



Post-Crash Care: EMS Response to MVC-Related Injuries

June 2022
NEMSIS Technical Assistance Center



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NHTSA Office of EMS

Improving patient care and field clinician safety in the out-of-hospital setting by:

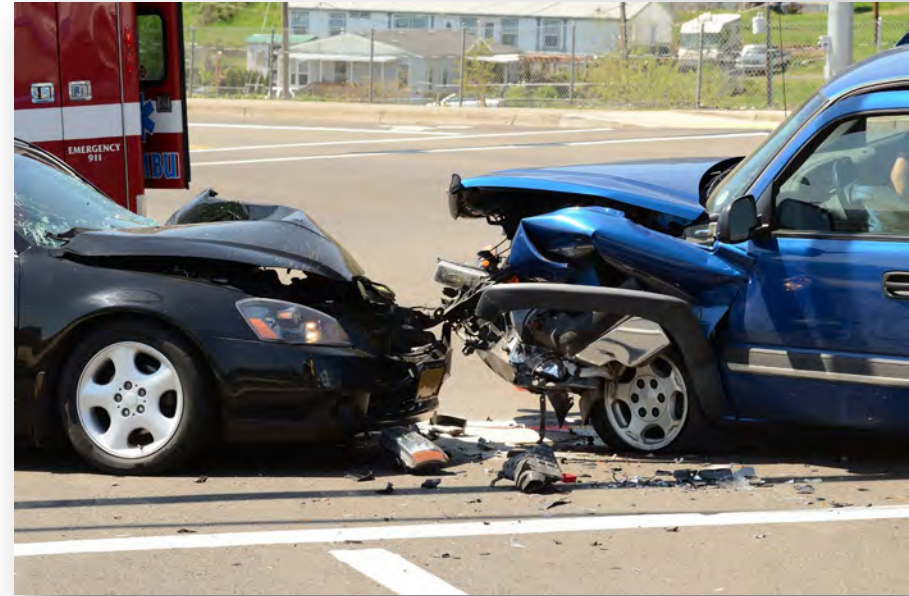
1. Bringing together available data and industry experts to identify the most critical issues facing the profession,
2. Tackling those issues through collaboration with partners, including other federal agencies and leading associations, and
3. Providing awareness and education about best practices and evidence-based guidelines.



National Roadway Safety Strategy

The National Roadway Safety Strategy (NRSS) focuses on five key objectives:

1. Safer People.
2. Safer Roads.
3. Safer Vehicles.
4. Safer Speeds.
5. Post-Crash Care.



Between 2011-2020, over **370,000** people died in transportation incidents in the U.S. More than **94%** of them died on our roads.

<https://www.transportation.gov/NRSS>

National Roadway Safety Strategy

United States Department of Transportation | January 2022



Safe System Approach

The Safe System Approach (SSA) of the NRSS emphasizes preventing fatalities and serious injuries.

Key Principles:

1. Death and serious injury are unacceptable.
2. Humans make mistakes.
3. Humans are vulnerable.
4. Responsibility is shared.
5. Safety is proactive.
6. Redundancy is crucial.

“We must strive for zero roadway fatalities and severe injuries - no other number is acceptable.”

- U.S. Secretary of Transportation,
Pete Buttigieg



Post-Crash Care Facts

200 Million

Over 5,300 public safety answering points answer 200 million requests for emergency assistance annually¹



Deaths rates increase by 3% for every minute first responders are delayed³

12,000

EMS agencies responded to 1,436,763 motor vehicle crashes in 2021²

10,660

patients were severely injured in motor vehicle crashes in 2021²



CONTACT INFO
<https://www.nhtsa.gov/>
<https://nemsis.org/>



SOURCES

- 1 National Highway Traffic Safety Administration (NHTSA) National 911 Progress Report: 2020 Data
- 2 National EMS Information System (NEMSIS)
- 3 James Byrne, MD, PhD, Association Between Emergency Medical Service Response Time and Motor Vehicle Crash Mortality in the United States <https://doi.org/10.1001/jamasurg.2018.5097>
- 4 NHTSA Fatality Analysis Reporting System (FARS)

Post-Crash Care Facts

2 out of 5

crash victims were alive when first responders arrived, but later died⁴

10%

For every crash death, there are another 10% who suffer a severe or debilitating injury²

3%

First responders only learn 3% of crash victim outcomes²



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<https://nemsis.org/>



SOURCES

- 1 National Highway Traffic Safety Administration (NHTSA) National 911 Progress Report: 2020 Data
- 2 National EMS Information System (NEMSIS)
- 3 James Byrne, MD, PhD, Association Between Emergency Medical Service Response Time and Motor Vehicle Crash Mortality in the United States <https://doi.org/10.1001/jamasurg.2018.5097>
- 4 NHTSA Fatality Analysis Reporting System (FARS)



Key NHTSA Actions for Post-Crash Care

- EMS on-scene safety.
- Traffic Incident Management training and technologies.
- Expand the use of and support for NEMSIS.
- Improve the delivery of EMS throughout the nation.



Report Considerations

- Date Range: January 2018 to present day
- All data is from the National EMS Data Repository (NEMSIS)
 - Exception is FARS Comparison slides
- Rate is used instead of count due to the variation in submitting states/agencies over the years
- This is preliminary data. For research data that is reproducible, use the Public-Release Research Dataset provided annually.

Please see the Appendices for specific parameters, inclusion, and descriptions.



NEMSIS Dataset Counts

EMS data are voluntarily submitted by states/territories wishing to participate in the National EMS Data Repository. Not all states collect nor submit **all** EMS activations that occur in their state/territory.

Year	Total Annual Count of 911 Records Reported to NEMSIS	Total Annual Count of MVC-Related Records	Reporting States/Territories
2016	19,021,555	1,041,314	49
2017	8,021,832	441,623	35
2018	16,953,577	896,693	43
2019	22,945,698	1,202,904	47
2020	28,547,098	1,313,017	50
2021	31,405,223	1,497,179	52
2022	16,015,554*	699,711*	53

*Will increase each month.

Preliminary Data

For additional information regarding which states/territories submitted data each year, see the Research User Guide here: <https://nemsis.org/using-ems-data/request-research-data/research-data-resources/>.



Trend of Motor-Vehicle Crashes Regardless of Injury: 2016-2022

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.

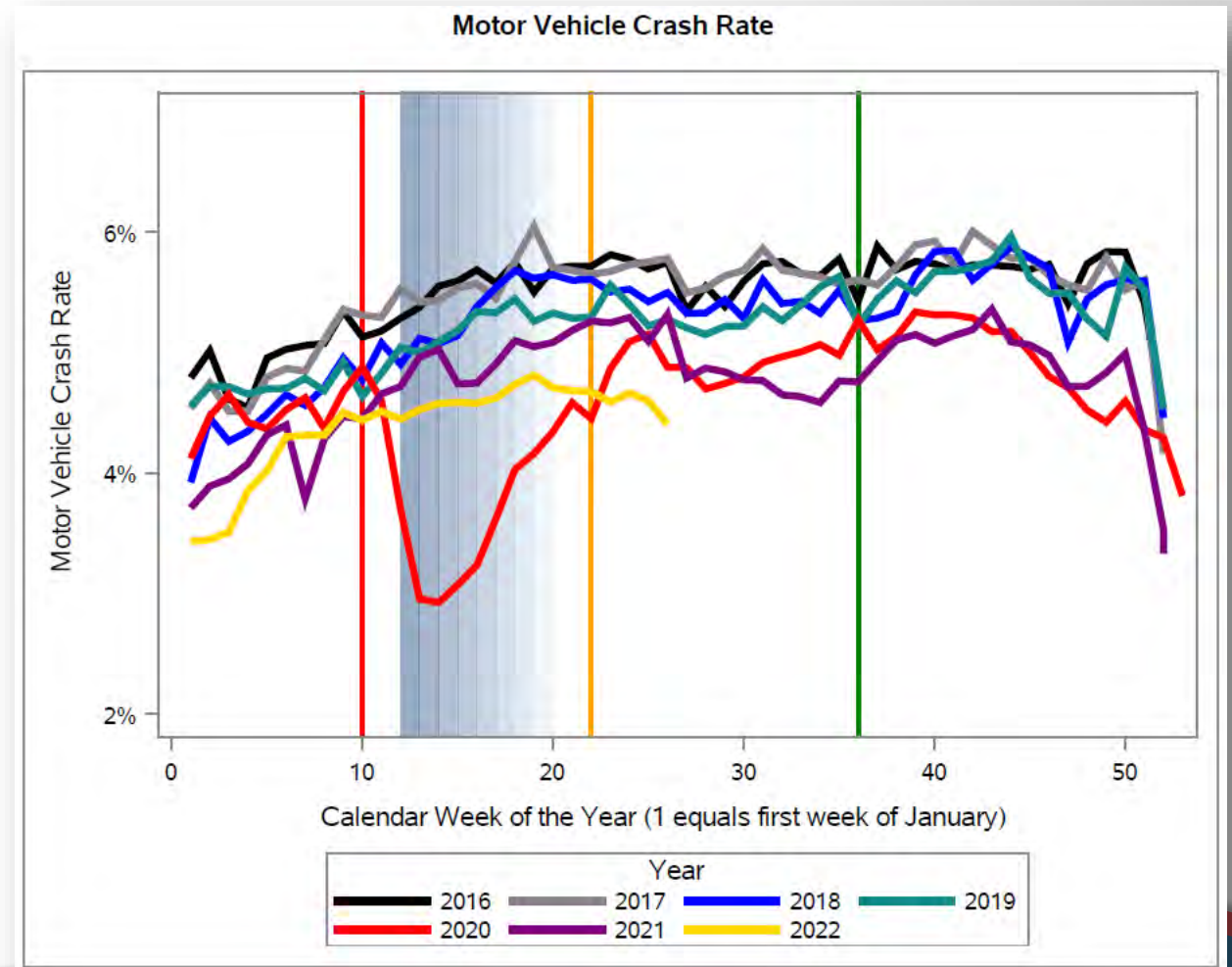
Date Lines

Orange: 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)

Yellow: Memorial Day (week 22)

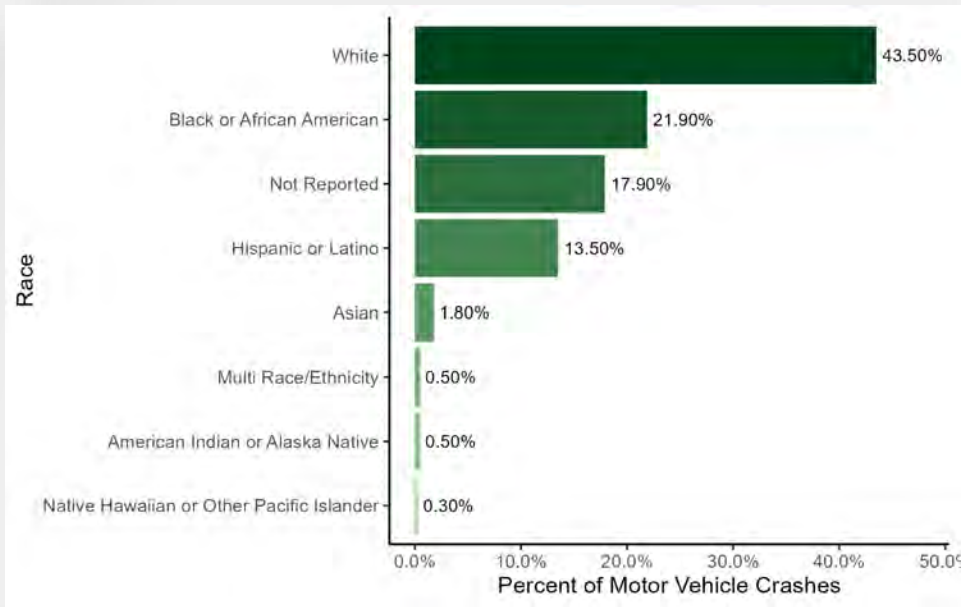
Green: Labor Day (week 36)



*Motor-vehicle crashes may generate multiple activations, patient encounters, and ePCRs. See Appendix B: Definitions/Descriptions.

MVC Patient Demographics

- Date Range: Aggregated for 2018 – 2022.
- Includes all types of MVC-related injuries.
- Race is entered into the patient care report (ePCR) by the clinician in the field. They can select as many descriptors as needed.
- Click here to access the [Public Motor Vehicle Crash Dashboard](#).



Age Range	Female	Male
0-4 Years	0.20%	0.20%
5-9 Years	0.00%	0.00%
10-14 Years	3.30%	3.40%
15-19 Years	5.10%	4.70%
20-24 Years	6.20%	6.00%
25-29 Years	5.30%	5.50%
30-34 Years	4.50%	4.90%
35-39 Years	3.80%	4.10%
40-44 Years	3.30%	3.50%
45-49 Years	3.10%	3.20%
50-54 Years	3.10%	3.30%

55-59 Years	3.00%	3.30%
60-64 Years	2.50%	2.70%
65-69 Years	1.90%	1.90%
70-74 Years	1.50%	1.40%
75-79 Years	1.00%	0.90%
80-84 Years	0.60%	0.60%
85-89 Years	0.30%	0.30%
90-94 Years	0.10%	0.10%
95-99 Years	0.00%	0.00%
100+ Years	0.00%	0.00%
Unknown	0.20%	0.20%

Defining Severe Injury

Distinguishing “severe injury” from all injuries provides perspective regarding the national burden of injury. Severe injury may be identified in EMS data in different ways.

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

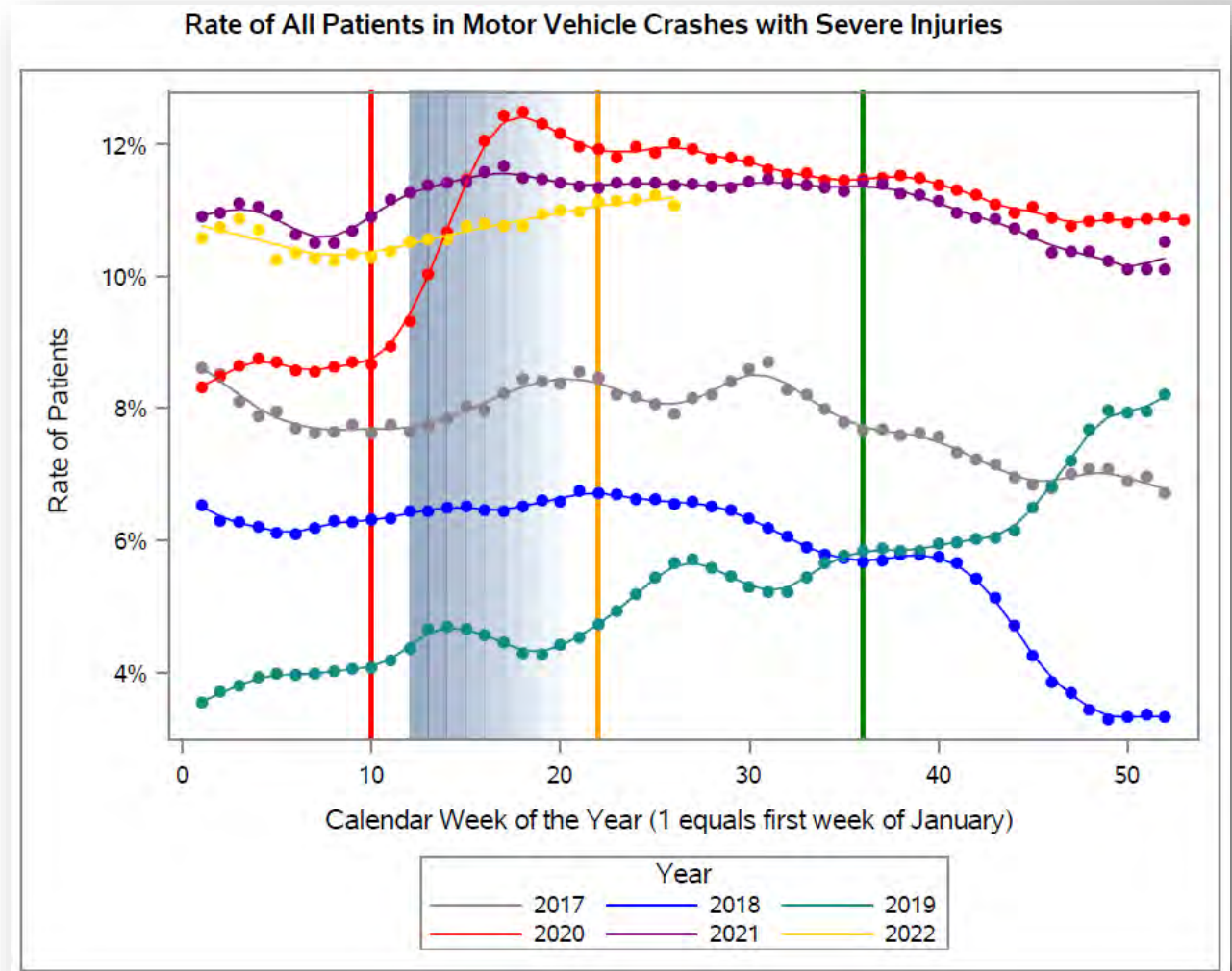
MVC Severely Injured Patients

- “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.

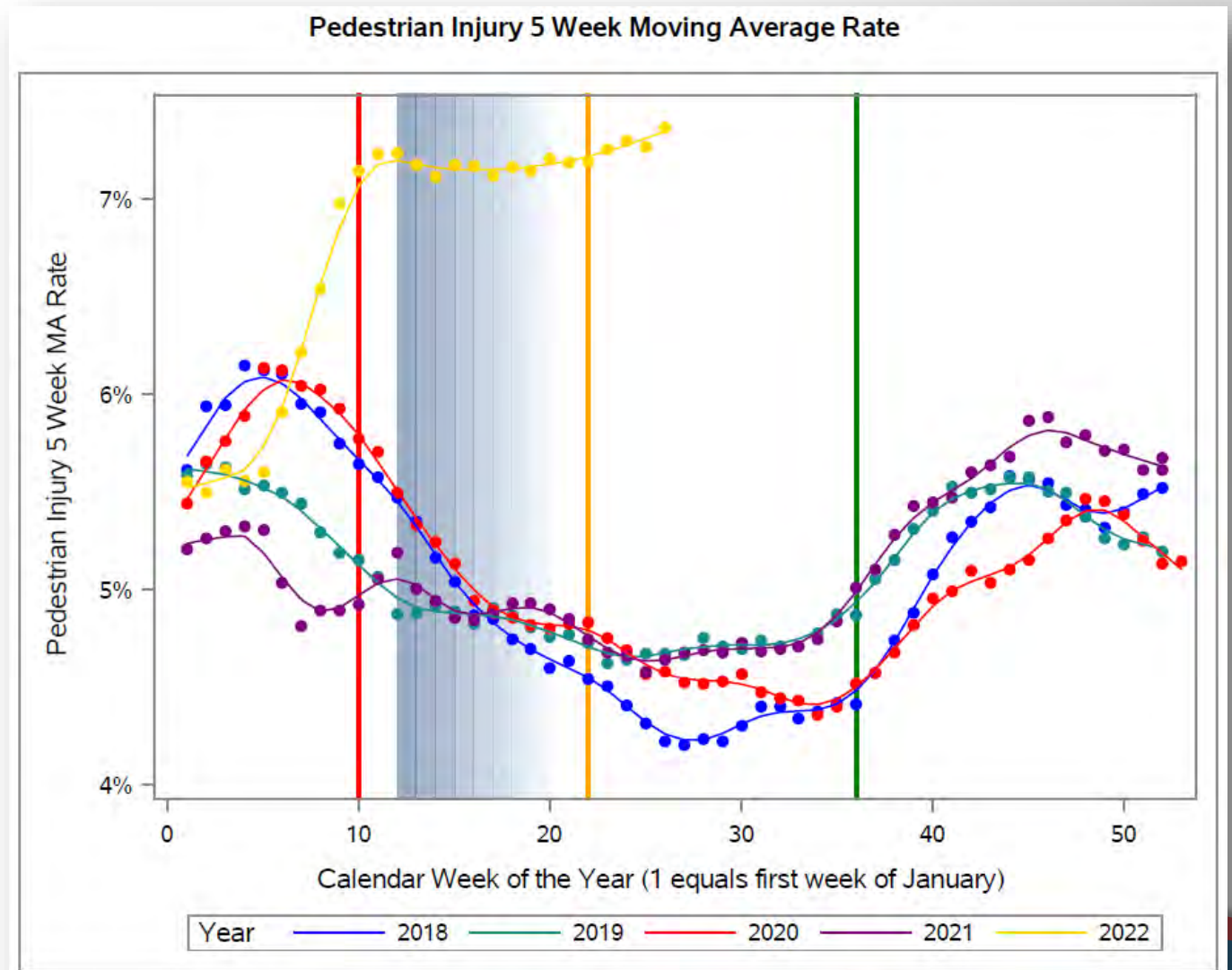
EMS trends that are more infrequent are illustrated using this process as it smooths the “sawtooth” impact of fewer or sporadic activations helping to better communicate the trend of activations.

Each dot is the weekly data point.



How Often are Pedestrians Injured in an MVC?

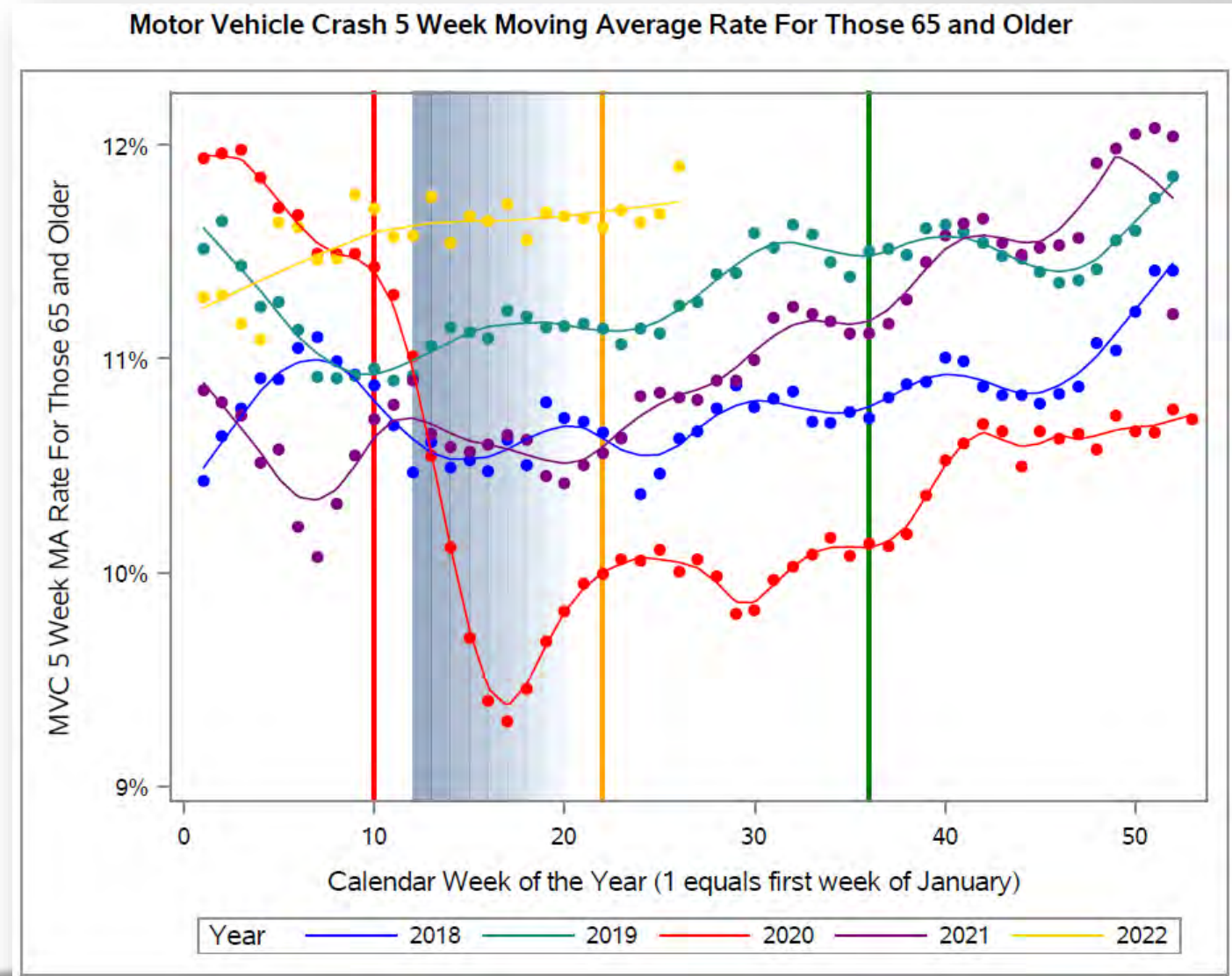
MVC vs. pedestrian injuries are identified by the cause(s) of injury entered into the electronic patient care report (ePCR) by the EMS field clinician which include ICD-10-CM Codes V00-V09: Pedestrian injured in transport accident.



Preliminary Data

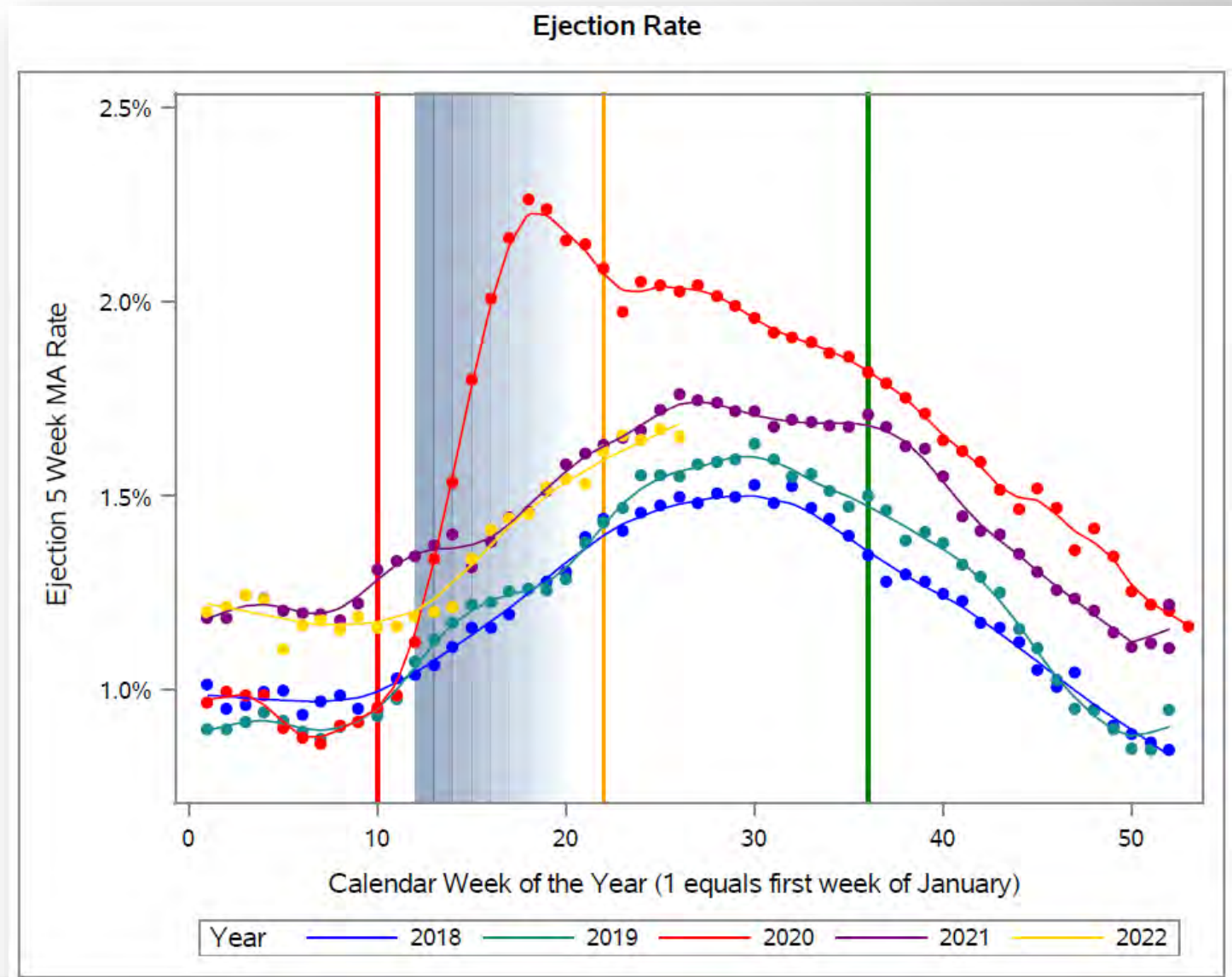
How Often are Older Adults Injured in an MVC?

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



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

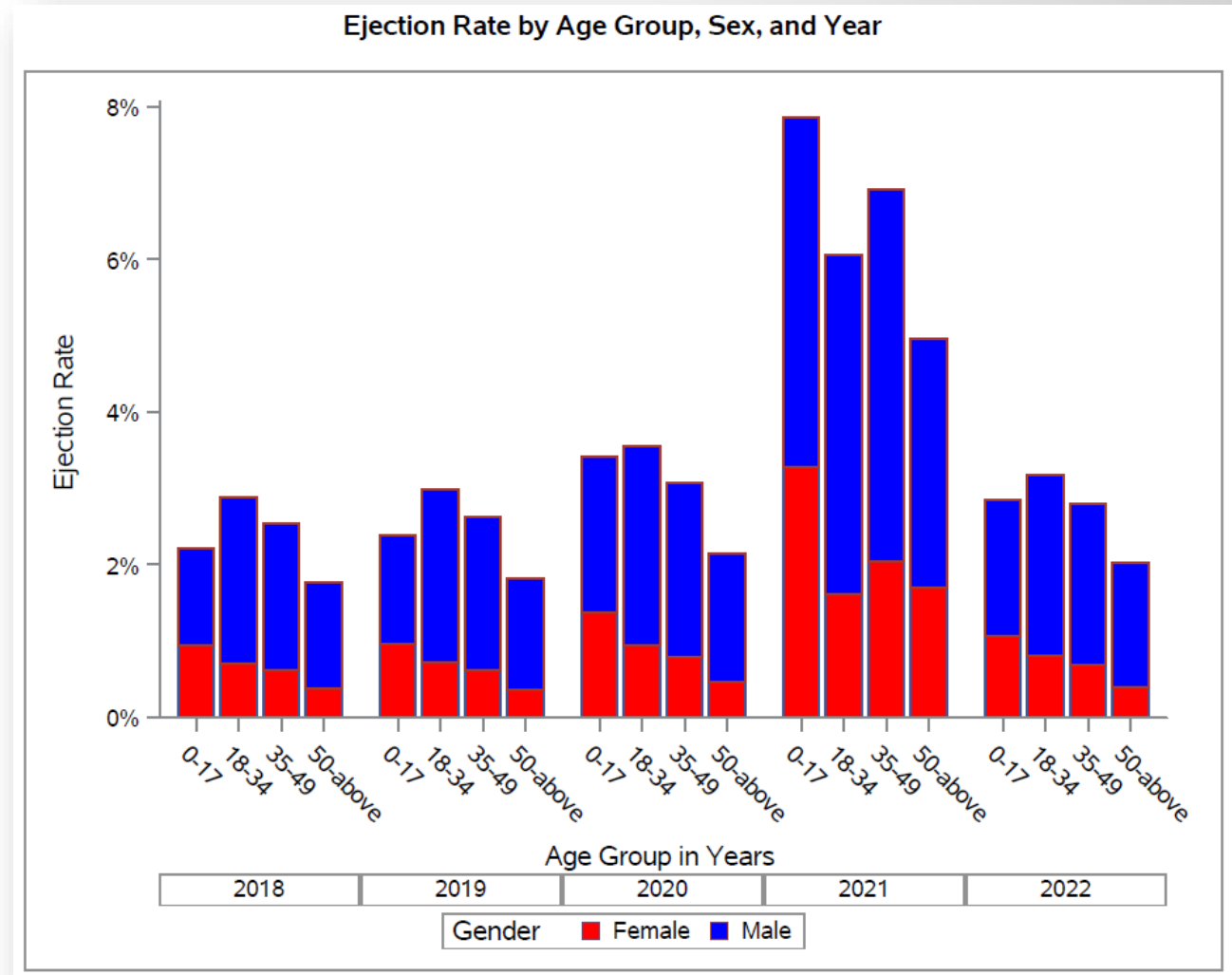
- The rate represented are patients with an injury risk factor of “crash ejection from automobile”.*
- This is not a rate of crashes. This is a **rate of activations** in which EMS encountered a patient who was ejected from a vehicle during a crash. Crashes can have multiple patients, each one with a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



Preliminary Data

MVC Ejections by Age and Sex

- The rate represented are patients with an injury risk factor of “crash ejection from automobile” based on age group, sex, and year.*
- 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.





What Types of Injuries Qualify Patients for Trauma Center Care?

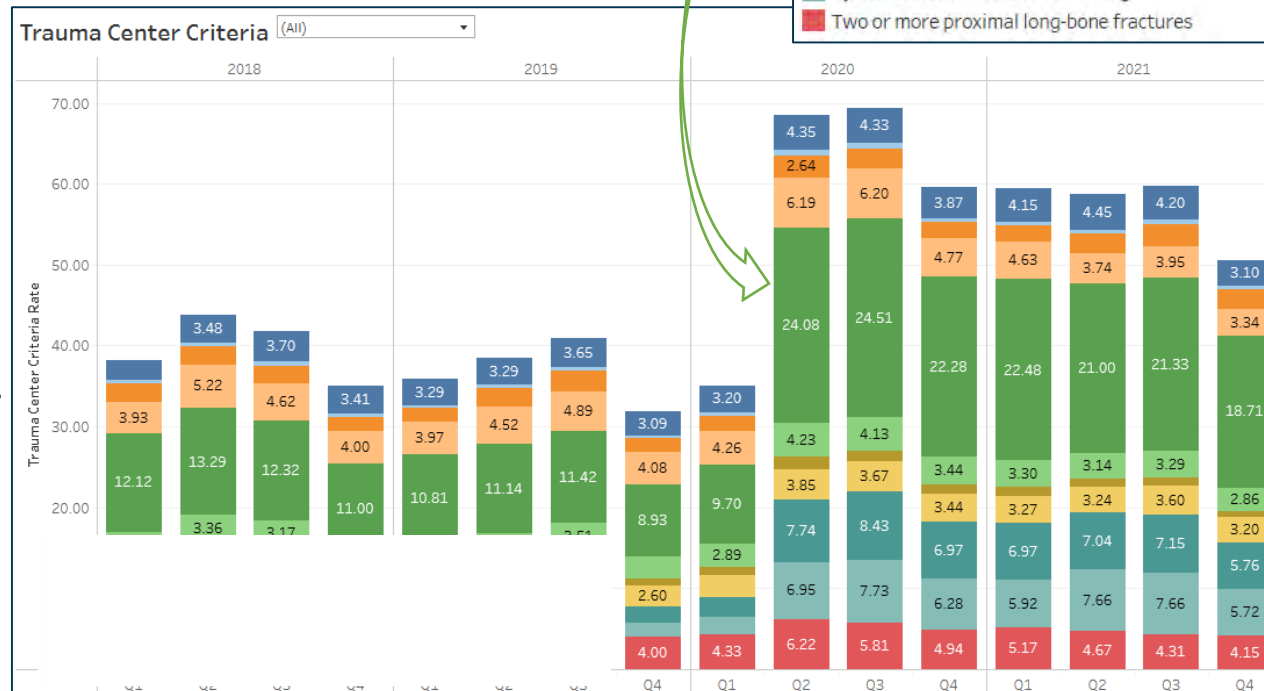
- Date Range: January 01, 2018 to December 31, 2021.
- Includes all types of MVC-related injuries.
- Demonstrates changes in WHY patients are qualified to go to a Level I or II Trauma Center. More patients were severely injured during the pandemic associated with critical vital signs.

Table of Trauma Center Criteria

Select Trauma Center Criteria	
<input checked="" type="checkbox"/>	All penetrating injuries to head, neck, torso, and extremities proximal to elbow or knee
<input checked="" type="checkbox"/>	Amputation proximal to wrist or ankle
<input checked="" type="checkbox"/>	Chest wall instability or deformity (e.g., flail chest)
<input checked="" type="checkbox"/>	Crushed, degloved, mangled, or pulseless extremity
<input checked="" type="checkbox"/>	Glasgow Coma Score < 14
<input checked="" type="checkbox"/>	Open or depressed skull fracture
<input checked="" type="checkbox"/>	Paralysis
<input checked="" type="checkbox"/>	Pelvic fractures
<input checked="" type="checkbox"/>	Respiratory Rate <10 or >29 breaths per minute (<20 in infants aged <1 year) or need for ventilatory support
<input checked="" type="checkbox"/>	Systolic Blood Pressure <90 mmHg
<input checked="" type="checkbox"/>	Two or more proximal long-bone fractures

Preliminary Data

Y-axis: Rate is per 1,000 crashes



*This does not necessarily represent patients transported to a Trauma Center - just those who were identified as needing one. There are many factors that influence transport to a Trauma Center.

[Click here for the **Public MVC Severity Dashboard**.](#)

[Click here for the **Federal Access MVC Severity Dashboard**.](#)



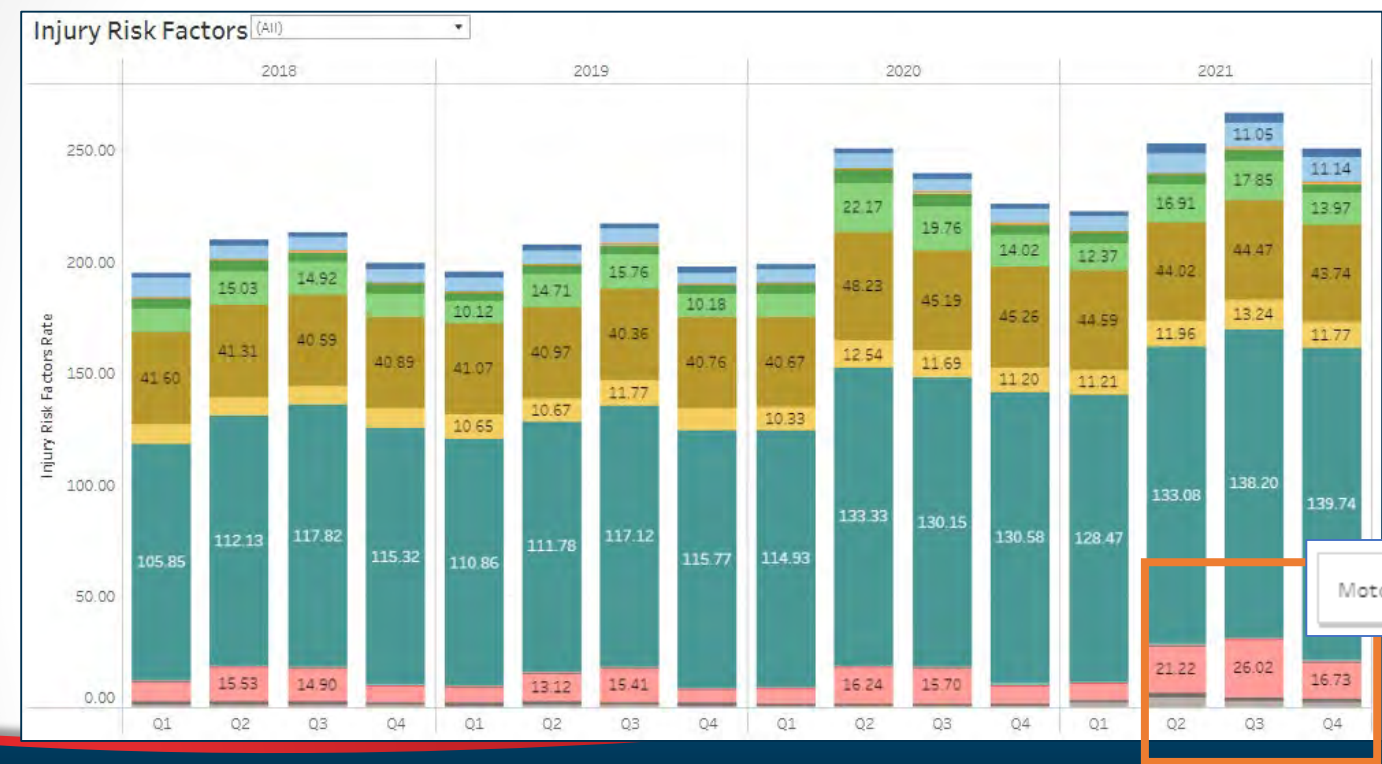
What Other Injury Risk Factors Influence Transport to a Trauma Center?

- Date Range: January 01, 2018 to December 31, 2021.
- Includes all types of MVC-related injuries.
- Demonstrates changes in risk factors that help to inform severity and trauma center criteria.

Table of Risk Factors

Anticoagulants and Bleeding Disorders
Auto v. Pedestrian/Bicyclist Thrown, Run Over, or > 20 MPH Impact
Burn, with trauma mechanism
Burn, without other trauma
Crash Death in Same Passenger Compartment
Crash Ejection (partial or complete) from vehicle
Crash Intrusion, including roof: > 12 in. occupant site; > 18 in. any site
Crash Vehicle Telemetry Data (AACN) Consistent with High Risk of Injury
EMS Provider Judgment
Fall Adults: > 20 ft. (one story is equal to 10 ft.)
Fall Children: > 10 ft. or 2-3 times the height of the child
Motorcycle Crash > 20 MPH
Pregnancy > 20 weeks
SBP < 110 for age > 65

Y-axis: Rate is per 1,000 crashes



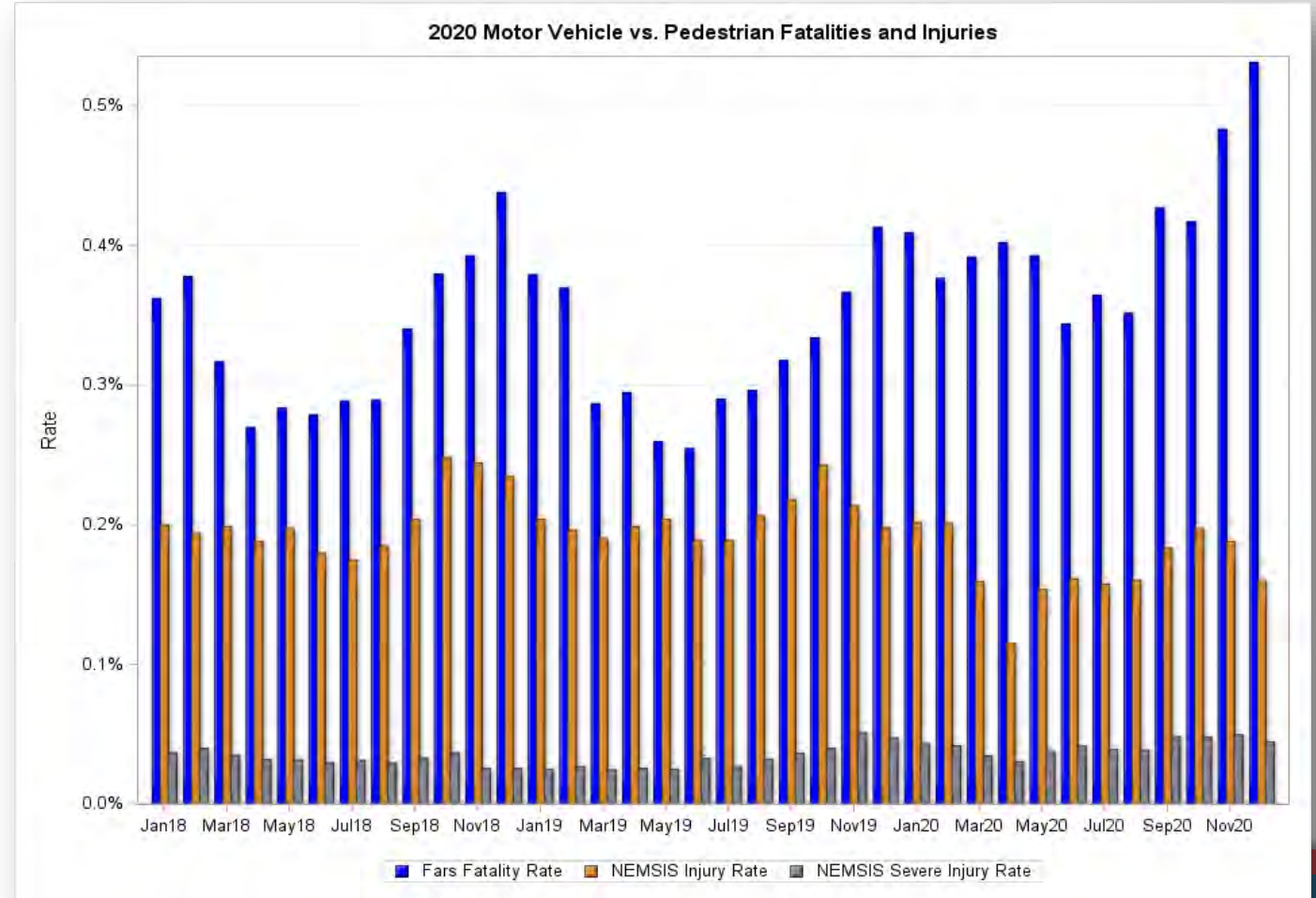
Motorcycle Crash > 20 MPH

Preliminary Data

Comparing Fatalities and Injuries: Motor Vehicle vs. Pedestrian

The FARS and NEMSIS data have different denominators:

- FARS Data: Total motor-vehicle crashes vs. pedestrian fatalities over all MVC activations*
- 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

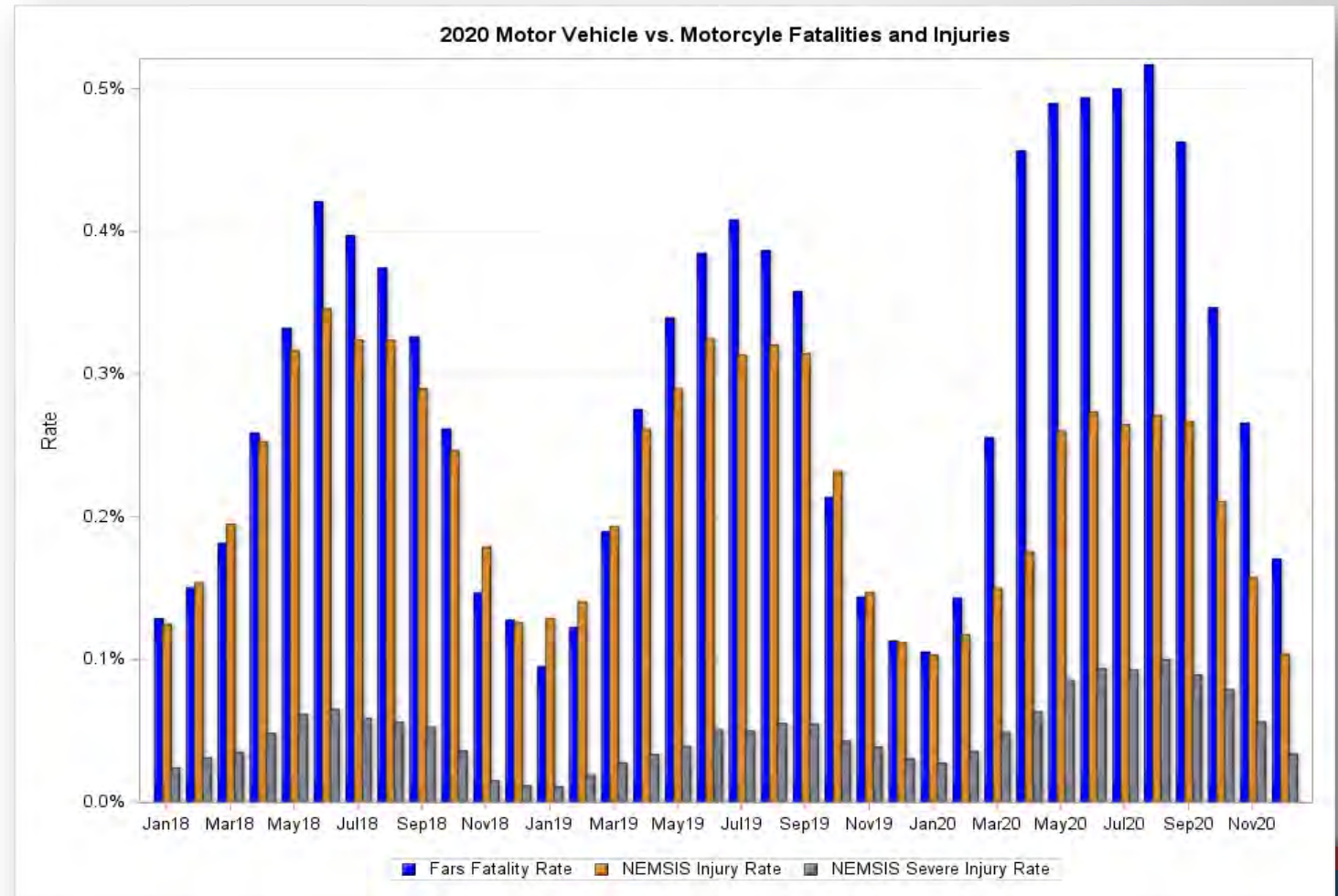


Preliminary Data

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 all MVC activations*
- 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

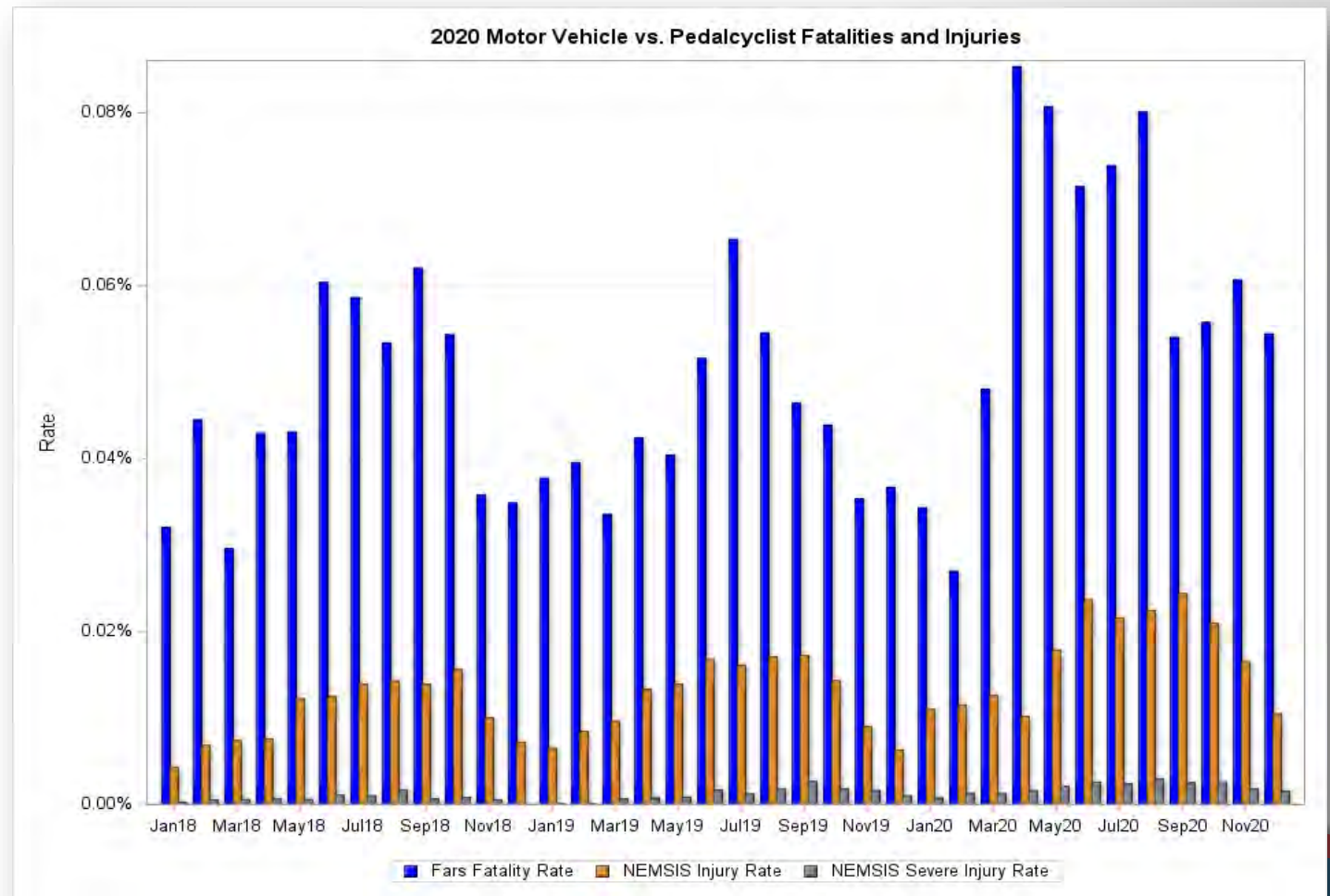


Preliminary Data

Comparing Fatalities and Injuries: Motor Vehicle vs. Bicyclist

The FARS and NEMSIS data have different denominators:

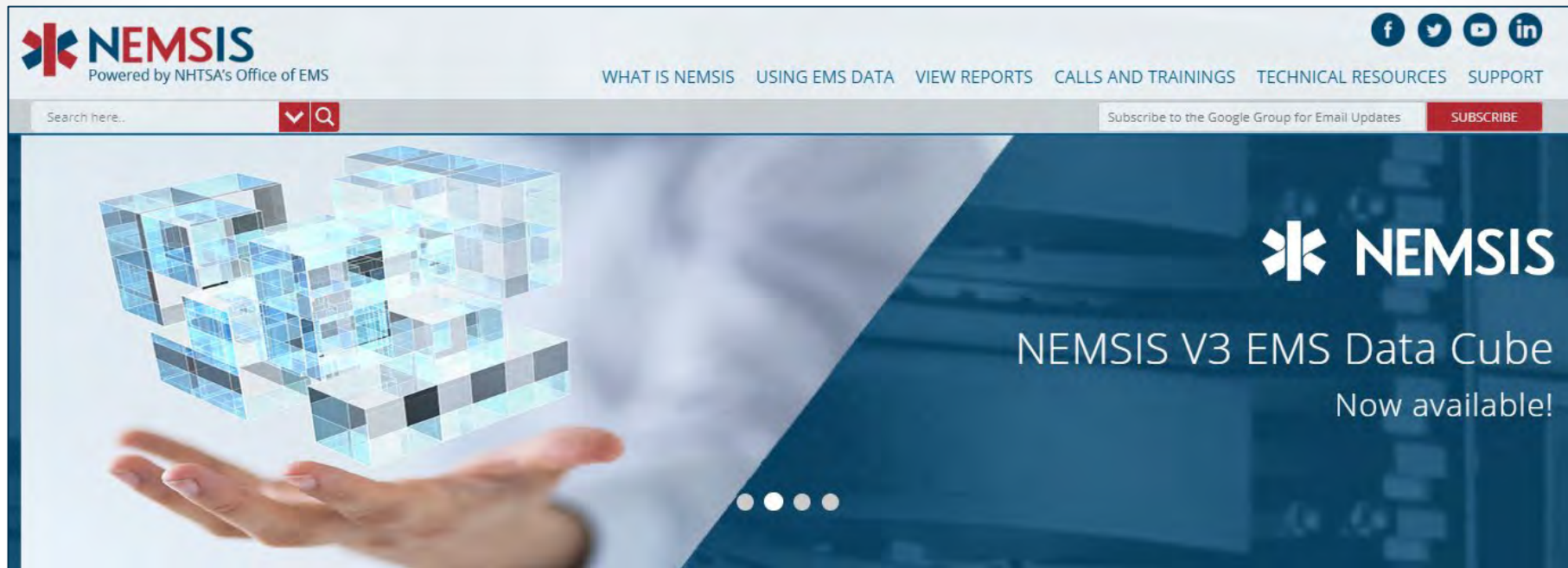
- FARS Data: Total motor-vehicle crashes vs. pedestrian fatalities over all MVC activations*
- NEMSIS Injury: Total motor-vehicle crashes vs. pedestrian injuries over all MVC activations
- NEMSIS Severe Injury: Total motor-vehicle crashes vs. pedestrian who sustained a severe injury over all MVC activations



Preliminary Data

Questions?

For more information, visit www.nemsis.org or
Email the Technical Assistance Center nemsis@hsc.utah.edu



Appendix A: Parameters of Data

Source: Unless otherwise noted, all data in this report are from the National EMS Information System ([NEMSIS](#)) National EMS Data Repository managed by the NEMSIS Technical Assistance Center (TAC). This is often referred to as “NEMSIS Data.”

Date Range: January 01, 2018 through present day. The report is updated monthly and the current date is reflected on the title slide.

Data inclusion criteria (unless otherwise specified):

- 911-initiated EMS responses.
- Motor-vehicle crashes (MVC).
- Positive for patient contact. (Not all patients present with MVC-related injuries.)
- Response date is within the year represented.
- Excludes Standby, Assist, and Cancelled calls where no patient contact occurred.

Date lines on selected graphs:

- Orange:** 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).
- Yellow:** Memorial Day (week 22).
- Green:** Labor Day (week 36).

Smoothing: 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.



Appendix A: Parameters of Data (continued)

Timeliness: 75% of EMS data submitted to the National EMS Data Repository are generally available within 8 days of the EMS encounter.

Completeness: Approximately 92% of all 911 EMS activations across the country are represented.

Duplicates: Resubmission of an electronic patient care report (ePCR) supersedes and replaces the previous ePCR submission. This helps to reduce duplicate records in the database.

Preliminary Data: For research data that is reproducible, use the [Public-Release Research Dataset](#) provided annually.

Use of Report: Please refrain from removing single slides or graphs from this report without additional pages or clear reference to the parameters and source of the data. Taken out of context, the individual slides or graphs may not be represented accurately. Please contact the NEMSIS TAC for specific and updated slides or graphs when needed.

nemsis@hsc.Utah.edu

Appendix B: Definitions/Descriptions

Activation: An event in which EMS is dispatched to respond to a call for medical assistance. Also referred to as a “run” or a “call”. Not all activations have a patient encounter. Motor-vehicle crashes may generate multiple activations, patient encounters, and ePCRs.

EMS Data: The data represented in the National EMS Data Repository are documented by EMS field clinicians during or after the activation through electronic patient care report software. Although only data that are consistent with the current National EMS Data Standard are accepted, and while much care is taken to ensure quality with 400+ validation rules, the data are largely left “as entered”.

ePCR: An Electronic Patient Care Report is initiated when an EMS unit is dispatched to an event. ePCRs are created even when there is no patient contact such as a standby, assist, or cancelled call. The EMS unit that is dispatched or sent to the event is the originator of the record or ePCR.

LOESS: Locally estimated scatterplot smoothing technique. Some trends have a LOESS curve applied to a 5 week moving average. This process smooths the “sawtooth” impact of fewer or sporadic activations helping to better communicate the trend of activations.

MVC: Motor vehicle crashes are documented in EMS data when there is a patient encounter. Not all patients require medical assistance. When there is no patient present upon EMS arrival, that is generally documented as a cancelled call/event/activation and is not included in the denominator of the data represented in this report unless otherwise indicated.

Patient: Refers to the person that EMS encounters when responding to a 911 call for medical assistance. Not all patients are injured or require medical assistance.

Appendix C: Frequently Asked Questions

Why use RATE and not COUNT?

Over the years, the number of states and EMS agencies submitting data to the National EMS Data Repository has increased. RATE is used to account for variations in submissions and is a more consistent descriptor of EMS response characteristics.

Do these data represent a complete census of all EMS activations?

The NEMSIS Technical Assistance Center receives an estimated 92% of all EMS activations from across the country. There are some states that do not require all EMS agencies to report their data. As of March 2022, there was 1 state and 2 territories that do not submit data to NEMSIS (Delaware, American Samoa, Puerto Rico).

Is the National EMS Data Repository a registry of patients?

No. One patient may initiate multiple EMS activations. Each EMS encounter with the patient is generally recorded as a new record or ePCR. For example: A patient is injured in an MVC and a first response EMS unit arrives on scene to stabilize the patient (ePCR #1). The first response unit transfers care to a transporting unit that takes the patient to the hospital (ePCR #2). The hospital transfers the patient to a higher level facility via ground or air transport (ePCR #3). This is minimized by filtering data to 911-initiated activations.

Why is there variation in documentation practices throughout the country?

Hundreds of thousands EMS clinicians from every walk of life, in every demographic, and multiple staffing models document their patient encounters. There is no single right way to complete a patient care report (PCR) and documentation training is extremely varied. As such, EMS data are rarely collected in calm, sterile, predictable environments. States, territories, and agencies all impact the methods and requirements used to document EMS response activities.

Why are fatalities not well accounted for in EMS data?

EMS clinicians do not always complete a patient care report when there is an obvious fatality upon arriving at the scene. EMS is also not always activated when an obvious fatality has occurred. Thus, EMS data are far better suited to injury and not a complete resource for fatalities.

Do deceased patients (fatalities) show up in EMS data?

Generally, EMS documents activations where they treat and/or transport a patient. If a patient is clearly deceased at the scene, it is not uncommon for EMS to be cancelled prior to arrival. If the patient expires during treatment or transport, it is usually captured in the ePCR.



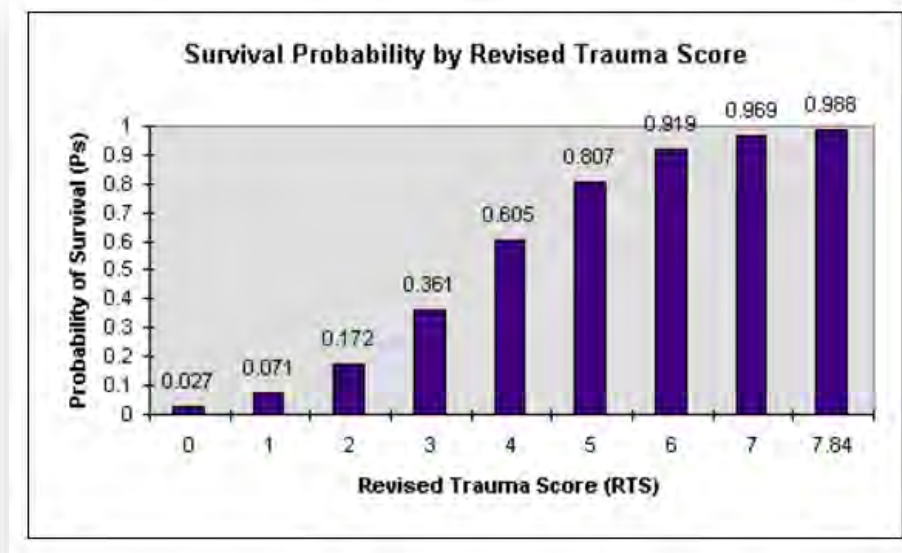
Appendix D: Calculation for Injury Severity

- Injury severity is determined using a measure called the revised trauma score (RTS) to calculate an approximate probability of survival (POS).
- Patients who present with a probability of survival of 36.1% or less are considered severely injured and should be transported to a Level 1 Trauma Center.
- RTS is calculated as described in the box below, and its value translates to a probability of survival (POS) score as described in the companion bar chart.

Revised Trauma Score			
The Revised Trauma Score is a physiological scoring system, with high inter-rater reliability and demonstrated accuracy in predicting death. It is scored from the first set of data obtained on the patient, and consists of <u>Glasgow Coma Scale</u> , <u>Systolic Blood Pressure</u> and <u>Respiratory Rate</u> .			
Glasgow Coma Scale (GCS)	Systolic Blood Pressure (SBP)	Respiratory Rate (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

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

Values for the RTS are in the range 0 to 7.8408. The RTS is heavily weighted towards the Glasgow Coma Scale to compensate for major head injury without multi-system injury or major physiological changes. A threshold of $RTS < 4$ has been proposed to identify those patients who should be treated in a trauma center, although this value may be somewhat low.



Preliminary Data

Appendix E: Process for FARS Comparison

Fatality Analysis Reporting System (FARS)

<https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars>

FARS is a nationwide census providing NHTSA, Congress and the American public yearly data regarding fatal injuries suffered in motor vehicle traffic crashes.

The FARS Fatality Data used in this report was run online by using the FARS Query System for 2018 – 2020.

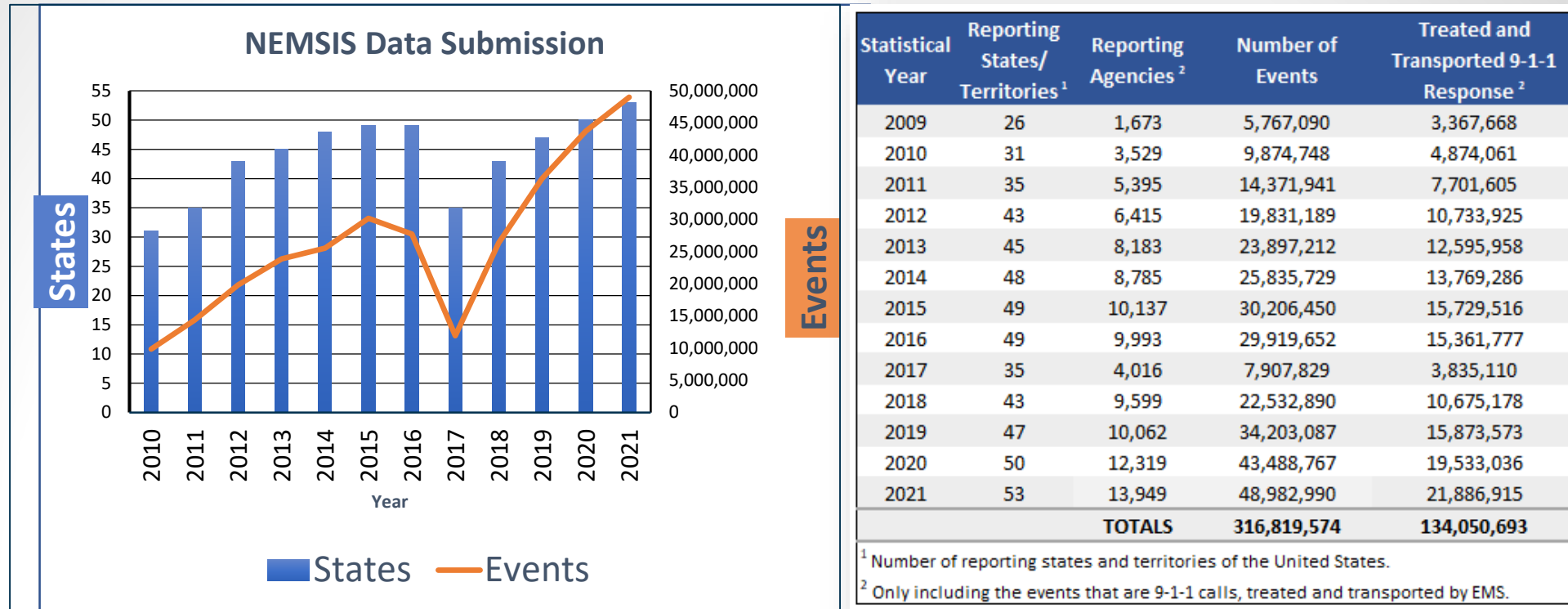
The calculations are as follows using pedestrian as the example:

FARS rate = FARS pedestrian death over FARS total MVC count

NEMSIS injury rate = NEMSIS pedestrian injury over NEMSIS total MVC

NEMSIS severe injury rate = NEMSIS pedestrian injury with Probability of Survival (POS) less than .361 over NEMSIS total MVC (*See Appendix C: Calculation for Injury Severity*)

Appendix F: Historical Data Submission



Preliminary Data

NRSS Post-Crash Care Goals

1. Develop and implement an outreach plan for EMS personnel for on-scene safety and traffic incident training.
2. Advance Traffic Incident Management training and technologies targeted at improved responder and motorist safety.
3. **Expand the use of and support for the National Emergency Medical Services Information System — the national database that is used to store EMS data from the U.S. States and Territories — by funding applied research and data quality improvements.**
4. Improve the delivery of EMS throughout the nation in collaboration with the Federal Interagency Committee on Emergency Medical Services and the National Emergency Medical Services Advisory Council by focusing on shortening ambulance on-scene response times.

[National Roadway Safety Strategy](#)

