

## Preventing Sudden Death in Athletes

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## Causes of Sudden Death in Athletes



Hank Gutten, 1990

- Medical
  - Asthma
  - Diabetes
  - Heat stroke
  - Hyponatremia
  - Sickle Cell
  - Cardiac Arrest
- Trauma
  - Brain injuries
  - Cervical Spine Injuries
- Environmental
  - Lightning
- Other

Journal of Athletic Training 2013;48(4):546-553

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## MEDICAL ISSUES: ASTHMA

- Affects about 22 million people in USA per 2009 estimates
  - Includes about 6 million children
- Airway inflammation with restriction of airflow
  - Mast cell activation
  - Increased eosinophils
  - Fluid shifts
    - All above lead to bronchial constriction and acute swelling from fluid shifts



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## MEDICAL ISSUES: ASTHMA

### • Symptoms

- Cough
- Shortness of breath
- Sweating
- Drowsiness
- Confusion
- Chest tightness
- Use of accessory muscles
- Low Oxygen Saturation

### • Triggers

- Respiratory infections
- Allergens
- Pollutants
- Inhaled irritants
- Aspirin
- NSAIDs
- Cold exposure
- Exercise



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## MEDICAL ISSUES: ASTHMA

### • Prevention

- Through PPE & Health History
  - Know your athletes
- Warm-up exercises prior
  - Decreases refractory period
  - May reduce medication use
- Education
  - Teach coaches & athletes S&S
  - Medication use
  - Spirometry use
  - EAP



### • Treatment

- Recognize they are in trouble
- Initial treatment
  - Short acting Beta agonist (SABA)
    - >3-4 doses in one hour=ER
  - Supplemental Oxygen
    - Keep SaO2 > 94%
- Prevention
  - Inhaled corticosteroids
    - Medical exception forms
  - Leukotriene modifiers
  - Treat allergy symptoms

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## MEDICAL ISSUES: ASTHMA

### • Return to Play Criteria

- No specific criteria
- Be asymptomatic
- Graded increases in exercise
- Peak flow near baseline
- Identify and treat Triggers!

Being diagnosed with asthma doesn't mean you have to stop living a normal life



#ADAM

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### Medical Issues: Diabetes

"Diabetes is a chronic metabolic disorder characterized by hyperglycemia caused by either absolute insulin deficiency or the resistance to the action of insulin at the cellular level, which results in the inability to maintain blood glucose levels in the normal range of 70-110mg/dL."



Photo: The women of Team Novo Nordisk in training. (EBreakThrough Media)

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### Medical Issues: Diabetes

- 25.8 million people (8.3% of pop.)
  - 18.8 million diagnosed
  - 7 million undiagnosed
- 79 million "pre-diabetes"
- 1.9 million newly diagnosed age >20 in 2010
- Occurs in about 1 in every 400 children
- Leading cause of blindness & kidney dz.
- 245 Billion total cost for diagnosed DM in US in 2012



Gary Hill, Jr.

Data from the 2011 National Diabetes Fact Sheet (released Jan. 26, 2011)

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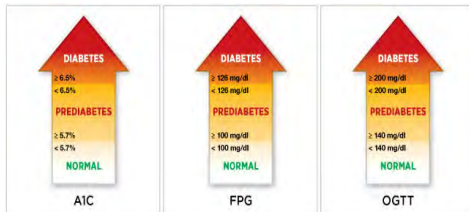
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### Medical Issues: Diabetes



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## Medical Issues: Diabetes



Photo: The book for an athlete with diabetes. (©BikeThrough Media)

- If glucose < 100 pre-exercise eat small carb meal
- Pre-exercise glucose ideally 110-250
- If glucose > 300 no exercise allowed
- If glucose 250-300 check ketones
- If activity > one hour check glucose every 30 minutes
- Eat after an event & continue to monitor glucose




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## Medical Issues: Diabetes

- Preventing Hypoglycemic/hyperglycemic event in athletes
  - Frequent blood monitoring
  - Carb supplementation
  - Insulin adjustments
- Mild hypoglycemic events can be treated on the sidelines
  - 10-15g of fast acting carb, recheck levels 15 minutes and repeat if still low
  - Activate EMS if level not improved post 2<sup>nd</sup> dose of carb
- Severe hypoglycemic event require EMS
  - consider glucagon
- No specific RTP guidelines



Dominique Wilkins

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## Medical Issues: Exertional Hyponatremia

- Serum Sodium <130mEq/L
- Exertional Hyponatremia is **RARE**
- Incidence
  - < 1% military Recruits
  - 30% Distance Athletes
  - Females>males in activities >4hours
- **Caused by either water intoxication or when sweat sodium losses are not replaced**
- **Symptoms**
  - Overdrinking
  - Nausea
  - Vomiting
  - Dizziness
  - Muscle twitching
  - Altered mental status
  - Seizures
  - Paresthesia
  - Pulmonary edema

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### Medical Issues: Exertional Hyponatremia



#### Prevention

- Determine pre & post exercise weight(kg)
- Determine sweat rate
  - (Pre-Post wgt)+fluid in+(urine vol./exer. time,hr)
  - Average = 0.5L/hr – 1.5L/hr
- Encourage daily salt intake but not necessarily in rehydration fluids
  - Salt as part of fluids only if activity >2 hours
- Rehydrate with water, carbs, electrolytes
- **Do not drink beyond thirst**

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### Medical Issues: Exertional Hyponatremia

#### Treatment

- Recognition is key
  - Use Handheld analyzer
- Basic ABC's in collapsed athlete
- Hypertonic(3%Saline) only when sodium <120 and severe symptoms present\*\*
- Fluid restriction and increase oral sodium intake in stable cases



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### Medical Issues: Exertional Hyponatremia



#### Return to Play

- No specific criteria
- Recovery depends on severity of symptoms & recovery
- Plan on preventing future episodes

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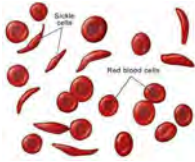
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## Medical Issues: Exertional Sickling



- Medical emergency in athletes with sickle cell trait (SCT)
  - Incidence of SCT is 8% of African Americans; 0.5% of Hispanics; 0.2% in Whites
  - Screening for SCT in PPE
  - Mandatory Testing In NCAA
- Prevention involves education of coaches, athletes and staff
- Often confused with heat cramps

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## Medical Issues: Exertional Sickling

### • Symptoms

- Leg or low back cramps
- Debilitating back pain
- Weakness
- Difficulty recovering
- Fatigue
- The harder & faster an athlete works the earlier & greater the sickling



Ryan Clark

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## Medical Issues: Exertional Sickling

### Prevention

- Work-rest cycles adjusted for heat, altitude etc.
- Hydration
- Control of asthma
- No work outs if ill
- Encourage athlete to report symptoms

### Treatment

- Check vitals
- Administer Oxygen
- Cool the athlete
- If condition declines, call 911



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## Medical Issues: Exertional Sickling

### Return to Play

- Athletes whose symptoms are identified quickly & managed may RTP the same day that symptoms subside.
- Those with self limiting myalgias from myonecrosis may need 1-2 weeks to recover.
- Those with severe rhabdomyolysis may have long lasting symptoms (compartment syndrome, renal failure)




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## Medical Issues: Exertional Heat Illness

- Heat Stroke is a core body temperature > 104F with CNS dysfunction
  - Confusion, dizziness, vomiting, diarrhea, balance & gait issues, irritability, collapse
- Dehydration of as little of 2% of body weight causes changes in thermoregulation
- Poor physical conditioning is related to intensity
- Wet Bulb readings >86F puts all at risk



Corey Stringer

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## MEDICAL ISSUES: Exertional Heat Illness

### Intrinsic Factors

- History of EHI
- Inadequate heat acclimatization
- Low fitness level
- Overweight or obese
- Inadequate hydration
- Lack of sleep
- Fever
- Stomach illness
- Highly motivated/ultra-competitive
- Pre-pubescent

### Extrinsic Factors

- Intense/prolonged exercise & minimal breaks
- High temperature/humidity/sun exposure
- Inappropriate work/rest ratios based on intensity
- Wet Bulb Globe Temperature (WBGT)
- Clothing
- Equipment
- Fitness
- Lack of education/awareness of heat illness
- Absence of an emergency action plan
- No or limited access to fluids or breaks during practice
- Delay in recognition of signs & symptoms associated with EHS




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## Medical Issues: Exertional Heat Illness



### Treatment

- Cold water immersion
  - Water temp 35F
- Lower body temp to 102F or less within 30 minutes of collapse
  - Initiate 911
  - Monitor vitals
  - ABC's
  - Get core body temp <102F before transport
- RTP guidelines are lacking
  - Identify cause

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## Medical Issues: Exertional Sickling vs. Heat Illness

EXERTIONAL SICKLING	EXERTIONAL HEAT ILLNESS
Typically happens within first 30 minutes on the field	Typically happens after prolonged exercise for more than 30 minutes
Core temperature is not elevated	Core temperature is typically >104°F
Pain is strong and generalized	Heat cramps: muscle twinges and focused pain
Typically slump to ground with weak muscles; sufferers will lie fairly still and muscles will look and feel normal to the observer	Heat cramps: suffers "hobble" and muscle are locked up and hard to touch, sufferers will yell out/writhe in pain

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## Medical Issues: Cardiac

- 1:160,000 to 1:300,000 competitive athlete deaths per year due to CV disease in USA per Maron & Van Camp
- 1:28,000 for athletes aged 12 to 35 in Veneto region of Italy per Corrado 2006 study in JAMA
- 1:27,000 in children & young adults (ages14-24) reported by Atkins et al in 2009 article in Circulation
- 1:9000 in US military recruits ages 18-35 by Eckart et al in 2004 article in Annals of Internal Medicine

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## Medical Issues: Cardiac

**Structural**

- Hypertrophic Cardiomyopathy(HCM)\*
- Coronary Artery Anomalies\*
- Aortic Rupture/Marfan Syndrome\*
- Dilated Cardiomyopathies\*
- Myocarditis
- Mitral Valve Prolapse
- Atherosclerotic Heart Disease\*
- Arrhythmogenic Right Ventricular cardiomyopathy(ARVC)\*
- Post op Congenital Heart Disease

**ELECTRICAL**

- Long QT Syndrome (LQTS)\*
- Wolf-Parkinson-White syndrome (WPW)
- Brugada Syndrome\*
- Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT)\*
- Short QT syndrome\*
- Complete Heart Block

**OTHER**

- Drugs and Stimulants
- Primary Pulmonary Hypertension (PPH)\*
- Commotio Cordis

Dresner et al, Can Sports Med J, vol 9 no 2,84-92,2010.

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Medical Issues: Cardiac

**Appendix Table 1. Criteria for Abnormality on Preparticipation Medical History and Physical Examination Screening, as Proposed by the American Heart Association\***

**Medical history**

**Personal history**

- Exertional chest pain or discomfort
- Unexplained syncope or near-syncope not clearly attributable to neurocardiogenic or vasovagal mechanism
- Excessive and unexplained dyspnea or fatigue associated with exercise
- Previous recognition of a heart murmur
- Elevated systemic blood pressure

**Family history**

- Premature (sudden and unexpected) death of  $\geq 1$  relative before age 50 y due to suspected or confirmed heart disease
- Disability from heart disease in a close relative  $\geq 50$  y of age
- Knowledge of hypertrophic or dilated cardiomyopathy, the long QT syndrome, the Marfan syndrome, or clinically important arrhythmias in any family member

**Physical examination**

- Heart murmur
- Diminished or asymmetric femoral pulses (to exclude aortic coarctation)
- Physical stigmata of the Marfan syndrome
- Asymmetric or elevated ( $>140/90$  mm Hg) brachial artery blood pressure

\* See reference 2. Annals of Internal Medicine

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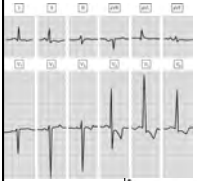
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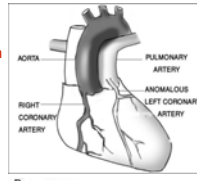
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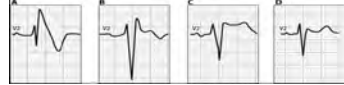
## Medical Issues: Cardiac



**Prevention**

- Pre-participation Exam
  - AHA guidelines
- To do ECG or Not?
  - European
  - American
    - Seattle Criteria





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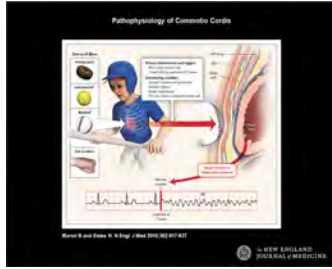
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**Medical Issues: Cardiac (Commotio Cordis)**

"Ventricular fibrillation and sudden death triggered by a blunt, non-penetrating and often innocent-appearing unintentional blow to the chest without damage to the ribs, sternum or heart (and in the absence of underlying cardiovascular disease)."

*"Agitation of the Heart"*

Accounts for ~20% of all cases of sudden death in athletes in USA but may be under reported



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**Medical Issues: Cardiac (Commotio Cordis)**

**Traumatic cause of SCD**

- 50% of events in competitive athletes
- 25% of events in recreational sports
- 25% of events not related to sports



**Primary Prevention**

- Chest Protectors do not protect against arrhythmias
- Education of coaches, parents, staff
  - Early recognition of event
  - CPR certification
  - EAP

**Secondary Prevention**

- AED

Maron, Estes, Commotio Cordis. N Engl J Med 362:10 March 11, 2010

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**TRAUMA**

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**TRAUMA: MILD TRAUMATIC BRAIN INJURY(MTBI) vs. CASTASTROPHIC BRAIN INJURIES(CBI)**

**Concussion\* is a classified as a MTBI**

- CDC notes 1.6-3.8 million occur annually in sports
- Occur in helmeted & non-helmeted sports
- \*2012 Zurich guidelines separate Concussion from MTBI as Concussion can occur without a direct head injury\**

**Subdural & Epidural Hematomas; Skull Fractures; Malignant Cerebral Edema(2<sup>nd</sup> impact syndrome) all = CBI**

- Although rare, CBI result in more fatalities from direct trauma than any other sport injury
- CBI rank 2<sup>nd</sup> only to cardiac related injuries/illnesses as most common cause of fatalities in football players

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**TRAUMA: MTBI vs. CBI**

**Prevention**

- |   |   |
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| <ol style="list-style-type: none"> <li>1. Educate           <ul style="list-style-type: none"> <li>• Parents, coaches, athletes, teachers, school nurses</li> </ul> </li> <li>2. Enforce use of certified, sport specific equipment           <ul style="list-style-type: none"> <li>• (NOCSAE;HECC;ASTM)</li> </ul> </li> <li>3. Use comprehensive baseline &amp; post injury assessment tools           <ul style="list-style-type: none"> <li>• (ImPACT, SCAT etc.)</li> </ul> </li> </ol> | <ol style="list-style-type: none"> <li>4. Home care &amp; proper monitoring post injury           <ul style="list-style-type: none"> <li>• When to go to ER</li> </ul> </li> <li>5. Systemic &amp; Graduated RTP           <ul style="list-style-type: none"> <li>• Documentation of individual treatment and progress</li> </ul> </li> <li>6. On field management and preparedness           <ul style="list-style-type: none"> <li>• Medical team responsibilities</li> </ul> </li> </ol> |
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**TRAUMA:MTBI vs. CBI**

**REMEMBER!!**  
**HELMETS MEANT TO PROTECT AGAINST SKULL FRACTURES AND OTHER CBI DO NOT PROTECT AGAINST CONCUSSIONS**




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## TRAUMA: Concussion

### Recognition

- 49-75% of athletes do not report their concussions
- Comprehensive battery including grades symptom check list, computerized neuropsychological test and balance test reached a sensitivity of 94%
- As of 2010, NFL, NHL & NCAA required an objective assessment as part of a written concussion management protocol

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## TRAUMA: Concussion

### Recognition

- Symptoms - somatic (eg, headache), cognitive (eg, feeling like in a fog) and/or emotional symptoms (eg, lability)
- Physical signs (eg, loss of consciousness, amnesia)
- Behavioral changes (eg, irritability)
- Cognitive impairment (eg, slowed reaction times)



Clinical Journal of Sport Medicine - March 2013 - Volume 23 - Issue 2 - p 89-117

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## TRAUMA: Concussion

### When a player shows ANY features of a concussion:

- The player should be evaluated by a physician or other licensed healthcare provider onsite
- The appropriate disposition of the player must be determined by the treating healthcare provider in a timely manner. If no healthcare provider is available, the player should be safely removed from practice or play and urgent referral to a physician arranged.
- Once the first aid issues are addressed, then an assessment of the concussive injury should be made using the SCAT3 or other sideline assessment tools.
- The player should not be left alone following the injury and serial monitoring for deterioration is essential over the initial few hours following injury.
- A player with diagnosed concussion should not be allowed to return to play on the day of injury.

Clinical Journal of Sport Medicine - March 2013 - Volume 23 - Issue 2 - p 89-117

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## TRAUMA: Concussion

**Treatment**

- Physical and cognitive rest until the acute symptoms resolve and then a graded program of exertion prior to medical clearance and return to play.
- Gradual return to school and social activities (prior to contact sports) in a manner that does not result in a significant exacerbation of symptoms.
- Low-level exercise for those who are slow to recover may be of benefit, although the optimal timing following injury for initiation of this treatment is currently unknown.

Clinical Journal of Sport Medicine: March 2013 - Volume 23 - Issue 2 - p 89-117

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## TRAUMA: Concussion RTP Issues

**Know Your State Laws**

Beginning in 2009, the state of Washington passed the first concussion in sports law, called the Zackery Lystedt Law. One month later, Max's law passed in Oregon. In total, between 2009 and 2012, 43 states, and the District of Columbia, passed laws on concussions in sports for youth and/or high school athletes (often called Return to Play laws). Some organizations, such as the National Conference of State Legislatures, created online maps to track and update concussion in sports laws by state.

Source: National Conference of State Legislatures, 2013-6

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## TRAUMA: Concussion RTP Issues

Most concussion in sports laws include three action steps:

- 1. Educate Coaches, Parents, and Athletes:** Inform and educate coaches, athletes, and their parents and guardians about concussion through training and/or a concussion information sheet.
- 2. Remove Athlete from Play:** An athlete who is believed to have a concussion is to be removed from play right away.
- 3. Obtain Permission to Return to Play:** An athlete can only return to play or practice after at least 24 hours *and* with permission from a health care professional.

Source: National Conference of State Legislatures, 2013.6

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## Trauma: Cervical Spine Injuries



- Injury above C5 can cause immediate death
- Most common = axial loading
  - Helmets do not prevent axial loading
- Education is key in prevention
  - Head up contact
  - Spearing illegal
  - No face mask contact
  - Enforcement of rules

Journal of Athletic Training 2013;48(4):546-553

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## Trauma: Cervical Spine Injuries

- EAP is vital to survival
  - Practice techniques
- Initiate Spine Protocol
  - Any LOC
  - Bilateral numbness/weakness
  - Midline spine pain
  - Obvious deformity
- Basic ABC's of Life Support
  - Keep C-Spine Neutral
  - Remove equipment only if needed
- Immobilize and transport



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## Environmental Issues: Lightning Safety



• To date, there have been 22 lightning fatalities in 14 states in 2013.



NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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## Environmental Issues: Lightning Safety

- The average thunderstorm is six to ten miles wide.
- The average rate of travel of a thunderstorm is 25 mph.
- Lightning can strike from as far away as 10 miles
- **Static electricity in the air = imminent strike**



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## Environmental Issues: Lightning Safety

- Flash to Bang Interval of 30 seconds
  - Five Seconds = One Mile
  - If you count 30 seconds you are within 6 miles of a strike and are in danger.
  - In most cases, when you can hear thunder, you are no longer safe.
- Stay indoors for at least 30 minutes after the last sound of thunder or after the last lightning strike.

**30**  
seconds  
**30**  
minutes



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## Environmental Issues: Lightning Safety

### Safe Places

- Enclosed building with solid roof and plumbing & electric wiring
- Buses or Cars that are fully enclosed with windows rolled up
- Avoid using phones, electrical equipment or sitting by windows

### Treatment

- First responder should make sure they are safe
- CPR and AED
- Treat for concussive injuries, dislocations and other injuries
- RTP depends on injuries sustained & prolonged symptoms incurred from incident

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## “OTHER “



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**Thank  
YOU!**

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