Emerging Vehicle Technology // User Readiness & Trust

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SE Wisconsin Transportation Symposium
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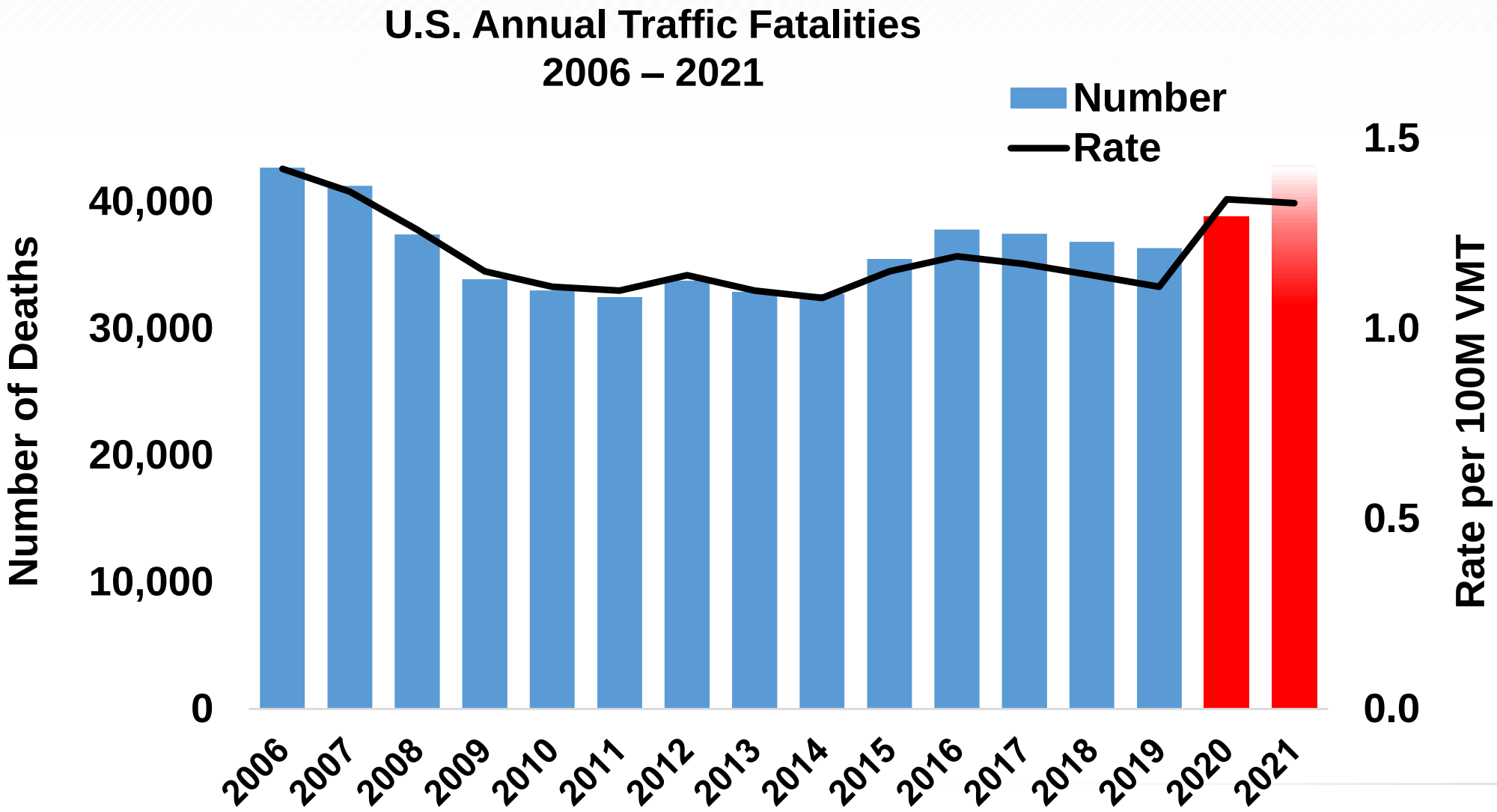
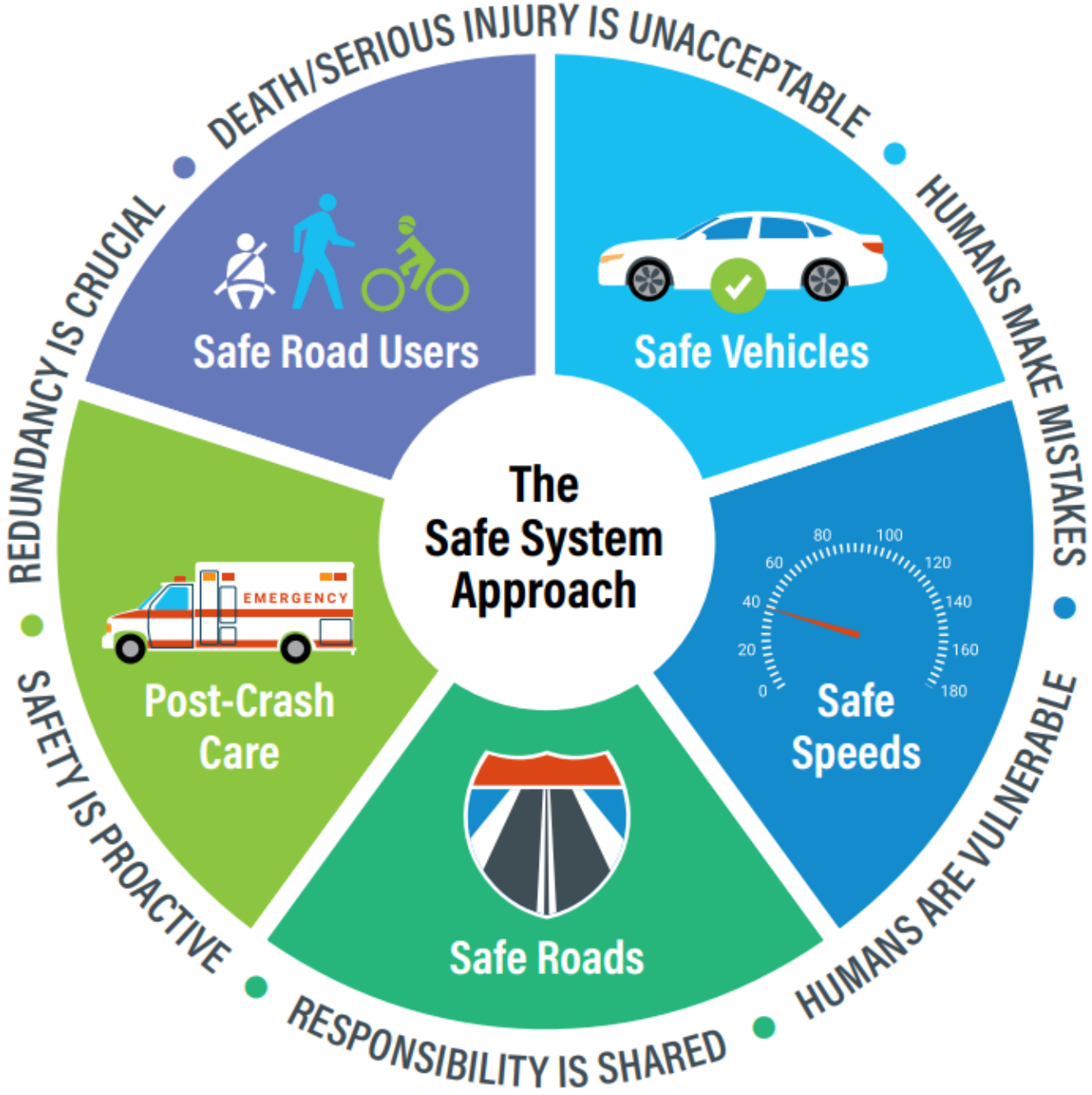
Traffic Fatalities Reach Record High

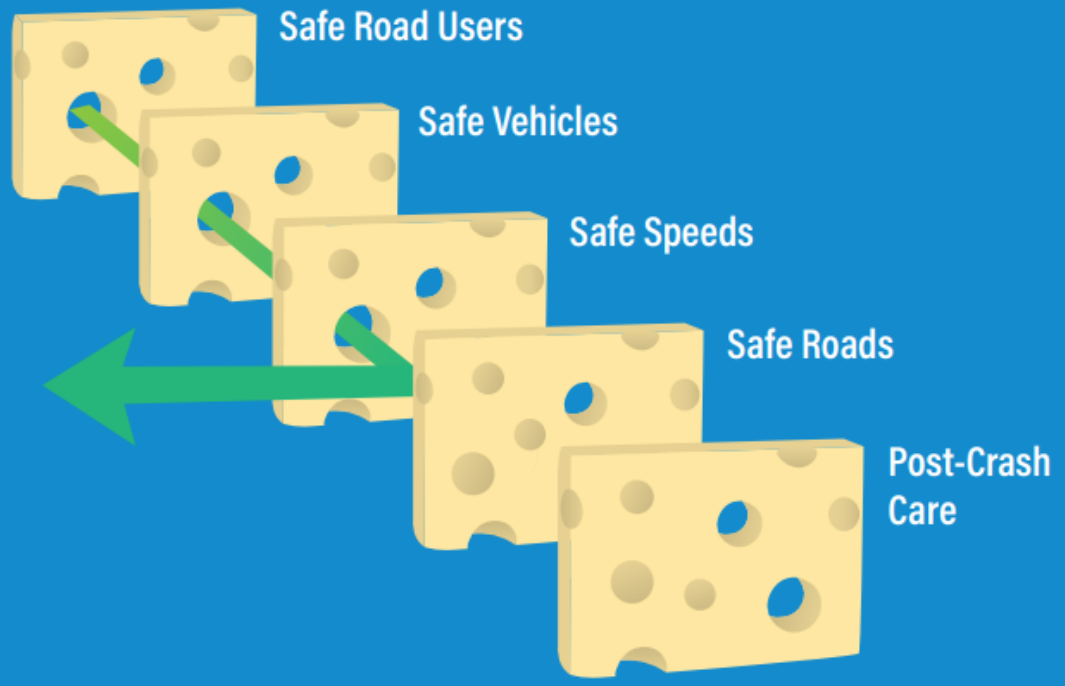


2006-2020 data from NHTSA's Fatality Analysis Reporting System
2021 data = NHTSA preliminary estimate (Report No. DOT HS 813 283.

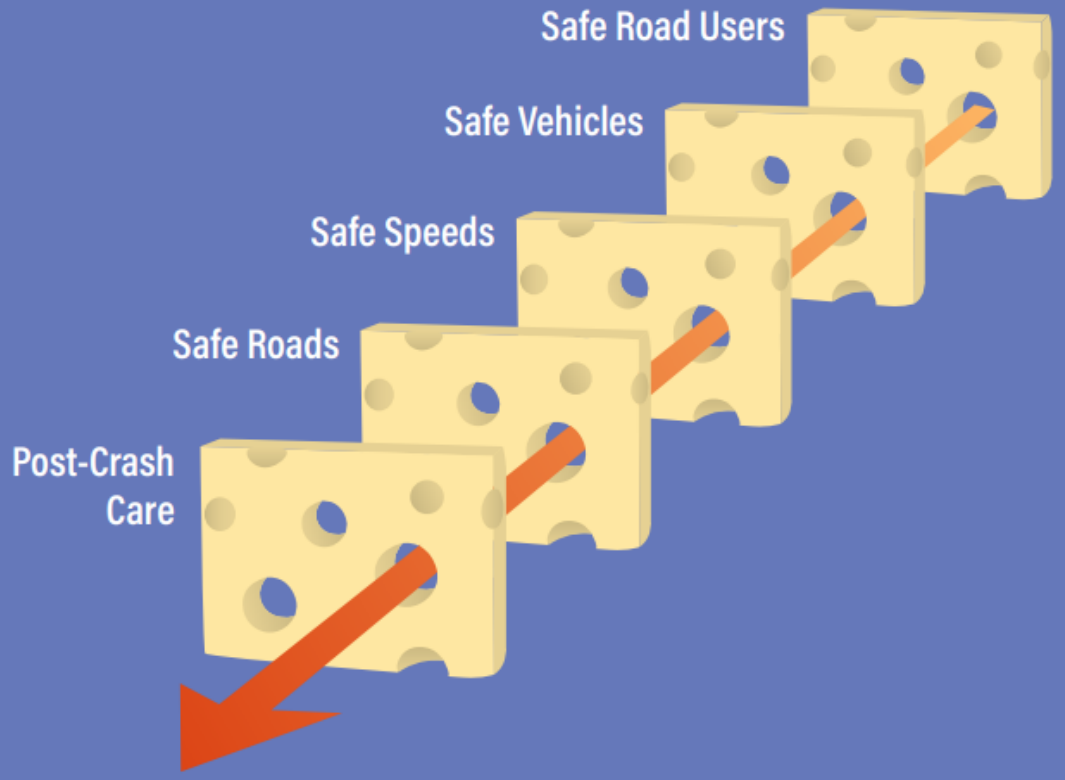

DEATH/SERIOUS INJURY IS UNACCEPTABLE
HUMANS MAKE MISTAKES
HUMANS ARE VULNERABLE
RESPONSIBILITY IS SHARED
SAFETY IS PROACTIVE
REDUNDANCY IS CRUCIAL
Safe Road Users
Safe Vehicles
Safe Speeds
Safe Roads
Post-Crash Care
EMERGENCY
The Safe System Approach

Source: FHWA

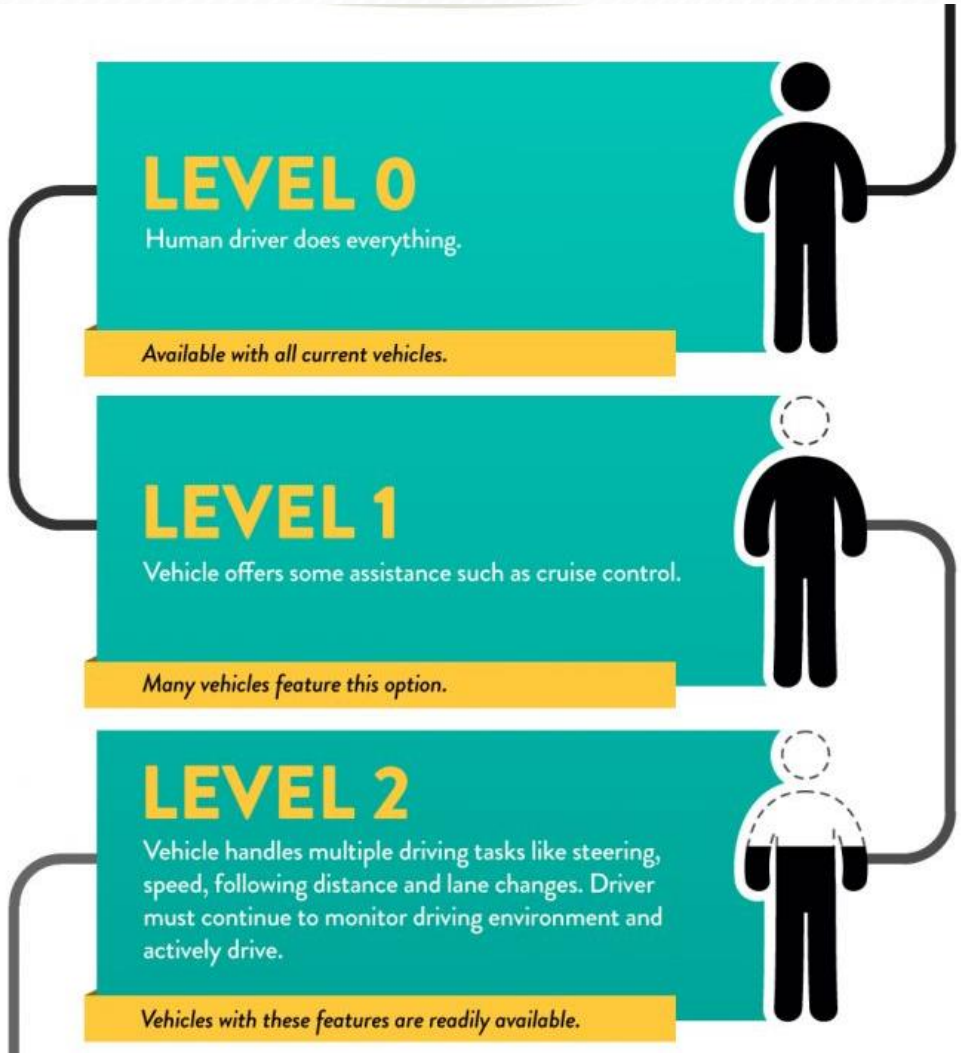
The "Swiss Cheese Model" of redundancy creates layers of protection.

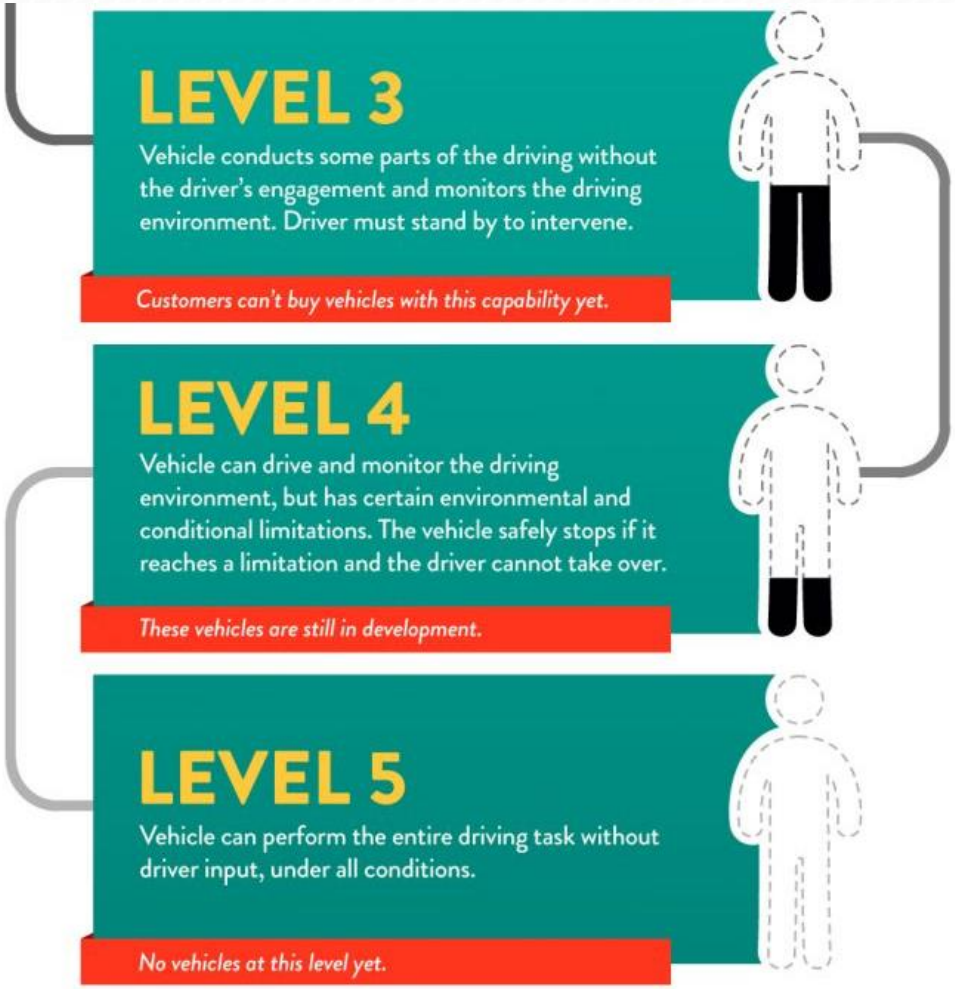


Death and serious injuries only happen when all layers fail.

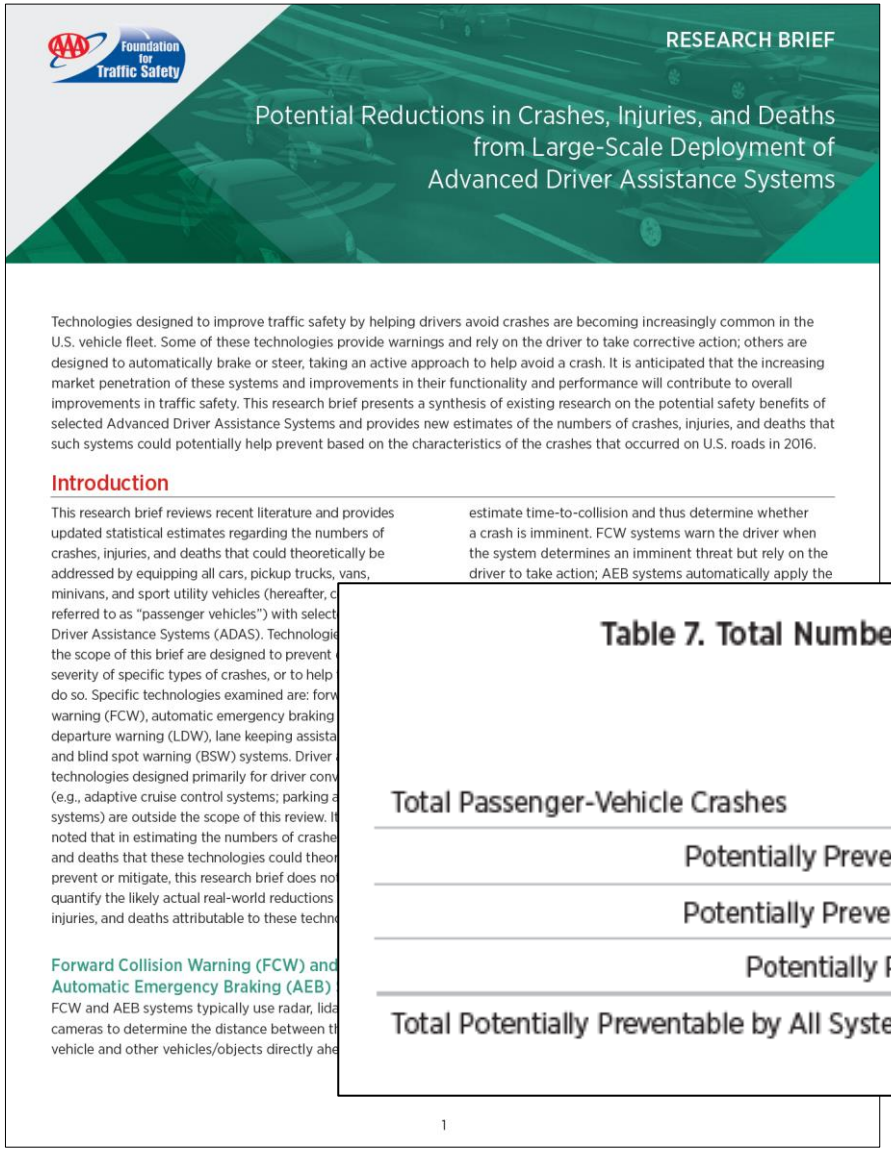


Source: Washington Traffic Safety Commission, 2021


LEVEL 0
Human driver does everything.
Available with all current vehicles.
LEVEL 1
Vehicle offers some assistance such as cruise control.
Many vehicles feature this option.
LEVEL 2
Vehicle handles multiple driving tasks like steering, speed, following distance and lane changes. Driver must continue to monitor driving environment and actively drive.
Vehicles with these features are readily available.


LEVEL 3
Vehicle conducts some parts of the driving without the driver's engagement and monitors the driving environment. Driver must stand by to intervene.
Customers can't buy vehicles with this capability yet.
LEVEL 4
Vehicle can drive and monitor the driving environment, but has certain environmental and conditional limitations. The vehicle safely stops if it reaches a limitation and the driver cannot take over.
These vehicles are still in development.
LEVEL 5
Vehicle can perform the entire driving task without driver input, under all conditions.
No vehicles at this level yet.

Technology Can Save Lives…



RESEARCH BRIEF

Potential Reductions in Crashes, Injuries, and Deaths from Large-Scale Deployment of Advanced Driver Assistance Systems

Technologies designed to improve traffic safety by helping drivers avoid crashes are becoming increasingly common in the U.S. vehicle fleet. Some of these technologies provide warnings and rely on the driver to take corrective action; others are designed to automatically brake or steer, taking an active approach to help avoid a crash. It is anticipated that the increasing market penetration of these systems and improvements in their functionality and performance will contribute to overall improvements in traffic safety. This research brief presents a synthesis of existing research on the potential safety benefits of selected Advanced Driver Assistance Systems and provides new estimates of the numbers of crashes, injuries, and deaths that such systems could potentially help prevent based on the characteristics of the crashes that occurred on U.S. roads in 2016.

Introduction

This research brief reviews recent literature and provides updated statistical estimates regarding the numbers of crashes, injuries, and deaths that could theoretically be addressed by equipping all cars, pickup trucks, vans, minivans, and sport utility vehicles (hereafter, c referred to as "passenger vehicles") with select Driver Assistance Systems (ADAS). Technologie the scope of this brief are designed to prevent severity of specific types of crashes, or to help do so. Specific technologies examined are: forw warning (FCW), automatic emergency braking departure warning (LDW), lane keeping assista and blind spot warning (BSW) systems. Driver technologies designed primarily for driver conv (e.g., adaptive cruise control systems; parking a systems) are outside the scope of this review. It noted that in estimating the numbers of crashe and deaths that these technologies could theor prevent or mitigate, this research brief does no quantify the likely actual real-world reductions injuries, and deaths attributable to these techn

estimate time-to-collision and thus determine whether a crash is imminent. FCW systems warn the driver when the system determines an imminent threat but rely on the driver to take action; AEB systems automatically apply the

Forward Collision Warning (FCW) and Automatic Emergency Braking (AEB)

FCW and AEB systems typically use radar, lida cameras to determine the distance between t vehicle and other vehicles/objects directly ahe

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- Provided estimates of the safety benefits of select ADAS systems
  - FCW, AEB, LDW, LKA, BSW
- Data from NHTSA's 2016 Fatality Analysis Reporting System (FARS) and Crash Report Sampling System (CRSS)

Table 7. Total Numbers of Crashes, Injuries, and Deaths that Selected Advanced Driver Assistance Systems Could Potentially Help Prevent Individually and in Aggregate.

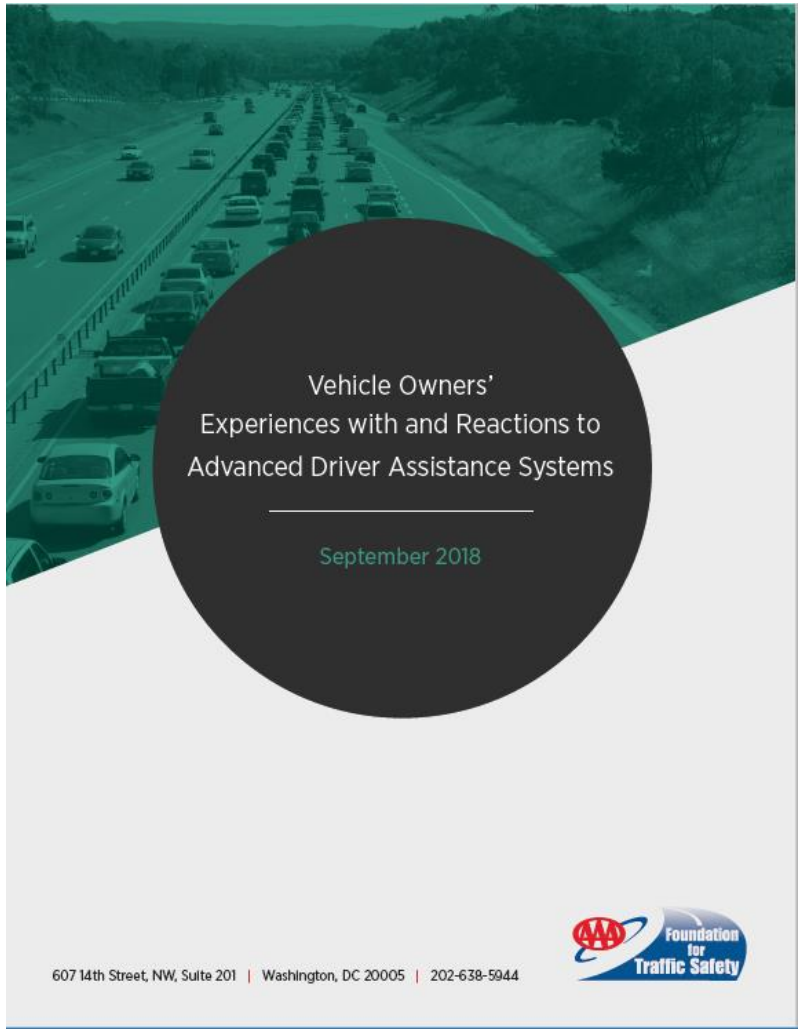
	Crashes	Injuries	Deaths
Total Passenger-Vehicle Crashes	6,950,000	3,033,643	32,702
Potentially Preventable by FCW/AEB	1,994,000 (29%)	883,911 (29%)	4,738 (14%)
Potentially Preventable by LDW/LKA	519,000 (7%)	186,875 (6%)	4,654 (14%)
Potentially Preventable by BSW	318,000 (5%)	89,205 (3%)	274 (1%)
Total Potentially Preventable by All Systems Above	2,748,000 (40%)	1,128,045 (37%)	9,496 (29%)

…But Still Has Long Way to Go

Tests conducted by AAA have found:

- **Active Driver Assistance**
  - Failed to prevent head-on collisions **100%** of the time
  - Failed to prevent collisions with cyclists 33% of the time.
- **Automatic Emergency Breaking**
  - Failed to prevent “T-bone” collisions **100%** of the time
  - **Prevented rear end collisions only 30%** of the time at 40mph, compared to 85% at 30 mph
- **Driver Monitoring**
  - Camera based systems were roughly twice as effective as those detecting steering wheel movement, but **still allowed an average of 2.25 minutes of distracted driving during a 10 minute test drive.**

People Don’t Fully Understand Technology



- Vehicle Owners’ ADAS Survey
  - Surveyed registered owners of 1,200+ ADAS-equipped vehicles
- Generally favorable opinions about all tech examined
- Knowledge gaps, risky behaviors
  - Owners do not understand system functions and limitations
  - Overreliance on some technologies
  - Comfort in engaging in other activities while driving

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People Can Become Complacent

- What do drivers do when using Level 2 systems?
  - Drivers may become distracted or more drowsy
  - On-road behaviors from two naturalistic driving studies (NDS)
- Drivers with more experience with L2 technology:
  - More likely to engage in distracting tasks compared to when driving manually
- Not so for relatively new users of the technology

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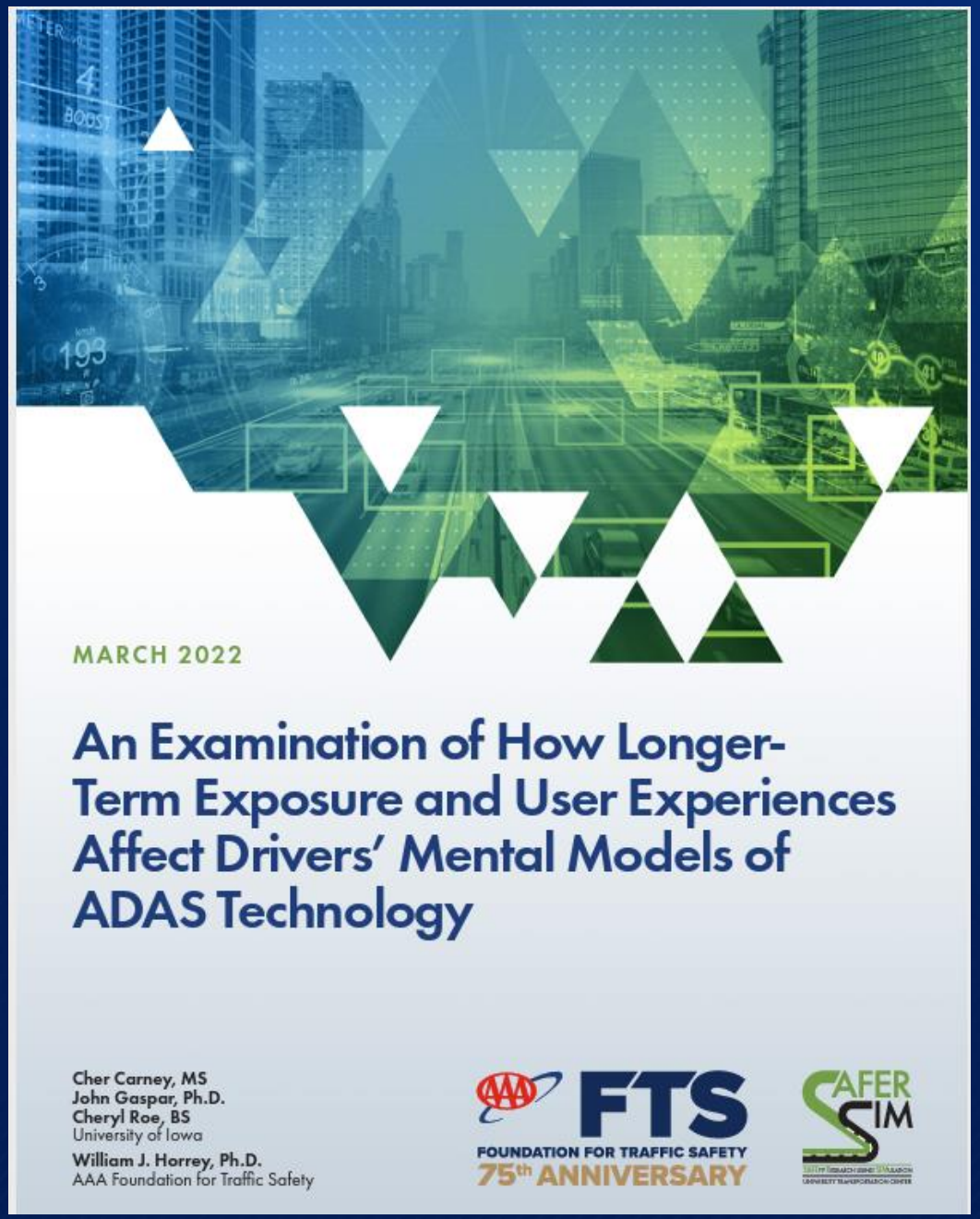
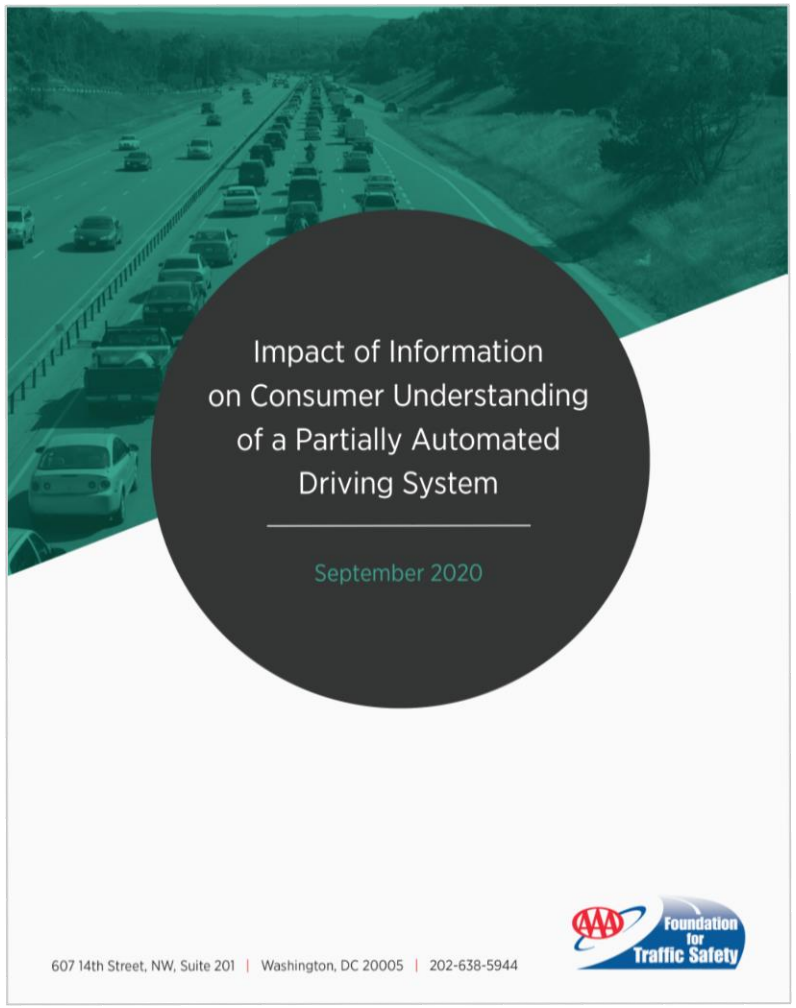


New car owners need safe, effective, and enjoyable training before they hit the road.

Learning Technology: Words, Tone Matter



- Influence of branding, tone, emphasis in consumer information (e.g., manuals, videos)
  - On-road study of one system with two “brandings”
- *AutonoDrive*: Emphasis on capabilities (minimizing limitations)
  - Overconfident drivers missed / overlooked key limitations
- *DriveAssist*: Emphasis on system limitations and driver responsibility
  - Better understanding, less overconfidence

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CLEARING THE CONFUSION:
Recommended Common Naming for Advanced Driver Assistance Technologies

Advanced Driver Assistance Systems (ADAS) have become increasingly prevalent on new vehicles, but the terminology used by automakers to describe them varies widely and so far has focused on marketing strategies.

The common naming outlined is simple, specific and based on system functionality. The list is meant to aid in reducing driver confusion and define the functions of ADAS in a consistent manner. **This is critical to ensure that drivers are aware these systems are designed to assist, not replace an engaged driver.**

The list is not meant to replace automaker proprietary system or package names, but rather help identify key functions within those packages and provide clarity to consumers. *The list will be continually refined as we work with other stakeholders and as new systems are developed.*

COLLISION WARNING	
Blind Spot Warning	Detects vehicles in the blind spot while driving and notifies the driver to their presence. Some systems provide an additional warning if the driver activates the turn signal.
Forward Collision Warning	Detects a potential collision with a vehicle ahead and alerts the driver. Some systems also provide alerts for pedestrians or other objects.
Lane Departure Warning	Monitors vehicle's position within the driving lane and alerts driver as the vehicle approaches or crosses lane markers.
Parking Collision Warning	Detects objects close to the vehicle during parking maneuvers and notifies the driver.
Rear Cross Traffic Warning	Detects vehicles approaching from the side at the rear of the vehicle while in reverse gear and alerts the driver. Some systems also warn for pedestrians or other objects.

COLLISION INTERVENTION	
Automatic Emergency Braking	Detects potential collisions with a vehicle ahead, provides forward collision warning, and automatically brakes to avoid a collision or lessen the severity of impact. Some systems also detect pedestrians or other objects.
Automatic Emergency Steering	Detects potential collisions with a vehicle ahead and automatically steers to avoid or lessen the severity of impact. Some systems also detect pedestrians or other objects.
Reverse Automatic Emergency Braking	Detects potential collisions while in reverse gear and automatically brakes to avoid or lessen the severity of impact. Some systems also detect pedestrians or other objects.

Consumers faced w/ as many as 20 names for a single ADAS feature.

Upcoming Research

- Evaluating Advanced Vehicle Technologies' Impact on Driver Workload, U Utah
- Setting Realistic Expectation for Consumers: How Many Motor Vehicle Crashes and Fatalities will Automated Vehicles Prevent in the Future?, UNC
- Measuring Takeover Readiness in Drivers of Partially-Automated Vehicles, U Michigan
- Mapping how comprehension of advanced vehicle technology varies across different driving and road user populations, what are the most pressing gaps in comprehension stemming from individual differences like age and other differentiating factors, U Iowa (SAFER-SIM)
- Which outcome measures should be used to evaluate the effectiveness of consumer education and training relative to vehicle automation? U Mass (SAFER-SIM)

Other Considerations

- Driver monitoring systems to detect impairment?
- Fatigue, DUI, Medical?

- How can we grant access to life-saving technology to lower-income consumers?

- More conservative estimates for higher-level AV deployment?
- More time to prep consumers.

THANK YOU!

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