

Using Data to Improve Rural Road Safety

December 23, 2025 Webinar





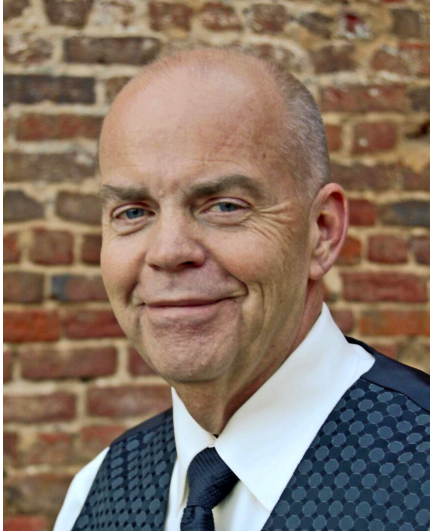
Webinar Logistics

- Duration is 1.5 hours
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 - Click on the “Show Captions” button at the bottom of your screen.
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- Recording webinar for website archival
 - <https://ruralsafetycenter.org/webinar-archive/>
- Q&A pod to ask questions of presenters and alert organizers of technical difficulties
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NEW Home Safely Podcast: Episode 6



- Jack Sullivan
 - Director of training for the Emergency Responder Safety Institute (ERSI)
- In this conversation:
 - Vulnerabilities involved with responding to crashes
 - Methods and tactics responders use to be vigilant
 - Impact of ERSI on improving the general standard approach to responding to crashes
- Listen and subscribe!





NEW Home Safely Podcast: Episode 7



- Nick Parr
 - Director of the Boone County Highway Department in Indiana
- In this conversation:
 - Decades long experience in rural road safety
 - How his department has evolved over the years
 - Regularly identifying opportunities to implement the Safe System Approach
- Listen and subscribe!





Road Safety Champion Program

- Safety 101 program
- Core Modules
 - Tuesdays 1-3 pm ET Starting Jan. 13th



Learn More!

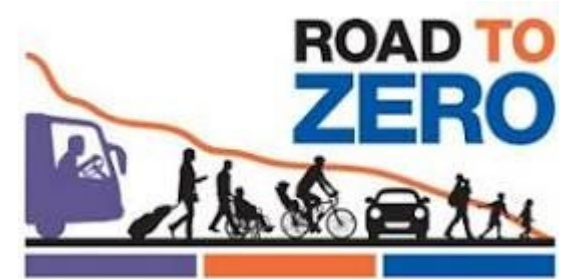


Register Now!



2026 Road to Zero Community Traffic Safety Grants

- Funded by NHTSA
- Grants support innovative and promising projects, programs and research to achieve our mission of zero traffic fatalities
- Successful recipients will be funded for one year
- Projects address one or more components of the Safe System Approach to traffic safety
- Informational webinars on Nov. 18th and Nov. 21st
- Applications close Friday, Jan. 16, 2026 at 11:59 p.m. Eastern





NEW GHSA Resource

- *A Data-Driven Action Plan for Safer Roads*

- *Telematics*
- *AI*





Today's Presenters

- Nick Parr, Boone County Director of Highways, nparr@co.boone.in.us
- Ian Hamilton, AICP, Transportation Planner, Vanasse Hangen Brustlin (VHB), Inc., IHamilton@vhb.com
- Dr. Clay Mann, NEMESIS Technical Assistance Center, clay.mann@utah.edu



Please Reach Out!

- info@ruralsafetycenter.org
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@ruralroadsafety



National Center for Rural Road Safety

A Federal Highway Administration Center for Excellence



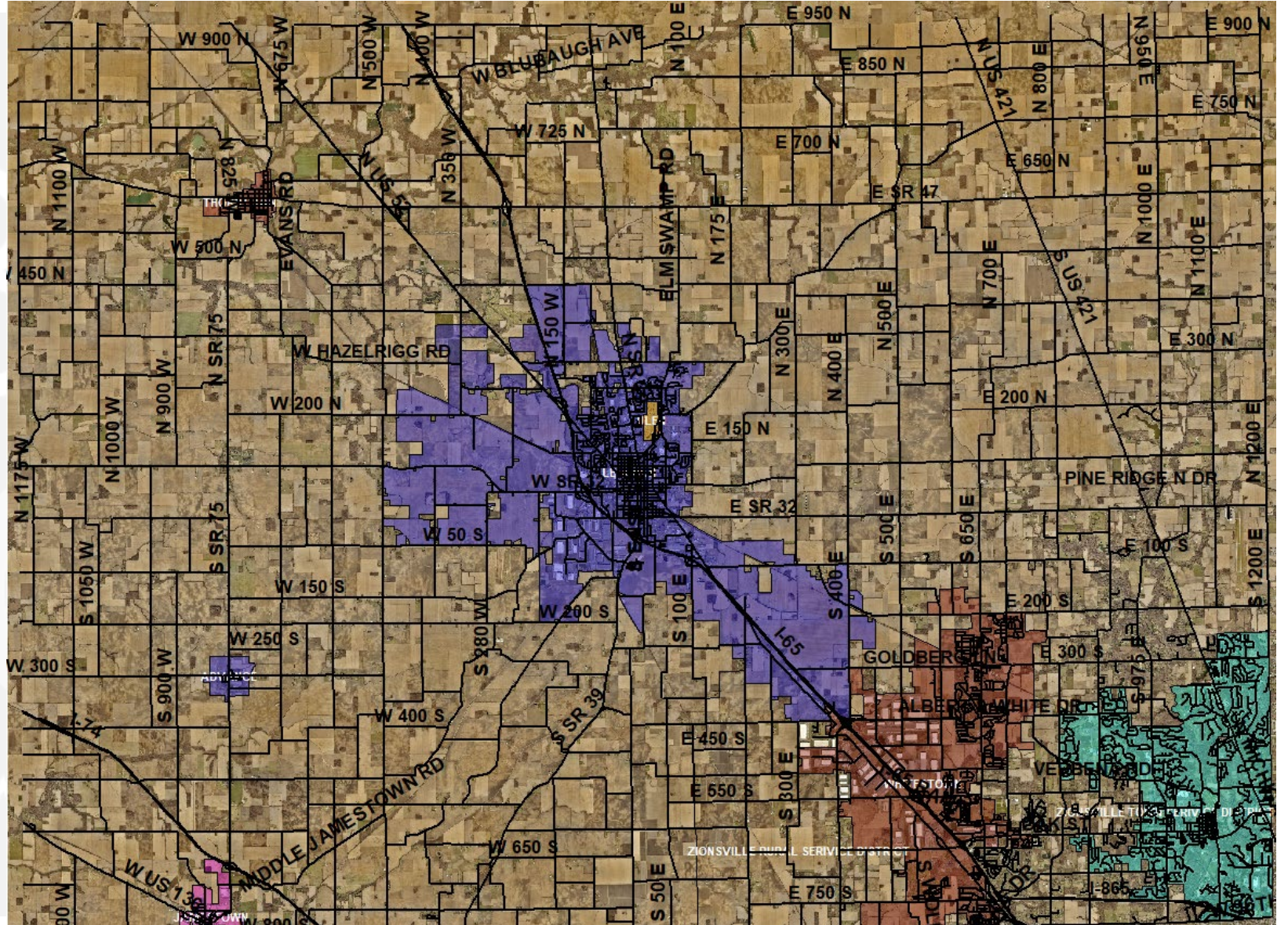
The logo for Boone County Highway Department features the words "BOONE" and "COUNTY" in a large, white, sans-serif font. The letter "O" in "BOONE" is stylized as a thick, grey, circular road that loops around the letter "C" in "COUNTY". In the center of this loop, there is a small, grey, stylized illustration of a bridge or overpass. Below the main text, the words "Highway Department" are written in a smaller, white, sans-serif font.

BOONE
COUNTY
Highway Department

"Get Home Safe"

- **730 Total centerline miles of roadway**
 - 425 miles paved surface
 - 305 miles gravel surface
- **195 Bridges**
- **320+ “Small” Structures**
 - 48” to 19.9’ drainage structures
- **County population 80,000**





Why did we choose to create a Local Road Safety Plan?

We average 1 fatality per year on our network and that number needs to be ZERO.

Highway/Street Departments are the frontline, the boots on the ground that can make immediate impact to prevent crashes.

Who else is better suited to lead the charge to get to zero deaths and serious injuries caused by traffic crashes?

Local Road Safety Plan

Goals

- **Identify infrastructure solutions for “hot spots”**
- **Utilize crash data and system characteristics to identify systemic solutions**
- **Develop long-term implementation plan**
- **Secure and/or dedicate necessary budget to fund the plan**

Local Road Safety Plan

Development Roadmap- 2020



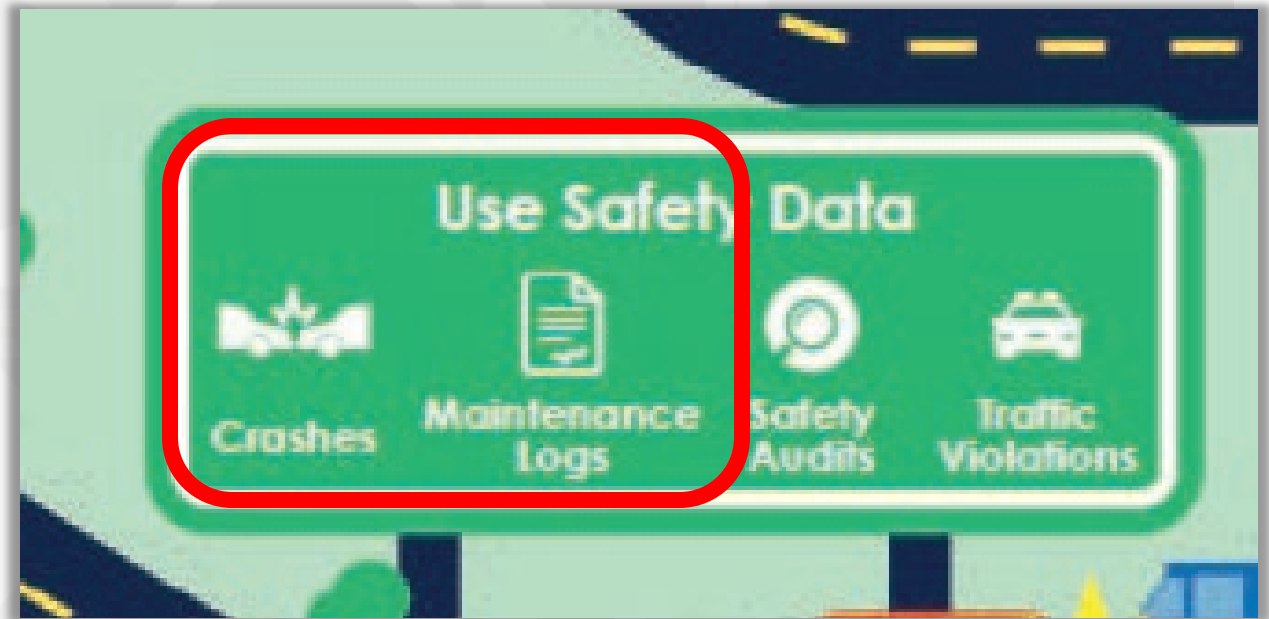
Local Road Safety Plan

Development Roadmap- 2020



Local Road Safety Plan

Development Roadmap- 2020



Highway Department

Data for the Local Road Safety Plan (LRSP) was collected by Indiana Local Technical Assistance Program (INLTAP) from the Automated Reporting Information Exchange System (ARIES) database.

- **ARIES is where all crash report data is entered by responding law enforcement officers across the state.**



Local Technical Assistance Program (LTAP)



Laura Slusher, PE
Traffic Safety Engineer/HELPERS Program Manager
lslusher@purdue.edu

Data was merged with other available data including:

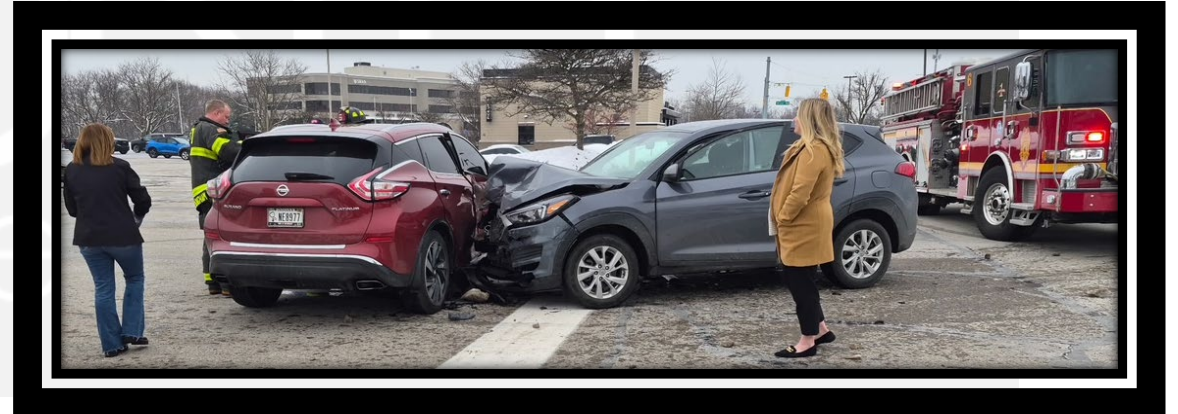
- **Pavement condition**
 - **Highway department annual Pavement Surface Evaluation and Rating (PASER) data**
- **Roadway geometrics**
 - **Horizontal Curves (curves & turns in the road)**
 - **Vertical Curves (hills and valleys)**
- **Crash Location**
 - **ARIES data was “cleaned up” to verify crash report was geo-located correctly**
- **Speed limit**
 - **Highway department sign inventory**
- **Traffic Counts**
- **Roadway surface**
 - **Paved or unpaved**

988 crashes over the five-year period were included the data set

- **Limited to roadways within Boone County's jurisdiction**
- **Excludes municipal Streets**
- **Excludes INDOT roadways**

Data analysis was performed to identify systemic risk factors

Crash data was analyzed to see if there was an overrepresentation of crashes relative to that criteria



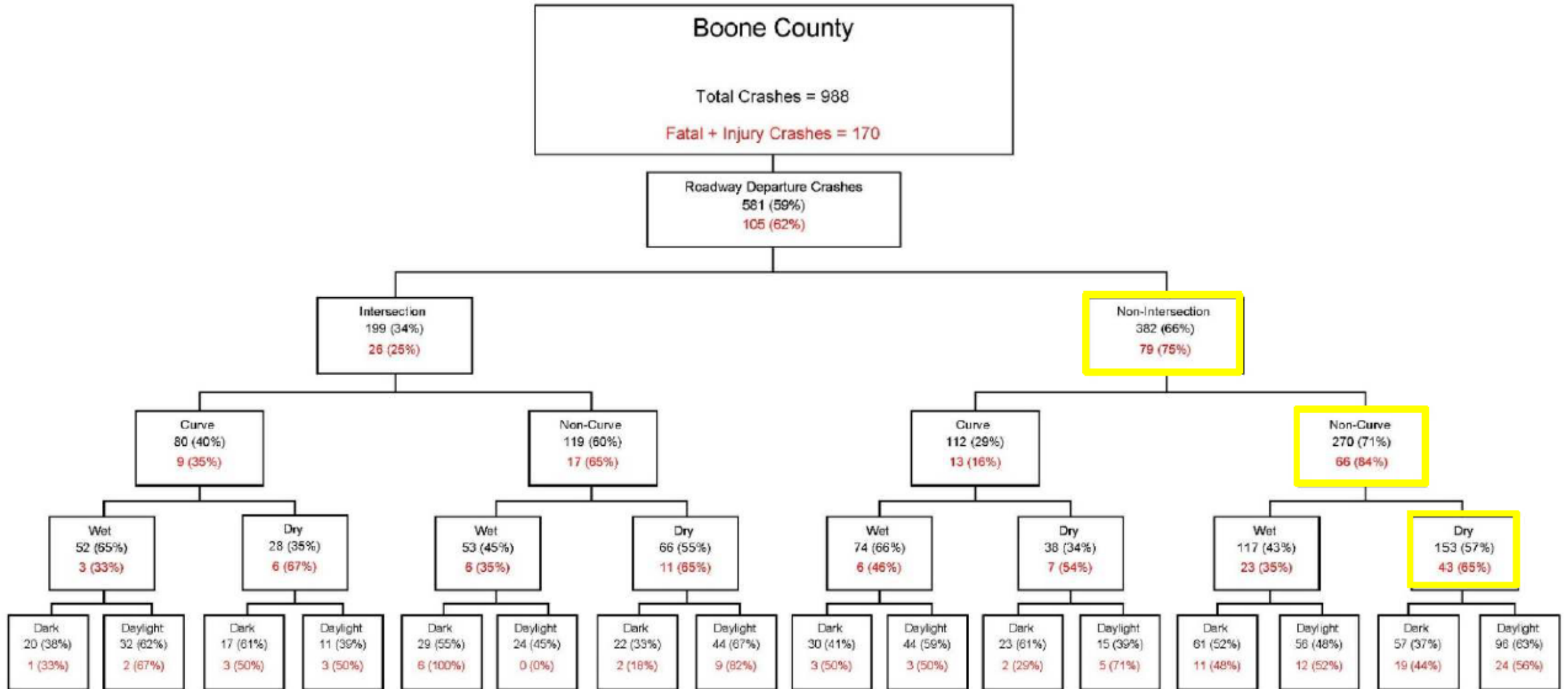
	Total Crashes	% Crashes	Number of Crashes per Year				
Total Crashes	988	-	156	186	214	218	214
Fatal Crashes	4	0.4%	0	1	2	1	0
Injury Crashes	166	17%	23	30	42	33	38
Roadway Departure Crashes	581	59%	101	124	123	123	110
Animal Crashes	95	10%	17	8	19	20	31
Angle/Left-Turn Crashes	133	13%	24	22	19	35	33
Rear-End Crashes	68	7%	8	11	17	18	14
Dark Roadway Crashes	418	42%	74	71	96	93	84
Wet Roadway Crashes	367	37%	58	71	67	89	82
Horizontal Curve Crashes	228	23%	33	33	50	63	49
Intersection Crashes	406	41%	69	74	95	85	83
Gravel Roadway Crashes	80	8%	14	16	21	13	16

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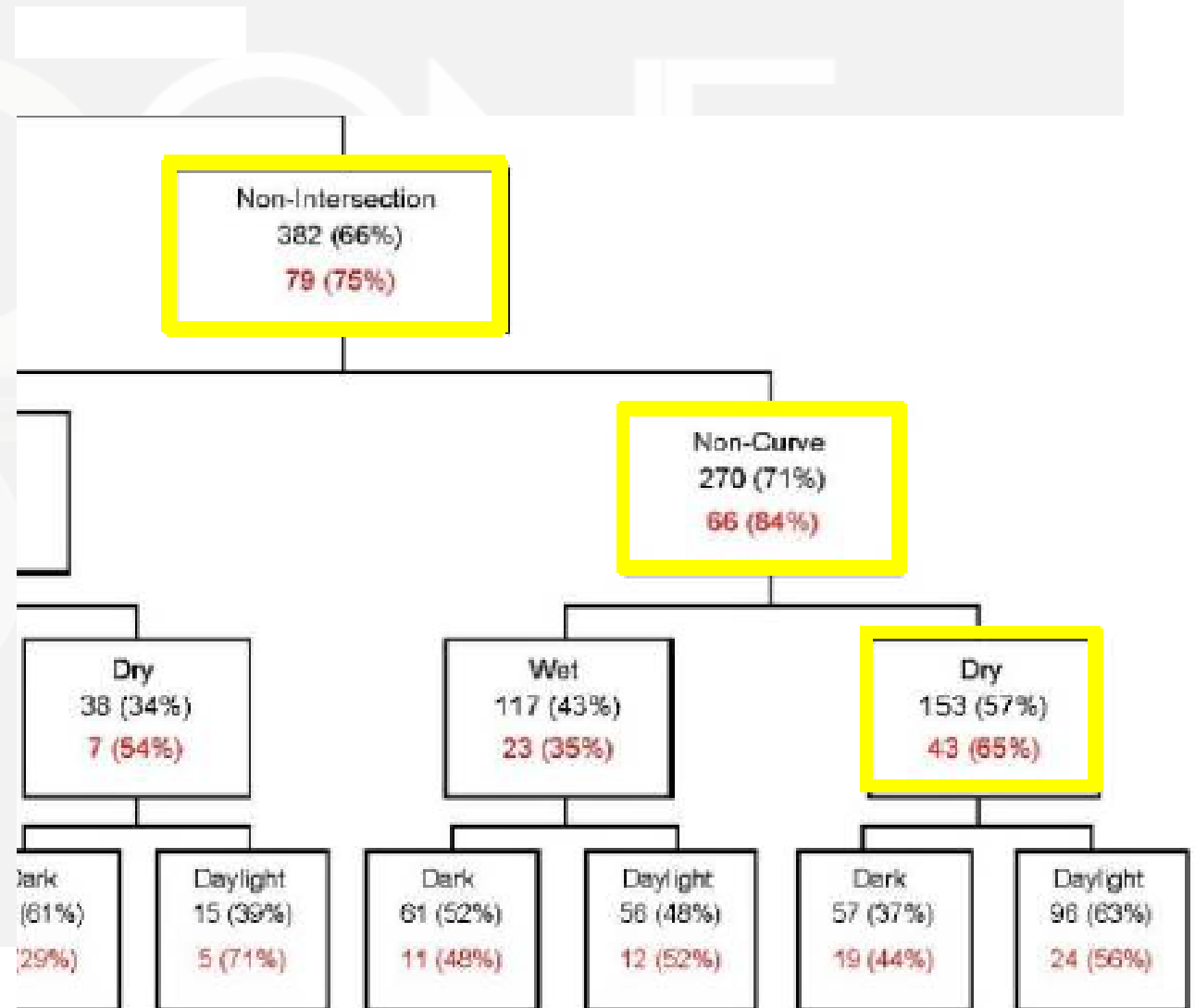
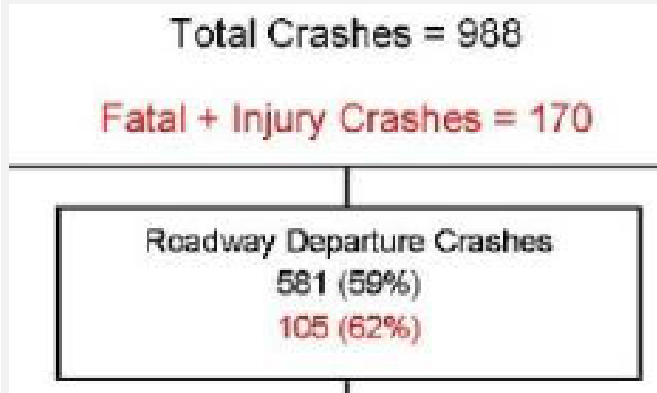
Legend

- + Fatality
- Injury
- Property Damage Only

Roadway Departure Crashes



Roadway Departure Crashes



Systemic Analysis

Systemic analysis was performed to identify connections between roadway characteristics and crash data.

For each roadway characteristic, crash data was tabulated and analyzed to determine if the characteristic resulted in a disproportionately high number of crashes.

These characteristics were then identified as risk factors.

From this analysis, the clearest connections between roadway characteristics and crash data are related to the following risk factors:

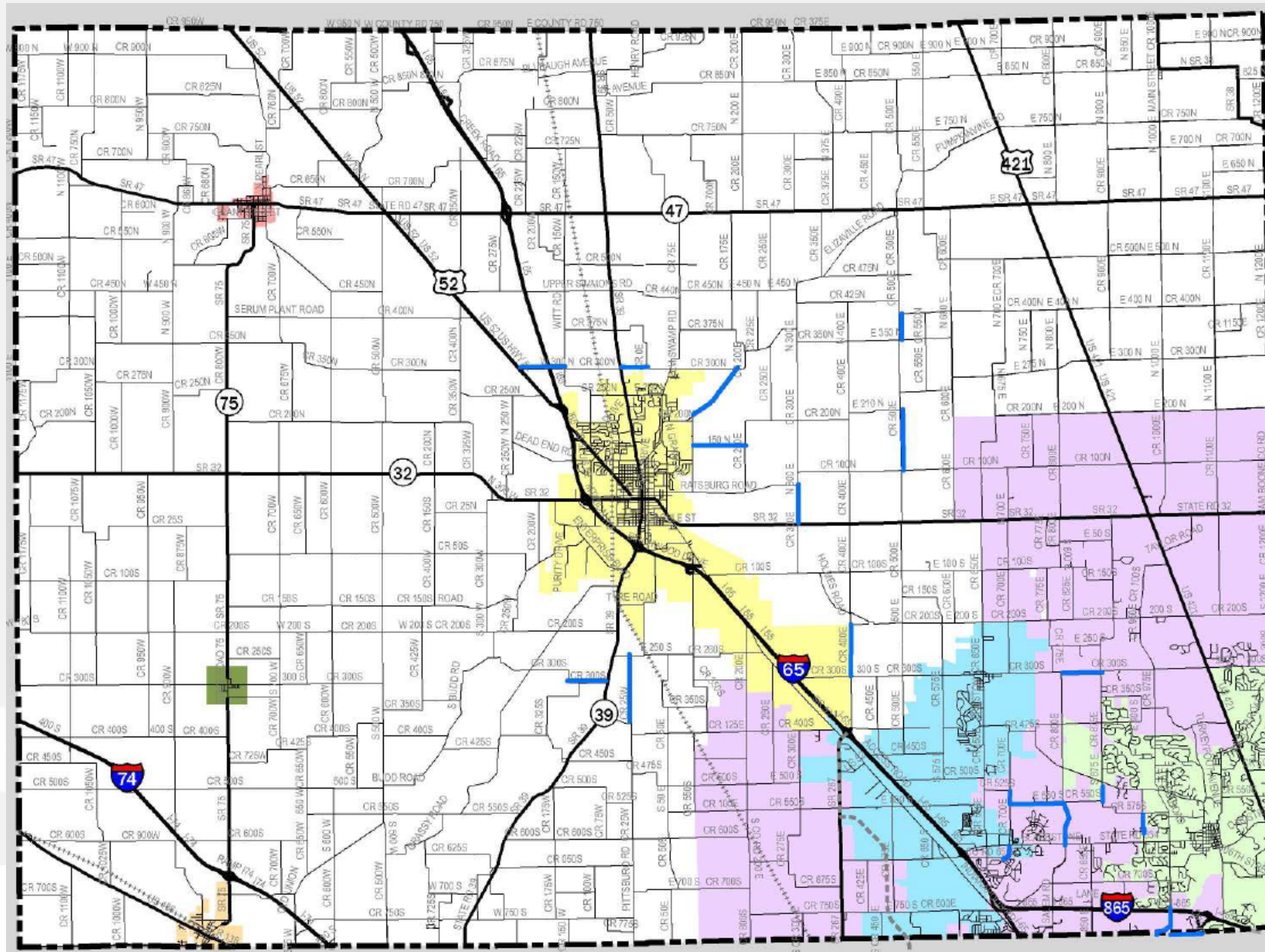
- Higher volume roads (AADT greater than 1,000)**
- Somewhat narrow roads (20 to 22 feet in width)**
- Poor pavement condition (PASER rating of less than 5)**
- Located in growth areas**

Systemic Analysis

The roadways in this table represent corridors that have similar risk factors as roadways with higher crash rates, indicating that these roadways have the potential for future crashes.

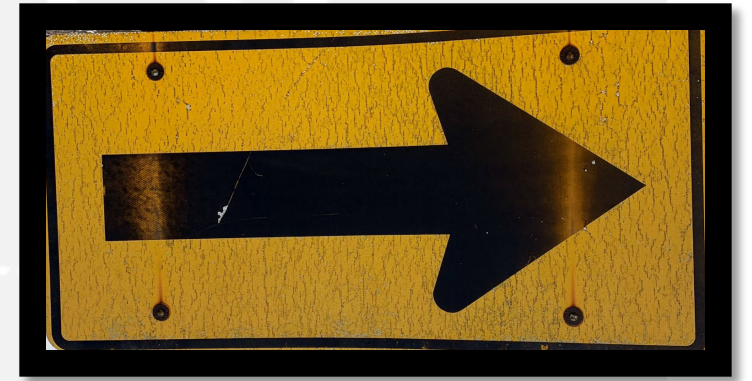
The goal is to proactively implement countermeasures to reduce the risk of future crashes.

Priority Corridor	Location	Road Classification
C.R. 300 N	S.R. 39 to C.R. 25 E	Minor Arterial
C.R. 300 N	S.R. 52 to C.R. 150 W	Minor Arterial
C.R. 500 E	C.R. 100 N to C.R. 210 N	Minor Collector
C.R. 500 E	C.R. 350 N to C.R. 400 N	Minor Collector
C.R. 300 S	C.R. 875 E to C.R. 800 E	Major Arterial
C.R. 550 S	C.R. 700 E to C.R. 800 E	Local
96 th /Ford Rd	Ford Rd. to Moore Rd.	Minor Arterial
Ford Rd	Irishmans Run Ln to 96 th St	Minor Arterial
C.R. 800 E	C.R. 550 S to S.R. 334	Local
C.R. 600 S	C.R. 950 E to 900 E	Major Collector
C.R. 400 E	C.R. 200 S to Key Rd	Major Collector
C.R. 300 S	C.R. 150 W to S.R. 39	Major Collector
C.R. 25 W	C.R. 375 S to C.R. 250 S	Major Collector



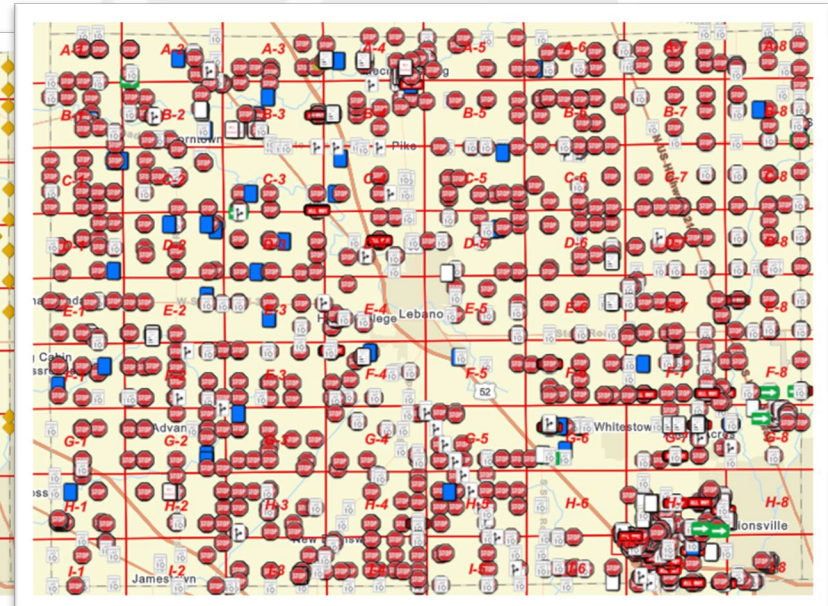
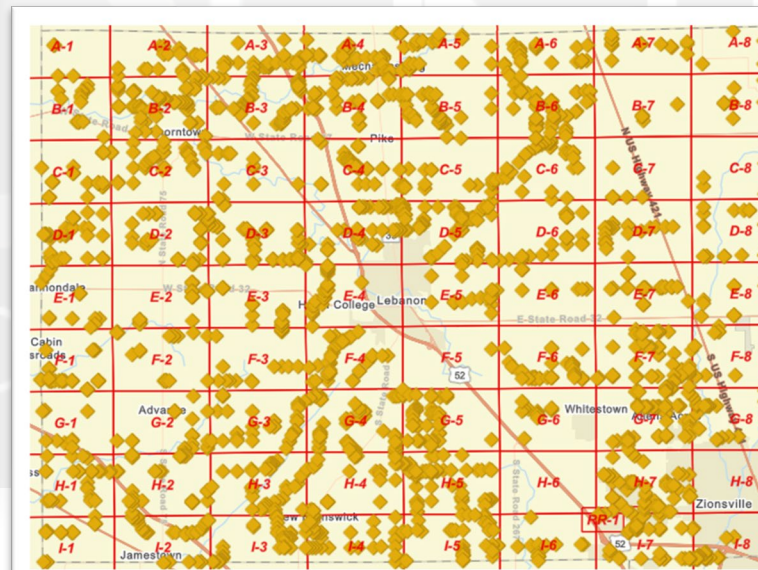
Action Items

- Implement centerline striping and no-passing zones on all paved roads in the county
- Improve shoulder conditions on paved roads in the county
- Install edge striping on paved roads 20 feet wide or greater
- Keep intersections free of obstructions that block sight lines and the view of traffic control devices
- Install high visibility traffic control devices
- Maintain minimum pavement rating condition in growth areas
- Develop and implement a county-wide sign replacement program



Countywide Sign Replacement

- **2018**
 - Sign Inventory Completed
 - Thousands of signs needing replaced
- **2021 HSIP Funds Awarded**
 - 90% Federal Funds
 - 10% Local
 - 4,500 Regulatory & Warning Signs have been Replaced
 - Construction Cost \$1,170,628
 - Completed 12/2025



Countywide Striping



- **2020**
 - No Passing Zone Study Completed
 - 450 Miles of Paved Roads
- **2022 HSIP Funds Awarded**
 - 90% Federal Funds
 - 10% Local
 - Adding pavement markings where they do not exist
 - On system roads- Collectors & Arterials
 - Construction Cost \$1,373,668.84
 - Letting 9/2025

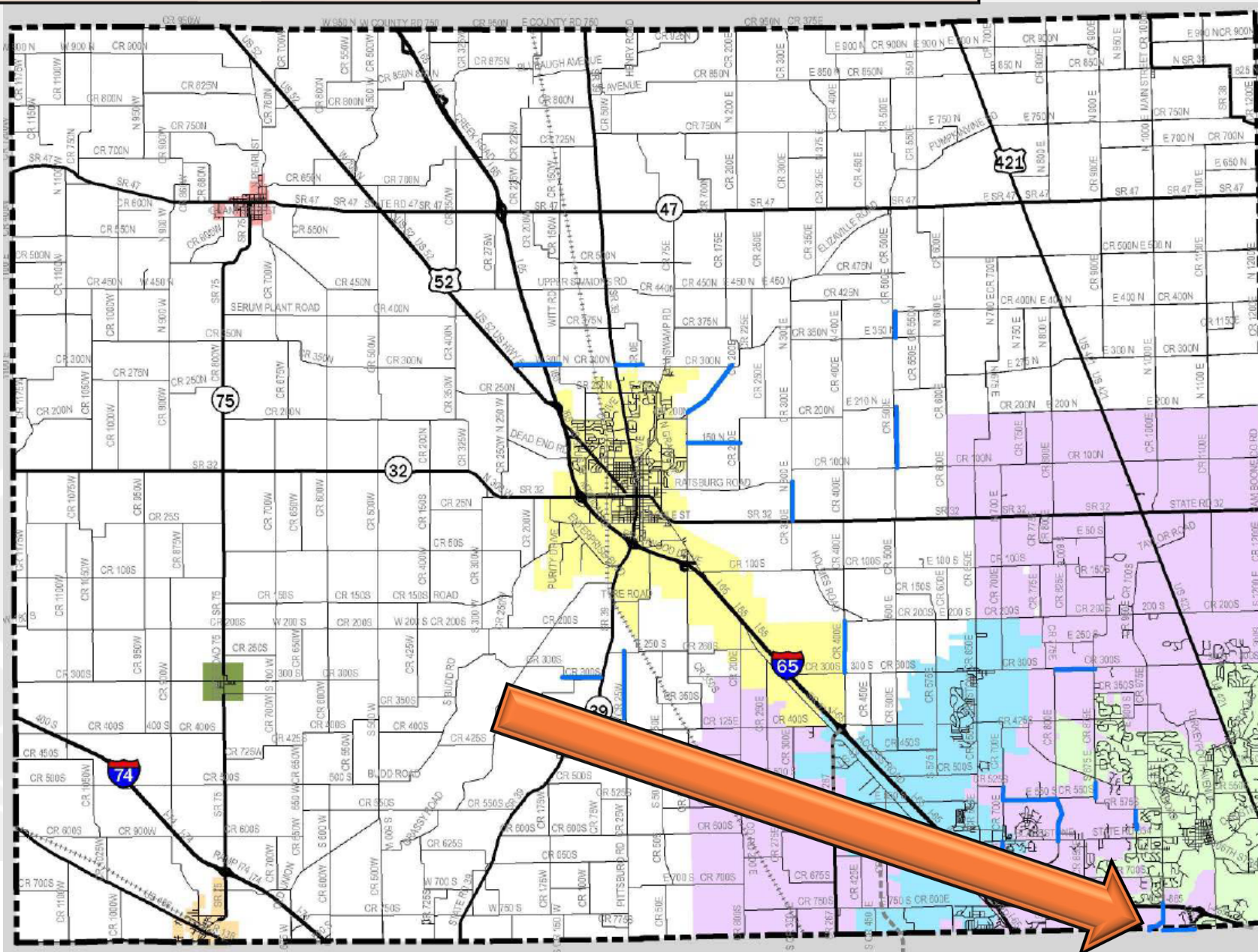


96th Street East of Moore Road



96th St Curve East of Moore Road

Systemic & Hot Spot



96th Street East of Moore Road

- **5-year analysis**
 - Crash data indicated an average of 3 Crashes per Year
 - Many more crashes occurred- Car parts were cleaned up regularly, signs replaced, utility pole hit often causing power outages
- **Project**
 - Curve correction project- Slope in the curve was corrected to create a super elevated curve, High Friction Surface Treatment was applied. Construction cost \$315,000.
- **Result**
 - 2 Crashes total
 - No signs replaced, car parts cleaned up or utility pole strikes





E
C
Highway

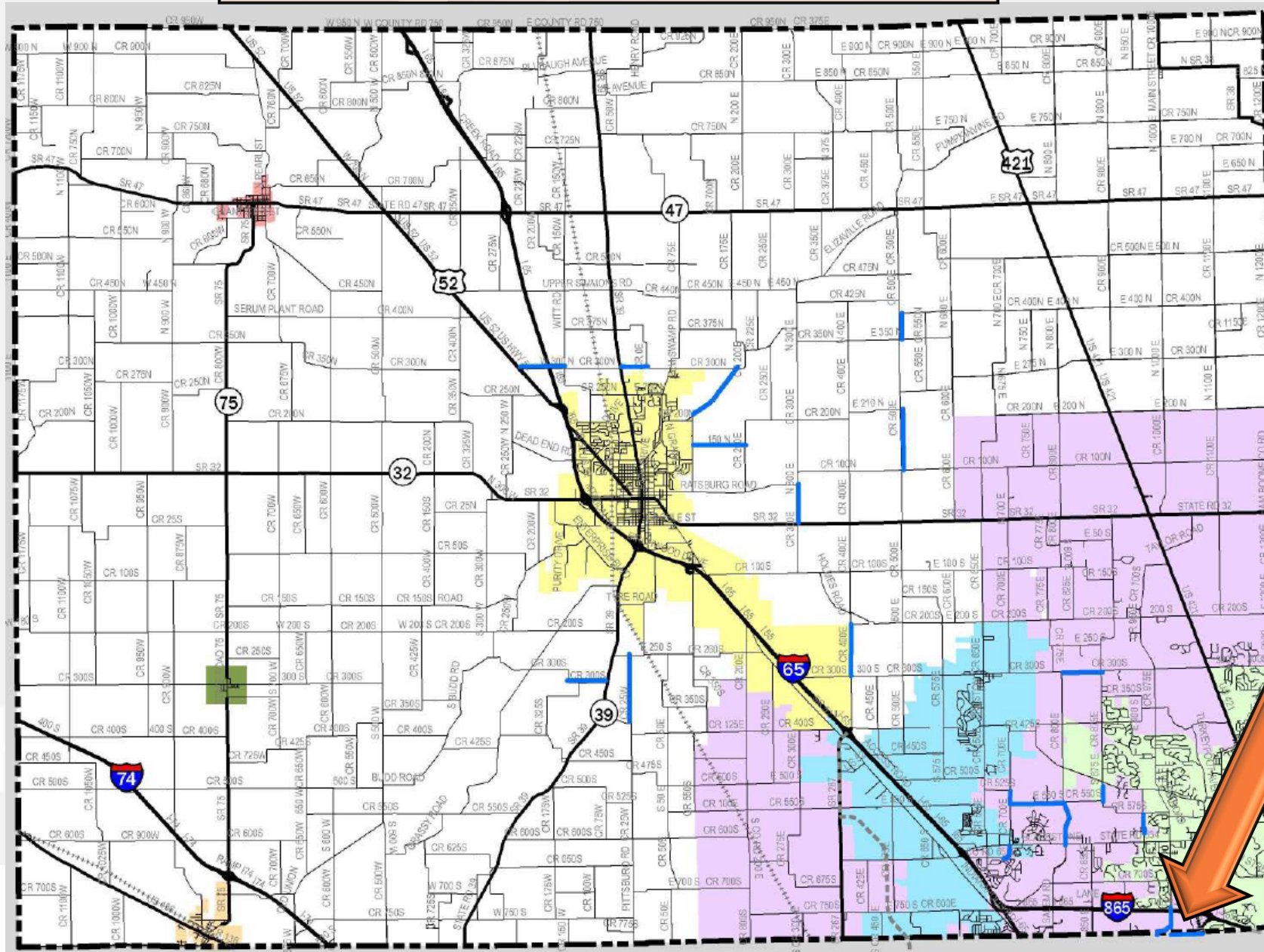
E
Y
ment

Ford Road & 96th St Curve

**Systemic &
Hot Spot**



Ford Road & 96th St



96th & Ford Road

- **5-year analysis**
 - 12 crashes per year average- Signs replaced regularly
 - Crash frequency increased after a bridge replacement project
- **Project**
 - Resurfacing project, modified elevation of the curve
 - Previously designed for 30 mph
 - Added High Friction Surface Treatment (\$41,000)
- **Year 1 Result**
 - 3 Crashes for the same object in the road, not curve, condition or speed related- no other crashes
- **Year 2 Result**
 - Zero Crashes
- **Year 3 Result**
 - 1 Crash, unsafe speed noted, ran off the road

Ford Road Looking South





Our Vision:

To help all users of Boone County's transportation system to reach their destination safely.

Boone County
Highway Department

Our Mission:

Eliminate fatal and serious injuries resulting from traffic crashes, making decisions based on their ability to reach zero deaths on Boone County's transportation system.

Highway Department

"Get Home Safe"

Nick Parr

Director of Highways

1955 Indianapolis Avenue

Lebanon, IN 46052

T 765.482.4550

E nparr@co.boone.in.us





Developing a Framework for Large Animal-Vehicle Crash Risk

A Safe System Approach to Cost-Effective Safety Improvements

Ian Hamilton, VHB

Bridget Donaldson, VTRC

December 23, 2025

Technical Review Panel

- Amy Golden, VDOT - champion
- Stephen Read, VDOT - champion
- John Miller, VDOT/VTRC
- Peter Ohlms, VDOT/VTRC
- Lisa Sztukowski, DWR
- Nelson Lafon, DWR

Technical Advisory Committee

- Katherine Martin, DWR
- Peter Acker, DWR
- Jordan Green, DWR

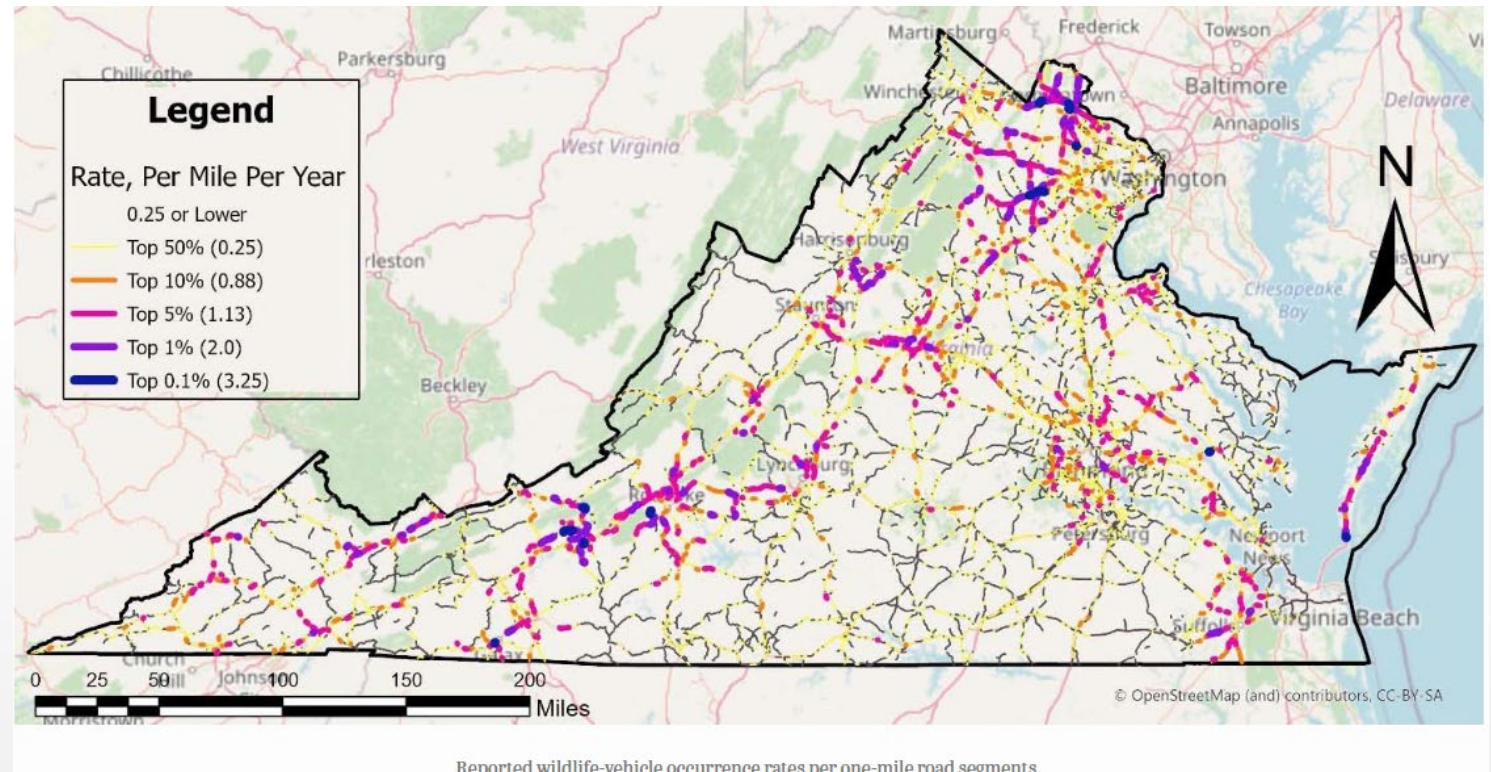
Project Team

- Bridget Donaldson, VTRC
- Ian Hamilton, VHB
- Michael Spear, VHB
- Scott Himes, VHB
- Kenlee Fischer, VHB
- Sam Arnold, VHB

Background

Wildlife Corridor Action Plan (Code of Virginia § 29.1-579)

- Identify wildlife corridors, existing or planned barriers to movement along such corridors, and areas with a **high risk of wildlife-vehicle collisions**
- Prioritize and recommend wildlife crossing projects intended to promote driver safety and wildlife connectivity



Wildlife Corridor Action Plan (2023)
Deer and bear crashes based on police report data

Purpose

VDOT's Safe System Approach (U.S. DOT's approach, addressed in the Virginia Strategic Highway Safety Plan or SHSP)

- Addresses the **risk** of a crash occurring rather than reacting to previous crashes
- Reduces driving risks by proactively focusing on the design and management of **road infrastructure**

The study:

- Developed a predictive model to identify high risk road segments for white-tailed deer- and black bear-vehicle collisions;
- scored road segments statewide;
- compared results to the previous WCAP; and
- drafted a method for conducting a benefit/cost analysis associated with proposed improvements.

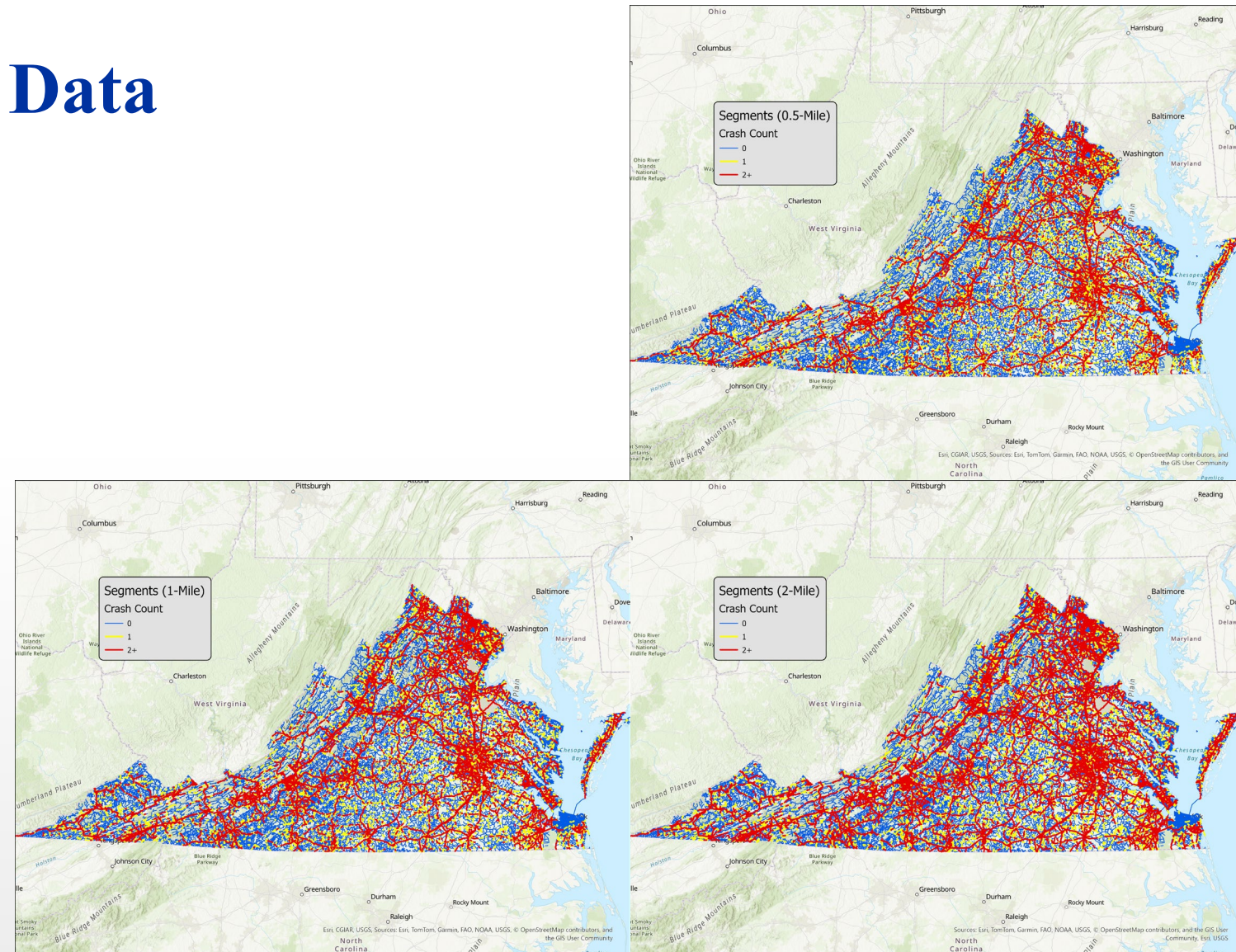
Data Review



Existing Literature & Data

Crash data helped inform preferred segmentation

- Investigated distribution of crashes by segment length:
 - 0.5 mi
 - 1 mi
 - 2 mi
- Goal to build sample size
- Identified 0.5 mi as a reasonable segmentation for initial modeling



Existing Literature & Data

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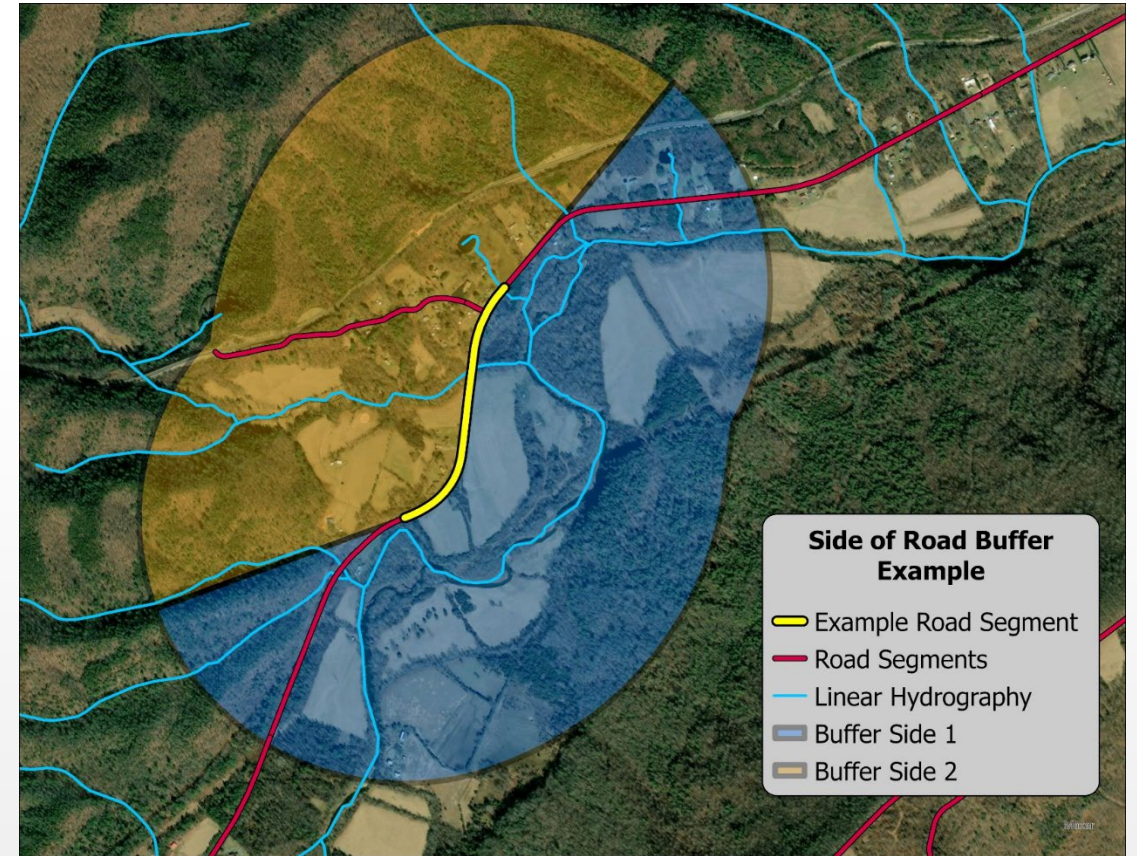
Segment Length	Segments with 0 Crashes	Segments with 1 Crash	Segments with 2+ Crashes
0.5 miles	308905	14069	12350
1 miles	242415	8952	10198
2 miles	218733	5951	7749

Segment Length	% Segments 0 Crashes	% Segments 1 Crashes	% Segments 2+ Crashes
0.5 miles	92.12%	4.20%	3.68%
1 miles	92.68%	3.42%	3.90%
2 miles	94.11%	2.56%	3.33%

Existing Literature & Data

Data from multiple publicly available sources:

- Virginia Department of Transportation (VDOT)
- Virginia Department of Motor Vehicles (DMV)
- Virginia Department of Wildlife Resources (DWR)
- Virginia Department of Conservation and Recreation (DCR)
- United States Geological Survey (USGS)
- Multi-Resolution Land Characteristics Consortium (MRLC)
- Federal Emergency Management Agency (FEMA)
- United States Census Bureau



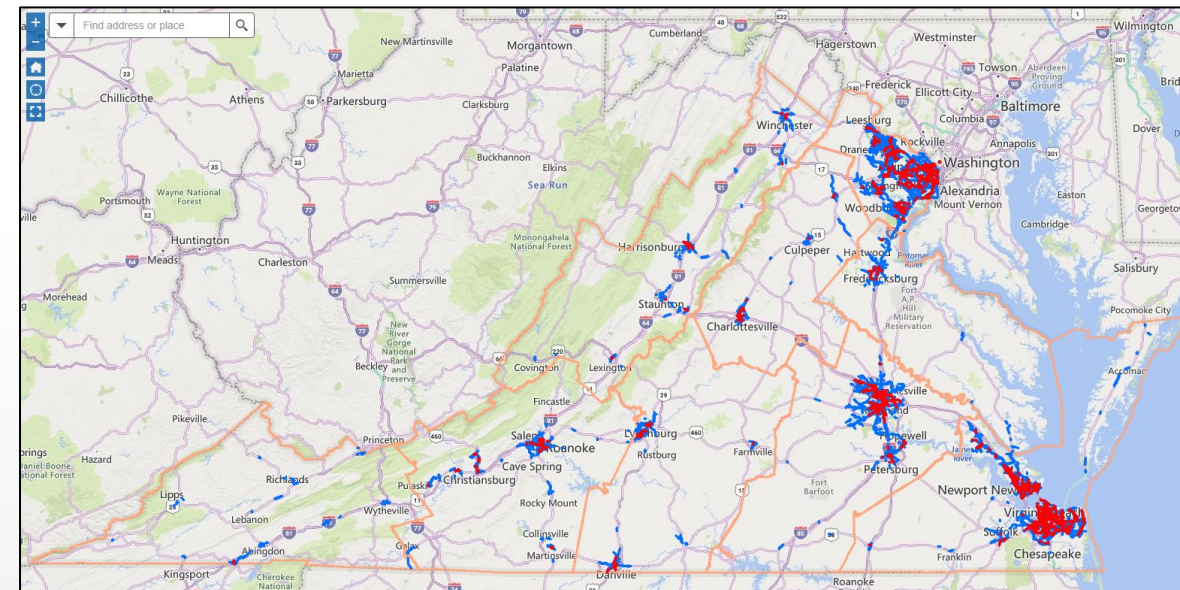
Methodology



Developing the Risk-Based Methodology

Developed a methodology for assessing the risk or likelihood of WVC for all eligible study area road segments

- Scalable to geographic area
 - State
 - District
 - County/City
- Focus is on risk, not observed crashes
 - Crashes are the basis of analysis, but analysis is not reliant on crash locations only
- Method helped determine the importance and “weight” of key characteristics



Developing the Risk-Based Methodology

- 6 statistical models investigated
 - Panel discussions emphasized preference for “KABCO” approach
 - Logit models developed to estimate crash likelihood on a segment
- Based on:
 - Animal
 - Crash Severity
 - Facility Type
- Key needs:
 - Support countermeasure selection
 - Applicable in low data environments

Animal	Crash Severity	Facility
Bear	Total Crash (KABCO)	Fed-Aid – Freeway
		Fed-Aid – Non-Freeway
		Non-Fed-Aid
Deer	Total Crash (KABCO)	Fed-Aid – Freeway
		Fed-Aid – Non-Freeway
		Non-Fed-Aid

Results



Deer Crash Results

- Increased risk of a deer crash:
 - Higher AADTs
 - Communities with a higher deer population density
 - Urbanized areas
 - Forest and cultivated fields land cover
 - Greater mix of “natural” land cover
 - A greater number of stream/river crossings

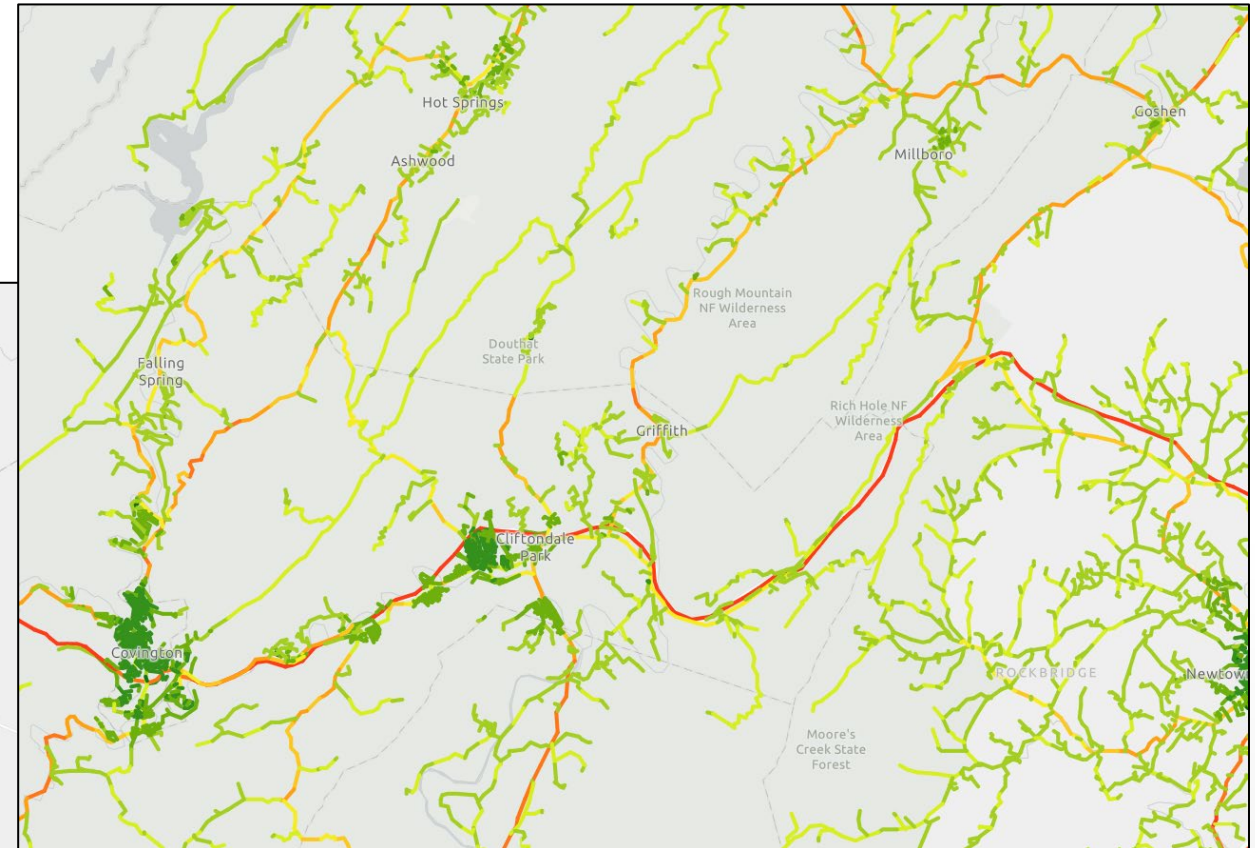
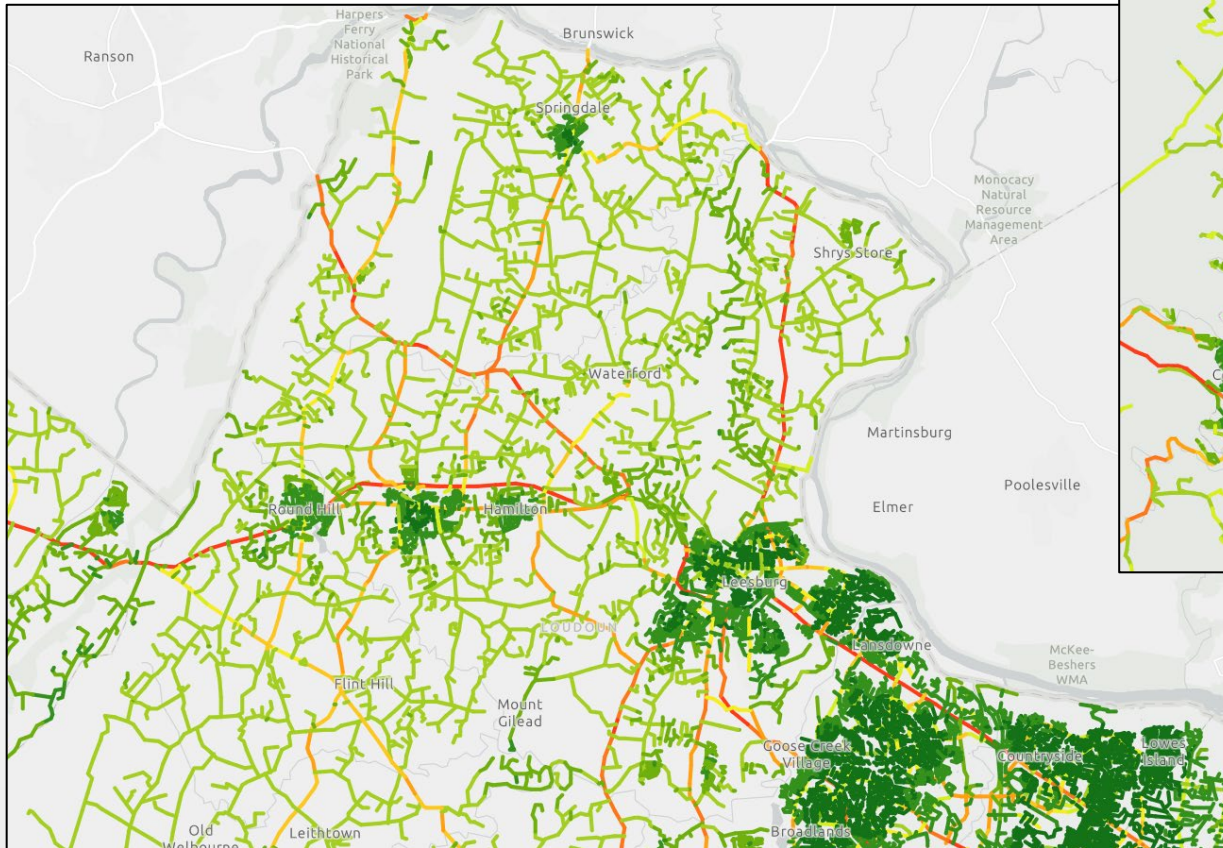
Risk Factor	Access-Controlled Freeways	Non-Freeway, Federal Aid Roads	Non-Freeway, Non-Federal Aid Roads
Natural Log of AADT	+++	+++	
Deer Density Rating	+++	+++	+++
Human Population Density		---	-
Urban Area Flag	+++	+++	++
Area of Forest Land Cover	+	+++	+++
Area of Cultivated Land Cover	+++	+++	+++
Area of Open-Uncultivated Land Cover	---	---	+++
Natural Land Use Mix	+++	+++	+++
3 or More Lanes Present		+++	
Grass Median Present	+++	+++	
Jersey Barrier or Guardrail Present		---	
Median Present * Median Width	+++		
Intersection Density	--	---	+
Building Density		---	---
Hydro Crossing Count	++	+++	+++

Bear Crash Results

- Increased risk of a bear crash:
 - Higher AADTs
 - Communities with a higher bear population density
 - Forest and cultivated fields land cover
 - Greater mix of “natural” land cover
 - A greater number of stream/river crossings

Risk Factor	Access-Controlled Freeways	Non-Freeway, Federal Aid Roads	Non-Freeway, Non-Federal Aid Roads
Natural Log of AADT		+++	
Bear Density Rating	+++	+++	+++
Human Population Density		-	-
Area of Forest Land Cover	+++	+++	+++
Area of Cultivated Land Cover	++	+++	+++
Area of Open-Uncultivated Land Cover	---	+++	+
Natural Land Use Mix	+++	+++	+
3 or More Lanes Present		+++	
Median Present * Median Width	+++		
Intersection Density	---	-	--
Building Density		---	-
Hydro Crossing Count	+	+++	+

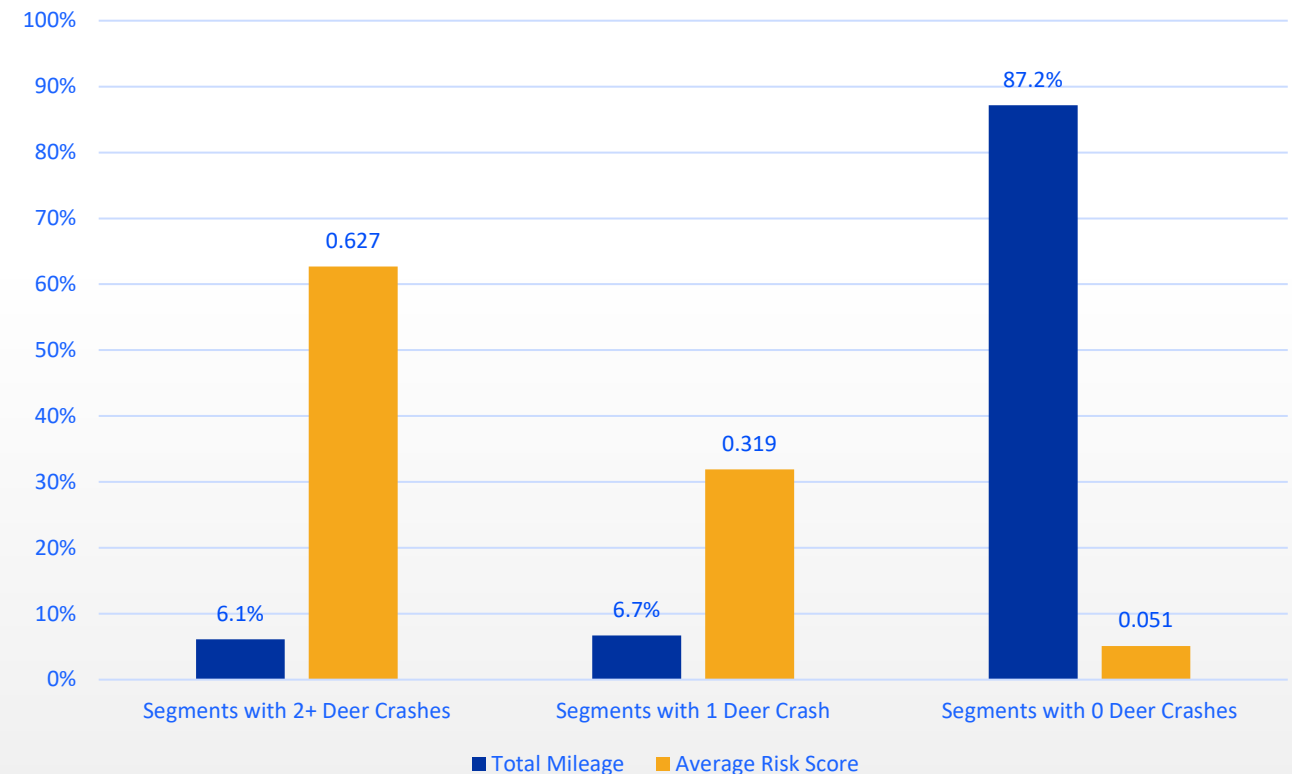
Results: On the Map



Results: By the Numbers

Risk analysis focuses on segments where risk is highest

- Highest 1.4% of deer risk segments covers 19.8% of deer crashes
- Highest 1.7% of bear risk segments covers 49.4% of bear crashes
- Segments with **more crashes** historically have a **higher risk score**





Benefit-Cost Methodology

Benefit-Cost Methodology

Estimated typical crash costs for large mammal crashes

- Based on 2025 VDOT cost analysis
- 10 years of crash data
- Crash costs based on reported crashes:
 - Bear: \$90,213
 - Deer: \$48,158

Table 1. Virginia KABCO Crash Unit Costs (2025)

Severity	Economic Crash Unit Costs	QALY Crash Unit Costs	Comprehensive Crash Costs
K	\$2,404,686	\$14,438,170	\$16,842,856
A	\$181,961	\$803,246	\$985,207
B	\$80,469	\$244,541	\$325,011
C	\$57,257	\$131,343	\$188,599
O	\$17,130	\$0	\$17,130

Source: VDOT Traffic Crash Costs 2025

Benefit-Cost Methodology: Consider Un-reported Crashes

- Of the annual ~60,000 deer-related insurance claims in Virginia 5,000-6,000 are in police crash records
- Carcass removal data reflects this discrepancy (but these records are not available statewide)
- Modified the benefit-cost methodology to account for these crashes

Benefit-Cost Methodology: Consider Un-reported Crashes

- Create “Factored” crashes
 - Based on existing research of insurance claims and carcass removal records
 - Assume 5x as many deer property damage only (PDO) crashes as recorded
 - Assume 3x as many bear PDO crashes as recorded
- Adjust crash costs by animal type:
 - Bear: \$43,763
 - Deer: \$23,760

Total Cost	Deer – Reported	Deer - Factored	Bear - Reported	Bear - Factored
	\$48,158	\$23,760	\$90,213	\$43,763

Benefit-Cost Methodology: Supporting Tool

- Results can be available via interactive map
- Supporting spreadsheet tool:
 - Apply model results from map or historic crashes
 - Use crash cost estimates
 - Determine where countermeasures are cost effective

A	B	C	D	E	F
1	General Information				
2					
3	Analyst:		Clear General Information Reset Worksheet		
4	Agency or Company:				
5	Date (MM/DD/YYYY):				
6	Town/City:				
7	Jurisdiction:				
8					
9	Analysis Inputs				
10					
11	General	Analysis type	Predicted Crashes		
12		Corridor length (miles)	0.50		
13		Crash type	Deer & Bear		
14					
15	Crashes	<u>Factored Annual Crashes</u>			
20		Deer			
21		Bear			
22					
23		Discount rate (%)	7%		
24					
25	Economic Factors	<u>Comprehensive Cost per Crash</u>			
26		Deer	\$23,759.43		
27		Bear	\$43,762.89		
28					
29	Countermeasures	Countermeasure Name			
30		Crash modification factor (CMF)			
31		Countermeasure service life (years)			
32					
33					
34	Results				
35					
36	Benefits	Present value of benefits from countermeasure implementation			
37		Maximum countermeasure cost to yield BCR ≥ 1.0			
38			Calculate Results		

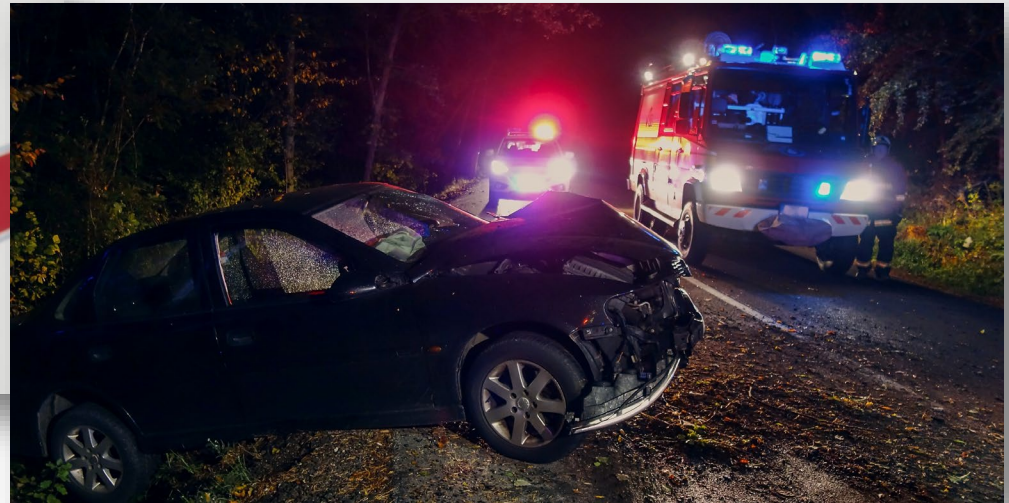
Thank You

Bridget Donaldson | bridget.donaldson@vdot.virginia.gov

Amy Golden | amy.golden@vdot.virginia.gov

Ian Hamilton | ihamilton@vhb.com

Using NEMSIS Data to Surveil and Identify Trends among Motor Vehicle Crashes



Learning Objectives

- Description of National EMS Information System
- Are NEMSIS data accurate and reliable?
- What does NEMSIS data bring to the table?
 - Initial description of injury severity
- Can NEMSIS data trend changes in MVC attributes?

NEMSIS

NEMSIS provides standardized EMS documentation and data collection practices to facilitate the sharing of EMS data with local, state and national organizations.

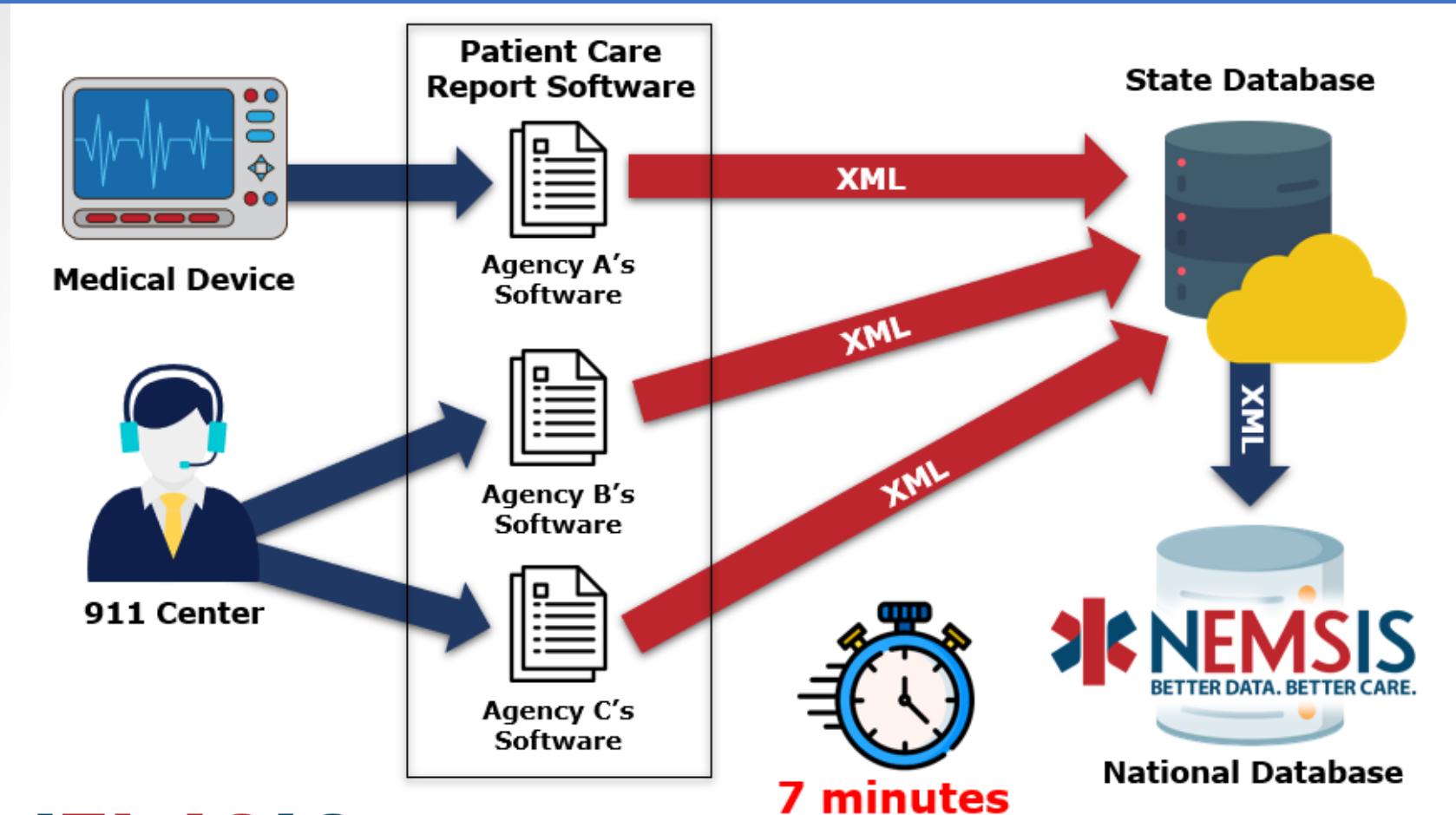


Core Components of NEMSIS

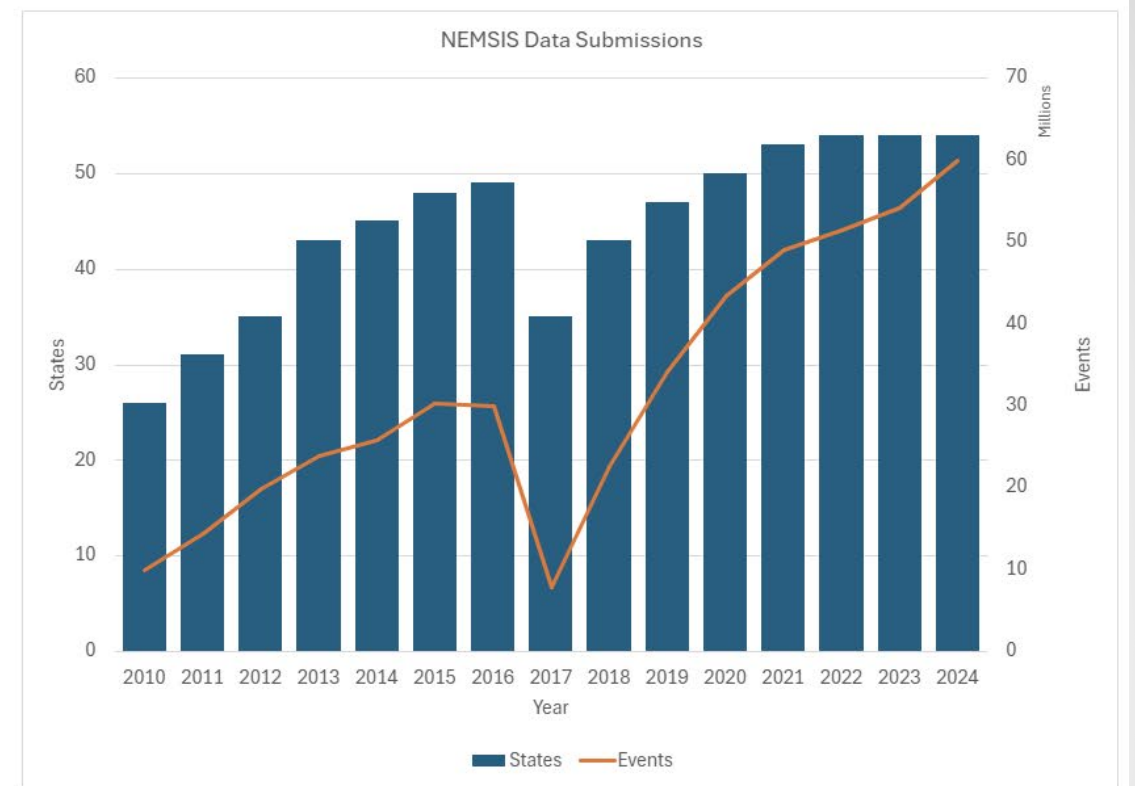
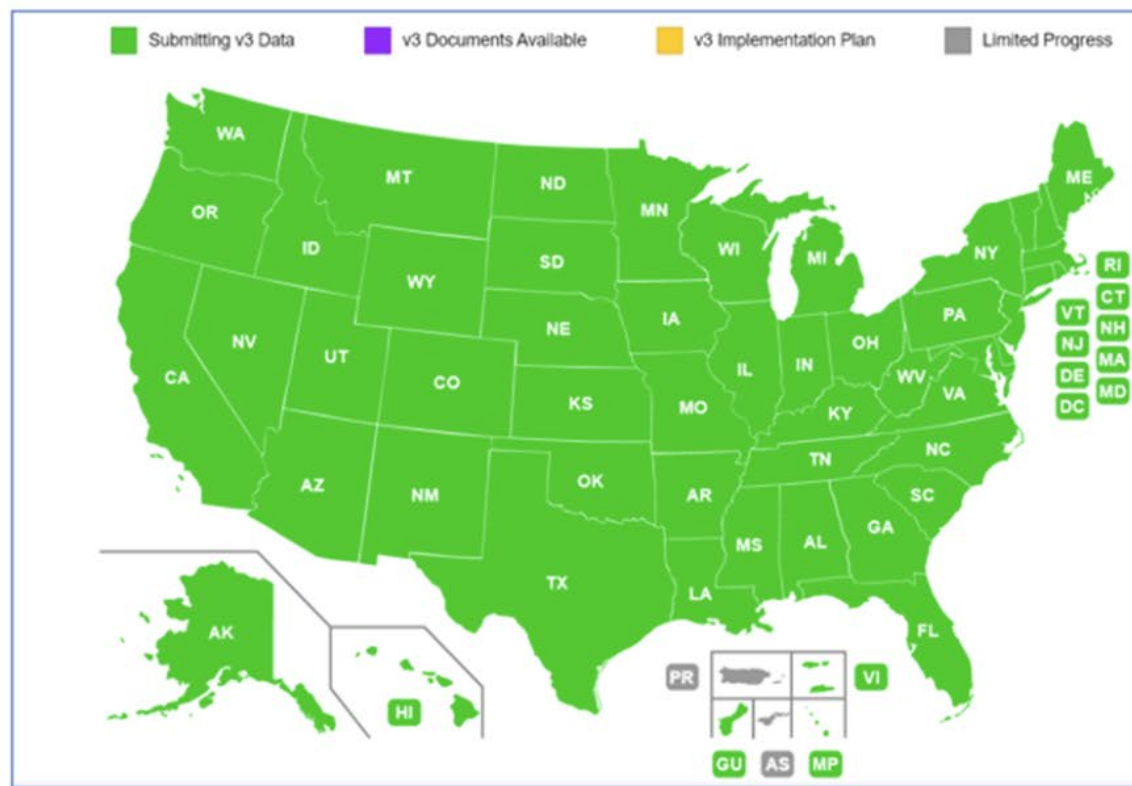
- **Documentation standard** for EMS response and care
- **Data definitions** for point of care data collection
- **Compliance testing** for EMS ePCR software
- **Interoperability** and exchange standards
- National EMS **Database**



The Portability of EMS Data



Participating States/Territories

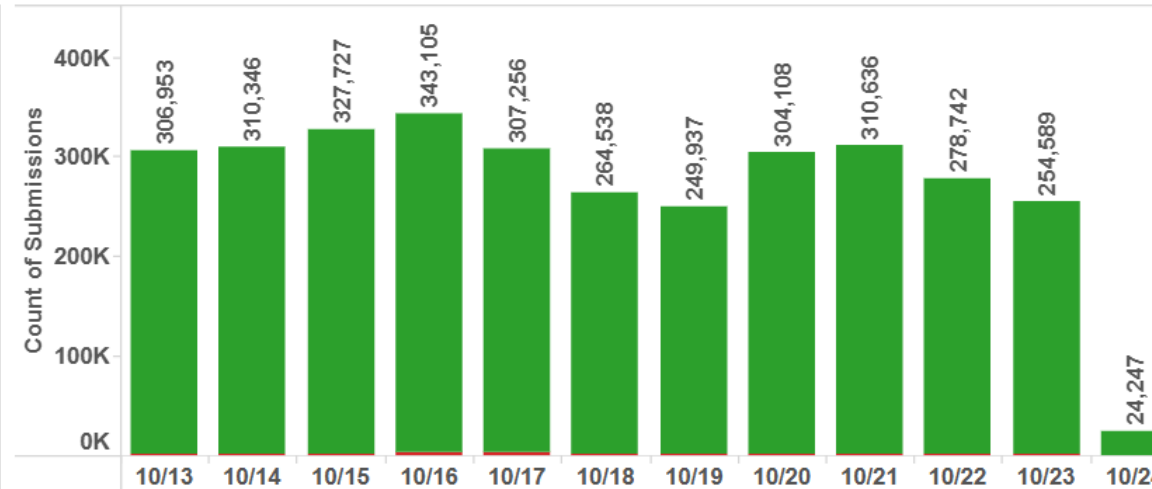


Timeliness of Data

Submissions

Accepted	3,257,615
Rejected	24,569

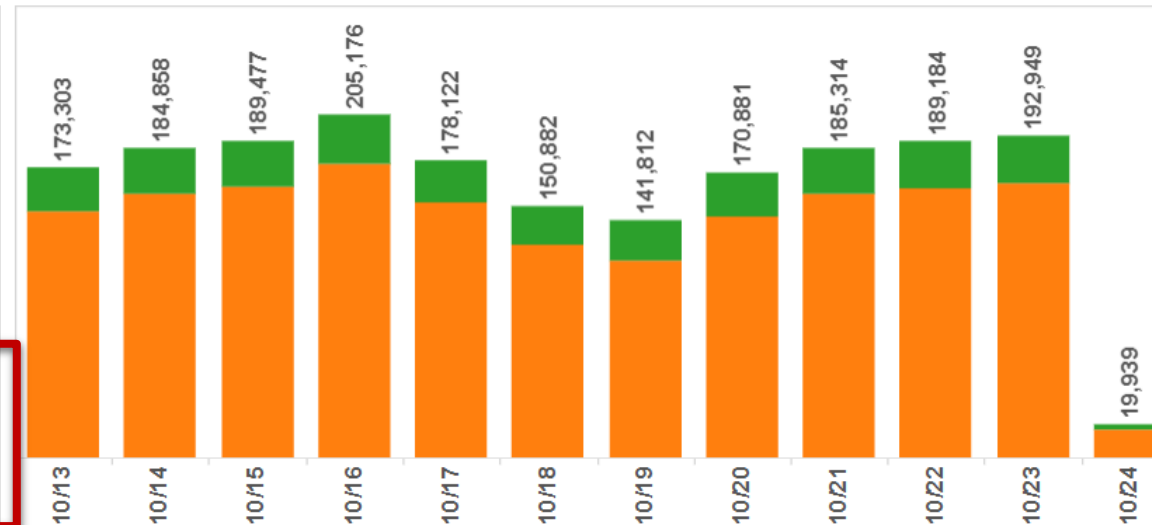
Submissions Accepted vs Rejected



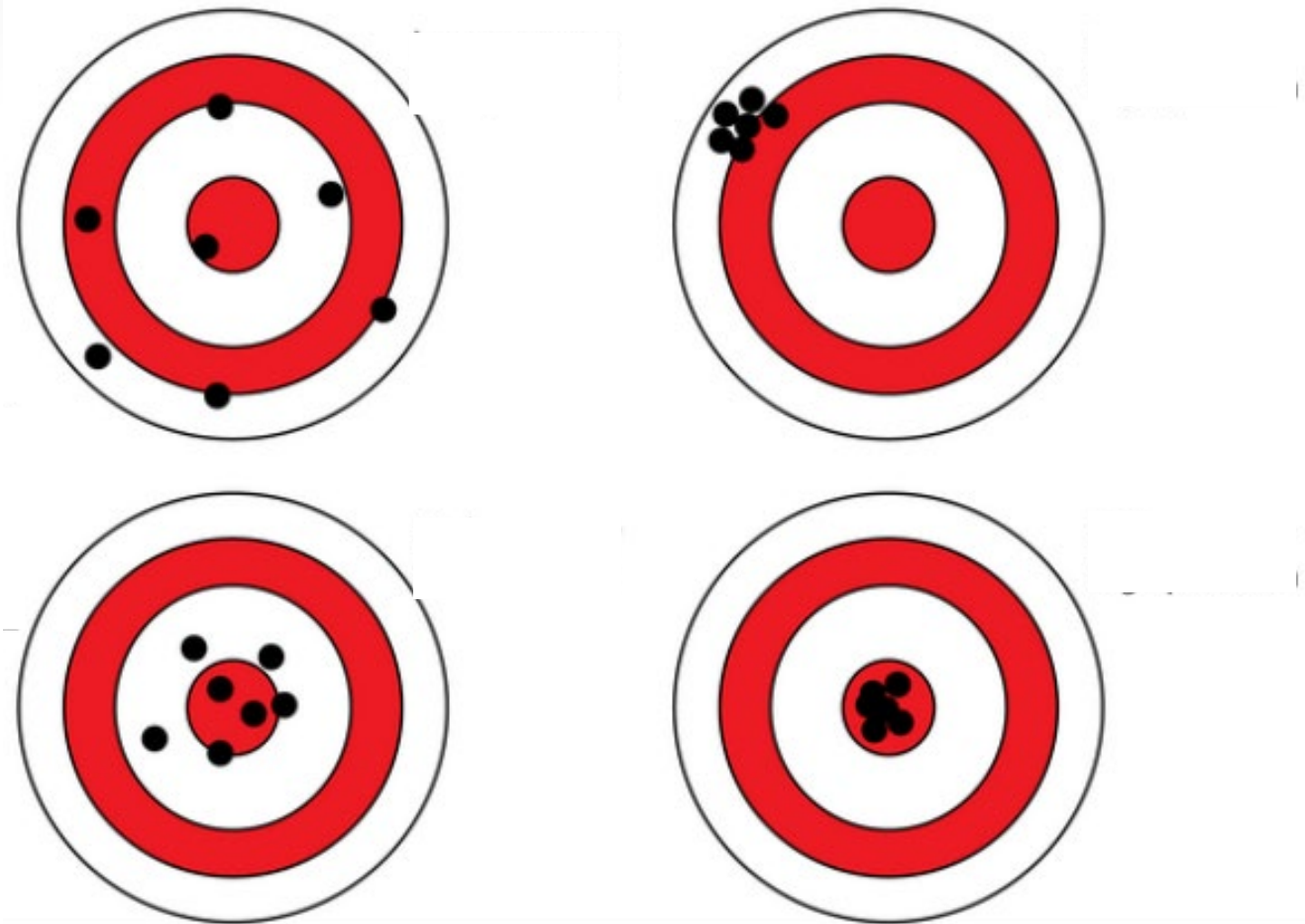
Patient Care Reports (PCR) Processed

Count of Activations	1,981,897
Count of Activations with Warnings	1,685,481
Count of Warnings for all Accepted Activations	5,800,824
Warnings Per Activation	2.9
Average Activations per Accepted File	1.0
Count of PCRs Resubmitted	223,315
Submission Lag 25% (hours)	8.2
Submission Lag 50% (hours)	19.2
Submission Lag 75% (hours)	55.5

PCRs Processed With & Without Schematron Warnings



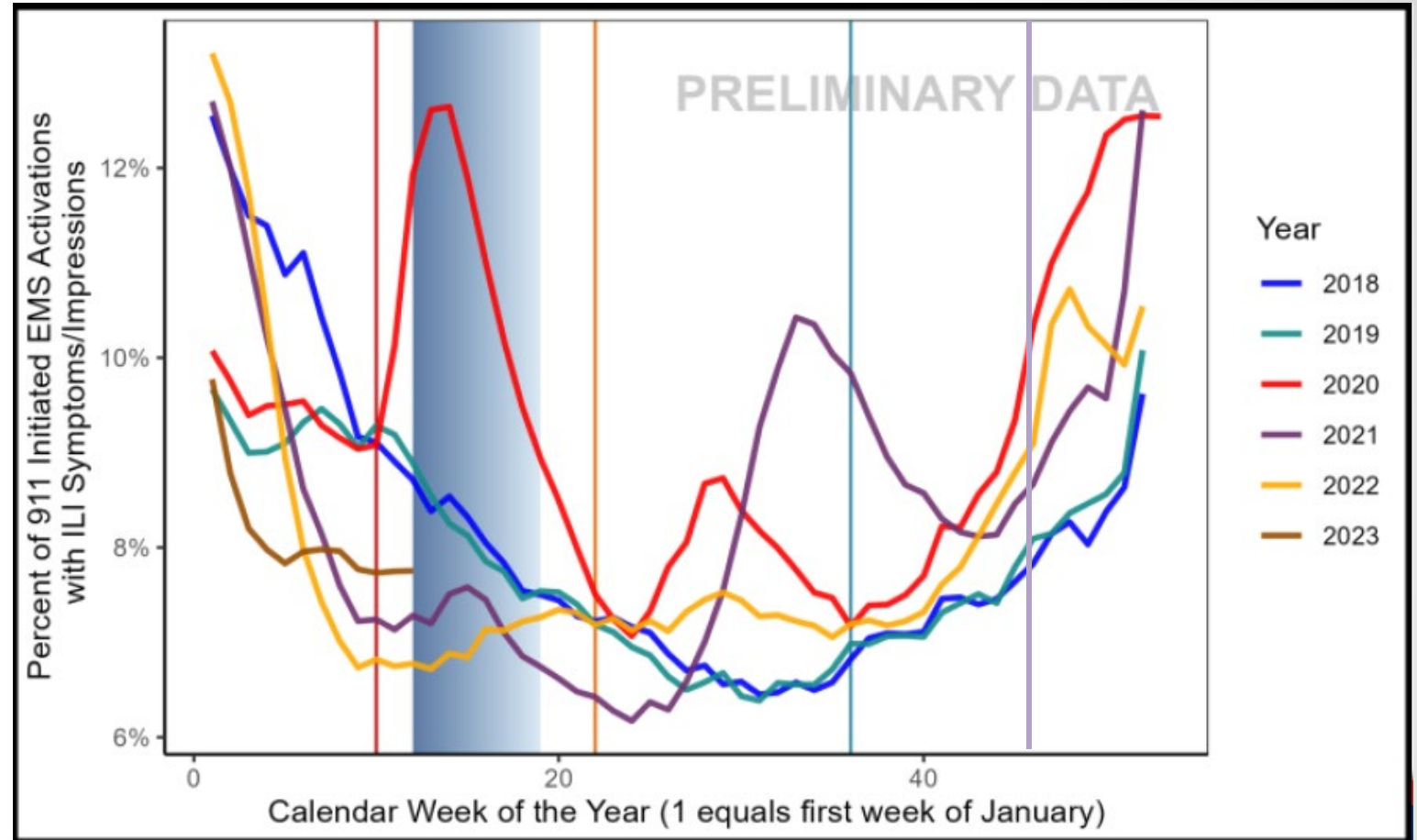
Accuracy and Reliability



EMS Activations for ILI

- CDC announces Community Spread
- States initiate “stay at home” orders
- Memorial Day weekend
- Labor Day weekend
- Thanksgiving weekend

Total sample includes 141,350,987 9-1-1 initiated EMS activations resulting in patient contact

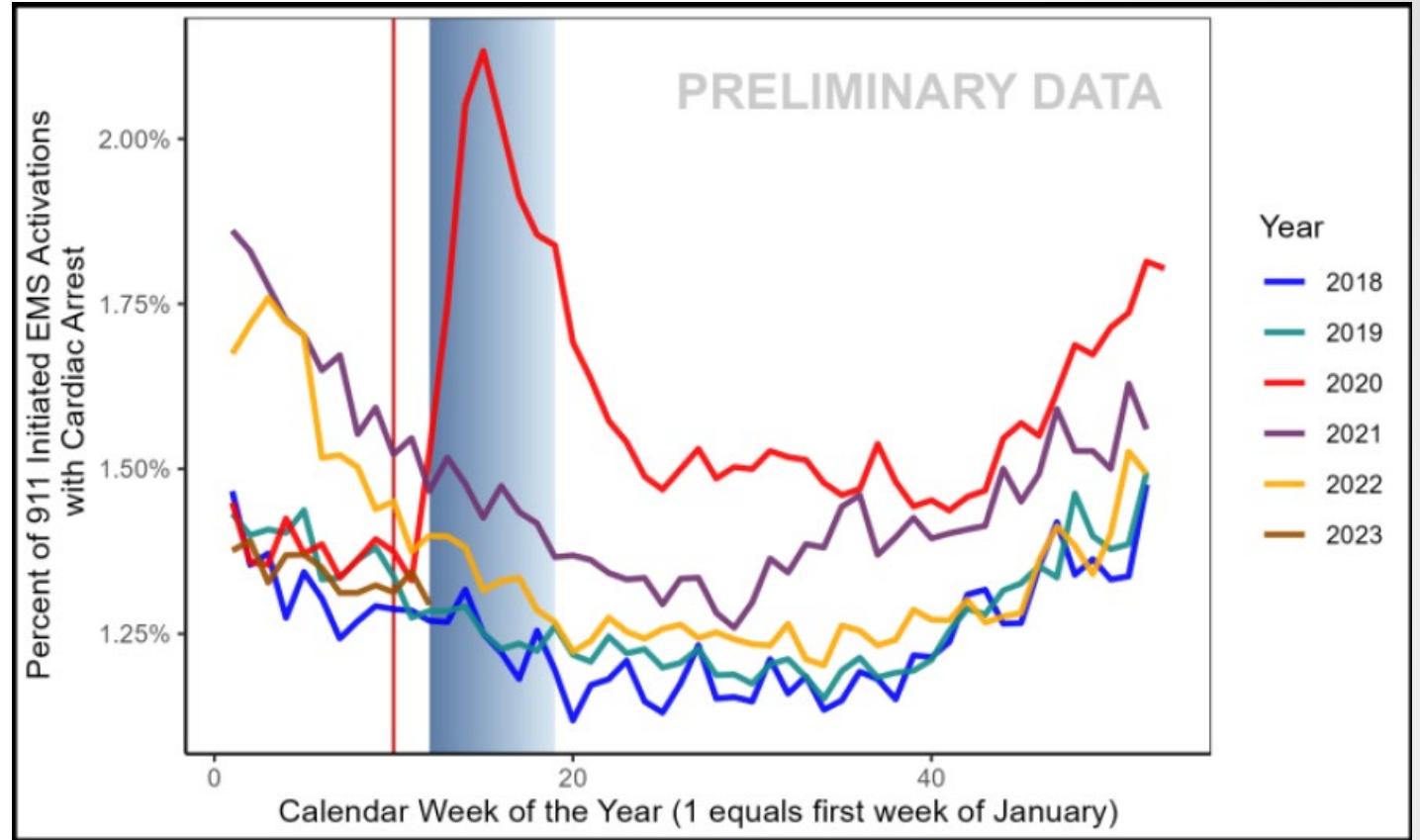


EMS Activations for Cardiac Arrest

- CDC announces Community Spread
- States initiate “stay at home” orders

'Cardiac calls' to 911 in New York City surge, and they may really be more COVID cases

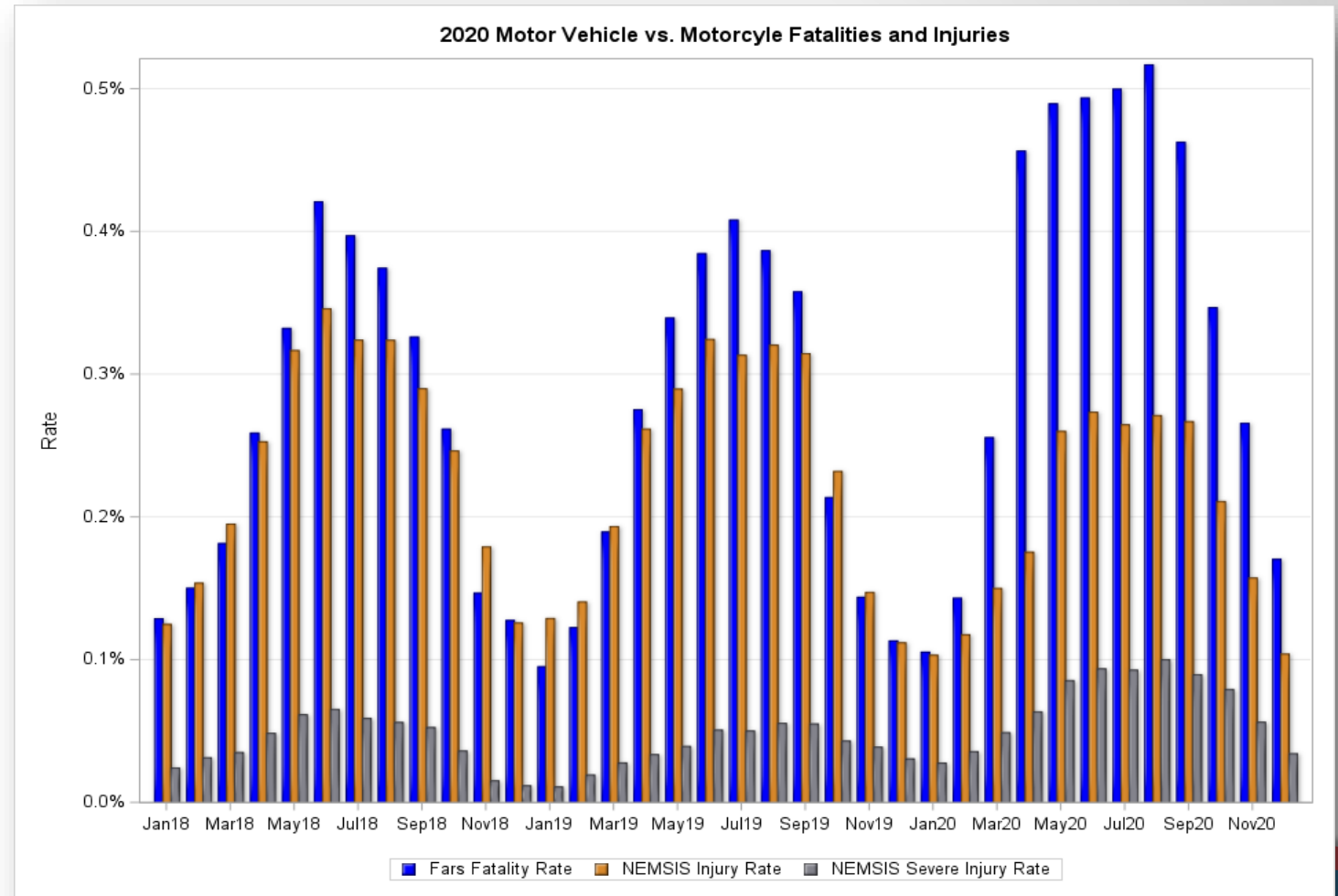
Fire Department data show ambulances are responding to a surge in fatal or near-fatal heart attacks suffered by New Yorkers whose true health issue may be COVID-19.



Comparing Fatalities and Injuries: Motor Vehicle vs. Motorcyclist

The FARS and NEMSIS data have different denominators:

- FARS Data: Total motor-vehicle crashes vs. pedestrian fatalities over population*
- NEMSIS Injury: Total motor-vehicle crashes vs. pedestrian injuries over all MVC activations
- NEMSIS Severe Injury: Total motor-vehicle crashes vs. pedestrian who sustained a severe injury over all MVC activations



Preliminary Data

Data related to MVCs

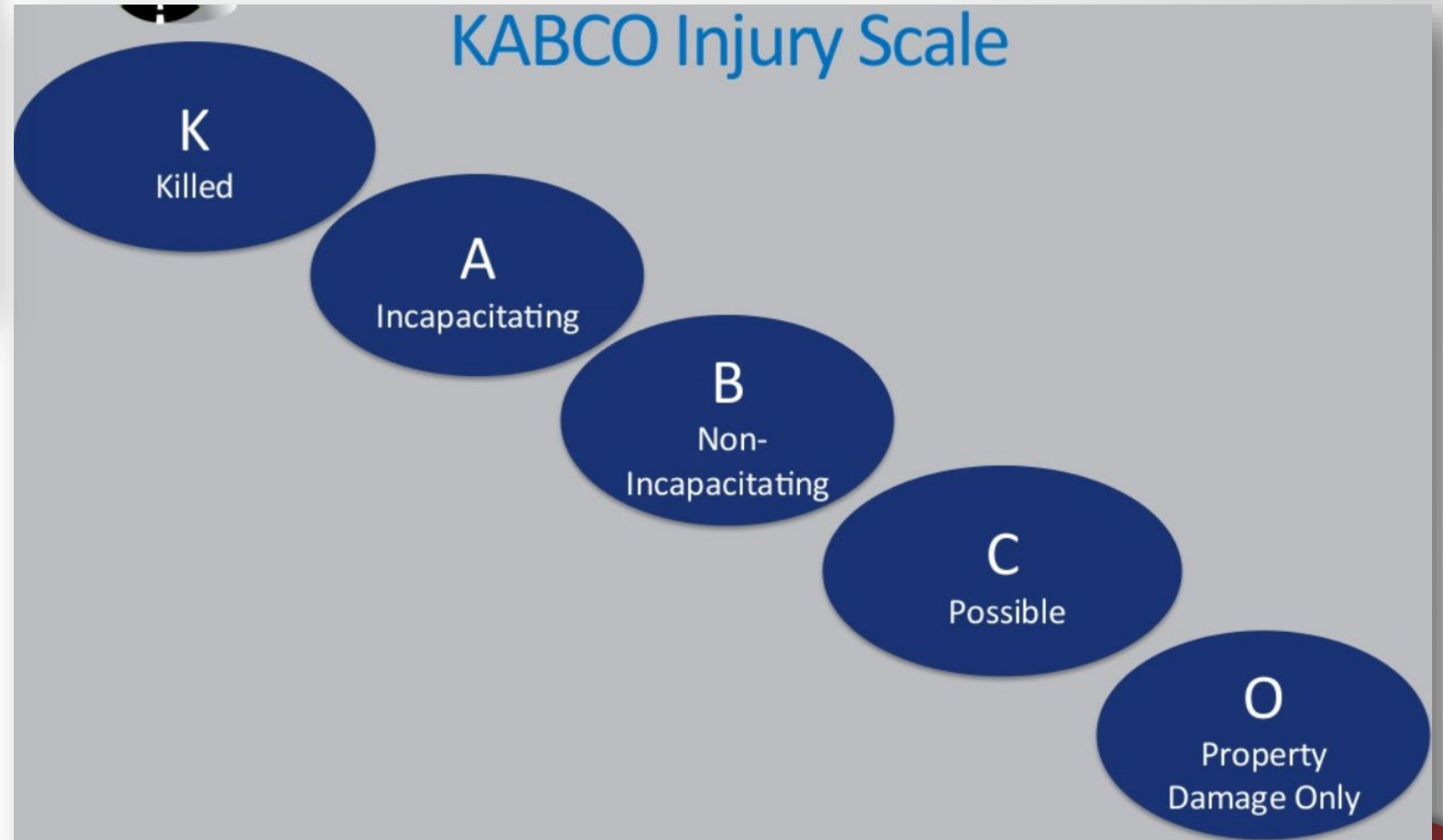
eSituation.11	Provider's Primary Impression
eSituation.13	Initial Patient Acuity
eInjury.02	Mechanism of Injury
eInjury.03	Trauma Triage Criteria (Steps 1 and 2)
eInjury.04	Trauma Triage Criteria (Steps 3 and 4)
Automated crash notification (ACN) data	
eVitals.23	Total Glasgow Coma Score
eVitals.26	Level of Responsiveness (AVPU)
eVitals.33	Revised Trauma Score
eDisposition.19	Final Patient Acuity



Defining Severe Injury

Need for Time-Sensitive Care	Need for Critical Trauma Care	Probability of Patient Survival*
Provider assessment of Final Patient Acuity = "Critical" or "Emergent"	Pre-arrival alert or activation to the receiving facility for trauma	Revised Trauma Score (RTS) translated to probability of survival (POS)
Data element: eDisposition.19-Final Patient Acuity	Data element: eDisposition.24-Destination Team Pre-Arrival Alert or Activation	Based on patient vital signs

Use of KABCO



Alabama	2009 to Present		
	1 Fatal	K	Fatal: This code will be entered if a victim is pronounced dead at the scene or before the report is completed. If not, one of the other codes will apply. However, if a victim dies later as a result of the crash this code will need to be updated according to the following directions. The Department of Public Safety uses a thirty (30) day counting period for traffic fatalities. If a person dies as a result of injuries received in a traffic crash within thirty days of the date of the crash, that victim is conserved to be a traffic fatality, and the victim injury type must be updated to code 1 in this data item.
	2 Incapacitating	A	Incapacitating: This means that the victim must be carried or otherwise helped from the scene. If the victim needs no help, then either a code 3 or 4 applies even though medical assistance may have been administered at the scene.
Alaska	2012 to Present		
	04 – Fatal Injury (killed)	K	Fatal Injury (Killed): A fatal injury is any injury that results in death within 30 days after the motor vehicle crash in which the injury occurred. If the person did not die at the scene but died within 30 days of the motor vehicle crash in which the injury occurred, the injury classification should be changed from the option previously assigned to 04 – Fatal Injury (Killed).
	03 – Suspected Serious Injury	A	Suspected Serious Injury: Is an injury other than fatal which results in one or more of the following: Severe laceration resulting in exposure of underlying tissue/muscle/organs or resulting in significant loss of blood; Broken or distorted extremity (arm or leg); Crush injuries; Suspected skull, chest or abdominal injury other than bruises or minor lacerations; Significant burns (second and third degree burns over 10% or more of the body); Unconsciousness when taken from the crash scene; or Paralysis

Assessing Injury Severity

Scoring systems describing injuries can be classified into:

- **Physiologic** e.g., Glasgow Coma Scale, and Revised Trauma Score.
- **Anatomical** e.g., Abbreviated Injury Scale and the Injury Severity Score
- **Combined** score such as the TRISS method

Revised Trauma Score (RTS)

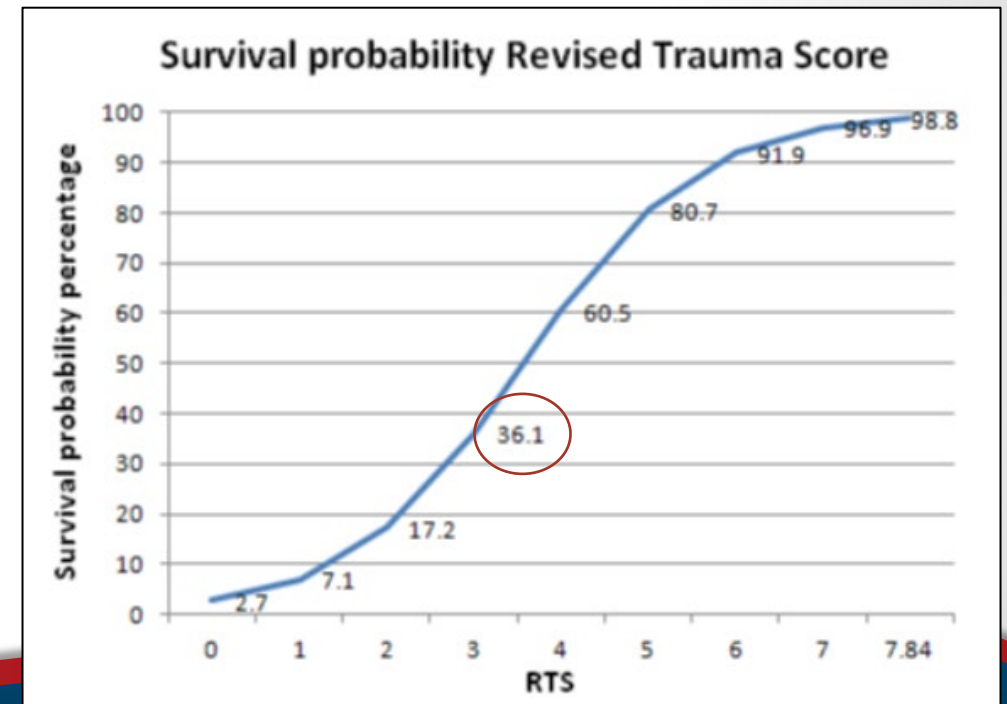
GCS	SBP	RR	Coded Value
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

- + Easier to use
- + Part of TRISS (most widely used)
- Survival basis: MTOS (1990)

Champion HR et al. A Revision of the Trauma Score, J Trauma 29:623-629,1989.



$$\text{RTS} = 0.9368 \text{ GCS} + 0.7326 \text{ SBP} + 0.2908 \text{ RR}$$



Glasgow Coma Score

Glasgow Coma Score (GCS)

- Quantify the level of consciousness following traumatic brain injury.
- Can be adapted for pediatric patients
- The scale (3-15) is the sum of three parameters:

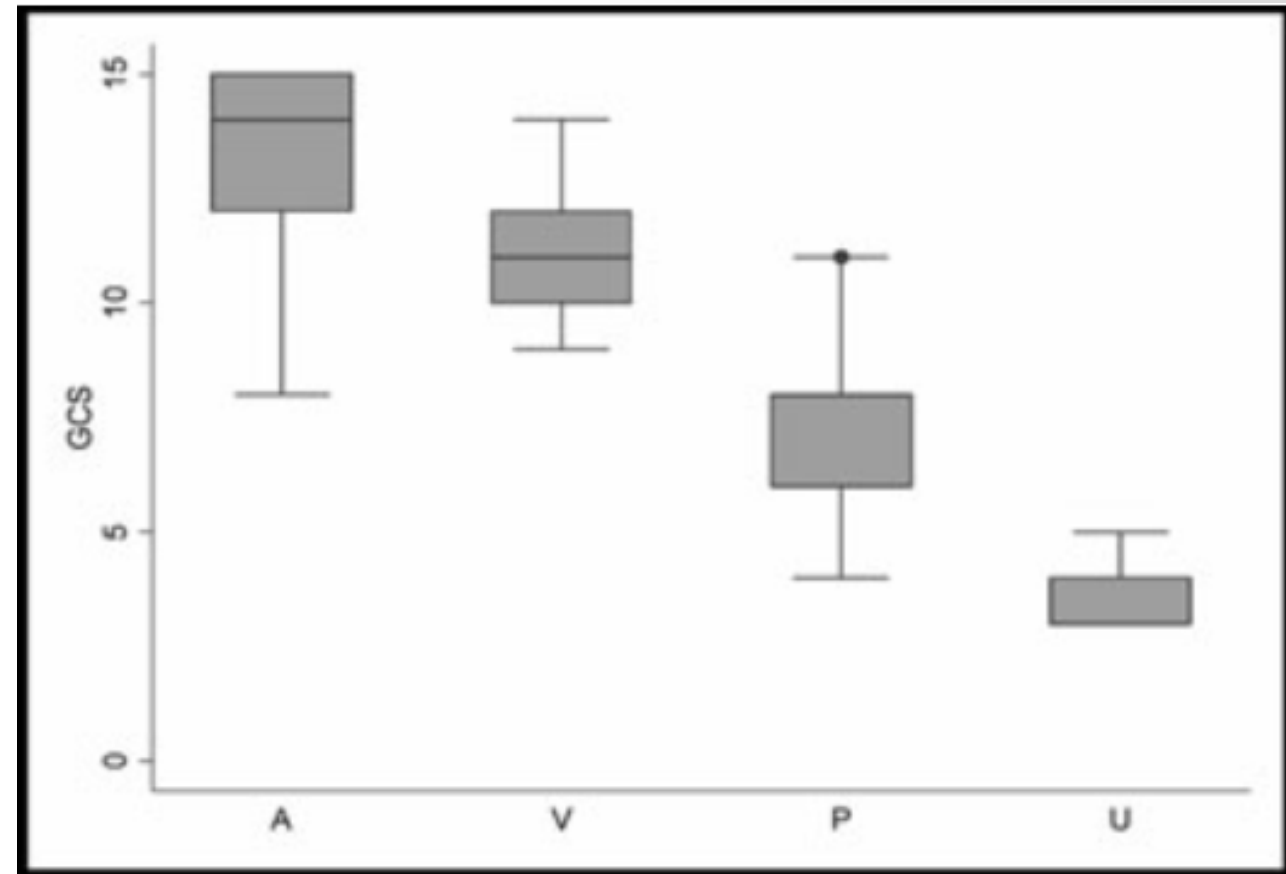
- + Moves well across care services
- + Well maintained
- - Only indicative of “level of consciousness”

Eye Opening (E)	Best Verbal Response (V)	Best Motor Response (M)
4 = Spontaneous	5 = normal conversation	6 = normal
3 = to voice	4 = disoriented	5 = localizes to pain
2 = to pain	3 = incoherent words	4 = withdraws to pain
1 = none	2 = incomprehensible	3 = decorticate (flexion)
	1 = none	2 = decerebrate (extension)
		1 = none

Teasdale G., Jennett B., Lancet (ii) 81-83, 1974.

AVPU

AVPU - GCS	
A	The patient is alert
V	The patient responds to vocal stimulation
P	The patient responds to pain
U	The patient is unresponsive



Severe Injury: Seek Trauma Care

TRAUMA SYSTEMS

National Guidelines for the Field Triage of Injured Patients

National Guideline for the Field Triage of Injured Patients

RED CRITERIA High Risk for Serious Injury

Injury Patterns	Mental Status & Vital Signs
• Penetrating injuries to head, neck, torso, and proximal extremities • Skull deformity, suspected skull fracture • Suspected spinal injury with new motor or sensory loss • Chest wall instability, deformity, or suspected flail chest • Suspected pelvic fracture • Suspected fracture of two or more proximal long bones • Crushed, degloved, mangled, or pulseless extremity • Amputation proximal to wrist or ankle • Active bleeding requiring a tourniquet or wound packing with continuous pressure	All Patients • Unable to follow commands (motor GCS < 6) • RR < 10 or > 29 breaths/min • Respiratory distress or need for respiratory support • Room-air pulse oximetry < 90% Age 0-9 years • SBP < 70mm Hg + (2 x age years) Age 10-64 years • SBP < 90 mmHg or • HR > SBP Age ≥ 65 years • SBP < 110 mmHg or • HR > SBP

Patients meeting any one of the above RED criteria should be transported to the highest-level trauma center available within the geographic constraints of the regional trauma system

YELLOW CRITERIA Moderate Risk for Serious Injury

Mechanism of Injury	EMS Judgment
• High-Risk Auto Crash - Partial or complete ejection - Significant intrusion (including roof) • >12 inches occupant side OR • >18 inches any site OR • Need for extrication for entrapped patient • Death in passenger compartment • Child (Age 0-9) unrestrained or in unsecured child safety seat • Vehicle telemetry data consistent with severe injury • Rider separated from transport vehicle with significant impact (eg, motorcycle, ATV, horse, etc.) • Pedestrian/bicycle rider thrown, run over, or with significant impact • Fall from height > 10 feet (all ages)	Consider risk factors, including: • Low-level falls in young children (age ≤ 5 years) or older adults (age ≥ 65 years) with significant head impact • Anticoagulant use • Suspicion of child abuse • Special, high-resource healthcare needs • Pregnancy > 20 weeks • Burns in conjunction with trauma • Children should be triaged preferentially to pediatric capable centers If concerned, take to a trauma center

CDC/ACS Trauma Triage Criteria

RED CRITERIA

High Risk for Serious Injury

Injury Patterns

- Penetrating injuries to head, neck, torso, and proximal extremities
- Skull deformity, suspected skull fracture
- Suspected spinal injury with new motor or sensory loss
- Chest wall instability, deformity, or suspected flail chest
- Suspected pelvic fracture
- Suspected fracture of two or more proximal long bones
- Crushed, degloved, mangled, or pulseless extremity
- Amputation proximal to wrist or ankle
- Active bleeding requiring a tourniquet or wound packing with continuous pressure

Mental Status & Vital Signs

All Patients

- Unable to follow commands (motor GCS < 6)
- RR < 10 or > 29 breaths/min
- Respiratory distress or need for respiratory support
- Room-air pulse oximetry < 90%

Age 0-9 years

- SBP < 70mm Hg + (2 x age in years)

Age 10-64 years

- SBP < 90 mmHg or
- HR > SBP

Age ≥ 65 years

- SBP < 110 mmHg or
- HR > SBP

Patients meeting any one of the above RED criteria should be transported to the highest-level trauma center available within the geographic constraints of the regional trauma system

CDC/ACS Trauma Triage Criteria

YELLOW CRITERIA

Moderate Risk for Serious Injury

Mechanism of Injury

- High-Risk Auto Crash
 - Partial or complete ejection
 - Significant intrusion (including roof)
 - >12 inches occupant site OR
 - >18 inches any site OR
 - Need for extrication for entrapped patient
 - Death in passenger compartment
 - Child (age 0-9 years) unrestrained or in unsecured child safety seat
 - Vehicle telemetry data consistent with severe injury
- Rider separated from transport vehicle with significant impact (eg, motorcycle, ATV, horse, etc.)
- Pedestrian/bicycle rider thrown, run over, or with significant impact
- Fall from height > 10 feet (all ages)

EMS Judgment

Consider risk factors, including:

- Low-level falls in young children (age ≤ 5 years) or older adults (age ≥ 65 years) with significant head impact
- Anticoagulant use
- Suspicion of child abuse
- Special, high-resource healthcare needs
- Pregnancy > 20 weeks
- Burns in conjunction with trauma
- Children should be triaged preferentially to pediatric capable centers

If concerned, take to a trauma center

Patients meeting any one of the YELLOW CRITERIA WHO DO NOT MEET RED CRITERIA should be preferentially transported to a trauma center, as available within the geographic constraints of the regional trauma system (need not be the highest-level trauma center)

Trend of Motor-Vehicle Crashes Regardless of Injury: 2016-2023

MVC Rate:

All activations with a motor-vehicle crash related injury over all 911 activations with patient contact.*

“Patient” refers to the person involved in the MVC that EMS encounters when dispatched to a crash. Not all patients sustain injuries in an MVC.

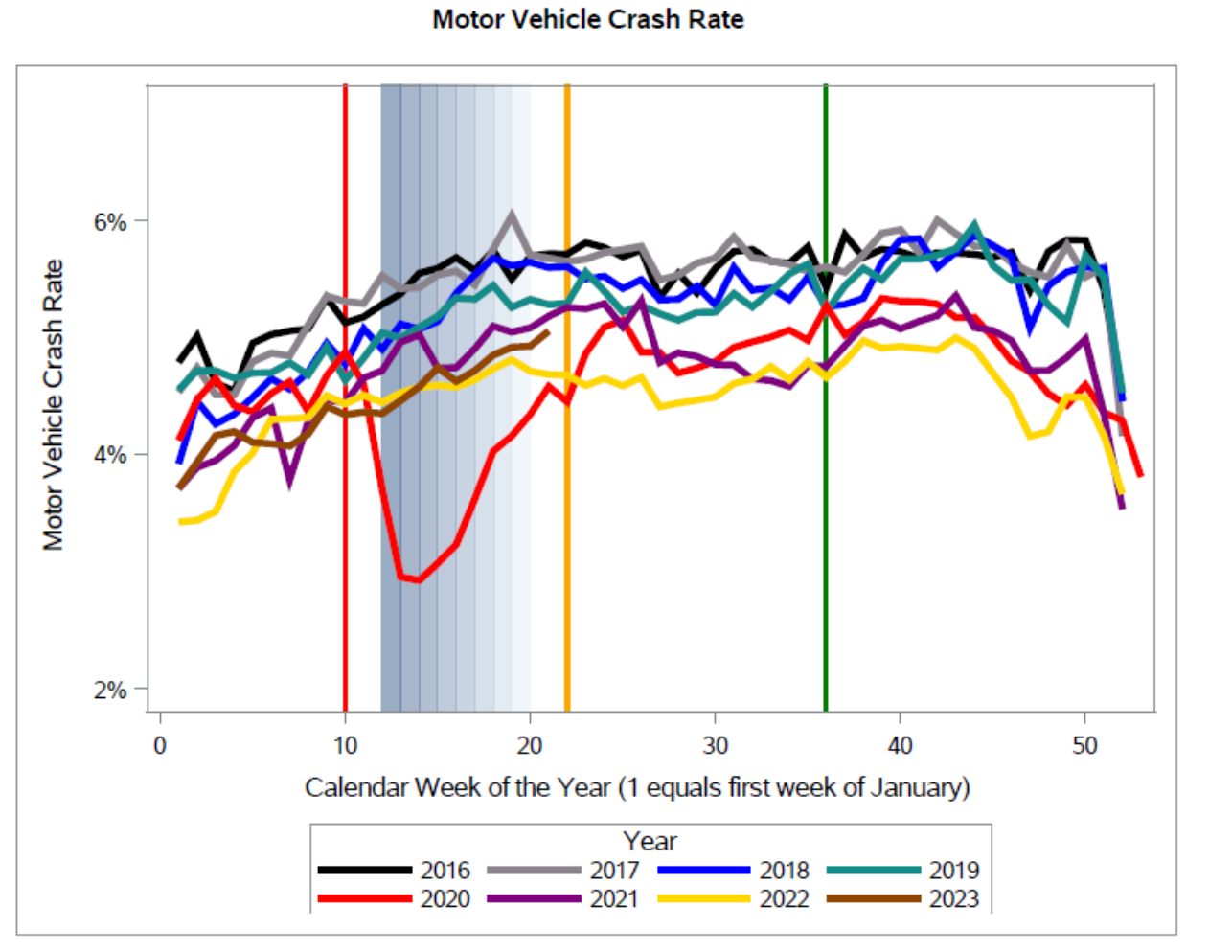
Date Lines

Red: 2020 CDC reports COVID community spread (week 10)

Blue gradient: 2020 States begin initiating Stay-at-Home orders phasing out in Week 19 (weeks 12-19)

Orange: Memorial Day (week 22)

Green: Labor Day (week 36)



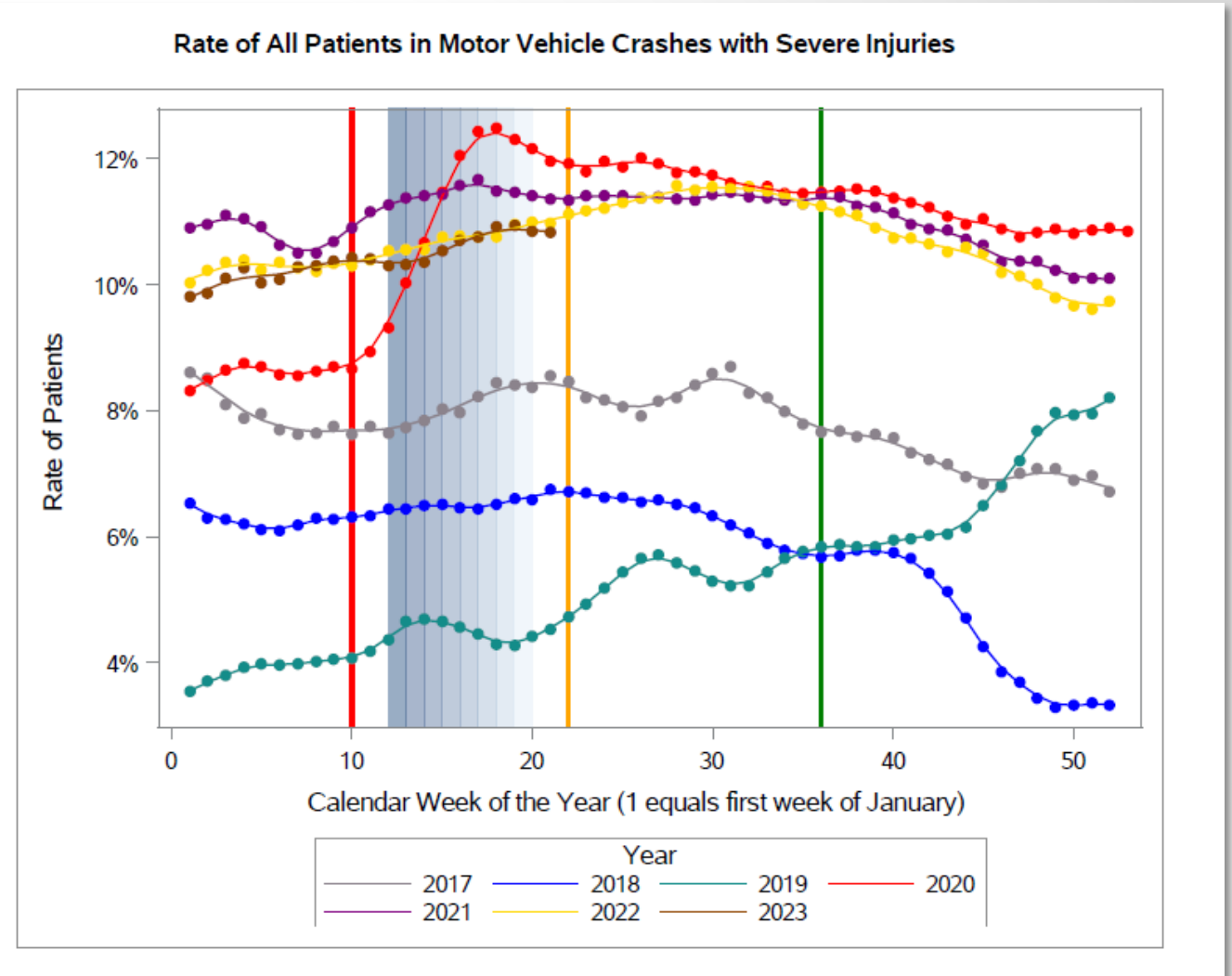
MVC Severely Injured Patients

- “Severe injuries” are assessed using measures for patient acuity, trauma team activation (pre-alert), and probability of survival (POS).*
- Severe injuries increased with the onset of the COVID-19 pandemic.

Some trends have a LOESS (locally estimated scatterplot smoothing) curve applied to a 5 week moving average.

EMS trends that are more infrequent are illustrated using this process as it smooths the “sawtooth” impact of fewer or sporadic activations helping to better communicate the trend of activations.

Each dot is the weekly data point.

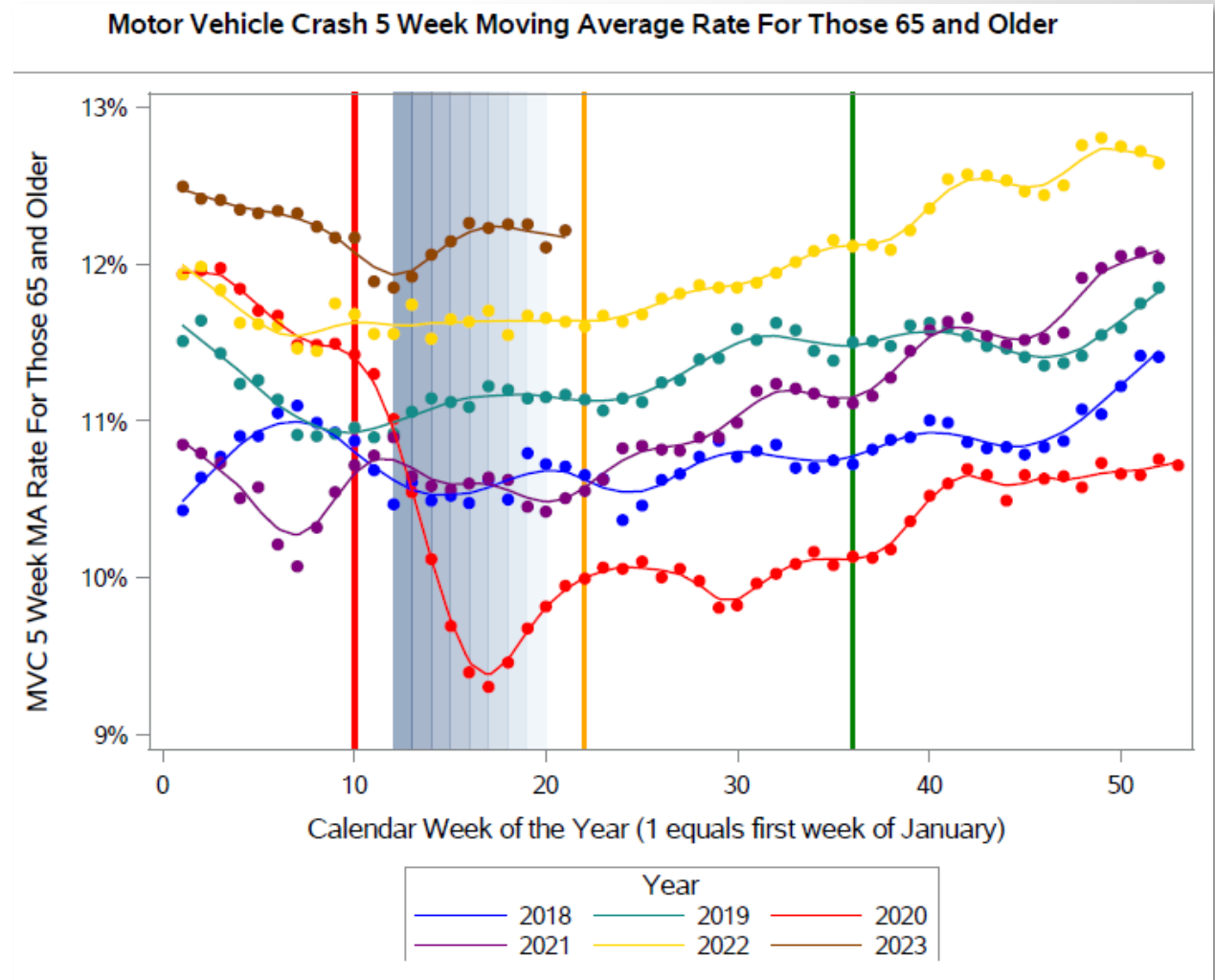


Preliminary Data

*See Appendix D: Calculation for Injury Severity.

How Often are Older Adults Injured in an MVC?

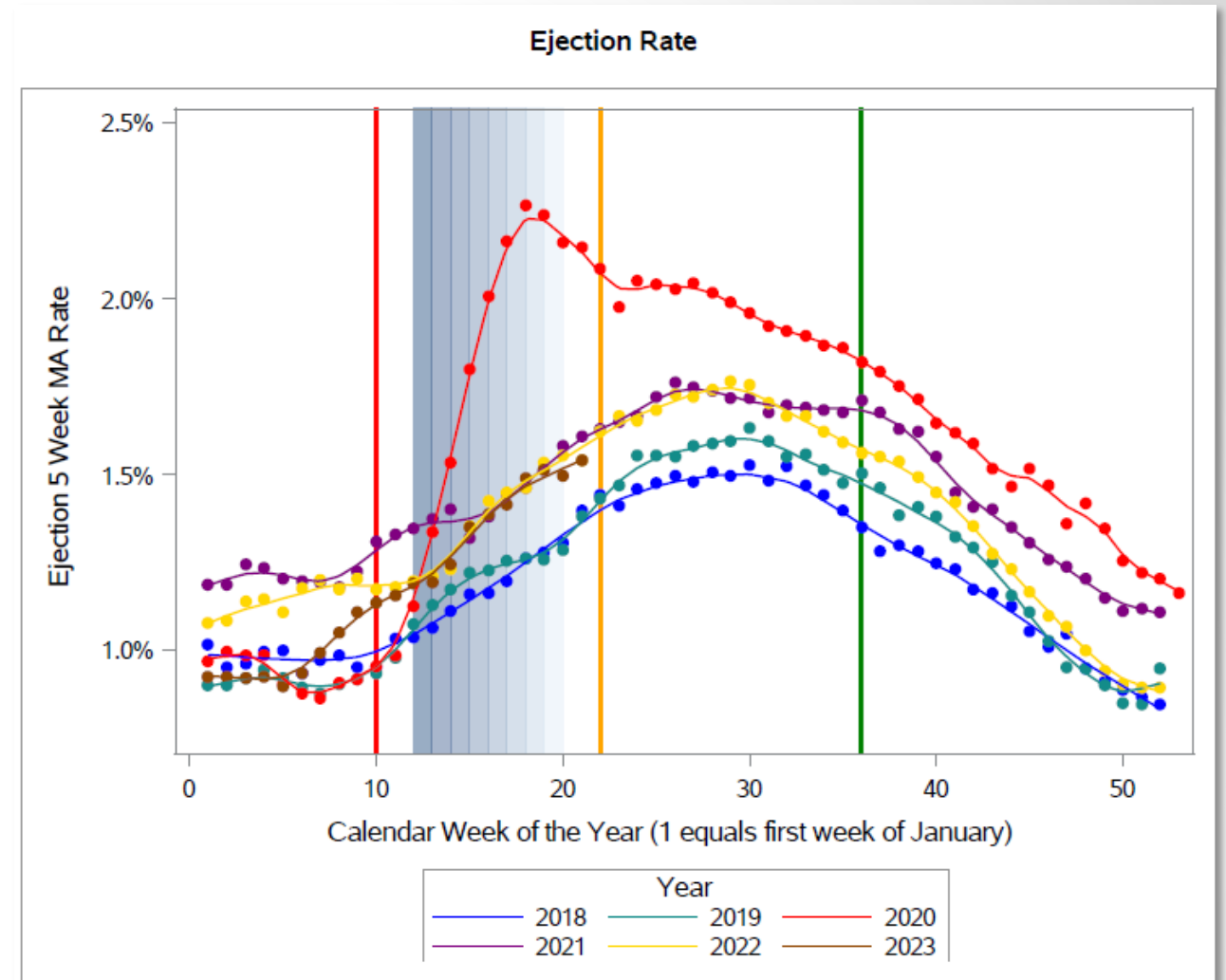
Trend lines represent patients 65 years and older who sustained an MVC-related injury.



Preliminary Data

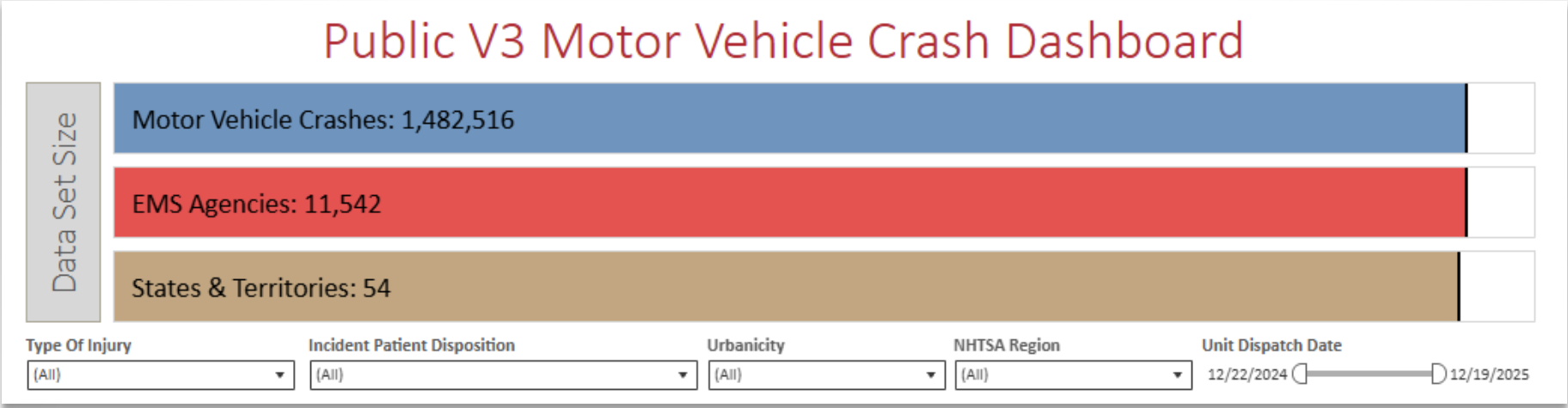
How Often are Patients Ejected From the Vehicle During an MVC?

- The rate represented are patients with an injury risk factor of “crash ejection from automobile”.*
- This is not a rate of crashes. This is a **rate of activations** in which EMS encountered a patient who was ejected from a vehicle during a crash. Crashes can have multiple patients, each one with a unique ePCR.



Preliminary Data

NEMSIS MVC Dashboards



Survival Probability based on (Revised Trauma Score)

2.7% (0)	7.1% (1)	17.25% (2)	36.1% (3)	60.5% (4)	80.7% (5)	91.9% (6)	96.9% (7)	98.8% (7.84)
6,773	1,268	1,813	4,963	14,289	15,502	35,187	50,242	2,804,810
0.23%	0.04%	0.06%	0.17%	0.49%	0.53%	1.20%	1.71%	95.58%

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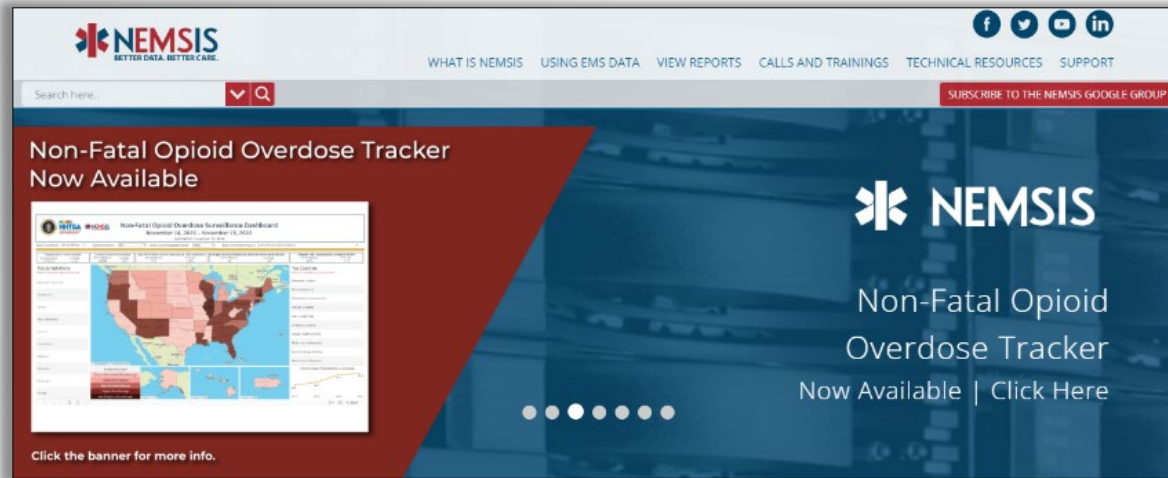
LinkedIn: <https://www.linkedin.com/company/nemsis>



YouTube: <https://www.youtube.com/c/NEMSISTAC>



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[NEMESIS.org](https://nemsis.org)

Help Desk

<https://nemsis.atlassian.net/servicedesk/customer/portals>

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