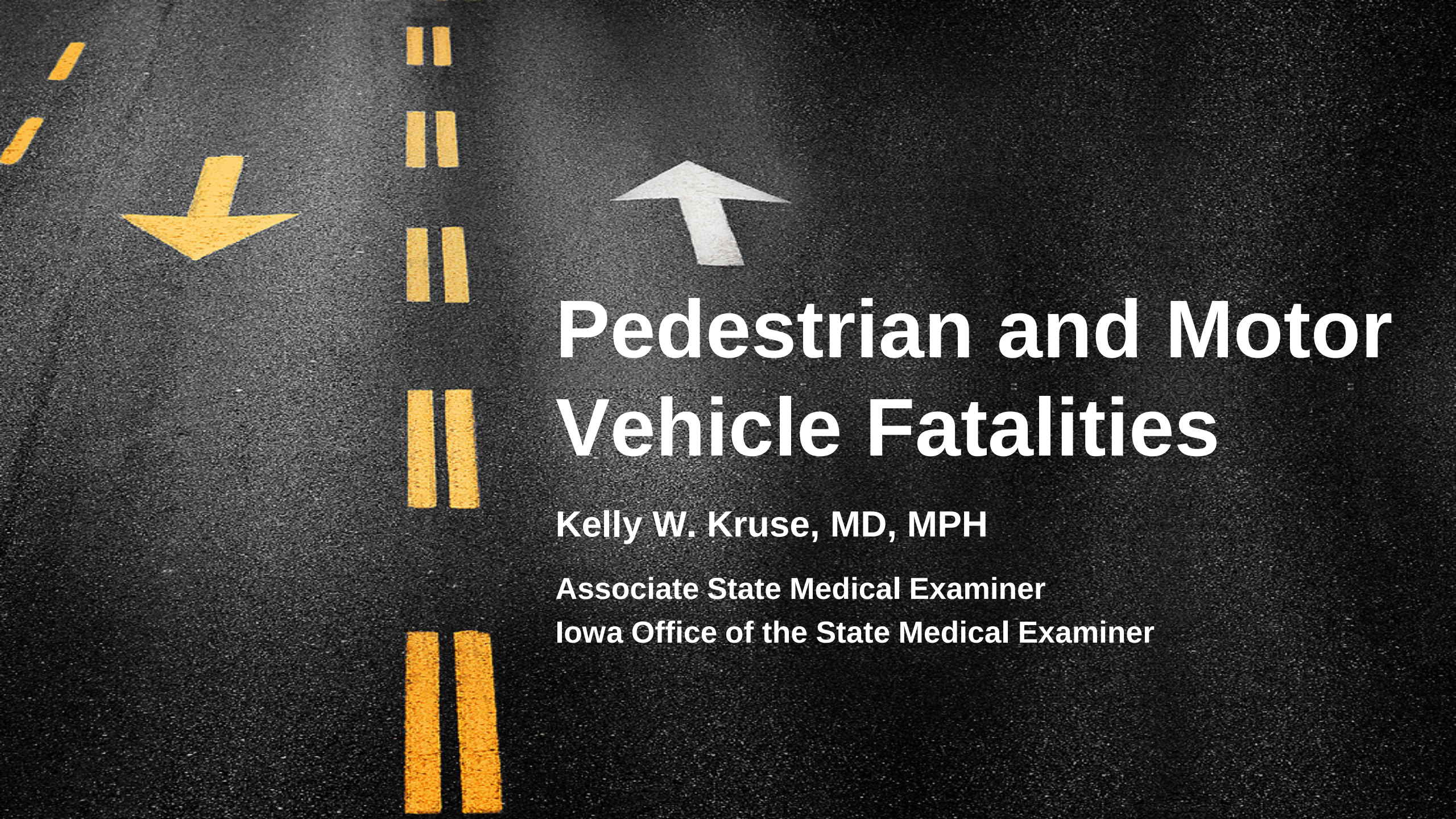

Pedestrian and Motor Vehicle Fatalities

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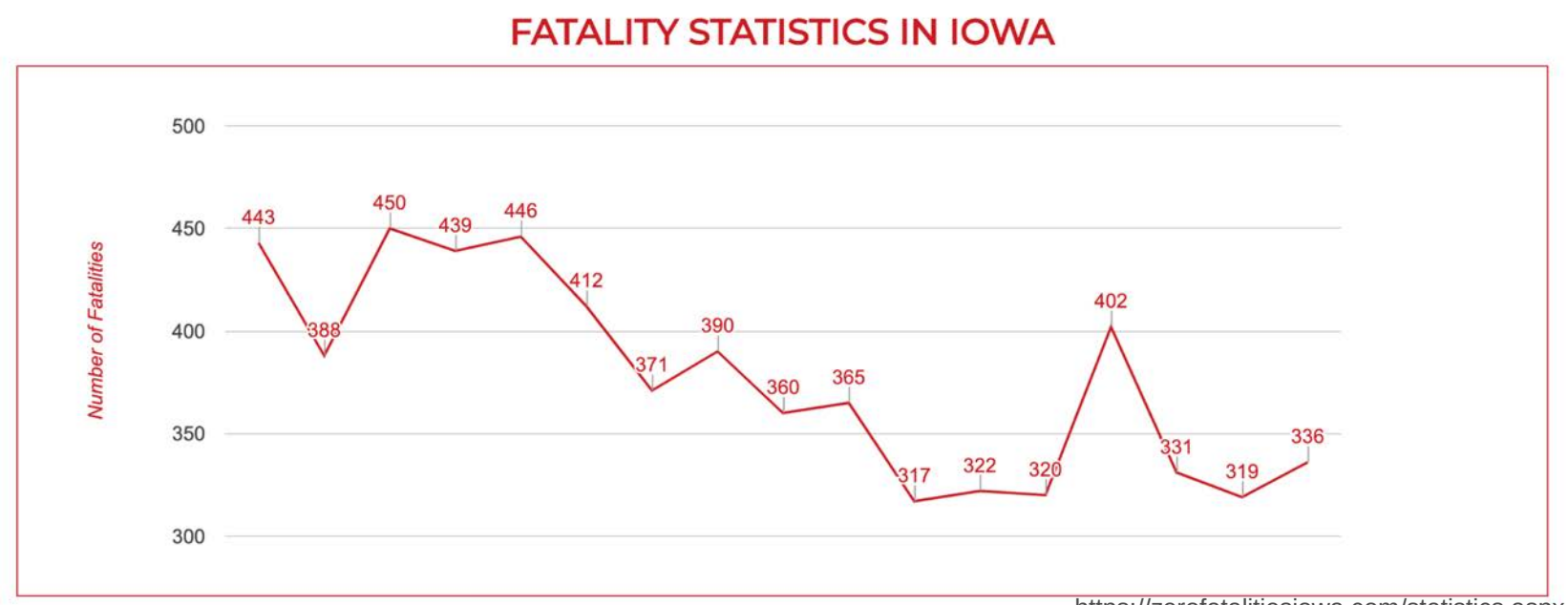
Objectives

- Describe the prevalence of motor vehicle and pedestrian fatalities.
- Recognize common injury patterns seen in motor vehicle and pedestrian fatalities.
- Identify pertinent scene findings that will assist in determination of cause and manner of death.


Motor Vehicle
Fatalities

Motor Vehicle Fatalities

- Motor vehicle fatalities comprise a significant number of cases in medical examiners' offices
- More than 35,000 traffic fatalities per year in the United States
  - 336 deaths in Iowa in 2019 (including 22 pedestrian deaths)
  - 269 in 2020 (as of October 30th)



https://zerofatalitiesiowa.com/statistics.aspx

Why Autopsy?

- In motor vehicle fatalities, an autopsy examination is performed to:
  - Positively establish the identity of the deceased
  - Determine extent of injury
  - Identify any contributing or precipitating factor(s) which may have been present
  - Document findings for possible litigation
  - Determine the actual cause of death

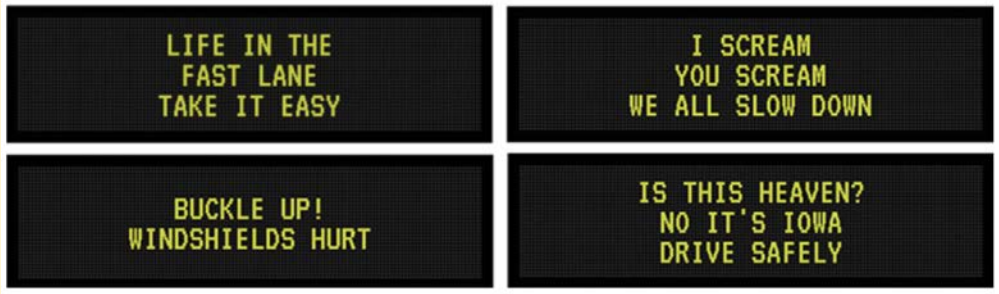
Blunt Force vs. Thermal Injuries

Blunt Force vs. Thermal Injuries

Blunt Force vs. Thermal Injuries

Motor Vehicle Fatalities

- Causes of motor vehicle crashes include:
  - **Impairment of the driver** by alcohol and/or drugs
  - Speed
  - Recklessness
  - Falling asleep at the wheel
  - **Natural disease** (e.g. myocardial infarct, stroke)
  - Environmental factors (e.g. ice, wet pavement, gravel)



Categories of Motor Vehicle Collisions

- **Four** main categories of motor vehicle collisions:
  - **Frontal** collision
  - **Side/lateral** collision
  - **Rollover**
  - **Rear** collision

Frontal Collision

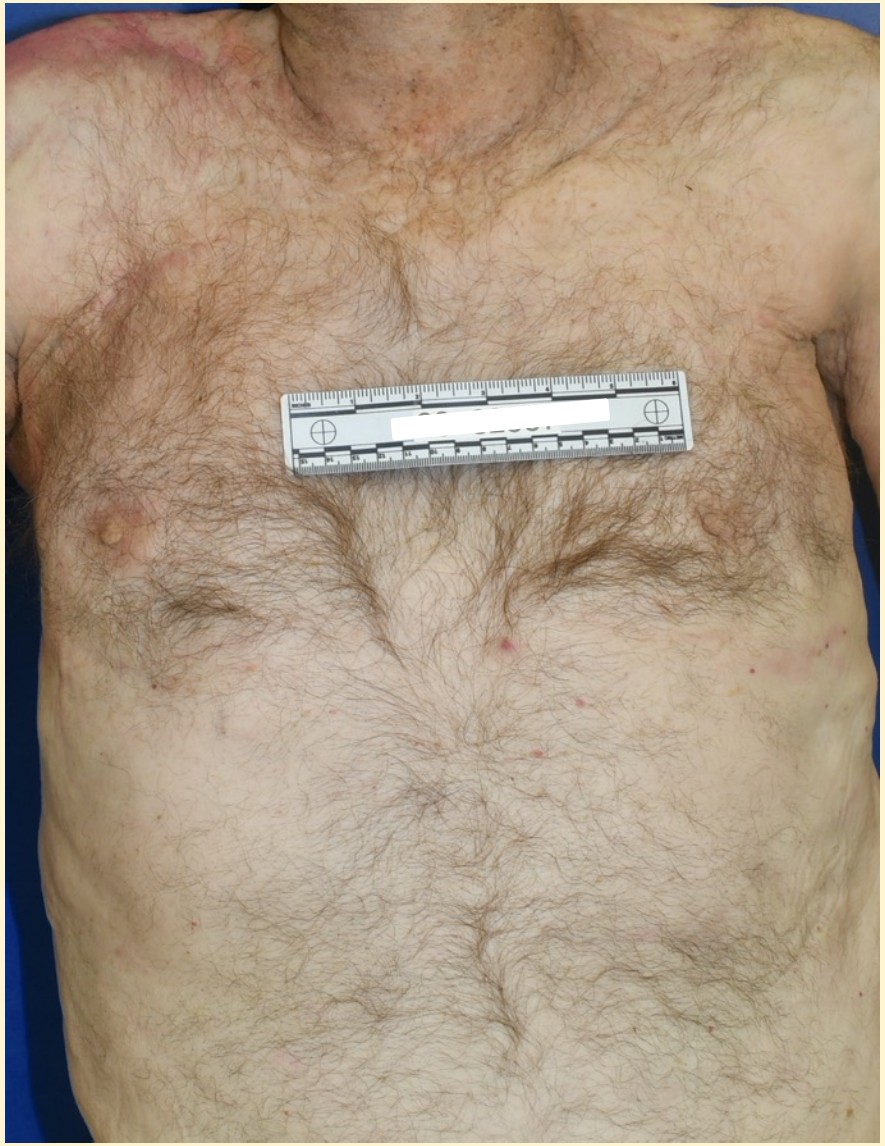
- Most common
- Two vehicles collide head-on or the front portion of a vehicle strikes a fixed object (e.g. wall, telephone pole, tree)
- Occupants of the motor vehicle will continue forward and impact the steering wheel, dashboard, windshield, or A-beam of the vehicle

Frontal Collision: Driver Injuries

- **Head:**
  - May impact the windshield resulting in abrasions of the forehead, nose, and chin
  - Internal injuries: basilar skull fractures, closed head injuries with diffuse axonal injury, and neck fractures (hyperflexion and extension)

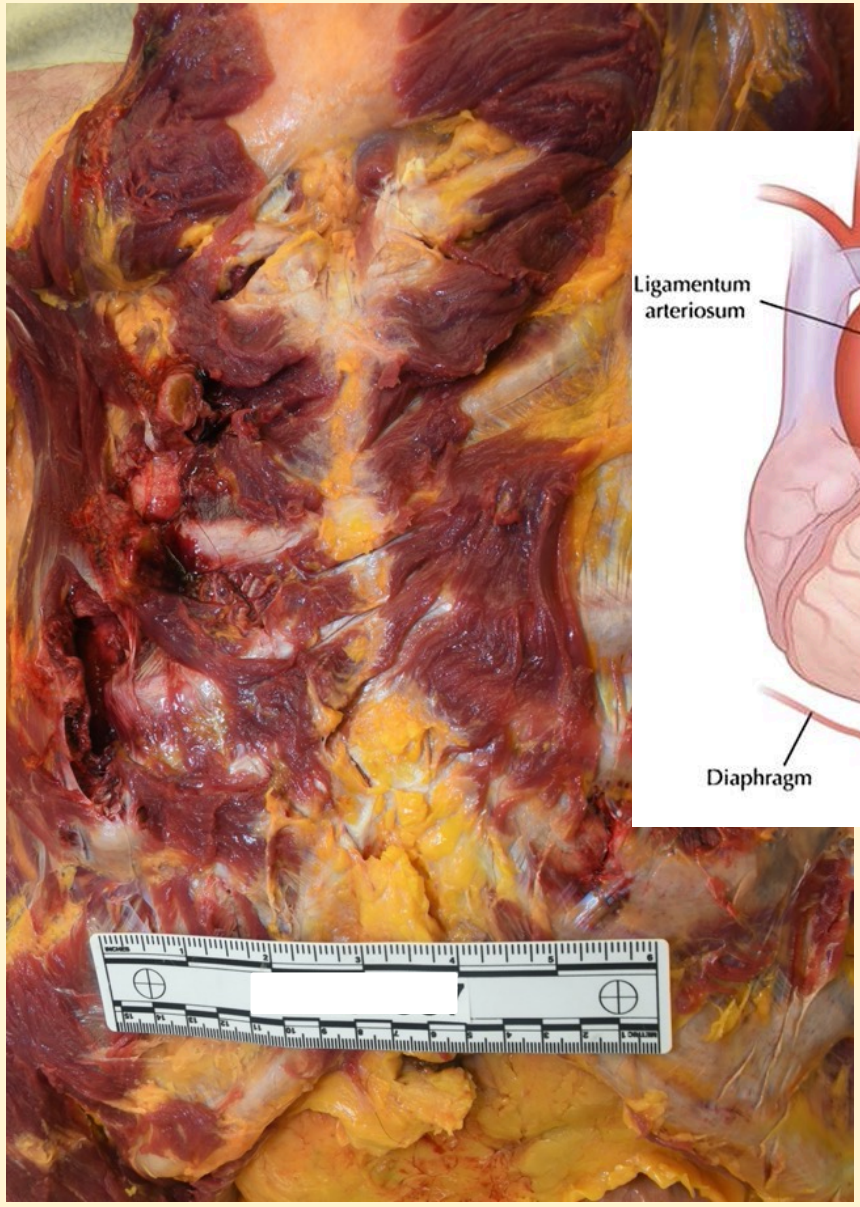
Frontal Collision: Driver Injuries

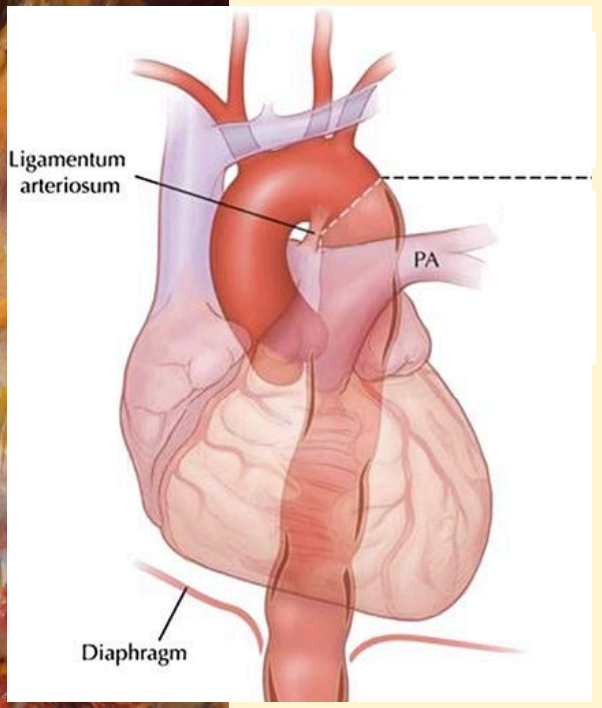
- **Torso:**
  - External injuries: chest may impact the steering wheel resulting in a patterned abrasion, contusion, or no visible injury at all



Frontal Collision: Driver Injuries

- **Torso:**
  - Internal injuries: fractures of the ribs and sternum, injury to lungs, pericardial sac, heart, aorta (laceration/transection), liver, and spleen (may have delayed rupture)





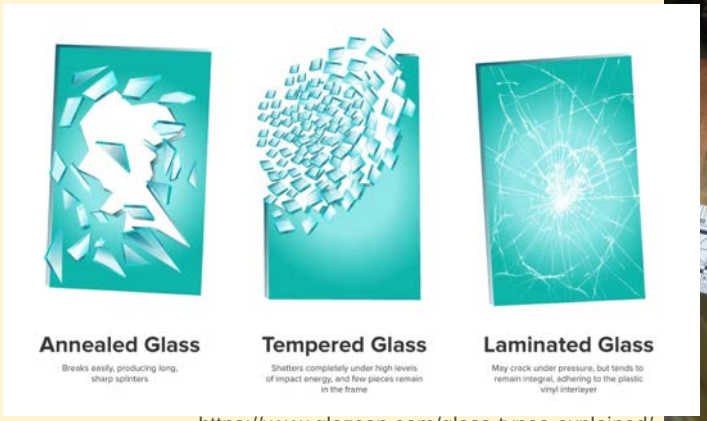
Elefteriades, J.. "Genetic testing in aortic aneurysm disease: CON." *Cardiology clinics* 28 2 (2010): 199-204 .

Frontal Collision: Driver Injuries

- **Extremities**
  - **Upper extremities:** wrist and forearm fractures consistent with hands on the wheel at impact
  - **Lower extremities:** ankle fractures if the foot/feet are braced against the floorboard or pressed firmly against the accelerator/brake pedal, or if the floor buckles upon impact

Frontal Collision: Driver Injuries

- **Dicing injuries:**
  - Injuries from tempered glass from side and rear windows – made to shatter into cubical fragments upon impact
  - Have a characteristic superficial, L-shaped, right angle, or linear pattern of cuts and abrasions
  - Usually on the left side of the body for drivers



https://www.glazcon.com/glass-types-explained/

Frontal Collision: Passenger Injuries

- **Front seat passengers:**
  - Injuries tend to be the same as those of the driver, except the unrestrained passenger will strike the dashboard and not the steering column
  - Dicing injuries tend to be on the right side of the body
- **Back seat passengers:**
  - If unrestrained, may be thrown forward, impacting the back of the front seat, the front seat passenger sun visor area, or windshield

Seatbelt Injuries

- Seatbelts have dramatically reduced the number of injuries that occur in motor vehicle crashes, especially in low-speed collisions
- Shoulder/lap belts may leave characteristic abrasions/contusions depending on position of the decedent
- Lap belts can cause internal injuries such as mesenteric tears, omental lacerations, and bowel contusions

Side/Lateral Collision

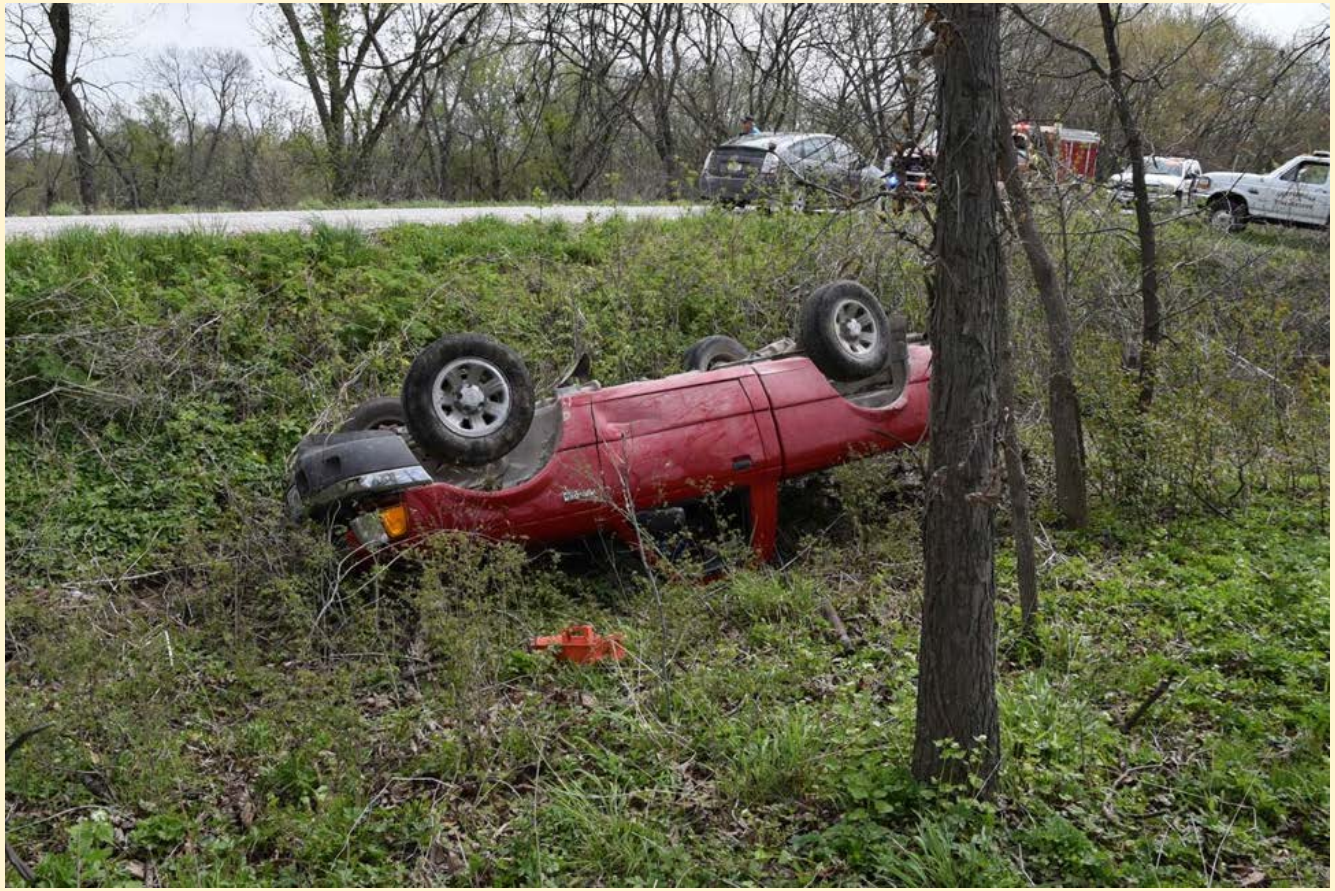
- Occurs at intersections when one vehicle impacts another or when a car skids sideways into a fixed object

Side/Lateral Collision

- May see the same injuries as those in a frontal impact collision, including aortic transection and basilar skull fractures
- If the impact is to the **left side of the vehicle**, the **driver** tends to have left-sided injuries and the front seat passenger may have fewer injuries
- If the impact is to the **right side of the vehicle**, the **passenger** will tend to right-sided injuries and the driver may also have right-sided injuries if no passenger is present

Rollover

- Tends to be more lethal than a side/lateral impact collision, especially if no seatbelt is worn and the occupant is ejected or thrown about the passenger compartment

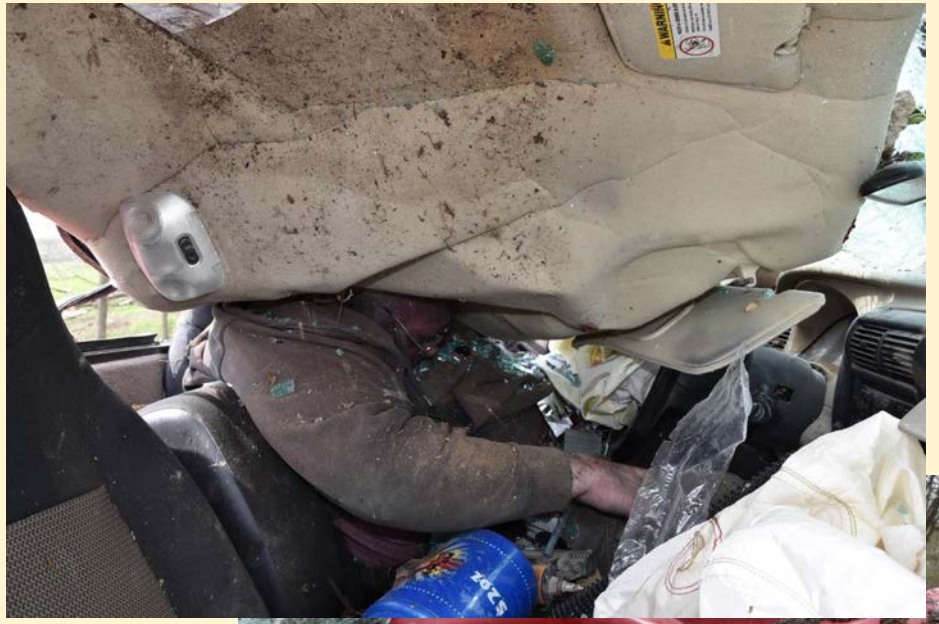


Rollover

- If full ejection occurs, numerous injuries may result when the victim lands on a firm surface, or in some cases, may be found crushed or trapped beneath the vehicle

Compressional/Traumatic Asphyxia

- May be the sole cause of death
- Photographs and/or description of body position play a pivotal role in determining cause of death



Compressional/Traumatic Asphyxia

Compressional/Traumatic Asphyxia

Rear Impact Collisions

- Rear impact collisions may cause “acceleration” injuries and are the least likely to result in death
  - Impact is reduced or absorbed to some degree by the trunk and rear seat compartment
- Most common injury is “whiplash” of the neck

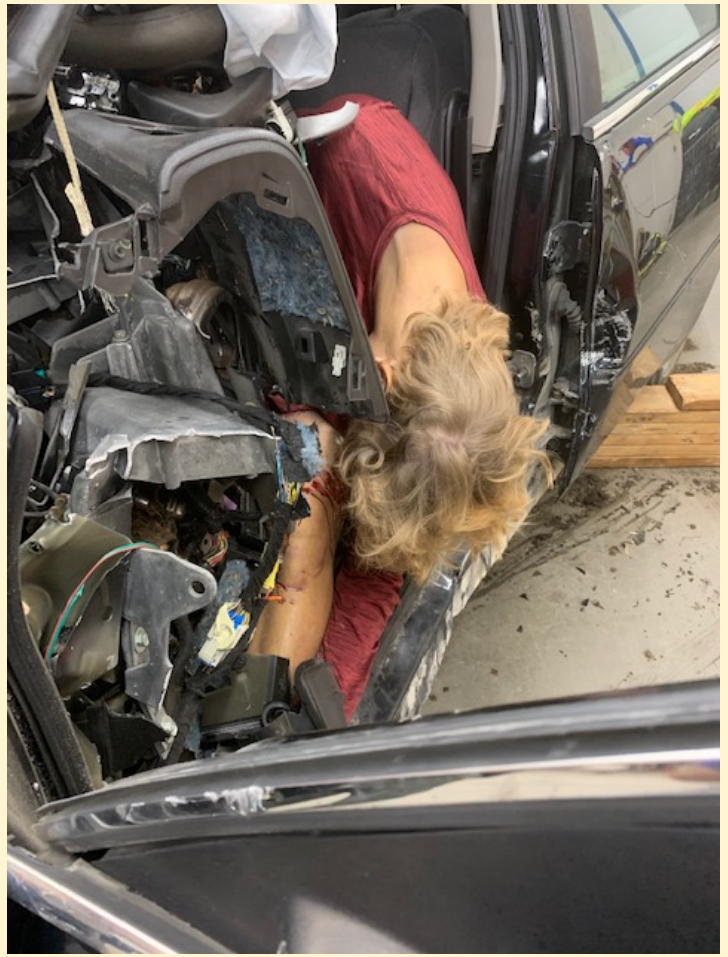
Toxicology Testing

- Toxicology should ideally be performed on both the driver and passenger(s)
- Analyses should include alcohol, carbon monoxide, and illicit and prescription drugs
  - **16% of traffic fatalities in Iowa in 2018 involved a driver with a blood alcohol concentration > 0.08 g/100 mL.**

Accident or Suicide?

- Some motor vehicle crashes may be intentional – determination can be difficult, but there may be some clues:
  - Vehicle is noted to have left the roadway and driven directly into a fixed object or oncoming vehicle
  - Scene investigation reveals no evidence of braking
  - **Decedent has a prior history of suicide attempts or ideations**
  - Evidence within the vehicle indicating a desire to continue accelerating (e.g. rock on the gas pedal)
- Investigation crucial and an answer may not be obtained

Accident or Suicide?




Pedestrian
Fatalities

Pedestrian Fatalities

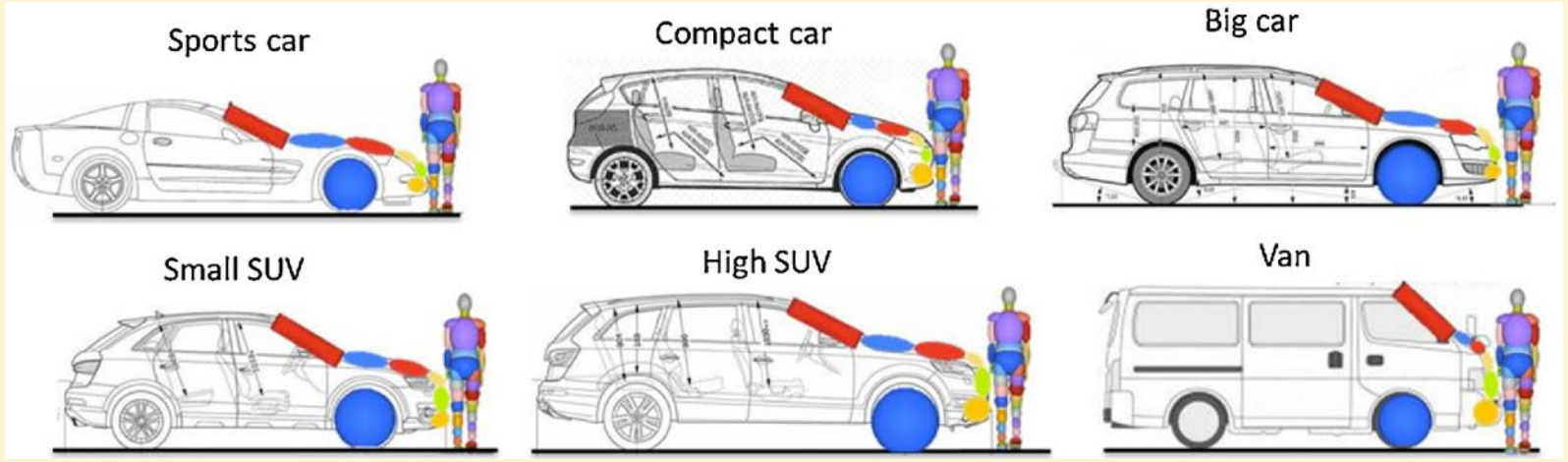
- When individuals are traveling on foot are struck by a moving motor vehicle
- Injuries may be:
  - **Primary**: due to impact with the vehicle
  - **Secondary**: due to impact with the ground or other object after being thrown from the vehicle

Pedestrian Fatalities

- Multiple factors influence the type and appearance of injuries:
  - **Speed** of the vehicle at the time of impact:
    - **High-speed:** pedestrian is picked up and thrown over the top of the car
    - **Low-speed:** pedestrian is picked up and as the vehicle continues forward, the he/she may land on the hood or continue backward to strike the windshield before sliding off the side of the vehicle

Pedestrian Fatalities

- Multiple factors influence the type and appearance of injuries:
  - **Type of vehicle:**
    - Vehicles with higher bumpers tend to impact the adult pedestrian at or above their center of gravity, knocking them down instead of picking them up



Crocetta, G., Piantini, S., Pierini, M., & Simms, C. (2015). The influence of vehicle front-end design on pedestrian ground impact. *Accident; analysis and prevention, 79*, 56-69 .

Pedestrian Fatalities

- Multiple factors influence the type and appearance of injuries:
  - **Braking:**
    - Braking will cause the front end of the vehicle to dip or lower and thus change the level of impact on the pedestrian
  - **Positioning of the decedent**:
    - Injuries at the same level suggest the person was standing still at the time of impact
    - Injuries at different levels may suggest the decedent was walking or running
    - Distance between the heel and injury site will be measured at autopsy

Pedestrian Fatalities

Patterned Injuries

- **Tire tread marks**
  - May or may not be present on the skin or clothing in cases where the tire of a vehicle has passed over the deceased
  - If present, tire tread marks should be carefully documented and photographed (ideally with a scale)

Patterned Injuries

- Imprints and injuries corresponding to parts of the vehicle (e.g. bumper, headlights)
- Should be carefully documented and photographed (ideally with a scale)

Pedestrian Fatalities

- When a pedestrian is struck by a motor vehicle, a chain of events is set into motion:
  1. As the bumper strikes the lower extremities of the pedestrian, fractures and soft tissue avulsion pockets can be produced at the point of impact
     - Injuries may be one-sided if the decedent was hit from the side

Pedestrian Fatalities

Pedestrian Fatalities

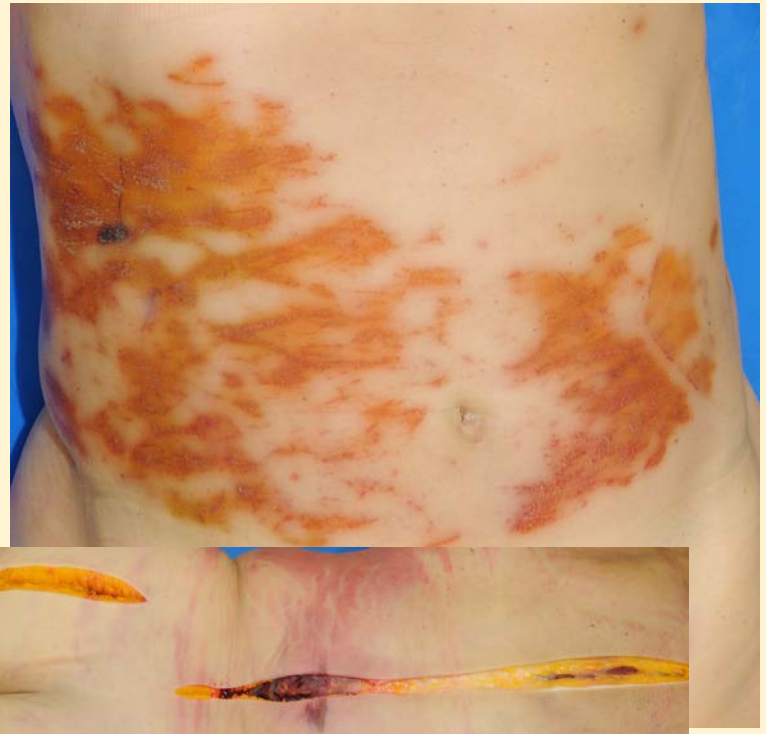
- When a pedestrian is struck by a motor vehicle, a chain of events is set into motion:

2. The buttocks/thighs may then impact the front of the vehicle or hood

Pedestrian Fatalities

- When a pedestrian is struck by a motor vehicle, a chain of events is set into motion:

3. As the body flexes, the skin within the inguinal folds (classically) becomes overstretched, leading to the superficial “stretch” lacerations, which appear dry, yellow, and bloodless



Pedestrian Fatalities

- When a pedestrian is struck by a motor vehicle, a chain of events is set into motion:

4. The head and neck may impact the windshield of the vehicle, resulting in large scalp lacerations with or without avulsion, skull fractures, and neck fractures/injuries
5. As a result of the impact, clothing may be torn

Collection of Evidence

- Trace evidence may be left on the decedent that can assist law enforcement in their investigation
  - On the vehicle: hair, skin, and blood from the decedent
  - On the decedent: paint chips, tire tread marks, or grease from the undercarriage

Pedestrian Fatalities: Manner

- “Hit-and-run” deaths: accident or homicide?
- Occasionally a pedestrian may step out in front of an oncoming vehicle in a suicide attempt
  - Investigation and witness accounts are important

Motor Vehicle and Pedestrian Fatalities: Scene Investigation

Important Variables

- Ask law enforcement and document:
  - **Type of crash**
  - Type of road
  - **If restraint used**
  - **Position in car**
  - **If decedent was ejected**
  - Estimated speed
  - If at an intersection
  - **Single vs. multiple vehicles involved**
  - Type of vehicle(s)
  - Weather conditions
  - **Concern for suicide or medical event?**

EMER

VEHICLES

Type of Road:

Estimated Speed:
Construction Zone:
At Intersection:
Intersection Street(s):

Intersection Control Present:
Intersection Control Type:

Crash Type
- ☐ Head On
- ☐ Angle
- ☐ Driver Side Impact
- ☐ Left Roadway
- ☐ Passenger Side Impact
- ☐ Rollover
- ☐ Rear End
- ☐ Other

Additional Crash Type Info:

Weather Condition:

Accident Description (Location Narrative):

Deceased Position in Vehicle:

Vehicle Type:

Vehicle:
Year:
Make:
Model:

Distractions Present during the Accident
- ☐ Cell Phone
- ☐ Changing Music
- ☐ Drag Racing:
- ☐ Alcohol Present in Vehicle
- ☐ Drugs Present in Vehicle
- ☐ Other:

If Decedent was Driver:
- ☐ Sleep Deprived

If under 18
# of Vehicle Occupants:
List Age of Each Occupant:

Date License/Permit Issued:

License Type:

Other Vehicles:
Vehicle Type:

Vehicle:
Year:
Make:
Model:

Additional Vehicles:

Restraint Used in Vehicle
- ☐ Restrained in Vehicle
- ☐ Unrestrained in Vehicle
- ☐ Unknown if Restraint Used
- ☐ Ejected from Vehicle
- ☐ Partially Ejected from Vehicle

Restraint Type:

Additional Restraint Info:
- ☐ Air Bags in Vehicle
- ☐ Air Bags Deployed
- ☐ Child Restraint

Point of Impact:

Tire Marks Description:

Helmet Worn:
Helmet Damage:

EMER

PEDESTRIAN

Pedestrian Circumstances

☐ If Intentional - Suicide?

Describe the location and direction of the Pedestrian:

Pedestrian Activity/Location

- ☐ Standing or Otherwise Immobile
- ☐ Walking
- ☐ Running
- ☐ Playing
- ☐ Working on Vehicle
- ☐ Entering Vehicle
- ☐ Exiting Vehicle
- ☐ Crossing at Intersection
- ☐ Crossing at Non-intersection
- ☐ In Course of Employment
- ☐ On Sidewalk
- ☐ Cycling
- ☐ Unknown

Scene Photography

- As with all other death scenes, photographs of the scene are indispensable
- In motor vehicle crashes, scene is often distorted by attempts to extricate the body
- Photographs to take:
  - Condition and position of the vehicle in its environment
  - Position of the body (especially if still in the vehicle)
- Diagrams may also prove useful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Scene Investigation

- Important questions to ask at the scene:
  - Type of crash? Single vehicle or multiple vehicles?
  - Seatbelt used or unrestrained?
  - Driver or passenger?
  - Decedent ejected?
  - Concern for medical event or suicide?
- Use EMER as a guide
- Photographs to take:
  - Vehicle(s) involved in crash
  - Location/position of decedent


Questions?