Objectives

- consensus highlights/topic updates
- office evaluation
- treatment options
- how to refer to sports medicine
  - non-sports concussions
- Epic phrases and GW forms
- Practice skills

Concussion Questions…

**How many Gs?**

- How many is too many?

**Is too much rest a bad thing?**

- Can they go back in the game?

**Risk for other injuries?**

**Will I get CTE?**

- How long will my symptoms last?

**How important is neuropsych testing?**
Epidemiology

2005-2009 2 million outpatient visits, 3 million ED visits (CDC 2018) - improved recognition/reporting

Prognosis: adults 10-14 days, children 4 weeks (McCory 2017)

30% experience post-concussive symptoms > 4wks (Babcock 2013, McCrea 2013)

Concussion Cascade

From: The New Neurometabolic Cascade of Concussion
Neurosurgery | Copyright © 2014 by the Congress of Neurological Surgeons
Computerized Neuropsychological Testing

ANAM, Axon Sports/Cogstate Sport, and ImPACT

High school and collegiate athletes completed two CNTs each at baseline.

Concussed (n = 165) and matched non-injured control (n = 166) subjects repeated testing within 24 hr and at 8, 15, and 45 days post-injury

Test–retest reliability was similar among these three CNTs and **below** optimal standards for clinical use on many subtests

Group differences in performance were mostly moderate to large at 24 hr and small by day 8
Clinical vs Physiologic Recovery

Concussion Trajectories

Using Concussion Clinical Trajectories to Inform Targeted Treatment Pathways

Source: "A comprehensive, targeted approach to the clinical care of athletes following sport-related concussion"
Equipment

Mouthguards do not protect against concussion

Skull sensors still unreliable

Q Collar still under testing and not available

CTE

Degenerative brain disorder

characteristic tau deposition

symptoms develop years after insults

? co-morbidities

  addiction, depression

diagnose postmortem

Increased safety of current game

  youth changes
Acute Concussion Evaluation

Epic smartphrase .ACUTECONCUSSION

Post-Concussion Symptom Scale

Standardized Assessment of Concussion (SAC)

Cervical Screen

Balance Screen

Vestibular-Ocular Screen

Youtube - Duke Neurology: Clinical Evaluation of the Athlete with Concussion

Common Symptoms

**TABLE 1**

Concussion: Signs, symptoms, and risks\(^8-10\)

<table>
<thead>
<tr>
<th>Common signs and symptoms</th>
<th>Risk factors for concussion or prolonged course</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Headache</td>
<td>• Female gender</td>
</tr>
<tr>
<td>• Dizziness</td>
<td>• History of migraine/chronic headache</td>
</tr>
<tr>
<td>• Light/noise sensitivity</td>
<td>• Learning disabilities</td>
</tr>
<tr>
<td>• Difficulty sleeping</td>
<td>• ADHD</td>
</tr>
<tr>
<td>• Difficulty concentrating</td>
<td>• Mood disorder</td>
</tr>
<tr>
<td>• Emotional lability</td>
<td>• Prior concussion</td>
</tr>
<tr>
<td>• Imbalance</td>
<td>• Greater number/severity of symptoms</td>
</tr>
<tr>
<td>• Amnesia</td>
<td>• Loss of consciousness &gt;1 min</td>
</tr>
<tr>
<td>• Confusion</td>
<td>• Post-traumatic amnesia</td>
</tr>
<tr>
<td>• Fatigue</td>
<td>• Younger age</td>
</tr>
</tbody>
</table>

ADHD, attention deficit hyperactivity disorder.

Sprouse, Harris, et al. JFP August, 2016
Red Flags to Consider ED

TABLE 3
Red flags that further testing is needed\textsuperscript{8-10}

- Focal neurologic deficits
- Loss of consciousness >1 minute
- Neck pain/injury
- Persistent disorientation
- Persistent nausea/vomiting
- Seizure
- Worsening headache

Sprouse, Harris, et al. JFP August, 2016

PECARN

Pediatric Head Trauma CT Decision Guide
Children 2 years and older

\begin{itemize}
  \item GCS < 15
  \item Signs of basilar skull fracture
  \item AMS (agitation, somnolence, slow response, repetitive questions)
\end{itemize}

\begin{itemize}
  \item Vomiting
  \item LOC
  \item Severe headache
  \item Severe mechanism of injury
    - Fall > 3 ft
    - MVA w/ejection, rollover, or fatality
    - Bike/ped vs. vehicle w/o helmet
    - Struck by high-impact object
\end{itemize}

\begin{itemize}
  \item \textbf{YES TO ANY}
  \item \underline{CT} High Risk – 4.3\% risk of ci-TBI\textsuperscript{*}

  \item \textbf{NO}
  \item \underline{CT not indicated, Observe} Low Risk – < 0.03\%
\end{itemize}

\begin{itemize}
  \item Intermediate Risk – 0.8\%
    \begin{itemize}
      \item Observation vs. CT using shared decision-making
        \begin{itemize}
          \item Clinical factors used to guide decision-making:
            \begin{itemize}
              \item Multiple vs. isolated factors
              \item Worsening findings during observation (AMS, headache, vomiting)
              \item Physician experience
              \item Parental preference
            \end{itemize}
        \end{itemize}
    \end{itemize}
\end{itemize}

\textsuperscript{*ci-TBI: risk of clinically important TBI needing acute intervention, based on PECARN validated prediction rules}
Canadian CT Head Rule

CT head is only required for minor head injury patients with any one of these findings:

**High Risk (for Neurological Intervention)**
1. GCS score < 15 at 2 hrs after injury
2. Suspected open or depressed skull fracture
3. Any sign of basal skull fracture*
4. Vomiting ≥ 2 episodes
5. Age ≥ 65 years

**Medium Risk (for Brain Injury on CT)**
6. Amnesia before impact ≥ 30 min
7. Dangerous mechanism ** (pedestrian, occupant ejected, fall from elevation)

*Signs of Basal Skull Fracture
- hematoma, ‘raccoon’ eyes, CSF otorrhea
-Battle’s sign

**Dangerous Mechanism
- pedestrian struck by vehicle
- occupant ejected from motor vehicle
- fall from elevation ≥ 3 feet or 3 stories

Rule Not Applicable If:
- Non-trauma cases
- GCS > 13
- Age < 18 years
- Coagulopathy or bleeding disorder
- Obvious open skull fracture

---

Differential Diagnosis

- Intracranial injury
- skull fracture
- hypoglycemia
- heat illness
- cervical injury
- seizure
- syncope
- migraine
- psychiatric illness
- malingering
- dehydration
Clinical Examination

<table>
<thead>
<tr>
<th>Cognitive</th>
<th>VOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cranial Nerves</td>
<td>King-Devick</td>
</tr>
<tr>
<td>Cervical</td>
<td>Smooth Pursuit</td>
</tr>
<tr>
<td>Balance</td>
<td>Saccades</td>
</tr>
<tr>
<td><strong>Timed Tandem Gait</strong></td>
<td>Convergence</td>
</tr>
<tr>
<td>Sway app</td>
<td>VOR</td>
</tr>
<tr>
<td>BESS</td>
<td>Visual Motion</td>
</tr>
<tr>
<td></td>
<td>Sensitivity</td>
</tr>
</tbody>
</table>

Cognitive - SAC

- Orientation
- Immediate recall
- Concentration (Digits backwards)
- Months backwards
- Delayed Recall
- WORLD backwards
- Serial 7s

“You’d better sit out the rest of the game. You might have a concussion.”
Cervical

- Cervical pain, weakness, paresthesia
- Palpation **midline** and for referred pain and headaches possible from trigger points in upper trap, SCM, etc
- Check ROM and isometric strength
- Upper extremity neuro exam
- R/O cervical instability

Balance

- Timed Tandem Gait quick screen
- Sway balance app
  - uses iPhone accelerometer
  - has reaction time component
- Balance Error Scoring System
  - rater experience may affect score
Timed Tandem Gait

3m line, hands on hips, <14 seconds, no errors

Vestibular-Oculomotor Screen (VOMS)

Smooth Pursuit
Saccades
Convergence
VOR
Visual Motion Sensitivity

“He can go back in the game. It’s just a bruise.”
Smooth Pursuit

Horizontal Saccades
Vertical Saccades

Near Point of Convergence

Patient focuses on target as you bring object closer to nose. Report when double vision

Greater than 6cm = abnormal

May have difficulty with focusing on targets and reading
Horizontal/Vertical VOR and Visual Motion Sensitivity

Post-Concussion Care Recommendations

- Early Home Care Instructions
- Return to Learn Recommendations
- Return to Work Recommendations
- Referrals for Sports Related Concussions
- Referrals for Non-Sports Related Concussions
Early Home Care Instructions

What to Do After a Suspected Concussion?

**Physical Activity:** Should be limited immediately following a concussion. Returning to activity too soon can cause symptoms to worsen or last longer. Consult with a concussion specialist to determine when you can safely return to activity.

**Schoolwork:** If reading and schoolwork cause increased symptoms, these activities should be limited. Student-athletes may also need to stay home from school to avoid busy and noisy environments.

**Screen Time:** Limit the use of phones, computers, tablets, or televisions to avoid a potential increase in symptoms.

**Sleep:** You may need more sleep immediately after a concussion. However, it is recommended to try to get on a normal sleeping routine within a few days. (Generally it is better to allow concussed individuals to sleep rather than waking them up frequently)

**Medicines:** Use of medicines is NOT recommended following a concussion. If medicine must be used for MILD pain/headache, acetaminophen may be given. Do not give ibuprofen or aspirin. Consult with your physician for questions about additional medicines.

**Driving:** Do not drive until cleared by physician.

**Supervision:** Individuals with suspected concussions should not be left alone. If athlete complains that headache is worsening in severity, has uncontrolled vomiting, or begins to have difficulty recognizing familiar people or places, call 9-1-1 or take them directly to the Emergency Room for immediate evaluation.

---

Symptom Management

**TABLE 4**

Managing symptoms\(^8\)-\(^{10}\)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>Acetaminophen (&lt;3 days)</td>
</tr>
<tr>
<td>Nausea</td>
<td>Ondansetron (&lt;3 days)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Vestibular rehabilitation</td>
</tr>
<tr>
<td>Insomnia</td>
<td>Sleep hygiene, melatonin</td>
</tr>
<tr>
<td>Neck pain</td>
<td>Ice, heat, massage</td>
</tr>
<tr>
<td>Light sensitivity</td>
<td>Sunglasses</td>
</tr>
<tr>
<td>Noise sensitivity</td>
<td>Ear protection</td>
</tr>
</tbody>
</table>

Sprouse, Harris, et al. JFP August, 2016
Questions?

corina.martinez@duke.edu  sportsconcussionclinic@duke.edu

NC State Laws/Requirements

Gfeller-Waller Concussion Awareness Act

Department of Public Instruction (DPI) - Concussion Monitoring and Management in Public Schools

NCHSAA - Forms and guidance for implementation of state laws
Gfeller-Waller Concussion Awareness Act

Signed into law June 16, 2011, effective 2011-2012 school year

1. Education

2. Emergency action and post-concussion protocol implementation

3. Clearance/RTP or practice following concussion

Gfeller-Waller Paperwork

All NCHSAA member school student-athletes diagnosed with a concussion are STRONGLY RECOMMENDED to have input and signature from a physician (MD/DO who is licensed under Article 1 of Chapter 90 of the General Statutes and has expertise and training in concussion management) before being cleared to resume full participation in athletics. Due to the need to monitor concussions for recurrence of signs & symptoms with cognitive or physical stress, Emergency Room and Urgent Care physicians should not make clearance decisions at the time of first visit. All medical providers are encouraged to review the CDC site if they have questions regarding the latest information on the evaluation and care of the scholastic athlete following a concussion injury. Providers should refer to NC Session Law 2011-147, House Bill 792 Gfeller-Waller Concussion Awareness Act for requirements for clearance, and please initial any recommendations you select. (Adapted from the Acute Concussion Evaluation (ACE) care plan [http://www.cdc.gov/concussion/index.html] and the NCHSAA concussion Return to Play Protocol.) The recommendations indicated below are based on today’s evaluation.

RETURN TO SCHOOL:

SCHOOL (ACADEMICS):

(LHC identified below should check all recommendations that apply.)

☐ Out of school until __/__/____ (date), LHC Initial: Date:
☐ Return for further evaluation on __/__/____ (date), LHC Initial: Date:
☐ May return to school on __/__/____ (date) with accommodations as selected on the LHC Concussion Return to Learn Recommendations page, LHC Initial: Date:
☐ May return to school now with no accommodations needed, LHC Initial: Date:

RETURN TO SPORTS:

SPORTS & PHYSICAL EDUCATION:

(LHC identified below should check all recommendations that apply.)

☐ Not cleared for sports at this time.
☐ Not cleared for physical education at this time.
☐ May do light physical education that poses no risk of head trauma such as walking laps.
☐ May start RTP Protocol under appropriate monitoring and may return to PE activities after completion.
☐ Must return to the examining LHC for clearance before returning to sports/physical education.
☐ May start the RTP Protocol under monitoring of First Responder. The examining LHC must review progress of student-athlete through stage 4 and before beginning stage 5 either electronically, by phone, or in person and an additional office visit is not required unless otherwise indicated by the LHC. If the student-athlete has remained free of signs/symptoms after stage 5 is completed, the LHC must then sign the RETURN TO PLAY FORM before the student-athlete is allowed to resume full participation in athletics.
☐ May start the RTP Protocol under monitoring of LHC and progress through all five stages with no office contact necessary unless required by examining LHC. If student-athlete remains free of signs/symptoms the LHC must sign the RETURN TO PLAY FORM before the student-athlete is allowed to resume full participation in athletics.

Comment: __________________________
Concussion Monitoring and Management in Public Schools

October 2015, NC State Board of Education approved policy HRS-E-001, titled Return-to-Learn After Concussion

Wider reaching - all students not just student-athletes

Focused on academic supports following concussion

Became effective in 2016-2017 academic year

Concussion Monitoring (cont.)

Each Local Education Agency (LEA) and charter school must develop a plan addressing needs for students suffering concussions (pre-school to 12th)

Guidelines for removal from activity (physical or mental)

Notification procedure to education staff regarding removal

Expectations regarding updates to medical care plan/school accommodations

Delineation of requirements for safe RTL/RTP

Annual staff training on concussion and brain injuries

Include question related to head injury/concussion on student health history and emergency medical information
Recommendations

Recommendations/Supports → Accommodations → Modifications
Accommodations level the playing field. Modifications change the field you are playing on.

Return to school with the following supports:

Length of Day

__ Shortened day. Recommended ___ hours per day until re-evaluated or (date) ________
__ 4 hours per day in class (consider alternating days of morning/afternoon classes to maximize class participation)
__ Shortened classes (i.e. rest breaks during classes). Maximum class length of ___ minutes.
__ Use ________ class as a study hall in a quiet environment.
__ Check for the return of symptoms when doing activities that require a lot of attention or concentration.

Extra Time

__ Allow extra time to complete coursework/assignments and tests.
__ Take rest breaks during the day as needed (particularly if symptoms recur).

Homework

__ Lessen homework by ___% per class, or ___ minutes/class; or to a maximum of ___ minutes nightly,
no more than ___ minutes continuous.

Testing

__ No significant classroom or standardized testing at this time, as this does not reflect the patient's true abilities.
__ Limited classroom testing allowed. No more than _____ questions and/or ______ total time.
__ Student is able to take quizzes or tests but no bubble sheets.
__ Student able to take tests but should be allowed extra time to complete.
__ Limit test and quiz taking to no more than one per day.
__ May resume regular test taking.

Vision

__ Lessen screen time (SMART board, computer, videos, etc.) to a maximum _____ minutes per class AND no more
than _____ continuous minutes (with 5-10 minute break in between). This includes reading notes off screens.
__ Print class notes and online assignments (14 font or larger recommended) to allow to keep up with online work.
__ Allow student to wear sunglasses or hat with bill worn forward to reduce light exposure.

Environment

__ Provide alternative setting during band or music class (outside of that room).
__ Provide alternative setting during PE and/or recess to avoid noise exposure and risk of injury (out of gym).
__ Allow early class release for class transitions to reduce exposure to hallway noise/activity.
__ Provide alternative location to eat lunch outside of cafeteria.
__ Allow the use of earplugs when in noisy environment.
__ Patient should not attend athletic practice
__ Patient is allowed to be present but not participate in practice, limited to ___ hours
<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>No activity</td>
<td>Complete cognitive rest — no school, no homework, no reading, no texting, no video games, no computer work.</td>
<td>Recovery</td>
</tr>
<tr>
<td>Gradual reintroduction of cogniti - tive activity</td>
<td>Relax previous restrictions on activities and add back for short periods of time (5-15 minutes at a time).</td>
<td>Gradual controlled increase in subsyptom threshold cognitive activities.</td>
</tr>
<tr>
<td>Homework at home before school work at school</td>
<td>Homework in longer increments (20-30 minutes at a time).</td>
<td>Increase cognitive stamina by repetition of short periods of self-paced cognitive activity.</td>
</tr>
<tr>
<td>School re-entry</td>
<td>Part day of school after tolerating 1-2 cumulative hours of homework at home.</td>
<td>Re-entry into school with accommodations to permit controlled subsyptom threshold increase in cognitive load.</td>
</tr>
<tr>
<td>Gradual reintegration into school</td>
<td>Increase to full day of school.</td>
<td>Accommodations decrease as cognitive stamina improves.</td>
</tr>
<tr>
<td>Resumption of full cognitive workload</td>
<td>Introduce testing, catch up with essential work.</td>
<td>Full return to school may commence Return-to-Play protocol (see Step 2 in Table 2).</td>
</tr>
</tbody>
</table>

*Source: Master CE, Gious GA, Luddy JJ, Grady MF*

---

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>No activity</td>
<td>None</td>
<td>Recovery</td>
</tr>
<tr>
<td>Light aerobic exercise</td>
<td>Walking, swimming, stationary bike. No resistance training.</td>
<td>Increase heart rate</td>
</tr>
<tr>
<td>Sport-specific exercise</td>
<td>Running soccer drills. No head impact activities (ie, skating).</td>
<td>Movement</td>
</tr>
<tr>
<td>Noncontact training drills</td>
<td>More complex training. Progressive resistance training (ie, shooting drill, noncontact plays).</td>
<td>Exercise, coordination, cognitive load</td>
</tr>
<tr>
<td>Full contact practice</td>
<td>After medical clearance. Full activities (ie, full scrimmage in practice).</td>
<td>Assess function</td>
</tr>
<tr>
<td>Return to play</td>
<td>Normal play (ie, full game play).</td>
<td>Assess function</td>
</tr>
</tbody>
</table>

*Information from McCrory P, et al.5*
Duke Sports Concussion Clinic

Established 2014

Initial clinic evaluation performed by PCSM physician

Mission Statement: To extend world class care of SRC through innovative research, education, baseline testing, rapid access, evidence-based evaluations, and multidisciplinary treatment.

Collaborations with outreach schools in DPS, OCS, WCS as well as local sports clubs/organizations

Assessments

- Post-Concussion Symptom Scale
- Cervical Screen
- Standardized Assessment of Concussion (SAC)
- King-Devick
- Vestibular-Ocular Motor Screen (VOMS)
- Sway Balance assessment (with reaction time)
- Senaptec Visual screening
- Neurocognitive Testing (if indicated)
- Cardiovascular (if indicated)
Multi-Disciplinary Team - Medical

- Physical Therapy
- Vision Clinic/Rehabilitation
- Neuropsychology
- Neurology
- Occupational Therapy
- Speech-Language Pathology
- Audiology

Return to Learn Difficulties

Neuropsychology: Behavioural changes, depression, anxiety - formalized testing to identify neurocognitive deficits

Occupational Therapy: Difficulty with environmental factors - lights, noises, busy environments, schedule management, planning/organizing

Speech-Language Pathology: Learning and processing difficulty, cognitive fatigue - Attention, memory, comprehension
Vision Correlates

Abnormal vision findings may contribute to:

- headaches with persistent reading/focusing
- attention difficulties
- difficulty with comprehension

Consider referral to Eye Center for vision evaluation

Support Team - Academic

- Athletic Trainers
- Guidance Counselors
- Athletic Directors
- Coaches
- First Responders
- Parents/Family
Referrals for Sports-Related Concussions

Contact Duke Sports Injury and Concussion Hotline @919-660-4117

if voicemail, be sure to leave message

Required information: Patient Name, DOB, contact phone number

If available, include MRN

If Medicaid, need contact info for patient’s PCP/pediatrician to get authorization for appointment

Non-Sports Related Concussion Referrals

For acute pediatric cases (up to 18yo): referral to pediatrician for follow-up management

For pediatric cases (up to 18yo) with symptoms greater than 2 weeks: referral to Pediatric Neurology

For adult cases: referral to either patient’s PCP or General Neurology scheduling center (919)668-7600 *oftentimes next available appt is 2-3 months

For patients with symptoms of neck pain, headaches, dizziness, imbalance, exercise intolerance: Referral to Outpatient PT for concussion evaluation (usually can be seen within 2-3 weeks)

For patients with cognitive processing, memory, communication deficits, referral to Speech Language Pathology for speech therapy
Speech Referrals

Please consider Referral to Speech Pathology Following Concussion if your patient demonstrates difficulties with any of the following:

- **Language**
  - Word finding
  - Engaging in conversation
  - Writing
  - Reading

- **Cognition**
  - Remembering things
  - Paying attention
  - Concentrating/ focusing
  - Learning new information

- **Executive Function**
  - Planning
  - Organizing assignments, tasks
  - Solving problems
  - Starting and finishing activities

- **Pragmatics/ Social Interaction**
  - Interacting with peers, parents, teacher, spouse
  - Irritability
  - Fatigue with tasks such as reading, typing/ writing
  - Inefficiency, poor performance
  - Acting out inappropriately (e.g., in classroom)
  - Not understanding jokes, humor
  - Withdrawing
  - Frustration with tasks being more difficult than before

---

**Speech Referrals**

**PROCESS**

1. **Place order**
   - Ambulatory Referral to Speech Pathology
   - Preferred location: Duke
   - Sched Inst: Hit F2, Select:
     - This order is for: Eval and Treat
     - Speech Lang Dx: Cogn comm s/p TBI

2. **Tell patient**
   - Speech clinic will call you to schedule the appointment
   - If symptoms have resolved at that time, you do not have to make the appointment

3. **Remind patient**
   - If symptoms return/ worsen after return to work or school call to make an appointment: 919-684-3859
Epic Smartphrases

.NCHSAACONCUSSIONEVALUATION —> Gfeller Waller Required Concussion Evaluation Form

.NCHSAARTLFORM —> NCHSAA RTL Recommendations

.CONCUSSIONINFO —> informational handout “What is a concussion?”

.CONCUSSIONFAQ —> FAQ about concussion (Duke form)

.CONCUSSIONRTL —> RTL info/guidelines (Duke form)

Thank you - Questions?

corina.martinez@duke.edu  sportsconcussionclinic@duke.edu