,292 crashes led to 276 fatalities. The estimated costs of fatalities at these two speed levels were \$3.86 billion and \$3.78 billion, respectively. These figures demonstrate that pedestrian fatalities not only increase in severity with speed, but also carry escalating economic consequences.

The relationship between speed and pedestrian fatality is further supported by patterns at very low and very high ends of the speed spectrum. There were no recorded fatalities at posted limits of 5, 8, or 17 mph, and only isolated deaths at 10 mph (1 fatality) and 15 mph (2 fatalities). At the opposite end, at 70 mph, 398 collisions led to 154 deaths, an exceptionally high fatality rate of 38.7% and a cost of \$2.11 billion. These extremes illustrate the non-linear nature of speed-related risk: while fatalities are rare in low-speed environments, they become significantly more likely, and more costly, as speeds increase.

This analysis strongly reinforces the importance of speed management in pedestrian safety. While lower-speed zones are associated with high collision volumes and therefore high aggregate harm, higher-speed roadways are dramatically more lethal when collisions do occur. Both contexts demand distinct interventions. Urban areas with 25 mph limits require investments in street design that physically separates pedestrians from vehicle traffic, including wider sidewalks, traffic calming measures, and pedestrian refuge islands. Meanwhile, high-speed corridors should be prioritized for engineering changes that reduce speed limits, implement automated speed enforcement, and integrate pedestrian overpasses or signalized crossings.

The data confirms that speed is one of the most powerful predictors of pedestrian fatality risk. Addressing speeding is not only a moral imperative for protecting human life but also a fiscal necessity, given the staggering \$133.85 billion in estimated costs associated with pedestrian deaths over this 11-year period. A systems-level approach that integrates planning, engineering, enforcement, and education is necessary to reduce these deaths and create safer, more walkable communities across California.



Figure 16. Comparison of Pedestrian Collisions and Fatalities (California 2011-2022)

Speeding and Road Classifications

Percentage of Speeding Related Collisions per Road Class (FARS, 2014-2023)

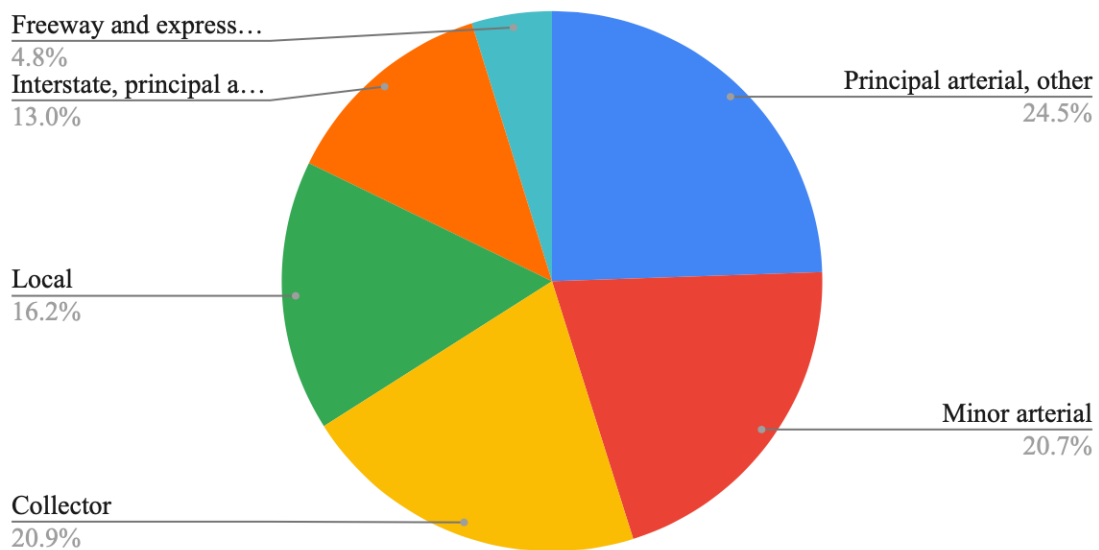


Figure 17. Speeding related crashes and road classification of crashes. Source: FARS National Dataset, 2014-2023.

Table 7. Total Collisions and Speeding-Related Collisions Road Classification (FARS, 2014-2023)

Road Classification	Total Crashes	Total Crashes Related to Speed	Percent Speeding Related	Average Travel Speed (mph)
Interstate, principal arterial	43,903	12,339	28.1%	50.36
Freeway and expressway, principal arterial	15,367	4,547	29.6%	50.69
Principal arterial, other	103,561	23,207	22.4%	41.49
Minor arterial	76,062	19,628	25.8%	42.82
Collector	65,748	19,789	30.1%	46.69
Local	45,539	15,387	33.8%	42.09

Analysis of crash data by road classification reveals the relationship between roadway type, average travel speed, and the prevalence of speeding-related collisions. While the highest average speeds are observed on interstate and expressway facilities, where both average travel speeds exceed 50 MPH, these roads do not hold the highest proportion of speed-related crashes. Interstate principal arterials accounted for 43,903 total crashes, with 28.1% (12,339 speeding-related crashes) involving speeding. Similarly, freeways and expressways saw 15,367 crashes, of which 29.6% (4,547 speeding-related crashes) were speed-related. Despite their higher speeds, these major facilities typically benefit from controlled access and more consistent geometric design, which may help moderate risk (Federal Highway Administration Office of Safety Research and Development 2022).

In contrast, local roads and collectors are shown to have lower average speeds (42.09 MPH and 46.69 MPH, respectively) and represent the highest percentage of speeding-related crashes. Speeding contributed to 33.8% of speeding-related crashes (15,387 crashes) on local roads and 30.1% speeding-related crashes (19,789 crashes) on collectors, exceeding the rates associated with higher-speed on interstates and principal arterials. This suggests that speeding on lower-classified roads may be more dangerous due to environmental complexity, such as more pedestrian activity, mixed-use traffic, and variable signage (Federal Highway Administration Office of Safety Research and Development 2022).

The principal arterial (other) category, which includes large arterial corridors not classified as interstates or expressways, experienced the highest absolute number of speed-related crashes, totaling 23,207 incidents, though the percentage of speed-related collisions in this category was lower at 22.4%. This likely reflects the high traffic volumes and the dual-purpose design of these roads, which are built to accommodate both high-speed through traffic and frequent local access, such as driveways, intersections, and pedestrian crossings, conditions that can increase the likelihood of conflicts and crashes Federal Highway Administration Office of Safety Research and Development 2010).

Table 8. Total Collisions and Speeding-Related Collisions involving a Bicyclist by Road Classification (FARS 2025)

Road Classification	Total Fatalities	Total Fatalities Related to Speed	Percent Speeding Related	Average Travel Speed
Interstate, principal arterial	169	5	3.0%	63.83
Freeway and expressway, principal arterial	156	10	6.4%	59.30
Principal arterial, other	3,681	279	7.6%	47.36
Minor arterial	2,552	237	9.3%	44.23
Collector	1,710	154	9.0%	46.09
Local	1,441	128	8.9%	38.30

Bicycle-Involved Fatalities Related to Speed (FARS, 2014-2023)

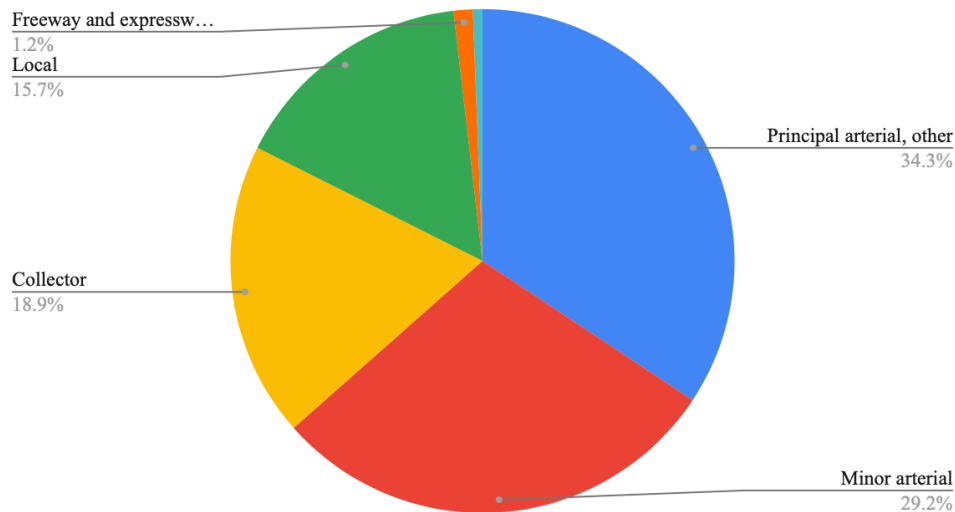


Figure 18. Speeding related Bicycle Crashes and Road Classification of Crashes. Source: FARS National Dataset, 2014-2023.

In relation to collisions involving a bicyclist, the data clearly demonstrates that the type of roadway plays a major role in shaping both the frequency and characteristics of bicycle collisions, especially those related to speed. “Principal arterial, other” roads stand out as the most common site for these incidents, accounting for 3,681 total crashes, significantly more than any other road classification. This category also represents the largest share of speed-related crashes (279), indicating that these roads pose a dual threat of both frequent and severe incidents. The average travel speed on these roads is 47.36 mph, suggesting arterial streets with relatively high speeds and frequent vehicle-bicycle interactions create hazardous conditions for cyclists. Minor arterials and collector roads, despite having slightly lower travel speeds of 44.23 and 46.09 mph respectively, also show substantial shares of speed-related crashes (9.3% and 9.0%, respectively). These figures emphasize the risks posed by mid-tier roads that are often designed for vehicular flow but still serve as key routes for cyclists.

High-speed facilities such as interstates and expressways, with 63.83 mph and 59.30 mph average travel speeds respectively, show relatively low numbers of total and speed-related bicycle crashes. This is likely because bicyclists are either prohibited or effectively excluded from these environments, reducing exposure despite the dangerous speeds. Local roads have the lowest average speeds (38.30 mph) and the fewest speed-related crashes (128), yet still show a speed-related crash percentage of 8.9%, similar to that of collector roads. This suggests that while speeds are generally lower on local streets, the relative lack of protected infrastructure or traffic calming may still contribute to a significant share of speed-related collisions.

Table 9. Total Collisions and Speeding-Related Collisions involving a Pedestrian by Road Classification (FARS 2025)

Road Classification	Total Fatalities	Total Fatalities Related to Speed	Percent Speeding Related	Average Travel Speed
Interstate, principal arterial	7,379	612	8.3%	50.43
Freeway and expressway, principal arterial	2,757	216	7.8%	50.52
Principal arterial, other	24,298	1,572	6.5%	39.15
Minor arterial	14,544	1,134	7.8%	39.19
Collector	6,985	586	8.4%	41.90
Local	7,339	664	9.1%	35.76

Total Pedestrian Crashes Related to Speed

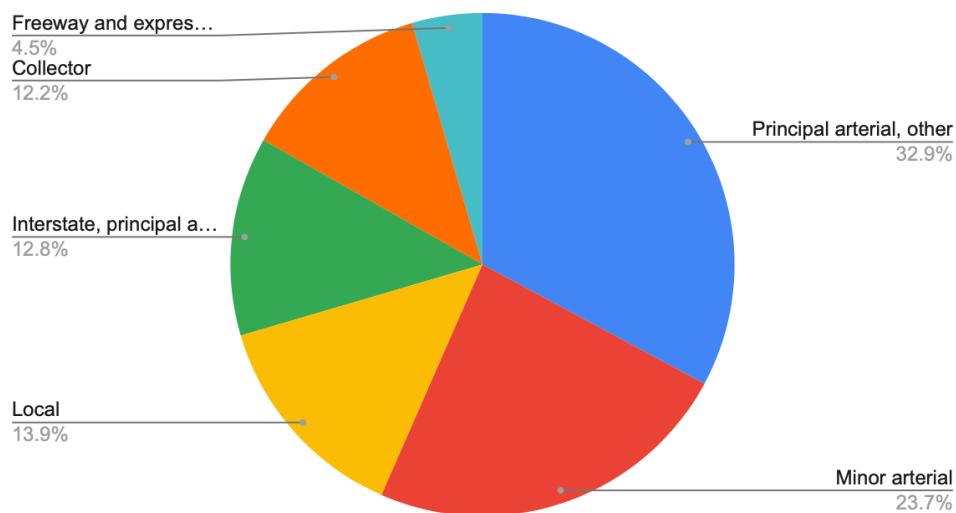


Figure 19. Speeding related Pedestrian Crashes and Road Classification of Crashes. Source: FARS National Dataset, 2014-2023.

The data presented in the above table reveals how roadway classification shapes both the frequency and context of pedestrian collisions and speeding-related pedestrian collisions. “Principal arterial, other” roads represent the largest share of pedestrian crashes, with 24,298 total collisions. This category also accounts for the highest number of speeding-related pedestrian crashes (1,572), despite a relatively modest average travel speed of 39.15 mph.

Local roads, while accounting for only 7,339 total crashes, had the highest percentage of speed-related pedestrian crashes at 9.1%. Although these roads have a lower average speed of 35.76 mph, the well-established link between speed and injury severity, as well as the documented rise in fatality risk when speeds exceed 25 mph, underscores the dangers of even minimal increases in speed in areas with high pedestrian activity, especially where infrastructure protections or speed enforcement are limited.

Higher-speed facilities like interstates and freeways show fewer total pedestrian crashes (7,379 and 2,757, respectively), likely reflecting limited pedestrian access. However, the average travel speeds on these roads, above 50 mph, remain deeply concerning when crashes do occur, as the severity of injuries is typically much greater, most often resulting in a fatality.

Context-sensitive Collision Information

Speeding-Related Crashes by Place Type

Table 10. Speeding-Related Crashes by Place Type (FARS, National, 2012-2022)

	Number of Fatal Crashes	Percent Speeding Related	Total Crashes related to speeding	Average Travel Speed
Rural	163,308	27.6%	45,073	49.63
Urban	211,034	26.8%	56,577	40.52
Rural Bike	2,000	8.2%	164	45.99
Urban Bike	7,629	8.2%	629	37.92
Rural Pedestrian	12,763	5.7%	721	44.21
Urban Pedestrian	58,882	6.7%	3936	39.21

Using national FARS data from 2014 to 2023, differences in crash prevalence, speed behavior, and associated costs were analyzed to highlight trends associated with speeding related crashes between rural and urban areas.

Over the ten-year period, rural areas experienced 163,308 total crashes involving a fatality, with 27.6% (45,073 crashes) being speeding-related. The average travel speed in rural crashes was 49.63 MPH, significantly higher than in urban areas. Despite lower population density and traffic congestion, rural environments often feature longer uninterrupted stretches of roadway, limited enforcement presence, and higher posted speed limits, often resulting in higher average speed associated with collisions and greater related crash severity (*Proven Safety Countermeasures in Rural Communities*, 2024).

While urban areas recorded a higher total number of crashes overall (211,034), the proportion involving speeding was slightly lower at 26.8% (56,577 crashes). The average travel speed in urban areas was 40.52 MPH. This higher crash rate and associated lower average speed can be attributed to more complex driving environments with characteristics such as frequent intersections, high pedestrian activity, and shorter street block lengths (Federal Highway Administration 2018).

Cost estimates based on NSC valuation methods show the economic impact of speeding is greater in urban areas, with urban speed-related crashes estimated to cost between \$678.1 million and \$725.74 billion, compared to \$540.25 million to \$578.25 billion in rural areas. These wide-ranging figures reflect variations in crash severity, fatality rates, and long-term disability outcomes, as well as assumptions around cost multipliers for medical care, productivity losses, and quality of life.

The findings suggest that while speeding in rural areas is associated with higher travel speeds and more severe individual outcomes, urban areas bear a higher overall crash volume and cumulative societal cost. In considering preventative policy measures in rural settings, emphasis should be placed on improving enforcement visibility, upgrading signage, and deploying advanced driver assistance systems like Intelligent Speed Assistance (ISAT). In urban areas, where even moderate speeding contributes to a large number of fatal crashes, interventions should prioritize automated enforcement, traffic calming infrastructure, and reduced speed limits on local streets and arterials. As noted in the literature review, ISAT may be expected to face severe political opposition if implemented universally. Hence, a reduction in all fatalities, even those associated with pedestrians, may be unrealistic to achieve. Hence, policymakers may be interested in estimating benefits if ISAT were implemented in certain limited contexts. Table 11 provides some specific contexts and corresponding speeding-related crashes and potential costs avoided by reducing fatalities.

Table 11. Speeding-related collisions and fatal crashes in California, CalTrans, California Strategic Highway Safety Plan Crash Data Dashboard (2013-2022 Finalized Data)

Location (California)	TOTAL COLLISIONS (2013-2022)	TOTAL COLLISIONS RESULTING IN FATALITIES	Estimated Monetary Costs of Fatalities from 2013-2023
Freeway Only, Interstate, Expressways, Other Principal Arterials	25,565	5,708	\$78.2 Billion
Urban Freeway, Interstate, Expressways, Other Principal Arterials	20,259	4,191	\$57.4 Billion
Rural Freeway, Interstate, Expressways, Other Principal Arterials	5,306	1,517	\$20.8 Billion
Construction Zone	788	328	\$4.5 Billion

As mentioned previously, based on a recent study by co-authors, the acceptance of ISAT varies by urban vs. rural drivers. Urban drivers are likely to be more accepting of ISAT; therefore, implementing such technology on the urban freeways may be more palatable politically. Rural freeways have fewer speeding-related crashes and fatalities, and residents near those freeways may be more opposed to ISAT. Furthermore, since the urban freeway miles are much smaller, ISAT technology would have a smaller footprint. Even with a lower implementation footprint, urban freeways have close to three times the cost savings as rural freeways (\$57.4 billion vs. \$20.8 billion).

One additional context, where ISAT is likely to be politically acceptable, is the work zones. While the numbers and potential benefits are relatively small (\$4.5 billion), work zone implementation of ISAT may be an appropriate way to pilot the ISAT application and build future political consensus. From a political perspective, ISAT implementation for the work zone may be a palatable way, as it is arguably intended to protect the blue-collar workforce.

Next, we analyzed pedestrian-involved fatal collisions where speeding was a factor by vehicle type to examine if vehicle class-based implementation of ISAT may be an effective approach.

Vehicle-Level Data

Vehicle Size, Speeding, and Average Travel Speed

The Fatality Analysis Reporting System (FARS) collects detailed vehicle characteristic data for each unit involved in a fatal crash. This dataset enables analysis of vehicle characteristics such as type, weight, and estimated travel speed at the time of the collision. This section analyzes vehicle

size classifications, speeding involvement, and reported travel speeds to reveal trends between car characteristics, speeding related collisions, and related fatalities.

To assess vehicle size, we used the “Gross Vehicle Weight Rating From” variable sourced from the VPICdecode file, which cross-references Vehicle Identification Numbers (VINs) provided in the FARS Vehicle File. The Gross Vehicle Weight Rating (GVWR) is defined as the maximum permissible operating weight of a vehicle, including the chassis, body, engine, fluids, fuel, accessories, driver, passengers, and cargo, excluding any attached trailers.

Based on the GVWR, vehicles were categorized into three standard weight classes in accordance with Department of Energy (DOE) classifications:

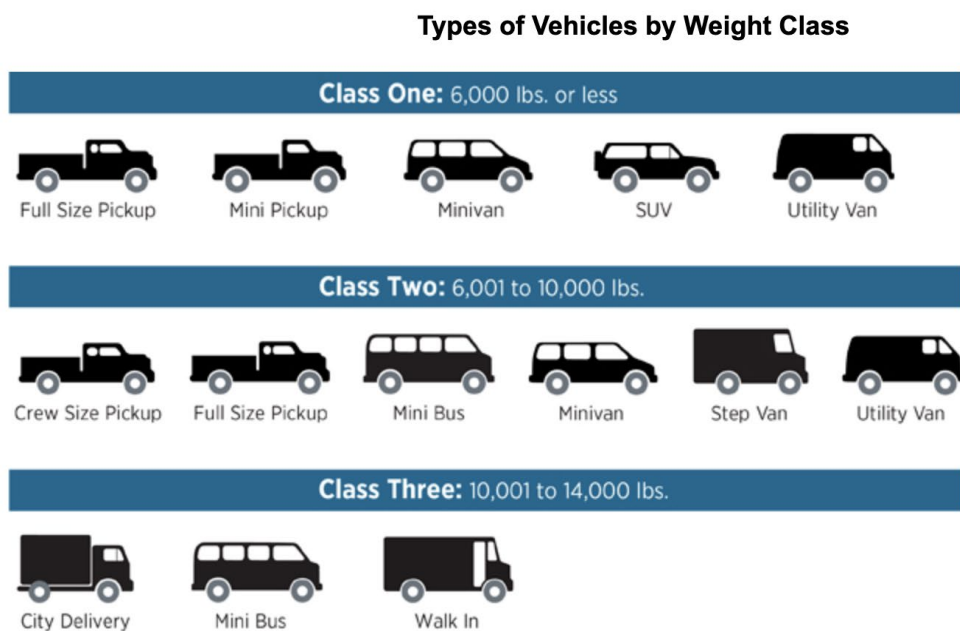


Figure 20. Types of Vehicle by Weight Class (U.S. Department of Energy)

- Class 1: Vehicles weighing 6,000 pounds or less, including most passenger cars and light trucks.
- Class 2: Vehicles weighing 6,001 to 10,000 pounds, typically encompassing larger pickups, vans, and some SUVs.
- Class 3 and above: Vehicles exceeding 10,000 pounds, including commercial trucks, buses, and utility vehicles.

These classifications were used to group collisions with similar variables to evaluate trends in speeding-related collisions across vehicle types. In conjunction with vehicle weight, we also examined travel speed estimates using available speed data in the FARS Vehicle File. This includes variables indicating whether a vehicle was speeding and reported pre-crash travel speed—however a significant fraction of the speed data was often incomplete or unreported, with travel speed estimates available for only about 40% of cases.

These vehicle-level variables offer insights into how vehicle size and speed behavior interact in fatal crash scenarios, informing targeted safety interventions by vehicle type and weight class.

Table 12. Annual Average Fatal or Injury-only Crashes by Vehicle Type (National Highway Traffic Safety Administration, USA, 2014-2023)

Vehicle Type	Average Annual Fatality or Injury-Only Collisions by Vehicle Type	Average Annual Fatal Collisions by Vehicle Type	Percentage of Collisions Resulting in Fatalities	Percentage of Annual Fatal Crashes among all Vehicle Classes
Passenger Car (Convertible, Sedan, Coupe, Hatchback, Wagon)	1,672,060	19,992	1.20%	37.04%
Light Trucks (Pickup, Van, Other)	571,509	9,572	1.67	20.6%
Light Trucks-Utility (SUVs only)	756,267	10,420	1.38%	19.31%
Large Trucks	112,100	4,894	4.37%	9.07%
Motorcycles	88,904	5,588	6.29%	10.36%
Buses	12,835	228	1.78%	0.42%
Others/Unknown	1,189,931	1,724	.14%	3.2%
Total	4,403,606	53,962	1.23%	100.0%

**Table 13. Annual Average Pedestrian-Involved Fatal or Injury-Only Crashes by Vehicle Type
(National Highway Traffic Safety Administration, USA, 2014-2023)**

Vehicle Type	Average Annual Fatality or Injury-Only Collisions by Vehicle Type (2014-2023)	Average Annual Fatal Collisions Involving Pedestrians	Percentage of Collisions Resulting in Fatalities	Percentage Total of Fatal Crashes among all Vehicle Classes
Passenger Car (Convertible, Sedan, Coupe, Hatchback, Wagon)	36,968	2889	7.81%	39.5%
Light Trucks (Pickup, Van, Other)	13,269	1,528	11.52%	20.89%
Light Trucks-Utility (SUVs only)	16,070	1,572	9.78%	21.49%
Large Trucks	1,756	471	26.82%	6.44%
Motorcycles	591	53	8.97%	.72%
Buses	839	58	6.91%	.79%
Others/Unknown	7,098	744	10.48%	10.17%
Total	76,591	7,315	9.55%	100.0%

Table 14. Annual Average Speeding-Related Pedestrian-Involved Collisions by Vehicle Type (National Highway Traffic Safety Administration, USA, 2014-2023)

Vehicle Type	Average Annual Fatality or Injury-Only Collisions by Vehicle Type	Average Annual Fatal Collisions by Vehicle Type	Percentage of Collisions Resulting in Fatalities	Percentage of Annual Fatal Crashes among all Vehicle Classes
Light Trucks-Utility (SUVs only)	479	104	21.71%	21.22%
Light Trucks (Pickup)	345	67	19.42%	13.67%
Light Trucks (Van)	87	15	17.24%	3.06%
Light Trucks (Other)	12	2	16.67%	0.41%
Large Trucks	53	20	37.74%	4.08%
Passenger Car (Convertible, Sedan, Coupe, Hatchback, Wagon)	1,401	230	16.42%	46.94%
Motorcycles	64	14	21.88%	2.86%
Buses	6	1	16.67%	0.20%
Others/Unknown	259	38	14.67%	7.76%
Total	2,704	490	18.12%	

In Table 14, large trucks (~38%) and SUVs (~22%) are the two classes of vehicles that lead to the highest proportion of fatal crashes among all speeding-related pedestrian crashes. Hence, it may be argued that implementing ISAT on large trucks followed by SUVs in urban areas (these areas are more likely to have pedestrian activities) may lead to the most benefits in terms of saving pedestrian lives. While implementing ISAT on large trucks may be politically feasible, the overall number of fatalities is lower. To get additional benefits, one would have to target the most popular new vehicle segment in the US, i.e., SUVs, which may prove politically challenging.

Overall, context-based analysis helps us identify areas where political consensus may be built for phasing in ISAT, in light of the findings about acceptance of the technology by the drivers. While we did not have national or state-level data on fatal collision involvement by “superspeeders,” given the precedent of restrictions and technology used for drivers convicted of repeated DUI offenses, mandating the use of ISAT for superspeeders may be another important politically feasible context for ISAT implementation. SUVs representing a notable number of collisions resulting in fatalities should especially be considered for ISAT implementation.

Table 15. Annual Average Pedacyclist-Involved Fatal or Injury-Only Crashes by Vehicle Type (National Highway Traffic Safety Administration, USA, 2014-2023)

Vehicle Type	Average Annual Collisions Resulting in Injury and Fatality Only by Vehicle Type (2014-2023)	Average Annual Fatal Collisions Involving Pedacyclists	Percentage of Collisions Resulting in Fatalities	Percentage of Fatal Crashes among all Vehicle Classes
Passenger Car (Convertible, Sedan, Coupe, Hatchback, Wagon)	23,865	361	1.51%	36.9%
Light Trucks (Pickup, Van, Other)	8005	235	2.94%	23.97%
Light Trucks-Utility (SUVs only)	11,282	201	1.78%	20.53%
Large Trucks	871	82	9.41%	8.4%
Motorcycles	490	12	2.45%	1.2%
Buses	427	10	2.34%	1%
Others/Unknown	4,203	78	1.86%	8%
Total	49,143	979	1.99%	100.0%

Despite lower travel speeds, Class 3 vehicles still contribute to a measurable number of fatalities due to their greater mass and crash severity, even at moderate speeds (Anderson & Auffhammer 2012). This underscores that speed alone does not determine crash lethality; vehicle weight and kinetic force are also critical factors. Therefore, policy efforts that mandate Intelligent Speed Assistance Technology (ISAT) should not be limited to high-speed or light vehicle contexts alone. Instead, regulations should prioritize ISAT integration in both lighter vehicles with high average speeds and heavier vehicles where even lower-speed collisions have deadly consequences. Tailoring ISAT policy mandates based on both speed behavior and vehicle mass can help maximize fatality prevention across the vehicle fleet.

What We Can Do

Methodology: Estimating the Economic Cost of Speed-Related Collisions

This analysis applies the National Safety Council's (NSC) comprehensive cost model to quantify the economic burden of speed-related collisions and evaluate the potential return on investment of speed management technologies such as ISAT. The methodology is structured to provide an estimate of the costs associated with fatal and injury crashes, and the benefits of preventing them through targeted interventions.

Cost Framework and Data Sources

The next step in the analysis was the estimation of the cost savings that may be achieved using ISAT by avoiding a certain percentage of speeding-related collisions. Cost estimates are based on the NSC's 2021 valuations of collision costs, which incorporate both direct costs (e.g., medical treatment, emergency services, administrative and legal expenses, property damage, and lost wages) and indirect costs (e.g., diminished quality of life, pain and suffering, and lost household productivity). This analysis uses the following NSC cost estimates per incident (National Safety Council, 2023):

- Fatal crash: \$13.7 million
- Disabling injury crash: \$1.1 million
- Non-disabling evident injury crash: \$242,000
- Possible injury crash: \$132,000
- Property damage only (PDO) crash: \$18,000

When applicable, the U.S. Department of Transportation's (USDOT) recommended Value of a Statistical Life (VSL) of \$12.5 million is also used to align with federal benefit-cost analysis calculations (USDOT, n.d.).

Collision Reduction Estimation

Projected benefits are estimated by applying assumed reductions in crash rates to baseline totals. For example, if ISAT implementation is associated with a 20% reduction in fatal crashes, and the study area experiences 100 fatalities annually, the avoided societal cost is calculated as:

$$\text{Avoided Cost} = 100 \times 0.20 \times \$13.7 \text{ million} = \$274 \text{ million}$$

Similar calculations are performed across all crash severity levels, using disaggregated local collision data when available.

Benefit-Cost Ratio (BCR) and Net Present Value (NPV)

Cost-effectiveness is evaluated using two standard economic metrics:

Benefit–Cost Ratio (BCR): $BCR = \text{Total Present Value of Benefits} / \text{Total Present Value of Costs}$
A BCR greater than 1.0 indicates that benefits outweigh costs.

Net Present Value (NPV): $BCR = PV_{\text{Benefits}} / PV_{\text{Costs}}$.
Positive NPV values represent economically sound investments.

Limitations

While NSC methods provide comprehensive cost estimates, they do not fully account for behavioral substitution effects, enforcement variability, or long-term modal shifts. Additionally, intangible social factors such as psychological trauma and community cohesion are acknowledged but not monetized in this model.

Intelligent Speed Assist Technology (ISAT)

Intelligent Speed Assist Technology (ISAT) has emerged as a promising intervention to reduce speeding and enhance road safety outcomes. ISAT systems, particularly those that actively limit vehicle speeds, have been associated with significant reductions in traffic collisions and fatalities. The European Transport Safety Council (ETSC) estimates that active ISA systems could reduce road fatalities by up to 20% (European Transport Safety Council, 2019). Complementary research by Carsten, Lai, and colleagues suggests that integrating ISAT with other driver assistance technologies, such as cruise control and collision avoidance systems, can lead to a 20% decrease in overall traffic accidents (Lai, et al. 2011).

The relationship between speed and crash severity further supports the case for ISAT. According to ETSC findings, even modest reductions in speed yield substantial safety benefits with studies showing that a 5% reduction in average speed corresponds to a 30% reduction in fatal crashes (Rowe et al., 2021) while a study by Carsten and Tate (2005) demonstrated that ISA implementation could reduce speeding-related crashes by approximately 30% (Peiris et al., 2022; Carsten & Tate 2005).

Europe's adoption of ISAT policies shows promising results in the efficacy of ISAT implementation; since mandating ISAT integration in new vehicles starting in 2020, the European Union has reported a 15% decline in road fatalities (EU 2020). The adoption of this policy has received high support in regions where speeding is a persistent concern with predictive modeling estimating a 33% reduction in collisions in urban areas (Lai et al., 2011).

ISAT offers a data-driven mechanism to mitigate speed-related risks. By encouraging compliance with posted speed limits, increasing driver situational awareness, and compensating for inconsistent or unclear signage, ISAT contributes meaningfully to broader goals of traffic calming and collision prevention (Elvik & Vaa, 2004).

Advisory vs. Mandatory Systems

ISAT systems are categorized based on their level of control. Guo et al. (2015) classify them as advisory, differential, or mandatory. Advisory ISAT provides informational alerts about speed limits; differential ISAT issues warnings when drivers exceed limits; and mandatory ISAT intervenes directly to prevent vehicles from surpassing speed thresholds. These systems can further be designated as overridable—allowing driver bypass—or non-overridable, ensuring continuous enforcement (Guo et al., 2015).

Legislative Responses to Super Speeders

ISAT has proven effective in curbing extreme speeding, reducing crash rates, and lowering fatalities. These systems use GPS, onboard mapping, and traffic sign recognition to notify drivers or, in mandatory configurations, actively limit speed.

In response to extreme speeding incidents, several U.S. states have advanced legislation mandating ISAT. In 2025, New York introduced the “Stop Super Speeders Act,” requiring non-overridable ISAT in vehicles of drivers who receive six or more automated speeding violations in one year or accrue 11 license points in two years (*NY State Senate Bill 2025-S4045B.*, 2025). The legislation followed a high-profile crash in Brooklyn, where a driver with 99 prior violations killed a mother and her two daughters (Brooklyn Paper, 2025).

Earlier, in 2023, a New York City pilot program equipped 50 municipal vehicles with active ISAT, resulting in a 64% reduction in speeding, 36% reduction in hard braking events, and 99% compliance with speed limits (City of New York, 2023; Fleet Management Weekly, 2023). Unlike passive systems that merely alert the driver, this program utilized GPS-linked data to actively prevent acceleration beyond posted limits. The outcomes paralleled the success of ignition interlock devices for DUI offenders, which reduce recidivism by up to 67% (New York Daily News, 2025).

Other states have followed suit. Virginia’s House Bill 2096 (HB2096), passed in 2025 and effective in 2026, requires convicted reckless drivers exceeding 100 mph to install ISAT on all vehicles they own or operate. It allows drivers with excessive demerit points to maintain licensure through voluntary ISAT installation. Oversight is provided by the Virginia Alcohol Safety Action Program (VASAP), and tampering with the devices is punishable as a Class 1 misdemeanor (Virginia General Assembly, 2025).

In Washington State, the BEAM Act mandates ISAT installation for those convicted of extreme speeding, following a fatal incident where a driver traveling at 112 mph killed four individuals (AP News, 2024). Georgia’s Stop Super Speeders Bill (HB308) passed both chambers in 2025 and would have required ISAT for those convicted of excessive speeding, capping speed at 20% above the posted limit. However, Governor Brian Kemp vetoed the bill, citing insufficient enforcement infrastructure (Office of Governor Brian Kemp, 2025). Nevertheless, Georgia’s effort reflects the rising national interest in ISAT as a public safety tool (Families for Safe Streets, n.d.).

California considered a broader policy with Senate Bill 961 (SB961), introduced by Senator Scott Wiener in 2024, which would have mandated passive ISAT in all new vehicles beginning in 2030. Though passed by the legislature, Governor Gavin Newsom vetoed the bill over concerns about alignment with federal safety regulations under review by the National Highway Traffic Safety Administration (AP News, 2024; NPR, 2024). These recent experiences suggest that where there has been some progress in targeted implementation of ISAT, any broader implementation remains a heavy lift.

European Leadership in ISAT

The European Union (EU) has emerged as the global frontrunner in the integration and regulatory advancement of ISAT, recognizing its potential to significantly reduce traffic-related fatalities and serious injuries. As of July 2022, the EU mandated that all newly approved for sale vehicles sold within member states be equipped with advisory ISAT systems as part of a broader suite of vehicle safety technologies under the General Safety Regulation (*Intelligent speed assistance (ISA) set to become mandatory across Europe* | *European Road Safety Charter*. (n.d.). This landmark policy aims to create a foundational shift in driver behavior by ensuring that drivers are continuously alerted when they exceed posted speed limits, using technologies such as GPS, digital maps, and traffic sign recognition.

According to projections by the European Transport Safety Council (2022), the widespread adoption of ISAT is expected to result in a 30% reduction in traffic crashes and a 20% decline in road fatalities across the EU. These estimates are grounded in both pilot programs and large-scale simulations conducted across multiple European jurisdictions, where advisory ISAT has demonstrated substantial benefits in reducing speed-related risks, particularly in urban settings where pedestrian and cyclist activity is highest. Given the higher prevalence of speeding and related crashes on the roads here in the US, one would expect higher reduction in crashes and fatalities here in the US pending compliance with the volunteer technology.

The European Commission has explicitly identified ISAT as a central tool in achieving its ambitious Vision Zero policy framework, which seeks to eliminate all road deaths by 2050. By embedding ISAT into the approval process for new vehicles, the EU has institutionalized speed regulation as a technological standard rather than relying solely on post-facto enforcement or educational campaigns (*Intelligent Speed Adaptation (ISA)*—*European Commission*, n.d.). This approach reflects a paradigm shift toward preventative safety strategies that assume human error and build in protections through automation and design.

The EU's leadership in ISAT also stems from its collaborative, cross-national research infrastructure and regulatory harmonization. The EU's Road Safety Policy Framework 2021–2030 encourages continuous refinement of vehicle safety technologies through feedback loops between governments, automotive manufacturers, and public health researchers. In this way, the EU offers a powerful policy model: mandating essential safety tools, providing regulatory clarity to automakers, and generating measurable public health returns through coordinated implementation.

This leadership also sets a strong precedent for non-EU countries, including the United States, where ISAT implementation remains piecemeal and politically contested. By establishing ISAT as a default safety standard, rather than an optional upgrade, the EU has demonstrated how coordinated policy can accelerate technological adoption, normalize safer driver behaviors, and make meaningful progress toward zero roadway deaths.

Evaluating ISAT Effectiveness

A growing body of research supports the effectiveness of ISAT in curbing speeding behavior, although the degree of success varies significantly by system type and context. Mandatory ISAT systems, those that actively prevent drivers from exceeding speed limits, are consistently found to be the most effective in reducing speeding. For example, Guo et al. (2015) reported that mandatory ISAT led to substantial decreases in average vehicle speeds across a variety of driving environments. However, these benefits came with trade-offs. Drivers using mandatory ISAT exhibited a higher incidence of lane departure errors, likely due to conflicts between driver expectations and system-imposed constraints (Guo et al., 2015).

Longitudinal studies further reveal that these effects may diminish over time or when system use ends. Varhelyi et al. (2004) observed that drivers in ISAT-equipped vehicles often returned to their original speeding habits after trial periods concluded. Lai and Carsten (2012) found that even during the intervention period, override rates were high, especially in pedestrian-dense urban environments where drivers felt compelled to make real-time decisions that overrode automated speed controls. Lai et al. (2010) documented a rise in driver frustration over time with mandatory ISAT use, suggesting that without adaptive or user-centered features, rigid enforcement can lead to decreased system acceptance and potential noncompliance.

Advisory and discretionary ISAT systems, which alert drivers to speeding without automatically intervening, have shown more mixed results. Guo et al. (2015) found that advisory systems could reduce speeding when drivers were responsive to feedback, but discretionary systems that continuously issue warnings often distracted users, particularly older adults who reported difficulty processing frequent auditory or visual alerts. This underscores the importance of designing alerts that are intuitive, non-intrusive, and tailored to the cognitive needs of diverse driver populations. Despite these challenges, other studies have demonstrated the behavioral benefits of well-calibrated advisory systems. Hazoor et al. (2024) found that drivers exposed to both visual and auditory alerts demonstrated improved lane discipline and greater adherence to posted speed limits. De Vos et al. (2022) further refined this understanding, showing that ISAT systems were most effective in moderating speeds on lower-speed roads, particularly in 60 km/h (approx. 37 mph) zones, while proving less impactful on faster roadways (e.g., 90 km/h or 56 mph), where higher baseline speeds and less environmental complexity reduced driver receptivity to warnings.

These findings point to several key design considerations: system type, override flexibility, alert modality, and contextual application all influence ISAT's effectiveness. While mandatory ISAT offers the highest potential for immediate speed compliance, it must be paired with safeguards to

avoid unintended behavioral consequences. Meanwhile, advisory systems may be better suited to fostering long-term behavioral change, especially when integrated into user-friendly, customizable interfaces that account for environmental and demographic variability (Guo et al., 2015; Hazoor et al., 2024; Lai & Carsten, 2012; Lai et al., 2010; Varhelyi et al., 2004; De Vos et al., 2022).

Evidence-Based Perspectives on ISAT Adoption

A companion study by Ghanipoor Machiani et al. (2025), conducted through the Center for Pedestrian and Bicyclist Safety (CPBS), provides critical empirical insight into the deployment of ISAT in California. The researchers employed a three-pronged methodology, comprehensive literature review, large-scale federal safety data analysis, and a targeted public survey, to evaluate ISAT's safety impacts, implementation challenges, and public acceptance.

The first component of the study synthesized decades of research on ISAT trials and deployment models across Europe, Australia, and the United States. This review reinforced existing findings that well-calibrated ISAT systems can effectively reduce excessive speeding, particularly when combined with supportive policy frameworks and driver education (Ghanipoor Machiani et al. 2025).

The second component involved analyzing more than two million consumer complaints and approximately 300,000 vehicle recall records from the National Highway Traffic Safety Administration (NHTSA). Filtering for speed control–related issues, the study identified over 100,000 complaints and 6,000 recalls linked to ISAT-relevant systems. Among these, more than 10,000 complaints involved crashes, with thousands of injuries and hundreds of fatalities reported. These findings highlight existing deficiencies in speed-regulation technologies, such as throttle malfunctions, unintended acceleration, sensor failure, and mapping inaccuracies. They underscore the critical need for reliable performance, appropriate override capabilities, and robust fail-safe systems in future ISAT deployment to prevent exacerbating current hazards (Ghanipoor Machiani et al., 2025).

The third research component was a survey of 286 licensed drivers in California, which gauged awareness, comfort, and behavioral responses to various ISAT configurations. Most respondents acknowledged that ISAT could enhance road safety by preventing dangerous speeding and reducing the risk of crashes in urban areas. However, there was widespread discomfort with mandatory or non-overridable systems, particularly regarding their potential to limit driver agency in complex or context-sensitive scenarios such as emergency maneuvers or temporary road conditions (Ghanipoor Machiani et al. 2025).

A strong preference emerged for user-centered system design. Participants favored visual or haptic warnings over audible alarms or automatic speed restrictions, and they emphasized the importance of customizable alert settings. Respondents also called for clear override options in cases where driver judgment should take precedence. Many expressed concerns about potential system errors, such as misinterpreting speed limits due to outdated GPS data or obstructed signs, which could jeopardize both safety and user trust.

The study posits that ISAT systems must strike a careful balance between automation and autonomy. To succeed at scale, ISAT policies and technologies should integrate driver-friendly features, ensure system transparency, and communicate clearly how data is collected and used. As emphasized by Ghanipoor Machiani et al. (2025), maximizing ISAT's safety benefits will require not only technical reliability but also public education, pilot testing in high-risk corridors, and attention to the human factors that shape driver behavior and technology acceptance.

Prioritizing High-Risk Vehicle Classes

The growing dominance of heavier vehicle types, particularly SUVs, pickup trucks, and vans, has raised serious concerns about pedestrian safety and the severity of crash outcomes. For example, according to recent data from IIHS, the share of Pickup trucks/SUVs in the fleet of new cars sold in the US has gone from 1 out of 2 in 2013 to almost 4 out of 5 in 2022. These high gross vehicle weight rating (GVWR) vehicles are consistently overrepresented in fatal and severe injury collisions, especially in dense urban areas where vulnerable road users like pedestrians and cyclists are most exposed (Families for Safe Streets, n.d.). Unlike smaller sedans, larger vehicles typically have higher front-end profiles, reduced driver visibility due to larger blind spots, and greater mass, which increases both the likelihood of a crash and the biomechanical force transferred to a pedestrian upon impact (Tefft 2013). As a result, even modest speeding in these vehicles is more likely to result in catastrophic injuries or fatalities.

Research has shown that the probability of fatal injury for a pedestrian struck by an SUV is significantly higher than that associated with smaller passenger cars at the same speed (Hu & Cicchino, 2018). Moreover, these vehicle types often lack standard features like pedestrian detection and speed-limiting assistive systems, further compounding the risks. Prioritizing ISAT integration into high-risk vehicle classes can thus offer a disproportionately large safety benefit compared to universal application alone.

Urban environments are especially in need of targeted intervention. With their higher population densities, greater multimodal travel, and more frequent pedestrian activity, cities are where the risks posed by large vehicles are most acute. Mandating ISAT installation for new high-GVWR vehicles, particularly those used for commercial purposes or in rideshare, delivery, and school transportation fleets, would help mitigate these risks. These vehicles are not only heavier and more dangerous in crashes but are also often driven for longer hours and over more miles in mixed-use traffic settings, amplifying their exposure and potential harm (NTSB 2022). It may also pave the path for broader future implementation if the safety benefits can be realized and communicated.

From a policy perspective, such targeted ISAT deployment represents a high-return safety investment. By focusing on vehicles with the greatest potential for harm, transportation agencies and lawmakers can better align limited implementation resources with maximum impact.

Behavioral and Fairness Considerations

Behavioral responses and fairness implications are central to the successful deployment of Intelligent Speed Assist Technology (ISAT). Survey data revealed that approximately two-thirds of drivers believed ISAT would make them less likely to speed, signaling the technology's potential to drive meaningful behavioral change (Ghanipoor Machiani et al., 2025). Many also anticipated that ISAT would help them avoid speeding tickets, reduce insurance premiums, and improve overall road safety—particularly on high-speed arterials and interstate corridors where excessive speeding is more prevalent and deadly.

However, support for ISAT was not universal or unconditional. Respondents strongly favored selective enforcement strategies, with high levels of support for geographically targeted deployment in urban zones, school areas, and known high-crash corridors. These areas were viewed as having the greatest need for speed regulation due to high pedestrian volumes, vulnerable populations, and elevated crash risk. In contrast, drivers were more cautious about ISAT in rural or low-density regions, where posted speed limits may be perceived as arbitrary or inconsistently enforced. This feedback underscores the importance of context-sensitive implementation that respects local conditions and travel behaviors.

Drivers also supported targeted applications of ISAT, particularly for commercial fleets, government vehicles, and repeat offenders. These groups were seen as having both heightened responsibility and greater exposure to speed-related risk. Targeting high-risk users, rather than imposing blanket mandates, was viewed as a fairer and more effective approach that prioritizes safety without unduly burdening average drivers. This aligns with the broader principle of graduated regulation (already applied for DUI-related offenses), in which more intensive interventions are reserved for those with demonstrated risk factors.

Across all demographic groups, respondents voiced a strong preference for incentive-based strategies rather than compulsory mandates. Popular proposals included insurance discounts, vehicle registration fee waivers, and state or federal tax credits for voluntarily adopting ISAT-equipped vehicles. These incentives were perceived not only as fair and flexible, but also as a way to encourage early adoption without the backlash often associated with top-down regulations.

Yet, despite this general openness to ISAT, one of the most consistent and serious concerns expressed by respondents was data privacy. Many were uncomfortable with the potential for ISAT systems to collect and transmit detailed information about speed behavior, location history, or driving habits, particularly if that data could be accessed by insurance companies, employers, law enforcement, or third-party vendors. There was broad demand for clear limits on data use, transparent privacy policies, and assurances that data would not be used for punitive or commercial purposes without consent.

Ultimately, behavioral and fairness considerations suggest that ISAT must be designed not only to improve safety, but also to build trust, respect driver autonomy, and avoid disproportionate burdens on certain communities. Tailored deployment strategies that account for geographic

variation, risk profiles, and public sentiment will be critical to achieving both safety outcomes and social legitimacy. Thoughtful planning can also ensure that the benefits of ISAT—such as reduced enforcement disparities and improved safety—are distributed fairly, particularly among communities most impacted by traffic violence.

Policy Design and Public Support

The long-term success of ISAT hinges not only on its technical performance but also on public trust, equitable deployment, and the policy frameworks that govern its use. A user-centered approach that emphasizes transparency, community engagement, and adaptive policy design is critical for widespread acceptance and sustained implementation.

Survey results and stakeholder feedback consistently indicate that public support for ISAT is contingent on how it is introduced and regulated. Respondents in recent studies expressed a strong preference for incentive-based approaches, such as insurance discounts, vehicle registration rebates, or tax credits, over blanket mandates. These incentive structures were seen as fairer, more flexible, and more effective in encouraging voluntary adoption without creating undue burdens for drivers (Ghanipoor Machiani et al., 2025).

At the core of public concern is control and autonomy. Many drivers, particularly those with long commutes or who regularly travel through variable-speed environments, expressed discomfort with non-overridable systems, fearing misapplication of speed limits or loss of control in critical situations. To address these concerns, effective policy design must include clear override protocols, allowing drivers to temporarily disable ISAT under certain conditions while maintaining accountability through tamper-resistant monitoring systems.

Additionally, data privacy emerged as a critical issue. ISAT systems, especially those tied to GPS mapping and telematics, have the potential to collect vast amounts of personal data, including speed behavior, trip histories, and location patterns. Without robust legal safeguards, this data could be misused by insurance companies, law enforcement, or commercial entities. Respondents overwhelmingly called for strict privacy protections, including clear data ownership policies, limits on third-party access, and transparency regarding what information is collected and how it is stored or shared.

The technical underpinnings of ISAT must also align with evolving traffic conditions. Real-time, accurate speed-limit databases are essential for ISAT to function reliably, particularly in jurisdictions with frequent construction activity or fluctuating limits in school or work zones. Moreover, adaptive system behavior, such as temporary overrides in hazardous conditions or allowance for the natural flow of traffic, can enhance both safety and user acceptance by making the system feel responsive rather than rigid.

From a strategic standpoint, targeted pilot programs offer an effective method to test ISAT in high-impact contexts. These programs should prioritize high-crash corridors, urban school zones, and repeat traffic offenders, where speed violations are known to contribute disproportionately to

injury and fatality rates. Early deployment in municipal fleets, public transit, or rideshare vehicles could also build public familiarity and normalize the technology in everyday settings.

Broad-based public education campaigns are essential. Many misconceptions about ISAT persist, including the belief that it completely overrides driver control or that it operates continuously regardless of context. Outreach must explain what ISAT can and cannot do, differentiate between advisory and mandatory versions, and highlight evidence of effectiveness. These campaigns should also be tailored to different communities, with multilingual resources, culturally relevant messaging, and attention to the specific concerns of rural, low-income, or historically marginalized populations.

In summary, public support for ISAT hinges on a delicate balance of trust, transparency, and flexibility. Policymakers must design regulations that respect driver autonomy while prioritizing safety and accountability. When paired with strategic incentives, robust privacy protections, and educational outreach, ISAT has the potential to transform speed management into a more equitable and effective tool for reducing traffic violence.

Infrastructure and Implementation Challenges

The successful deployment of Intelligent Speed Assist Technology (ISAT) depends heavily on the reliability of external infrastructure, particularly the clarity and consistency of speed limit signage and the accuracy of digital speed limit databases. ISAT systems rely on a combination of GPS-based mapping and real-time recognition of physical signage to determine applicable speed limits. When either of these inputs is inaccurate or unavailable, the system's effectiveness—and in some cases, its safety—can be compromised.

As Fleyeh et al. (2017) note, one of the primary obstacles to effective ISAT functionality is the poor visibility of road signs. Signage can be obstructed by vegetation, faded due to weather, or misaligned as a result of collisions or maintenance work. These physical conditions reduce the reliability of camera-based systems, particularly in suburban or rural areas where infrastructure maintenance is often underfunded or inconsistently managed.

Peiris et al. (2022) further emphasize that inconsistent speed limit policies across jurisdictions create complications for ISAT calibration. In areas where speed limits are not uniformly posted—such as on rural roads or within private developments—ISAT systems may default to outdated or incorrect digital map data. This not only undermines driver trust but may also result in false speed warnings or inappropriate intervention, especially in nonstandard or rapidly changing traffic environments such as construction zones or school areas.

The challenge is not only technical but institutional. Many jurisdictions in the U.S. lack comprehensive, machine-readable speed limit databases, and updates to road infrastructure are often not synchronized with digital mapping platforms. In California, for instance, these infrastructure limitations were a key reason cited in opposition to SB 961, a bill that would have mandated passive ISAT in all new vehicles by 2030. Lawmakers raised concerns that the state's

current signage infrastructure and digital mapping systems were insufficient to support consistent and equitable ISAT deployment across urban, suburban, and rural areas (“SUMMARY OF CHAPTERED AND VETOED LEGISLATION – 2024,” 2024).

Additionally, discrepancies between posted speed limits and “safe operating speeds” as defined by the prevailing speed of traffic—a common basis for speed setting in the U.S.—can create misalignment between ISAT enforcement and driver expectations. For instance, if the posted speed limit is outdated or not reflective of current road conditions, ISAT may prevent a driver from matching the speed of surrounding vehicles, potentially creating new hazards or user frustration.

There are also legal and governance challenges. The responsibility for setting and maintaining speed limits is often fragmented among state, county, and local agencies. Without coordinated standards and centralized data systems, implementing ISAT consistently across vehicle fleets becomes difficult. Efforts to build standardized speed limit databases, like those recommended by the National Association of City Transportation Officials (NACTO) and being piloted in some Vision Zero cities, are still in early phases and largely under-resourced.

While other impacts, like reduced fuel use or emissions, can be considered, the most compelling economic case for ISAT lies in its potential to prevent fatalities and life-altering injuries. By focusing on these human-centered outcomes, planners can justify ISAT policies that prioritize public well-being and safety. Table 4 shows fatalities avoided in a 10-year period based on ISAT effectiveness (FARS, National, 2014-2023). To evaluate the economic feasibility of ISAT deployment, a cost-benefit analysis (CBA) was conducted using the NSC 2021 estimates of crash-related costs. The NSC calculates the comprehensive cost of a traffic fatality at \$13.7 million, which includes both direct costs: medical expenses, lost productivity, and intangible losses: quality of life, emotional distress (NSC 2022). Using a conservative estimate on the collision reduction benefits of ISAT implementation, the prevention of one fatality per 1,000 vehicles over the operational lifetime of integrated ISAT into a vehicle will result in a monetized safety benefit of \$13,700 per vehicle.

The costs of implementation vary by vehicle type; for factory-installed ISAT in new vehicles, the cost ranges from \$312 to \$1,040 USD while retrofitting older vehicles with ISAT is more expensive at \$1,250 per vehicle (European Commission, n.d.). Using these figures, the resulting benefit-cost ratios (BCRs) are: 43.9:1 for factory-installed ISAT at \$312, 13.2:1 for factory-installed ISAT at \$1,040, 11.0:1 for retrofit ISAT at \$1,250

Our analysis of Table 4 demonstrates that implementing Intelligent Speed Assistance Technology (ISAT) with effectiveness rates ranging from 20% to 100% could result in substantial annual savings—from \$291.2 billion to \$1.5 trillion, based solely on the value of lives saved. At 50% effectiveness, ISAT could prevent over 53,000 fatalities each year, generating an estimated \$728 billion in societal benefits. While the maximum projected savings of \$1.5 trillion assumes full ISAT effectiveness and adoption, this scenario may be politically and logistically unlikely in the near term. Nonetheless, even modest implementation, such as 30% effectiveness, could still save

over 31,000 lives annually and yield nearly \$437 billion in benefits, illustrating the significant safety and economic value of widespread ISAT deployment.

Table 16. Cost savings related to effectiveness of implementing ISAT technology in all vehicles.

ISAT Effectiveness	Fatalities Avoided	Estimated Monetary Benefits
10%	10,627	\$146 Billion
20%	21,255	\$291.2 Billion
30%	31,882	\$436.8 Billion
40%	42,509	\$582.4 Billion
50%	53,137	\$728 Billion
60%	63,764	\$873.6 Billion
70%	74,391	\$1 Trillion
80%	85,018	\$1.2 Trillion
90%	95,646	\$1.3 Trillion
100%	106,273	\$1.5 Trillion

Conclusion

Research overwhelmingly indicates that ISAT is effective in reducing speeding, though challenges remain in driver compliance, infrastructure readiness, and associated costs (NHTSA 2024; Carsten & Tate 2005). Policymakers must balance technological enforcement with infrastructural and economic considerations. Expanding ISAT, particularly in high-risk zones, alongside legislative measures and public education, offers a promising avenue to enhance road safety and reduce traffic fatalities (Johansson, Almqvist, & Aretun, 2023). Additionally, the literature demonstrates that traditional speed enforcement measures, such as speed limits and automated enforcement technologies, deliver significant economic, environmental, and public health benefits. CBAs reveal consistently high BCRs for speed enforcement measures, with cost savings resulting from crash prevention, reduced healthcare costs, and enhanced road safety. Environmental and public health gains further support the implementation of these measures, contributing to lower emissions and safer conditions for vulnerable road users like pedestrians and cyclists.

Public Education and Law Enforcement

While technological advancements such as ISAT represent a critical mechanism in proactive speed control, traditional public education and enforcement strategies remain vital components of a comprehensive speed management system. Such laws include Super Speeder laws as a targeted enforcement mechanism aimed at deterring the most egregious speed violations. These statutes, which impose enhanced penalties on individuals exceeding specific speed thresholds, are designed to address a disproportionate share of risk attributed to high-speed offenders, particularly among younger drivers and repeat violators (NSC 2024).

Super Speeder laws are grounded in the recognition that extreme speeding, typically defined as driving more than 25 miles per hour over the posted speed limit or exceeding 85 miles per hour on highways, constitutes a particularly dangerous behavior that warrants stricter legal and financial penalties than those applied to conventional speeding violations. These laws aim to deter the most hazardous drivers by escalating the severity of consequences in response to the elevated risks associated with excessive speed. Georgia, one of the earliest adopters, imposes an additional \$200 state fee on top of local fines for individuals convicted under its Super Speeder Law, with revenues directed toward trauma care funding (Georgia Department of Driver Services 2023). Preliminary evaluations of automated speed enforcement strategies suggest that these policies can radically reduce instances of excessive speeding, especially when implemented alongside public awareness campaigns that heighten drivers' perception of enforcement. In a study conducted in Scottsdale, Arizona, Retting, Kyrychenko, and McCartt (2008) found that speed cameras combined with visible signage led to a more than 70% reduction in the number of vehicles exceeding the posted speed limit. Notably, even in areas where only signage was used, without actual camera enforcement, speeding decreased by 39%, compared to a 16% reduction in control areas where no interventions were present; supporting the theory that both the certainty of detection and the visibility of enforcement measures play critical roles in modifying driver behavior (Retting et al., 2008).

Data from FARS highlights the urgency of such interventions. Young drivers, especially males under 25, are consistently overrepresented in speeding-related fatalities, with elevated crash involvement at excessive speeds (NHTSA 2023). Additionally, repeat offenders exhibit a pattern of risk behavior that traditional fines and point systems fail to disrupt. Super Speeder laws offer a more focused deterrent by signaling zero tolerance for extreme speeding, which is often linked to loss-of-control crashes and high-severity impacts (IIHS 2023).

Benefit–Cost Analysis (BCR) of Enforcement and Public Education

Table 17. Cost-Benefit Analysis of Enforcement and Public Education.

Case Study	Primary Intervention	Benefit-Cost Ratio	Key Insights
Indiana Work Zones (2024)	Automated Enforcement + Signage	27:1	Net Present Value > \$3.9M; Annual savings \$0.55–1.3M
UK Speed Cameras (1996)	Fixed Speed/Red Light Cameras + Publicity	5:1 (Year 1) → 25:1 (Year 5)	High ROI from reduced fatalities and injuries
PA Work Zones (2021)	Automated Speed Feedback in Work Zones	—	Compliance improved from 25–50% to 63–84%
IL Radar Enforcement Vans	Radar-based Photo Enforcement Vans	—	Speeding dropped from ~40% to 8% (cars), 17% to 4% (trucks)
Global Camera Meta-Analysis	Automated Speed Cameras	2:1 to 10:1	Consistent global evidence for cost-effectiveness
Washington Traffic Safety Commission, 2021	Speed Cameras in School Zones (Washington State)	3.0	Reduced speeding, improved pedestrian safety near schools
FHWA 2021	Dynamic Speed Harmonization (Urban Highways)	2.1	Reduced crashes and travel delays through real-time speed adjustments
FHWA 2021	Speed Limit Reductions (Urban Arterials, Intersections)	4.5	Crash reduction, improved travel efficiency near intersections
FHWA 2021	High-Visibility Enforcement (Residential/School Zones)	2.0 – 4.0	Lowered crash rates in residential areas and school zones

The Federal Highway Administration (FHWA 2021) reports that lowering speed limits on urban arterials near intersections yields a benefit–cost ratio (BCR) of 4.5, meaning that for every dollar spent, \$4.50 in societal benefits are realized through reduced crashes and improved travel efficiency. Similarly, dynamic speed harmonization systems on urban highways demonstrate a

BCR of 2.1. High-visibility enforcement strategies, such as speed cameras and patrol presence in residential or school zones, return BCRs ranging from 2.0 to 4.0, depending on context and frequency (FHWA 2021).

In Washington State, an evaluation of speed cameras in school zones demonstrated a BCR of 3.0, primarily due to reductions in speeding and improved pedestrian safety (Washington Traffic Safety Commission, 2021). These results echo broader findings by the Insurance Institute for Highway Safety (IIHS, 2020) and Wilson et al. (2010), which confirm that automated enforcement systems can reduce total crashes by 9–35% and severe or fatal crashes by 17–58%, offering significant long-term cost savings when measured against collision-related losses, emergency response, and hospital treatment.

Even hybrid approaches that rely more on perception than enforcement demonstrate economic value. As illustrated in Scottsdale, public signage alone can generate significant reductions in speed without direct enforcement costs (Retting et al., 2008). While these strategies may not be quantified through traditional BCR metrics, their behavioral impact and cost-effectiveness make them attractive complements to automated or legal interventions.

Fairness, Engagement, and Enforcement Integration

While effective, enforcement alone is insufficient. To maximize the impact of Super Speeder laws, states must pair enhanced penalties with sustained public education efforts that communicate both the rationale and consequences of the law. Evidence-based campaigns, especially those that humanize risk through crash survivor narratives or frontline medical personnel, have shown greater efficacy in changing attitudes and behavior (Fleiter et al. 2013). Using targeted outreach via social media, driver’s education programs, and peer-focused interventions can deepen engagement with high-risk demographics, particularly younger drivers.

Fairness concerns must also inform the deployment of enforcement strategies. Without safeguards, traditional traffic stops may perpetuate racial and socioeconomic disparities in policing (Gonzalez & Perez 2020). Automated enforcement tools, such as speed cameras and in-vehicle ISAT systems, can mitigate bias by standardizing enforcement across all road users. Transparent data reporting and community oversight should accompany these tools to maintain public trust and align with Vision Zero and Safe System goals (National Transportation Safety Board, 2017).

Stories of Lost Loved Ones to Super Speeders

Niyell, 13 (NY)



“Speed is deadly. My family has learned this the hard way. In November, my 13-year-old daughter Niyell was struck and killed by a speeding SUV driver in New York City. Niyell was a freshman in high school and was attending a performing arts school, where she played the trombone and several other instruments in the school band and sang in the choir. Niyell was the life of the party, when the beat dropped, she hit the dance floor and spent hours making TikTok videos capturing the dance moves of her and her friends. She took pride in being a big sister and loved her little sisters Aminah and Jalayah dearly. She had dreams of becoming an actress, lawyer, or even a doctor.

She was crossing the street to catch a bus at 110th Street and Manhattan Ave to visit her cousin and get her hair done for her 14th birthday just 17 days away, but she never made it across the solid double yellow lines. She was in the hospital for just over a week in critical condition before she died from her injuries, leaving her family devastated. That’s why I’ve joined with Families for Safe Streets and poured my pain into fighting for legislation that would mandate anti-speeding technology to stop super speeders like the driver who killed my daughter before they cause harm to more innocent people like my daughter.”

-Darnell Sealy-McCrorey, father of Niyell McCrorey

Conner, 16 (VA)



“When my son Conner was 16 years old, he left for a homecoming dance and never came back. He accepted a ride from an unlicensed student who took off driving 70 mph in his family’s BMW, lost control and hit a tree, flipping the car. All three passengers were killed. I lost my son in an instant.

Conner was a bright, talented soccer player already being scouted by colleges. I often wonder if he might still be here today if the teenage driver that night hadn’t been so reckless, hadn’t been driving such a high-performance car, or had even been properly licensed.

These questions haunt me daily. That’s why I fight for legislative and policy change –because these crashes are preventable. I was proud to lead the effort in Virginia to #StopSuperSpeeders with anti-speeding technology and hope everyone will sign [my petition](#) so that every state has a Stop Super Speeders bill. I have been fighting for so many changes to make our streets safer since Conner died and I will not stop fighting until no one else has to experience this unimaginable heartache.”

-Tammy McGee, mother of Conner Guido

Raymond, 27 (CA)



“My beloved brother Raymond and his fiancée, Maria Rivas-Cruz, were walking across the street to their home in Compton, California when both were struck by a driver traveling at an excessive speed while fleeing a street takeover.

Raymond was a loving, caring, old soul. He was the first member of our family to graduate from college, earning a Bachelor of Science degree in Civil Engineering. He was determined to inspire those around him to work hard and pursue higher education. While still in school, he worked as a Student Engineer for the City of Los Angeles's Department of Public Works (DPW), where he was quickly promoted to an Environmental Engineering Associate 2 at the Department. He was engaged to Maria Rivas-Cruz, his longtime sweetheart. His life was on an upward trajectory, with so many good things that he worked hard to make happen. Raymond was just 27 with so much to look forward to. He was not supposed to leave me.”

-Cindi Enamorado, Raymond's sister

Conclusion

Ultimately, Super Speeder laws, when embedded within a broader ecosystem of public education, equitable enforcement, and cost-effective interventions, represent a powerful tool for reducing fatal and serious-injury crashes. The economic justification for their adoption is strong, with benefit-cost ratios on par with some of the most effective transportation safety interventions. Paired with emerging technologies like ISAT, they offer a comprehensive, just, and efficient path forward in the national campaign to end speeding-related fatalities.

Reducing Speed Limits

Lowering posted speed limits in high-risk areas is a well-documented and cost-effective strategy for reducing traffic fatalities, particularly in urban contexts. Slower speeds not only reduce the likelihood of crashes occurring but also significantly decrease the severity of those that do occur. The AAA Foundation for Traffic Safety (2022) found that reductions in speed limits on urban streets led to notable declines in fatal crashes, especially near intersections and in areas with high pedestrian activity. This finding aligns with the Insurance Institute for Highway Safety's (IIHS, 2023) evaluation of Seattle's citywide speed reduction initiative, where arterial speed limits were reduced from 30 mph to 25 mph downtown and from 25 mph to 20 mph in residential neighborhoods. The program yielded a 17% decrease in injury crashes outside the city center and a 20% reduction downtown, demonstrating the tangible safety benefits of modest speed reductions.

Table 18. Benefit–Cost Analysis and Safety Outcomes of Speed Control Interventions.

Source	Intervention	Benefit–Cost Ratio (BCR)	Effectiveness/Impact
FHWA (2021)	Lowering Speed Limits on Urban Arterials	4.5	Fewer fatal crashes, especially near intersections (AAA 2022)
FHWA (2021)	Dynamic Speed Harmonization Systems	2.1	Real-time adjustment reduces congestion-related crashes (FHWA 2021)
Avelar et al. (2022)	Variable Speed Limits (VSL) - Georgia/Wyoming	9.05 to 40.4	Significant crash reductions depending on traffic/crash context (Avelar et al., 2022)
IIHS (2020); Wilson et al. (2010)	Automated Speed Enforcement	Varies (Est. \$110M–\$43B in benefits)	Crash reductions: 9–35% total, 17–58% severe (IIHS 2020; Wilson 2010)
FHWA (2021)	High-Visibility Speed Enforcement	2.0 to 4.0	Effective in school/residential zones when combined with campaigns (FHWA 2021)
FWHA (2021)	Variable Speed Limit (isolated)	37:1	High return with isolated speed management implementation (FHWA 2021)

Source	Intervention	Benefit–Cost Ratio (BCR)	Effectiveness/Impact
FWHA (2021)	Variable Speed Limit (linked)	22:1	Series-based VSL systems reduce multi-location crashes (FHWA 2021)
FWHA (2021)	Variable Speed Limit (integrated corridor)	55:1	Major safety gains across corridors with integrated systems (FHWA 2021)
FWHA (2021)	Variable Speed Limit (in-vehicle)	53:1	In-vehicle systems increase compliance, reduce risk (FHWA 2021)
FWHA (2022)	VSL systems (statewide)	9.05–40.4	Wide state-level effectiveness; crash reduction not numerically specified (FHWA 2022)
FWHA (2022)	Weather-responsive VSL (Oregon)	Not quantified	Qualitative benefit > cost; used in adverse weather for safety (FHWA 2022)
FWHA (2021)	Traffic signal coordination (Alameda Avenue)	7:1	Crash frequency and delays reduced, improved energy efficiency (FHWA 2021)

The Federal Highway Administration (FHWA) has further validated the economic value of speed limit reductions through Benefit–Cost Analyses (BCAs). For example, lowering speed limits on urban arterials near intersections was found to yield a BCR of 4.5, meaning that for every dollar spent, society gains \$4.50 in benefits from reduced crash rates and improved safety outcomes (FHWA, 2021). Dynamic Speed Harmonization systems on highways, designed to adjust speed limits in real time to reflect traffic conditions, produced a BCR of 2.1 (FHWA, 2021).

Among the most economically advantageous approaches are Variable Speed Limit (VSL) systems, which adapt posted speed limits in real time based on factors such as weather, traffic congestion, work zones, or crashes. In Georgia and Wyoming, VSL deployments were associated with BCRs ranging from 9.05 to 40.4, illustrating extremely high returns on investment, particularly in corridors with frequent congestion or high crash rates (FHWA, 2022). A detailed U.S. DOT cost–benefit analysis found that isolated VSL systems achieved a BCR of 37:1, while linked (series) VSL systems had a BCR of 22:1. Integrated corridor systems and in-vehicle VSL components produced even greater returns, with BCRs of 55:1 and 53:1, respectively (FHWA, 2021).

Weather-responsive VSLs have also shown promise. In Oregon, the FHWA’s TOPS-BC tool was used to analyze a weather-responsive pilot program on OR-217. While precise BCR figures were not published in summary form, the report concluded that the benefits clearly outweighed the costs (FHWA, 2022). In related arterial management efforts, a case study on Alameda Avenue demonstrated a 7:1 BCR by coordinating traffic signals to reduce speeds, crashes, delays, and energy use (FHWA, 2021).

Beyond the benefits of reducing posted speed limits, the addition of high-visibility enforcement, such as automated speed cameras or targeted patrols, amplifies the effectiveness of speed management. According to FHWA (2021), these interventions produce BCRs between 2.0 and 4.0, especially when combined with public education campaigns in sensitive zones such as school areas and residential neighborhoods. Studies from multiple jurisdictions report that automated speed enforcement can reduce total crashes by 9% to 35% and severe or fatal crashes by 17% to 58%, resulting in estimated savings ranging from \$110 million to \$43 billion depending on implementation scale (Wilson et al., 2010; IIHS, 2020).

In addition to crash prevention, speed reduction strategies provide substantial secondary benefits. Lower travel speeds contribute to lower emergency response costs, reduced medical expenses, decreased vehicle damage, improved fuel efficiency, and reduced emissions. FHWA evaluations confirm that these outcomes advance not only transportation safety but also environmental and public health objectives (FHWA 2021). For example, Seattle’s low-cost speed management program required only minor infrastructure changes yet achieved significant injury reductions and improved perceptions of community safety (IIHS 2023).

These interventions also align with broader policy agendas promoting safety and sustainable urban mobility. Reduced speed limits are central to Vision Zero goals, help minimize speed variance between vehicles, and create safer environments for walking, biking, and transit use. As states and cities begin integrating ISAT into vehicle fleets, these systems can work in tandem with regulatory efforts by providing real-time driver feedback, reducing excessive speeding, and enhancing compliance with posted limits (NHTSA 2023).

Ultimately, the consistent crash reductions achieved through U.S.-based speed limit reduction programs—and their favorable cost-benefit outcomes—highlight a critical opportunity for policymakers. Lowering speed limits, when supported by appropriate enforcement and complementary technologies, is not only a proven public safety measure but also a fiscally responsible investment that yields measurable returns in saved lives, avoided costs, and more equitable transportation systems.

Infrastructure-based interventions such as speed bumps, roundabouts, and pedestrian-oriented zones play a vital role in mitigating vehicle speeds and reducing crash risks (Litman, 2021). A core objective of urban design is to reclaim streets—comprising nearly two-thirds of a city’s public space—for people. Achieving this goal requires strategic traffic control measures, including calming vehicular speeds and reallocating space to accommodate all users. Effective traffic design

ensures that drivers, pedestrians, cyclists, and other road users interact safely and harmoniously within the built environment. Urban designers must prioritize the safety and needs of the most vulnerable users, while also considering the character of the surrounding community.

To contribute meaningfully to traffic calming, designers must understand both driver behavior and the operational mechanics of traffic flow. This necessitates a working knowledge of basic traffic engineering principles to collaborate effectively with transportation professionals responsible for multimodal management and safety operations.

Traffic control measures fall into two general categories: nonphysical (psychological) and physical. Nonphysical controls—such as signage, street markings, and visual cues—rely on voluntary compliance and enforcement mechanisms. These are less restrictive, offering flexibility for emergency vehicle access, but often fail to guarantee consistent compliance, particularly in residential settings. In contrast, physical traffic calming measures definitively shape driver behavior through engineered interventions. These measures can be further divided into volume-control (e.g., diverters, cul-de-sacs) and speed-control mechanisms that utilize vertical or horizontal deflection.

Traffic calming not only affects speed, volume, and direction of vehicle flow, but also contributes to other urban design outcomes. These include improved safety for pedestrians and cyclists, increased accessibility for people with disabilities, enhanced neighborhood aesthetics, and reclaimed public space for community use. However, the visual quality and materiality of these devices matter—designs that appear punitive or unattractive may generate public resistance. Devices that serve multiple purposes, such as integrating greenery or seating, are more likely to gain community support (Litman, 2021).

Contemporary Relevance in Urban Design Practice

Traffic calming emerged as a formal element of urban design in the 1960s and 1970s, largely in response to rising automobile dominance and the accompanying surge in pedestrian and cyclist fatalities. Foundational works such as *Livable Streets* by Donald Appleyard helped reframe the street as a shared social space rather than solely a conduit for vehicles. This ethos continues in *Livable Streets 2.0* by Bruce and Donald Appleyard, which underscores the renewed focus on human-centered street design amid the rise of automated vehicles and technologically driven infrastructure.

Types of Traffic Calming Interventions

Most contemporary urban designers prioritize physical traffic-calming measures due to their proven effectiveness in reducing vehicle speeds, crash volumes, and traffic intrusions over the long term (Smith & Appleyard, 1980). However, nonphysical or psychological interventions, particularly those that increase "cognitive load" through environmental complexity, can be equally effective and cost-efficient, especially when implemented early in the planning process. These

tactics, often associated with Tactical Urbanism, influence driver behavior through uncertainty, perceived risk, and visual engagement.

While the body of research on nonphysical traffic-calming interventions is still relatively limited, particularly in terms of sample sizes and the evaluation of combined treatments, recent findings indicate that using multiple strategies in tandem can substantially enhance effectiveness. European practices often illustrate this principle, with traffic-calming programs that apply two or more measures at a single site achieving greater speed reductions than those relying on a single intervention (Ewing and Brown, 2017).

Moreover, reductions in driving speed may not fully reflect the behavioral changes prompted by these measures. Visually engaging environments, those characterized by diverse street elements, active pedestrian presence, or dynamic layouts, can prompt drivers to exercise increased caution and attentiveness (Dumbaugh 2005, Jacobsen 2003). This behavioral shift may occur even when measurable speed decreases are minor. The presence of people, in particular, reinforces safe driving behaviors by signaling shared use of the space, contributing to a phenomenon sometimes described as “safety in numbers” (Ewing 1999).

Nonphysical (Psychological/Cognitive) Measures

Several key psychological mechanisms explain how design strategies can influence driver behavior and reduce vehicle speeds (Norman, 2007). These mechanisms offer insight into how environmental cues, complexity, and perceived risk can shape driving decisions even in the absence of physical enforcement.

- Environmental uncertainty tends to lower speeds.
- Design complexity, achieved through street painting, trees, parked cars, and signage, increases perceived risk and cognitive demand.
- Visible pedestrian activity, bus lanes, or active bike lanes naturally encourage speed moderation.
- Narrow travel lanes and on-street parking elevate risk perception due to potential pedestrian or vehicle conflicts.
- Combining multiple measures enhances behavioral responses through varied psychological triggers.
- Limited forward visibility, winding roads, and natural vertical shifts (e.g., bridge humps) suppress speed by disrupting driver expectations.

Physical Measures

Physical traffic-calming strategies are typically categorized by their primary mechanism: vertical deflection, which alters roadway elevation to influence driver behavior, or horizontal deflection, which modifies the lateral alignment of the roadway. Volume-control devices, such as barriers, diverters, and forced-turn restrictions, are intended to reduce cut-through traffic, while speed-control measures aim to moderate vehicle speeds through changes in the road’s geometry.

Table 19. Physical traffic calming measures and effects on speed. (Ewing and Brown, 2009)

Physical traffic calming measures		
	Speed control measures	
Volume control measures	Vertical deflection	Horizontal/lateral deflection and narrowing
Full Closures (-44%)	Speed Humps and Lumps (-20%)	Traffic Circles (-5%)
Raised Islands Half Closures (-42%)	Speed Tables (-12%)	Chicanes and Realigned Intersections
Diagonal Diverters (-35%)	Raised Crosswalks	Pedestrian Bulb-outs
Median Barriers	Textured Pavements	Chokers and Center-Island Narrowings (-10%)

Vertical Deflection

Among the most widely implemented vertical deflection tools are speed humps, which are cost-effective (typically \$2,000–\$3,000) and have been shown to reduce average vehicle speeds by 22–25%, with associated collision reductions of up to 40% (Daniels et al. 2019). Speed cushions, which allow wider emergency vehicles to pass with minimal disruption, provide a 60% reduction in injury crashes and offer estimated cost savings of approximately \$160,000 per injury prevented (National Safety Council, 2023). Speed tables, designed with extended flat surfaces to accommodate pedestrian activity, deliver a 45% crash reduction and achieve a benefit–cost ratio (BCR) of 4.2:1 (FHWA 2018). Raised crosswalks, which elevate pedestrian crossings to increase driver awareness, cost between \$3,000 and \$15,000 and have been shown to reduce pedestrian collisions by up to 45%. Raised intersections, though more expensive (often exceeding \$20,000), elevate the entire junction to sidewalk level, effectively slowing vehicle turning speeds and improving pedestrian visibility and safety (FHWA 2018).

Horizontal Deflection and Road Narrowing

Horizontal measures such as chicanes introduce lateral shifts into the roadway, disrupting straight-line travel and thereby discouraging excessive speed. Mini traffic circles—distinct from larger, signalized roundabouts—are compact, low-cost interventions (typically \$5,000–\$15,000) that reduce injury crashes at intersections by 46% compared to stop signs or signals (FHWA 2020). Additional narrowing interventions include bulb-outs (curb extensions) and chokers, which visually and physically constrict travel lanes, shorten pedestrian crossing distances, and reduce crashes by up to 30%. Back-in angled parking, a striping-based intervention, improves sight lines for drivers exiting spaces and contributes to speed moderation through perceived lane narrowing; research also indicates it lowers crash rates compared to traditional head-in configurations (Appleyard 2021).

Table 20. Traffic Calming Measures and Cost-Benefit Ratios

Measure	Typical Cost	Primary Benefits / Crash Reduction	Estimated Savings from Crash Reductions
Speed Humps	\$2,000–\$3,000	22–25% speed reduction; 40% crash drop	High
Speed Cushions	\$2,000–\$4,000	60% crash reduction; compatible with emergency vehicles	Very High (\$160,000/injury crash)
Speed Tables	\$2,500–\$6,000	45% crash reduction; pedestrian friendly, smoother vehicle movement	High (BCR ~4.2:1)
Raised Crosswalks	\$3,000–\$15,000	Up to 45% pedestrian crash reduction	High
Raised Intersections	\$20,000.00	Improves driver awareness; safer pedestrian crossings	High
Chicanes	\$10,000–\$20,000	Reduces mid-block speeds; deters cut-through traffic	Moderate
Mini Traffic Circles	\$5,000–\$15,000	46% crash reduction at intersections	High
Bulb-Outs/Chokers	\$5,000–\$30,000	30% crash reduction; improves pedestrian visibility	Moderate to High
Back-In Angled Parking	N/A	Reduces driver conflicts; narrows roadway; improves visibility	Moderate

Conclusions

The data reveal that speeding was consistently involved in just under one-third of all traffic fatalities during the study period. Strikingly, 65% of pedestrian fatalities occur in 25-40MPH posted speed limit zones. However, drivers often far exceed posted limits—killing pedestrians at average speeds up to 176% (44 MPH) of the limit in 25 MPH zones. The trends demonstrate the potential benefits that are on the table with ISAT (Intelligent Speed Assistance Technology). This paper explores the legal, technological, and societal challenges in the complete elimination of speeding-related crashes. We quantify the benefits of reducing such crashes using two disaggregation methods. First, we vary the effectiveness of Intelligent Speed Assistance Technology (ISAT) from 20% to 100% to reflect a range of potential real-world outcomes, finding we could potentially save between \$291 billion and \$1.5 trillion annually, based on the value of lives saved alone.

Based on a detailed review of the literature and a survey conducted by co-authors for a recent study, the long-term success of Intelligent Speed Assist Technology (ISAT) depends not only on technical reliability but also on public trust, equitable deployment, and supportive policy frameworks. A user-centered context-sensitive approach that prioritizes transparency, community engagement, and adaptive policy design is essential for gaining widespread acceptance.

Given that privacy, control, and autonomy remain core concerns, allowing for legal safeguards about data, temporary overrides, paired with tamper-resistant accountability systems, can address fears about loss of control. However, these same requirements drive down the potential universe of crashes that may be avoided. From our work and understanding the difficulty in implementing ISAT systems, we must estimate potential benefits based on avoiding/reducing only a certain subset of collisions. Therefore, our analysis reported on a wide variance [20% vs. 100%] in terms of benefits. Pilot programs targeting high-risk corridors, school zones, or repeat offenders, as well as early adoption in municipal or fleet vehicles, offer promising strategies for incremental rollout. Equally important are public education campaigns that clarify how ISAT works, address misconceptions, and tailor messaging to diverse communities. Given this potential approach for targeted use of ISAT, we recommend that work zones and urban/suburban freeways may be targeted for all speed enforcement for all vehicle classes. For work zones, the overall number of crashes is small, but it may be politically palatable to get ISAT piloted due to its arguable potential to protect the blue-collar workforce. Furthermore, with 65% of pedestrian fatalities occurring in 25-40MPH posted speed limit zones, we should also consider urban corridors with pedestrian activity for ISAT deployment.

If one needs to target vehicle classes for ISAT implementation, the data shows that targeting large trucks in urban areas with pedestrian presence may be an effective pilot. Even though the overall fatality numbers are small, a larger percentage (~38%) of crashes involving large trucks tend to be fatal. To extend from there, the following vehicle class to implement ISAT would be SUVs that have the next highest percentage of speeding-related pedestrian crashes that result in fatalities. Given the popularity of SUVs, this may be politically fraught.

While the methodology offers a rigorous, data-driven approach to estimating ISAT’s potential impact, limitations remain—particularly in accounting for behavioral changes, enforcement dynamics, and unquantified social harms such as trauma and disparate outcomes among different groups.

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Appendix A

FARS Nationwide, 2014-2023

Vehicle Weight Classes	Percent of Speeding Vehicles	Total Vehicles	Average Travel Speed
Class 1: 6,000 lb or less (2,722 kg or less)	21.2%	35,730	46.7
Class 1A: 3,000 lb or less (1,360 kg or less)	34.2%	55,184	52.2
Class 1B: 3,001 - 4,000 lb (1,360 - 1,814 kg)	18.7%	13,960	44.1
Class 1C: 4,001 - 5,000 lb (1,814 - 2,268 kg)	14.8%	58,186	42.1
Class 1D: 5,001 - 6,000 lb (2,268 - 2,722 kg)	15.3%	59,412	44.0
Class 2: 6,001 - 10,000 lb (2,722 - 4,536 kg)	12.6%	1,376	43.0
Class 2E: 6,001 - 7,000 lb (2,722 - 3,175 kg)	16.2%	66,072	44.9
Class 2F: 7,001 - 8,000 lb (3,175 - 3,629 kg)	14.1%	19,626	44.6
Class 2G: 8,001 - 9,000 lb (3,629 - 4,082 kg)	15.4%	9,261	44.6
Class 2H: 9,001 - 10,000 lb (4,082 - 4,536 kg)	14.0%	12,643	45.0

Class 3: 10,001 - 14,000 lb (4,536 - 6,350 kg)	10.4%	6,991	41.8
Class 4: 14,001 - 16,000 lb (6,350 - 7,258 kg)	7.1%	1,480	37.1
Class 5: 16,001 - 19,500 lb (7,258 - 8,845 kg)	6.8%	1,771	35.7
Class 6: 19,501 - 26,000 lb (8,845 - 11,794 kg)	7.2%	3,085	34.6
Class 7: 26,001 - 33,000 lb (11,794 - 14,969 kg)	4.3%	3,566	32.0
Class 8: 33,001 lb and above (14,969 kg and above)	6.3%	33,520	37.9
Total	17.6%	381,863	44.5

Note: This is at the vehicle level (usually multiple vehicles per crash). Weight classification isn't available for all vehicles (About 71% of entries). Neither is estimated travel speed (about 40% of entries)