Brain Matters:
Identifying, Evaluating, and the Team Approach to Treating Concussion

Madison Brown, MPA,PA-C

Center for Neurorehabilitation Services
7401 Beaufont Springs Dr. Suite 205
Richmond, VA 23225

Mbrown@cnsva.net
Objectives

1. Participants will be able to identify students who have sustained a possible head injury and begin proper assessment measures.
2. Participants will be able to identify “red flag” symptoms that indicate emergent hospital care.
3. Participants will feel comfortable aiding students throughout the multiple stages of recovery from concussion including their reintegration back into the school setting.
4. Participants will be aware of the Virginia state policies associated with Return to Learn and Return to Play protocols for students who have sustained concussion.
5. Participants will be familiar with the multiple providers involved in the care of a concussion patient.
Today’s Topic

• Please note that today we are talking about **acute** concussions in students and student-athletes
• A large emphasis will be put on recognizing a concussion and helping a young adult on the road to recovery
• We will also take an in depth look at the topics of Return to Learn and Return to Play and ways that you can be assistance during this period of time for your students
• We will **not** be discussing the treatment of persistent concussion symptoms after a 4 week period......This would require much more time!
Brain Injury Association of America

• Created in 1980 and originally named National Head Injury Foundation

• Large role in advocacy, policy creation, education, awareness

• Dr. Gregory J. O’Shanick
  – Medical Director Emeritus
  – President and Medical Director of Center for Neurorehabilitation Services
Brain Injury Association of Virginia

• Anne McDonnell- Executive Director
• Established in 1983
• Services
  – Personalized Assistance: Information & Referral, Care Navigation, Resource Coordination
  – Outreach to newly injured Virginians
  – Public Awareness & Prevention Campaigns
  – Support Groups
  – Camp Bruce McCoy
  – Education and Training Programs
  – Advocacy
CDC Heads Up Program

- Provides education and awareness materials, videos
- Geared toward athletes, parents, coaches, sporting officials, medical providers
- Material on the updated guidelines for treating concussion
- Sports concussion policies and laws

Visit the HEADS UP Resource Center for Free Materials

www.cdc.gov/HEADSUP
Anatomy and Physiology of Concussion
What is a Concussion?

• BIAA Definition (2011) “An alteration in brain function, or other evidence of brain pathology, caused by an external force”

• Dazed, dinged, bell rung, dizzy, tired, disoriented, confused, irritable, “knocked out”

• Hit to head or “whiplash” type event

• ANYONE, ANYWHERE, ANYTIME
• An equal opportunity injury!

• Non-traumatic injuries count, too!! (seizures, loss of oxygen, heat stroke, poisoning...)
Acquired Brain Injury

• Traumatic Impact
  – Closed vs Open

• Traumatic Inertial
  – Non-contact!
  – Brain moving within the hard skull

• Non-Traumatic
  – “Internal insult”
American College of Rehabilitation Medicine

• “mTBI is a traumatically induced physiologic disruption of brain function, as manifested by at least one of the following”:
  – LOC
  – Any loss of memory for events immediately before or after incident
  – Alteration in mental state at the time of the incident
    • Dazed, confused, uncertain in answering simple questions
  – Focal neurologic deficit
  – Normal brain structure as demonstrated by a negative CT or MRI
    • This is required to meet criteria for mTBI
Pathophysiology of Concussion

• Release of glutamate which binds to the N-methyl-D-aspartate receptors resulting in a release of potassium in the extracellular space and calcium into the cell

• Hypermetabolic glycolytic state

• Lactate is produced, causing a decrease in blood flow and glucose utilization by the cells

• Altered metabolic state may last weeks!
  – Importance of recovery time and reduction of re-injury risk
# TBI Classification

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural imaging</td>
<td>Normal</td>
<td>Normal or abnormal</td>
<td>Normal or abnormal</td>
</tr>
<tr>
<td>Loss of consciousness (LOC)</td>
<td>0–30 min</td>
<td>&gt;30 min and &lt; 24 hours</td>
<td>&gt;24 hours</td>
</tr>
<tr>
<td>Alteration of consciousness/mental state</td>
<td>a moment up to 24 hours</td>
<td>&gt;24 hours. Severity based on other criteria</td>
<td>&gt;24 hours. Severity based on other criteria</td>
</tr>
<tr>
<td>Post-traumatic amnesia (PTA)</td>
<td>0–1 day</td>
<td>&gt;1 day and &lt; 7 days</td>
<td>&gt;7 days</td>
</tr>
<tr>
<td>Glasgow Coma Scale (GCS)</td>
<td>13–15</td>
<td>9–12</td>
<td>&lt;9</td>
</tr>
</tbody>
</table>

Alteration of consciousness/mental state must be immediately related to trauma to the head.

VHA/DoD = Veterans Health Administration and Department of Defense.
Rates and Incidence of Concussion in the USA
A Look at the Numbers

• Centers for Disease Control and Prevention
• **2.8 million** TBI (mild to severe) ED visits and hospitalizations in 2013
• **329, 290** children treated for sports/recreational related concussion/TBI in ED 2012
  – Ages 5-14 most common cause of concussion is sports and bicycle accidents
• You think these numbers are high??
  – Arbogast, 2016
  – Point of entry for 82% was primary care
A Look at the Numbers

• **7.8 Million** participants in high school sports across the country
• Boys: Football, outdoor track and field, basketball
• Girls: Track and field, basketball, volleyball
• Reports from National Federation of State High School Associations
Identifying Concussion
Who May Recognize a Concussion in Your Students?

- Student
- Family member
- Friends
- Teachers
- School nurse
- School bus driver

- Health Care Practitioner
  - Primary Care/Family Medicine
  - Pediatrics
  - Urgent Care
  - Emergency Medicine
  - Sports Medicine
  - Orthopedics
  - Dentist
Concussion Signs and Symptoms

“Signs Observed By School Nurses”

- CDC Fact Sheet for School Nurses
  - Appears dazed or stunned
  - Is confused about events
  - Answers questions slowly
  - Repeats questions
  - Can’t recall events prior to the hit, bump, or fall
  - Can’t recall events after the bump, hit, or fall
  - Loses consciousness (even briefly)
  - Shows behavior or personality changes

Concussion Symptoms: Physical

- Headache - Most Common!
  - Higher risk in those with a history of migraine
- Fatigue
- Light sensitivity
- Sound sensitivity
- Blurred vision
- Nausea
- Dizziness
- Seizure
- Impaired hearing
Concussion Symptoms: Cognitive

- Inattentiveness
- Decreased concentration
- Poor memory
- Impaired judgment
- Slowed processing speed
- Executive dysfunction
Concussion Symptoms: Behavioral

- Depression
- Anxiety
- Agitation
- Irritability
- Aggression
- Impulsivity
Concussion Symptoms: Sleep

- Increase in sleep
- Difficulty falling asleep
- Difficulty staying asleep
- Nightmares
- Non-restorative sleep
- Sleep cycle disturbance
What’s Next?
You’ve identified a concussion, now what?
When to Seek Emergency Care

• Red Flag Symptoms
  – Loss of consciousness
  – Worsening or persistent headache
  – Weakness, numbness, clumsiness
  – Repeated nausea/vomiting
  – Slurred speech
  – Appears very drowsy or can’t be awakened
  – Pupils unequal size
  – Convulsions/seizures
  – Doesn’t recognize people/places
  – Increasing restlessness/agitation/confusion
  – Unusual behavior
CDC Guidelines for School Nurses

1. Observe students for a minimum of 30 minutes. This should be direct observation.
   – This should be direct observation

2. Complete the Concussion Signs and Symptoms Checklist
   – Should be performed initially, at 15 minutes, and again at 30 minutes
3. Notify the student’s parent or guardian

- If signs and symptoms are present
  - Refer immediately to a health care professional
- If signs and symptoms are not present
  - “Student may return to class but should not return to sports or recreation activities on the day of concussion”
  - Send home a copy of the Concussion Signs and Symptoms Checklist and ask parent/guardian to continue observing the student
  - Be sure to tell them that if signs or symptoms appear to seek care right away by a healthcare professional
Concussion Signs and Symptoms

Checklist

Student’s Name: _____________________________  Date/Time of Injury: _____________________________

Where and How Injury Occurred: [Insert location and details of the event or activity that led to the injury here]

Description of Injury: [Provide a detailed description of the injury, including any visible signs or symptoms that occurred immediately after the injury]

DIRECTIONS:

Use this checklist to monitor students who come to your office with a head injury. Students should be monitored for a minimum of 30 minutes. Check for signs of symptoms when the student first arrives at your office, fifteen minutes later, and at the end of 30 minutes.

Students who experience one or more of the signs or symptoms of concussion after a bump, blow, or jolt to the head should be referred to a health care professional with experience in evaluating for concussion. For these instances when a parent is coming to take the student to a health care professional, observe the student for any new or worsening symptoms right before the student leaves. Send a copy of this checklist with the student for the health care professional to review.

**OBSERVED SIGNS**

<table>
<thead>
<tr>
<th>Time (Minutes)</th>
<th>0</th>
<th>15</th>
<th>30</th>
<th>45</th>
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<tbody>
<tr>
<td><strong>Phyiscal Symptoms</strong></td>
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<tr>
<td>Headache or &quot;pressure&quot; in head</td>
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<tr>
<td><strong>Cognitive Symptoms</strong></td>
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<tr>
<td>Difficulty thinking clearly</td>
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<tr>
<td>Difficulty concentrating</td>
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<tr>
<td>Difficulty remembering</td>
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<tr>
<td>Feeling more slowed down</td>
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<tr>
<td>Feeling dizzy, dizzy, lightheaded, or groggy</td>
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**Additional Symptoms**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Nausea</td>
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<tr>
<td>Vomiting</td>
<td></td>
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<td>Confusion</td>
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To decrease the risk of long-term effects, please complete all of the questions on this checklist. For an older or young student, this checklist can be used to monitor the student for any new or worsening symptoms.
Physical Activity Limitations

- If a student experiences a concussion, he/she is not permitted to return to sports or recreation on the same day of the injury under any circumstances
  - This includes practices, recess, PE class, games
  - Must be cleared by a healthcare professional
Sitting Out, It’s the Law

- 2009- Zackery Lystedt Law- Washington State
  - 13yo, struck his head on the ground after a tackle playing Junior High football
  - Sidelined for 3 plays, back in the game at the start of the 3rd quarter
  - At the end of the game he collapsed, was airlifted to the hospital and underwent emergency surgery due to his brain swelling
  - Spent 7 days on a ventilator and 3 months in a coma- took 3 years before he could stand (with assistance) again
Second Impact Syndrome

• Zackery Lystedt
• Occurs when a concussed person sustains a second concussion
  – Minutes, days, weeks
• Rapid brain swelling
• Possibly due to arterioles in the brain being unable to regulate their diameter
• Controversial term
  – Low incidence, not noted in the literature of other countries
Sitting Out, It’s the Law

• 2010- Virginia gets involved
• Bill 22.1-271.5 “Policies on concussions in student-athletes”
• 3 Parts:
  – Part 1: Board of Education Duties
    • Board of Education to develop and distribute policies to educate coaches, student-athletes, and parents in each school division on concussion, the criteria for removal from and return to play, and risks associated with continued to play with a concussion
Sitting Out, It’s the Law

• Bill 22.1-271.5
  – Part 2: School Division Duties
    • Creation of a “Concussion Policy Team”
    • Educate athletes and parents on an ANNUAL basis
    • Obtain a signature from each athlete and parents acknowledging that they have been educated
Sitting Out, It’s the Law

• Bill 22.1-271.5
  – Part 2: School Division Duties
  – “A student-athlete suspected by that student-athlete’s coach, athletic trainer, or team physician of sustaining a concussion or brain injury in a practice or game shall be removed from the activity at that time.”
  – “A student-athlete who has been removed from play, evaluated, and suspected to have a concussion or brain injury shall not return to play that same day.”
Sitting Out, It’s the Law

• Bill 22.1-271.5
  – Part 2: School Division Duties
    • A student-athlete may not return to play until:
      – 1. Evaluated by an appropriate licensed health care provider as determined by the Board of Education
        » Standardized concussion sideline assessment
      – 2. Has written clearance to return to play from a licensed health care provider.
      – Who is considered a “licensed health care provider”?
        » MD, DO, PA, NP, ATC, Neuropsychologist
Sitting Out, It’s the Law

• Bill 22.1-271.5
  – Part 3
    • Youth sports programs utilizing school property should either develop their own policies in compliance with the Board of Education policies or choose to follow the policies of the school division
    • Local school division is not required to enforce these policies
Something is missing....

- Bill 22.1-271.6
  - 2014
  - Return to Learn Protocol
    - “School personnel shall be alert to cognitive and academic issues that may be experienced by a student athlete who has suffered a concussion”
    - “School personnel shall accommodate the gradual return to full participation in academic activities....based on the recommendation of the student-athletes licensed health care provider”
Baseline and Sideline Evaluations
Baseline Testing?

• Is it necessary?
  – No formal recommendation from CDC
  – Consider cost involved

• Immediate Post Concussion Assessment and Cognitive Testing (ImPACT)
  – 25 minute computerized neurocognitive assessment
  – Scores before and after injury can be compared
  – Be wary as other factors can sway results: strenuous activity, pre-existing learning disabilities, ADHD, cumulative effects of prior concussion
Head Impact on the Field/Court

• Observable signs
  – Inability to recall events prior to or after a hit or fall
  – Appears dazed or stunned
  – Forgets instructions or inability to recall score or opponent
  – Moving clumsily
  – Answering questions slowly
  – Losing consciousness
    • Keep in mind, approximately 8.9% of sports related TBI results in LOC
  – Showing mood, behavior or personality changes
    – *Suggestions from CDC Heads Up Program
Acute Assessment: Sideline Protocols

- Standardized Sideline Assessments
  - Acute Concussion Evaluation (ACE)
  - Developed by the CDC
  - Free Resource!
Acute Assessment: Sideline Protocols

- Standardized Sideline Assessments
  - Sideline Concussion Assessment Tool (SCAT)
  - Office use too
  - Tool used in VB
Acute Assessment: Sideline Protocols

- Standardized Sideline Assessments
  - Standardized Assessment of Concussion (SAC)
Acute Assessment: Sideline Protocols

• Standardized Sideline Assessments
  – Balance Error Scoring System (BESS)

**Balance Error Scoring System (BESS)**

- Quantifiable clinical battery of tests
- Eyes are closed in all positions during test
- Utilizes different stances on both firm and foam surface
- Errors are tabulated when the athlete
  - Opens their eyes
  - Takes hands off hips
  - Steps/stumbles or falls

**Positions**
1. On firm surface
   a. Feet side by side
   b. Single foot balance
   c. One foot behind other
2. On unstable surface
   a. Feet side by side
   b. One foot balance
   c. One foot behind other
Care Outside of School Clinic
Evaluation in the Outpatient Clinic

- Thorough past medical, social, educational history
  - History of previous concussions
  - Previous performance in school
- Thorough history of the event
  - Look for post traumatic amnesia
Evaluation in the Outpatient Clinic

- Head and Neck Exam
- Neurologic Exam
- Vision/Oculomotor Exam
  - Convergence, Cover Uncover Test
- Gait/Balance Testing
  - Romberg, Fukada Marching Test, Tandem Gait
- Cognitive Assessment
Neuroimaging

• Red flag symptom → Emergency Department → CT Scan
  – Hematoma or Hemorrhage
• MRI
  – Neurologic exam abnormalities
  – 6 months post-injury and continues to be symptomatic
  – 1.5 Tesla vs 3.0 Tesla
• Diffusion Tensor Imaging
  – Identification of neural tracts
• Susceptibility Weighted Imaging
  – Ability to detect venous blood and evidence of hemorrhage
Treatment in the Acute Phase

- Activity limitations- physical and cognitive
  - Complete rest from school and physical exercise until acute symptoms start to improve
  - Length of time tailored to each patient
  - Slow reintroduction to activities
    - Cognitive and Physical
    - May utilize Buffalo Concussion Treadmill Test to get them moving! (Developed by Dr. John Leddy)
Treatment in the Acute Phase

• Emphasis on restorative sleep
  – Sleep hygiene
  – CBTi
  – Melatonin
    • 3-10mg 2 hours prior to bed
    • 0.3-0.5mg 5 hours prior to sleep to advance sleep-wake pattern
  – Amitriptyline
    • Be wary of morning “hangover” or fog
Treatment in the Acute Phase

• Headache
  – Identification of triggers
    • Light, noise, cognitive activity, physical activity
  – Identification or contributing factors
    • Neck injury, TMJ, vision deficits, dehydration
  – Abortive vs prophylactic treatment
    • Abortive medication should be limited to $\leq 3x/week$
Treatment in the Acute Phase

• Headache
  – Abortive- In the immediate time following concussion, avoid meds that restrict blood flow
    • Ibuprofen
    • Tylenol
    • Triptan medications
  – Prophylactic
    • Not to be considered until all of the above have been exhausted
    • Tricyclic antidepressants- Amitriptyline
    • Anti-epileptics
      – Topiramate
        » Can be used in children 12 and older
        » Side effects: paresthesias, drowsiness, memory impairment, anorexia
    – Gabapentin
    – Valproic acid
**Keep in mind that at this point, you have most likely transitioned into a persistent symptom phase**
Treatment in the Acute Phase

• Headache
  – Peripheral nerve blocks
  – Greater occipital nerve injections
Treatment in the Acute Phase

- Physical therapy referral
  - Neck pain, balance disorders
  - Vestibular rehabilitation
  - May be an integral part of return to play
- Cognitive Therapy
  - Speech-language pathologists, Occupational therapists
- Psychotherapy
- Vision Therapy
Return to Learn Protocols

How to help your students get back to being students
Return to Learn

• Driven by the licensed healthcare professional
  – Coordinate with individual school- **Support is needed**

• 6 Phases outlined by the Department of Education
  – Phase 1: Cognitive and Physical Rest- At home
    • Minimal cognitive activities
    • No homework
    • No driving
    • Minimal physical activity
    • **Not all patients will need to start here, some patients may start in Phase 2 or 3**
Return to Learn

– Phase 2: Light cognitive mental activity- At home
  • Up to 30 minutes of sustained cognitive exertion
  • No prolonged concentration
  • No driving
  • Limited physical activity

– Progression to part-time school when able to tolerate a minimum of 30 minutes of sustained cognitive exertion
Return to Learn

– Phase 3: Maximum instructional modifications
  • Shortened days with built-in breaks
  • Modified environment
  • Established learning priorities
  • Exclusion from testing
  • Elimination or reduction of homework
  • Extra assistance, modified assignment
  • **This is not a time to allow standardized testing
Examples of Classroom Accommodations

• Frequent breaks or passes to the clinic for rest
• *Allow students to put their heads down in class
• *Early dismissal from class to avoid crowded, noisy hallways
• *Allow student to wear sunglasses/brimmed hat/visor
• Avoid completion of major tests or projects during recovery period
• Decrease homework and make up workload
• *Allow student to eat lunch in a quiet area
• *Pre-printing or posting notes and lecture outlines, decreased use of Chrome Book
• *Assess knowledge with multiple choice questions instead of open-ended questions; testing in non-distracting setting
• Allow water and healthy snacks to be consumed as required
Return to Learn

– Phase 4: Moderate instructional modifications

– Phase 5: Minimal instruction modifications
  • Student should be able to tolerate full-time attendance without exacerbation of symptoms
  • May still utilize built-in breaks
  • Continued exclusion from standardized testing or summative testing
  • Continuation of instructional modification and supports in academically challenging subjects

– Phase 6: Attends all classes
  • Maintains full academic load
  • No instructional modifications
Return to Learn- Complications

• Doesn’t always go as planned!
• Homebound instruction
• Continuation of accommodations
• May consider 504 plan if student is 3-4 weeks post injury without improvement
Return to Play Protocols
Return to Play

- May begin after Return to Learn is completed
- Department of Education requires each student to have a written medical release from a licensed health care provider before beginning Return to Play
- Duration of Return to Play is unique to the athlete
- Chesterfield County (similar in VB)
  - No athlete will return to full participation of an activity before being symptom free at rest and with exercise for a minimum of 7 days
  - Return to play is completed under the direction of the Certified Athletic Trainers for the county
# Return to Play

## TABLE 3.

### Return-to-Play Protocol

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>No activity</td>
<td>Complete physical rest.</td>
<td>Recovery</td>
</tr>
<tr>
<td>Light aerobic exercise</td>
<td>Walking, swimming, aerobic exercise up to 70% of maximum predicted heart rate, no resistance training.</td>
<td>Increase heart rate.</td>
</tr>
<tr>
<td>Sport-specific exercise</td>
<td>Sport-specific exercise such as skating and running drills; no head impacts.</td>
<td>Add movement.</td>
</tr>
<tr>
<td>Noncontact training drills</td>
<td>Progress to complex drills; add resistance training.</td>
<td>Exercise, coordination, add cognitive load.</td>
</tr>
<tr>
<td>Full contact practice</td>
<td>Normal practice after cleared by medical personnel.</td>
<td>Restore confidence and timing, allow assessment of functional skills.</td>
</tr>
<tr>
<td>Return to play</td>
<td>Normal game play.</td>
<td>Full return to play.</td>
</tr>
</tbody>
</table>

*Source: Adapted from Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport held in Zurich, November 2008*
Prognosis and Future Care
Prognosis

• Good for young, otherwise healthy individuals
• Up to 90% of patients have symptoms resolved by 4 week mark
• Discussion regarding decreasing risk moving forward
  – Should I go back to sports?
Specialist Care

• Brain Injury Medicine
  – Psychiatry, Physical Medicine and Rehabilitation, Sports Medicine, Neurology
  – American Board of Psychiatry and Neurology
• Recommended when symptoms have not resolved in 2-4 weeks after injury
• Comprehensive evaluation and treatment of persistent symptoms: physical, cognitive, behavioral and sleep
Other Considerations

- Mood disorders
- Attention deficit disorder
- Neuroendocrine disorders
- Vitamin deficiencies as they may exacerbate symptoms such as fatigue
- Central auditory processing disorders
- Sexual dysfunction
- Musculoskeletal dysfunction such as spasticity
- Neurogenic bladder
Post Concussion Syndrome

- Term used when symptoms of concussion last longer than expected
- Controversial term, No overall consensus
- No clear cut objective findings
- No clear cut time frame- any where from 1 week to 6 months
- The patient is still suffering from concussion!
Chronic Traumatic Encephalopathy

- 1928- “Punch drunk”
- Etiology not completely known
  - Involvement of tau protein
- Correlations with length of time playing sports, number of injuries, age at which impacts started
  - Hundreds to thousands of impacts including subconcussive
- Slow deterioration
- Typically starts with deficits in attention, memory, etc and progresses to behavioral changes such as apathy and impulsiveness
- May develop into gait changes, tremors, slurred speech, dementia
Other concussion resources

- Centers for Disease Control and Prevention: cdc.gov/headsup/index.html
- Brain Injury Association of America: BIAUSA.org
- Brain Injury Association of Virginia: BIAV.net
- CenterForNeuroRehabServices.org
- SportzSafe.com
- Ontario Neurotrauma Foundation: ONF.org
- BrainSTEPS: (http://www.biapa.org/site/c.iuLZJbMMKrH/b.3486877/k.6F10/School_ReEntry_BrainSTEPS.htm)
  - Link for the concussion policies in student athletes in Virginia Beach
Resources and References

- [https://www.biausa.org/](https://www.biausa.org/)
- [https://www.biav.net/](https://www.biav.net/)
- [Centers for Disease Control and Prevention: cdc.gov/headsup/index.html](https://www.biav.net/)