National EMS Education Standard Competencies

Trauma

Integrates assessment findings with principles of epidemiology and pathophysiology to formulate a field impression to implement a comprehensive treatment/disposition plan for an acutely injured patient.

Epidemiology of Trauma

- **Trends in Trauma Deaths**
  - Unintentional injury is a devastating medical and social problem. It is the leading cause of death among people 1 to 44 years of age and the fourth-leading cause of death among all Americans.
  - Deaths from unintentional injury are increasing annually; however, most deaths from trauma can be prevented.

Epidemiology of Trauma

- **Trends in Trauma Deaths** (cont.)
  - Poisoning by solids and liquids, motor vehicle crashes, falls, fire and flames, drowning, and choking have been the leading causes of trauma deaths since 1970.

Epidemiology of Trauma

- **Phases of Trauma Care**
  - Trauma care is divided into three phases: preevent, event, and postevent.
    - The preevent phase refers to factors and events existing before the injury, such as intoxication, heart disease, or poor vision, which may influence the cause of the event or the patient's response to it.

Epidemiology of Trauma

- **Phases of Trauma Care** (cont.)
  - The event phase is the trauma event. It begins at first contact with the injuring force and ends when the energy causing injury is no longer applied.
  - The postevent phase is the phase where the paramedic uses his or her expertise and skills. This phase is the delivery of emergency care to injured patients.

Epidemiology of Trauma

- **Phases of Trauma Care** (cont.)
  - Important responsibilities for the paramedic in this phase include the following:
    - Gathering information
    - Performing lifesaving maneuvers
    - Properly preparing the patient for transport to an appropriate medical facility
    - Promptly transporting the patient to the appropriate medical facility

Epidemiology of Trauma

- **Transportation Considerations** (cont.)
  - **Aeromedical Transportation**
    - The availability and use of aeromedical services vary throughout the United States. Aeromedical services can provide rapid response time, high-quality medical care, and rapid transport to appropriate care facilities.
    - The paramedic should consider air transport in the following situations:
    - The time needed to transport a patient by ground to an appropriate facility poses a threat to the patient's survival and recovery.

Epidemiology of Trauma

- **Transportation Considerations** (cont.)
  - **Aeromedical Transportation** (cont.)
    - Weather, road, or traffic conditions would seriously delay the patient's access to definitive care.
    - Critical care personnel and equipment are needed to adequately care for the patient during transport.

Kinematics

- **Energy**
  - Kinematics is the process of predicting injury patterns.
  - The paramedic should consider the following when evaluating the trauma patient:
    - Multiplicity of infection (MOI)
    - Force of energy applied
    - Anatomy
    - Energy (e.g., mass, velocity, distance, and thermal, electrical, and chemical forms)

Kinematics

- **Energy** (cont.)
  - A transfer of energy from an external source to the human body causes injuries. The extent of injury is determined by
    - The type and amount of energy applied
    - The speed with which energy is applied
    - The part of the body to which energy is applied

Kinematics

- **Energy** (cont.)
  - **Physical Laws**
    - Newton's first law of motion
      - An object, whether at rest or in motion, remains in that state unless acted on by an outside force.
    - Conservation of energy law
      - Energy cannot be created or destroyed; it can only change form. (Energy can take mechanical, thermal, electrical, chemical, and nuclear forms.)
    - Newton's second law of motion
      - Force (F) equals mass (m) multiplied by acceleration (a) or deceleration (d).
    - Kinetic energy
      - Kinetic energy (KE) equals one-half the mass (m) multiplied by the velocity squared (v^2).

Blunt Trauma

- **Motor Vehicle Crash** (cont.)
  - **Head-On (Frontal) Impact**
    - Head-on crashes result when forward motion stops abruptly (e.g., a vehicle collides with another one traveling in the opposite direction).
    - In the down-and-under pathway, the occupant travels downward into the vehicle seat and forward into the dashboard or steering column.
    - In the up-and-over pathway, the body in forward motion strikes the steering wheel. As this impact occurs, the ribs and underlying structures absorb the momentum of the thorax.

Blunt Trauma

- **Motor Vehicle Crash** (cont.)
  - **Lateral Impact**
    - Lateral impact occurs when a vehicle is struck from the side.
    - If the damaged vehicle moves away from the point of impact, the occupant accelerates away from the point of impact. The occupant moves laterally with the car.

Blunt Trauma

- **Motor Vehicle Crash** (cont.)
  - **Rear-End Impact**
    - A vehicle that is struck from behind rapidly accelerates, causing it to move forward under the occupant.
    - Predictable injuries in rear-end collisions include back and neck injuries and cervical strain or fracture caused by hyperextension.

Blunt Trauma

- **Motor Vehicle Crash** (cont.)
  - **Rotational Impact**
    - Rotational impacts occur when an off-center portion of the vehicle (usually the front quarter) strikes an immovable object or one that is moving more slowly or in the opposite direction.
  - **Rollover Crashes**
    - In rollover crashes, the person tumbles inside the vehicle and can be ejected if unrestrained. The occupant is injured wherever his or her body strikes the vehicle.

Restraints

- **Lap Belts**
  - When used properly, safety belts reduce the risk of fatal injury by 50% and the risk of serious or critical injuries by 65%.
  - People who do not wear a seat belt are 30 times more likely to be ejected from their vehicle during a crash, and 75% of ejected people die from their injuries.
  - The lap belt, used alone or with a shoulder strap, is the most commonly used active restraint system.

Restraints

- **Lap Belts** (cont.)
  - Major injury can result even when a person uses a lap belt correctly. These injuries occur from angulation of the lumbar spine, pelvis, thorax, and head around the restraint system. Injuries also occur from failure of the restraint system to decrease the impact forces.

Restraints

- **Diagonal Shoulder Straps**
  - Use of a shoulder strap helps absorb the forward motion of the thorax after impact.
  - Pregnant women should wear personal restraints while traveling in a vehicle.
    - The lap strap should be positioned under the belly, across the hips, and as high as possible on the thighs.
    - The shoulder strap should be placed between the breasts, and off to the side of the belly.
    - Seat belt straps should never be placed directly across the belly.
    - The seat belt should fit snugly and airbags should remain operable.

Restraints

- **Airbags**
  - Some vehicles are equipped with side-impact airbags, curtain airbags, knee airbags, safety belt airbags, and rear-curtain airbags to protect against impacts.
  - However, the more common airbag is a frontal airbag that inflates from the center of the steering wheel and from the dashboard during frontal impact.
  - These devices cushion the forward motion of the occupant when used with a lap and shoulder belt. Frontal airbags deflate rapidly.

Restraints

- **Airbags** (cont.)
  - The following groups are at higher risk of injury from airbag deployment:
    - Infants and children younger than 13 years
    - Adults of short stature (shorter than 4 feet 6 inches [137 cm])
    - Older adults
    - People with special medical conditions

Restraints

- **Child Safety Seats**
  - The leading cause of death in children between 1 and 4 years of age is injuries sustained in motor vehicle crashes. Car seats reduce the incidence of death in vehicle crashes by 71% for infants and 54% for toddlers.

Organ Injuries from Crashes

- **Deceleration Injuries**
  - When body organs are put into motion after an impact, they continue to move.
    - They move in opposition to the structures that attach them to the body.
    - Thus a risk exists in separation of body organs from their attachments.
    - Injury to the vascular pedicle or mesenteric attachment can lead to brisk or exsanguinating hemorrhage.

Organ Injuries from Crashes

- **Deceleration Injuries** (cont.)
  - **Head Injuries**
    - When the head strikes a stationary object, the cranium comes to an abrupt stop. However, brain tissue inside the cranium continues to move.
    - The brain moves until it is compressed against the skull. This movement can cause the brain tissue to be concussed, bruised, crushed, or lacerated.

Organ Injuries from Crashes

- **Deceleration Injuries** (cont.)
  - **Thoracic Injuries**
    - As the thorax hits a stationary object, the heart and aorta continue in motion. This motion is in opposition to their attachment at the lower end of the aortic arch. The aorta usually is sheared at the level of its ligamentum arteriosum attachment.
  - **Abdominal Injuries**
    - The forward motion of the small and large intestines can result in mesenteric tears. The downward and forward motion of the liver can cause separation from the pedicle.

Organ Injuries from Crashes

- **Compression Injuries**
  - **Head Injuries**
    - Compression injuries to the head can result in open fractures, closed fractures, and bone fragment penetration (depressed skull fracture). Associated injuries include brain contusion and lacerations of brain tissue.
    - Compression forces to the skull also can produce hemorrhage from fractured bone, meningeal vessels, or the brain itself.

Organ Injuries from Crashes

- **Compression Injuries** (cont.)
  - **Thoracic Injuries**
    - Compression injury to the thorax often involves the lungs and heart. Associated injuries to external structures include fractured ribs and sternum, which can lead to an unstable chest wall, open pneumothorax, or both.
    - A serious lung injury that can occur from compression forces is called the paper bag effect. This injury occurs when increased intrathoracic pressure causes the rupture of the lungs.

Organ Injuries from Crashes

- **Compression Injuries** (cont.)
  - **Abdominal Injuries**
    - Compression injuries to the abdominal cavity can have serious effects. Some of these effects include solid organ rupture, vascular organ hemorrhage, and hollow organ perforation into the peritoneal cavity.
    - Common injuries include rupture of the bladder, especially if it is full, and lacerations to the spleen, liver, and kidneys.

Other Motorized Vehicular Crashes

- **Motorcycle Crashes**
  - **Head-On Impact**
    - When the motorcycle strikes an object that stops its forward motion, the rest of the bike and the rider continue forward until acted on by an outside force. Usually, the motorcycle tips forward. At that point, the rider is propelled over the handlebars.
    - If the feet remain on the footrests during impact, the midshaft of the femur absorbs the rider's forward motion. This mechanism can result in bilateral fractures to the femur and lower leg.
    - Severe perineal injuries can result if the rider's groin strikes the tank or handlebars of the motorcycle.

Other Motorized Vehicular Crashes

- **Motorcycle Crashes** (cont.)
  - **Angular Impact**
    - A motorcycle may strike an object at an angle. When this occurs, the rider often is caught between the motorcycle and the second object.
    - Predictable injuries include crush-type injuries to the patient's affected side, such as open fractures to the femur, tibia, and fibula, and fracture and dislocation of the malleolus.

Other Motorized Vehicular Crashes

- **Motorcycle Crashes** (cont.)
  - **Laying the Motorcycle Down**
    - Professional racers and recreational riders often use the strategy of laying the motorcycle down before striking an object.
    - Predictable injuries include massive abrasions (road rash) and fractures to the affected side as the rider slides on the ground or pavement. These injuries can be severe; however, they are usually less serious than are the injuries that occur from other types of impacts.

Motorcyclist Fatalities And Fatality Rates, 2010-2019

Source: U.S. Department of Transportation, National Highway Traffic Safety Administration; Federal Highway Administration.

Year	Fatalities	Registered motorcycles	Fatality rate per 100,000 registered motorcycles	Vehicle miles traveled (millions)	Fatality rate per 100 million vehicle miles traveled
	Fatalities	Registered Motorcycles	Deaths per 100,000 registered motorcycles	Miles traveled (millions)	Fatality rate per 100 million miles traveled
2010	4,518	8,009,503	56.41	18,513	24.40
2011	4,630	8,437,502	54.87	18,542	24.97
2012	4,986	8,454,939	58.97	21,385	23.32
2013	4,692	8,404,687	55.83	20,366	23.04
2014	4,594	8,417,718	54.58	19,970	23.00
2015	5,029	8,600,936	58.47	19,606	25.65
2016	5,337	8,679,380	61.49	20,445	26.10
2017	5,226	8,664,108	60.32	20,149	25.94
2018	5,038	8,659,741	58.18	20,076	25.09
2019	5,014	8,596,314	58.33	19,688	25.47

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Other Motorized Vehicular Crashes

- **All-Terrain Vehicle (ATV) Crashes**
  - A natural tendency is for the rider to put a foot down to support the ATV when stopping.
    - Doing so can lead to the rear tire running over the rider's foot, catching the leg, and throwing the rider forward off the vehicle and onto his or her shoulder or crushing the rider.
  - Predictable injuries from ATV crashes include extremity injury and fracture, clavicular fracture, and serious head and neck injuries.

Pedestrian Injuries

- **Adult Pedestrian**
  - During the initial impact, the adult usually is struck by the vehicle bumper in the lower legs, which often produces lower-extremity fractures.
  - The second impact occurs as the pedestrian falls toward the hood of the vehicle.
  - The third impact occurs as the pedestrian strikes the ground or is thrown against another object.

Pedestrian Injuries

- **Child Pedestrian**
  - Initial impact of the vehicle usually occurs above the knees or pelvis. Predictable injuries from the initial impact include fractures to the femur and pelvic girdle and internal hemorrhage.
  - The second impact occurs as the front of the hood of the vehicle continues forward, making contact with the child's thorax.
  - The third impact occurs as the child is thrown downward to the ground or another landing surface.

Other Causes of Blunt Trauma

- **Sports Injuries**
  - Injuries related to sports are caused by forces of:
    - Acceleration and deceleration
    - Compression
    - Twisting
    - Hyperextension
    - Hyperflexion

Other Causes of Blunt Trauma

- **Sports Injuries** (cont.)
  - The paramedic can use the general principles of kinematics to predict injuries by determining the following:
    - What energy forces were transferred to the patient?
    - To what part of the body was the energy transferred?
    - What associated injuries should be considered as a result of the energy transfer?
    - How sudden was the acceleration or deceleration?
    - Was compression, twisting, hyperextension, or hyperflexion involved in the injury?

Other Causes of Blunt Trauma

- **Sports Injuries** (cont.)
  - If the patient used protective equipment, the paramedic should evaluate it.
  - The condition of the equipment may help the paramedic determine the MOI.

Penetrating Trauma

- **Cavitation**
  - Cavitation is an opening produced by a force that pushes body tissues laterally away from the tract of a projectile.
  - Cavitation is temporary even in the presence of severe intraabdominal injury.
  - Permanent cavities are produced by penetrating injuries in which the force of the projectile exceeds the tensile strength of the tissue.

Penetrating Trauma

- **Ballistics**
  - The energy created and dissipated by the object into surrounding tissues determines the effect of a projectile on the body. The paramedic should consider the principles of kinematics when dealing with injuries from penetrating trauma.

Penetrating Trauma

- **Ballistics** (cont.)
  - **Damage and energy levels of projectiles**
    - Injuries caused by penetrating trauma result from three energy levels: low, medium, and high.
    - Low-energy projectiles such as knives, needles, and ice picks cause tissue damage by their sharp, cutting edges. The amount of tissue crushed in these injuries usually is minimal because the amount of force applied in the wounding process is small.

Penetrating Trauma

- **Ballistics** (cont.)
  - **Damage and energy levels of projectiles** (cont.)
    - Firearms can be labeled as medium- and high-energy weapons. Medium-energy weapons include handguns and some rifles with a muzzle velocity of 1,000 feet per second (304 m/s).
    - Handguns fire ammunition of lower velocities while rifles generally are designed to fire projectiles of much higher velocity with resultant higher energies. These weapons have a muzzle velocity of more than 2,000 feet per second (610 m/s).

Penetrating Trauma

- **Ballistics** (cont.)
  - **Implications of soft body armor**
    - Some EMS (emergency medical services) agencies have adopted soft body armor policies. The armor offers extra protection for paramedics against blunt and penetrating trauma.

Penetrating Trauma

- **Ballistics** (cont.)
  - Wounding forces of medium- and high-energy projectiles
    - The wounding forces of a missile depend on the
      - projectile mass
      - deformation
      - fragmentation
      - type of tissue struck
      - striking velocity
      - range
    - Blanks are ammunition without projectiles. The explosion of gas explains how blanks can cause injury or death when fired at short range.

Penetrating Trauma

- **Ballistics** (cont.)
  - **Shotgun Wounds**
    - The energy transferred to the body tissue and the resulting tissue damage depend on several factors: gauge of the gun, size of the pellets, powder charge, and distance from the injured person.
  - **Entrance and Exit Wounds**
    - The presence of entrance and exit wounds is affected by several factors, including range, barrel length, caliber, powder, and weapon.

Penetrating Trauma

- **Ballistics** (cont.)
  - Special considerations for specific injuries
    - Locating ballistic injuries requires a thorough physical examination of the patient because the resulting trauma from high- and medium-velocity missiles is unpredictable. The impact of any projectile is crucial in determining the type and severity of injury.
      - Head injuries
        - Gunshot wounds to the head typically are devastating because of the direct destruction of brain tissue and subsequent swelling.
        - High-velocity wounds to the skull produce massive destruction.

Penetrating Trauma (9 of 11)

- **Ballistics** (cont.)
  - Special considerations for specific injuries (cont.)
    - **Thoracic Injuries**
      - Gunshot wounds to the thorax can result in severe injury to the pulmonary and vascular systems.
      - Vascular trauma from penetrating injuries can result in massive internal and external hemorrhage.
      - Penetrating injury can cause thoracic trauma in the absence of visible chest wounds.o

Penetrating Trauma

- **Ballistics** (cont.)
  - Special considerations for specific injuries (cont.)
    - **Abdominal injuries**
      - Gunshot wounds to the abdomen usually require surgery to determine the extent of injury.
      - Penetrating trauma can affect multiple organ systems, causing damage to air-filled and solid organs, vascular injury, trauma to the vertebral column, and spinal cord injury.
      - The paramedic should assume a serious injury when managing people with penetrating abdominal trauma, even if a patient appears to be stable.

Penetrating Trauma

- **Ballistics** (cont.)
  - Special considerations for specific injuries (cont.)
    - **Extremity Injuries**
      - At times, gunshot wounds to the extremities are life threatening. Sometimes such wounds can result in lifelong disability. Special considerations with these injuries include vascular injury with bleeding into soft tissues and damage to nerves, muscles, and bones.
      - Bone can be deformed and fragmented directly if struck by a penetrating object, or indirectly from the pressure created by the sonic wave of the temporary cavity. If this occurs, the transfer of energy causes pieces of bone to act as secondary missiles, crushing their way through the surrounding tissue.

When we evaluate scene safety are we missing the gorilla?

Are we missing our surroundings changing?

It is easy to become focused and miss our surroundings.

Do Not Get Gorilla ’ed

Trauma Assessment

- **Assessment for Trauma Patients:**
  - Standard precautions
  - Scene size-up
  - General impression
  - MOI
  - Primary survey
  - Baseline vital signs
  - Patient history and history of the event
  - Secondary assessment
  - Reassessment

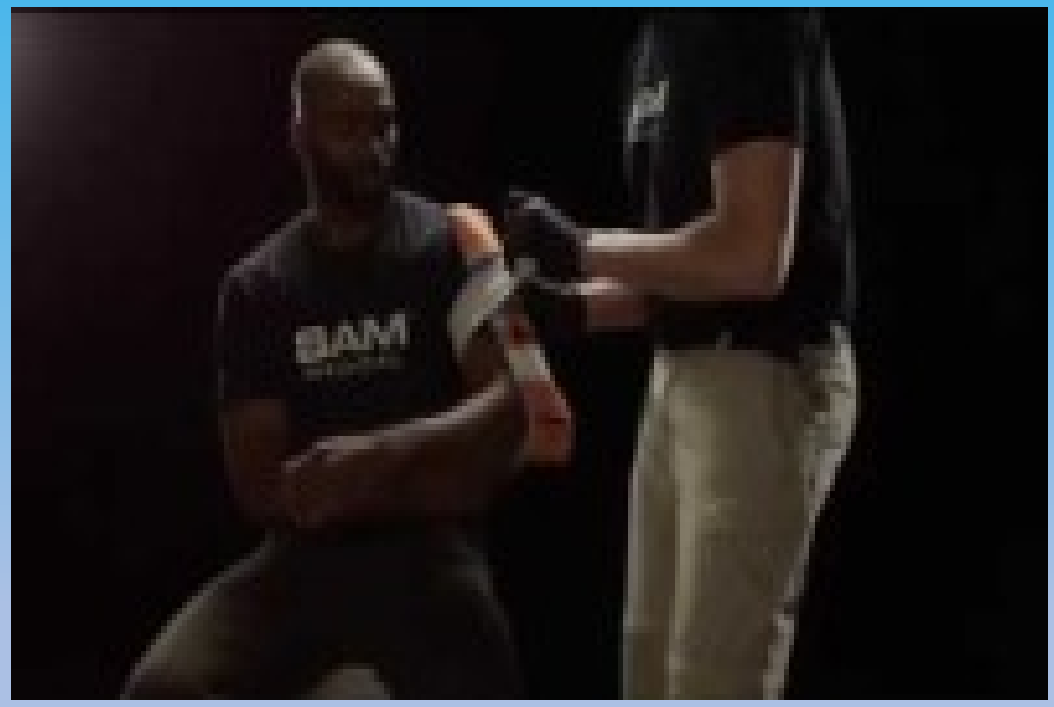
Trauma Assessment

- **Assessment Strategies Using MOI**
  - MOI can be used to guide assessment for trauma patients.
  - MOI can be categorized as significant or nonsignificant.

Role of Documentation in Trauma

- Findings at the scene and the provision of patient care should be well documented on the patient care report.
- A complete report is essential and will be referred to by the medical facility personnel.
- Documentation should include notations on an anatomic drawing for the location of wounds. It also should include a description of the scene and history of the event.

TRAUMA CARE EQUIPMENT REVIEW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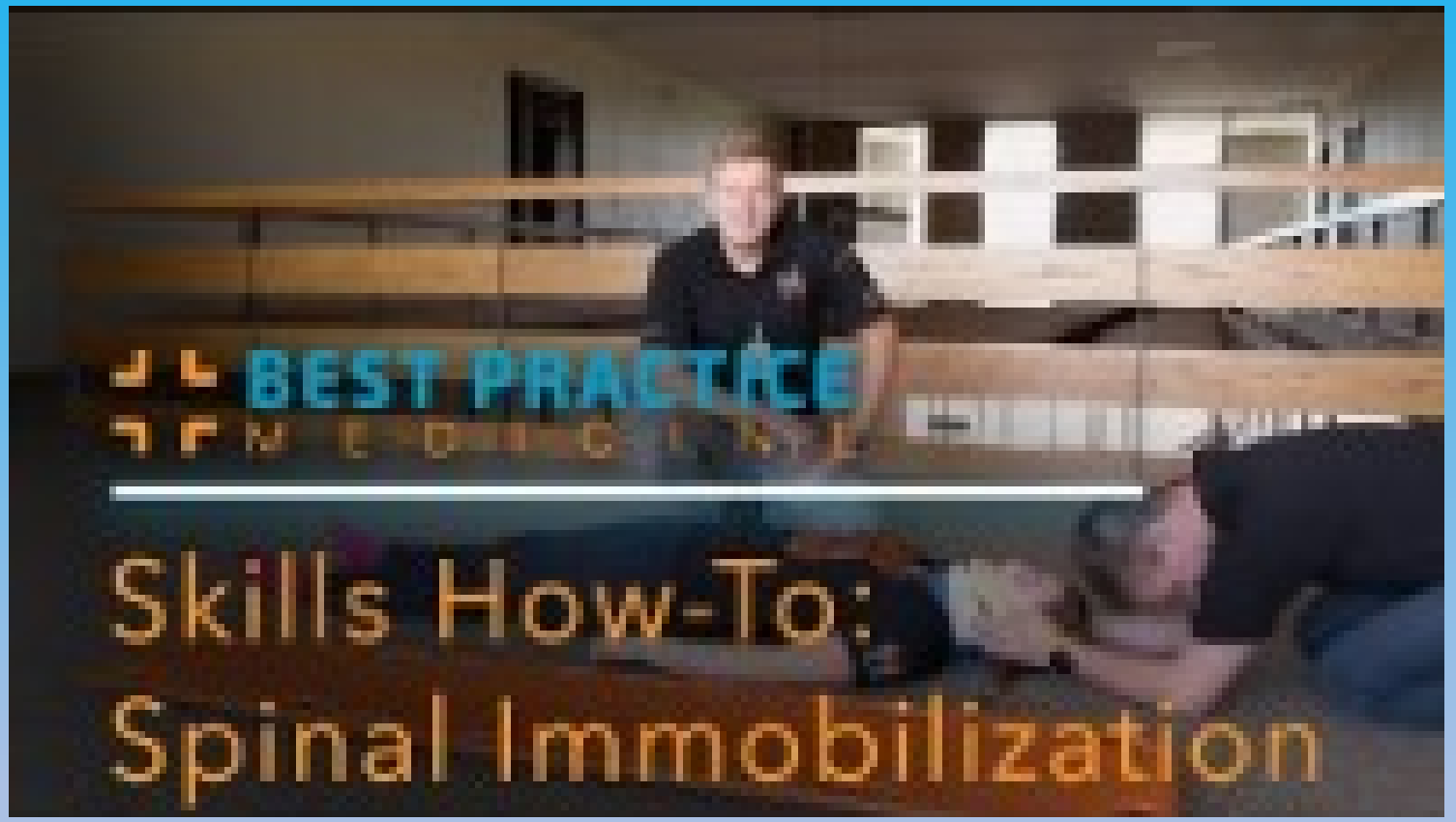
BEST PRACTICE
MEDICINE
Skills How-To:
Spinal Immobilization


NEEDLE
DECOMPRESSION


HOW TO:
SURGICAL
AIRWAY


PARAMEDIC
INTRAOSSEOUS
INFUSION