Supporting students with concussion: Getting school psychologists in the game

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Children’s National Health System
Professor, Depts. of Pediatrics and Psychiatry & Behavioral Sciences
George Washington University
School of Medicine
1. 50% percent of persons who sustain a concussion typically lose consciousness. **True/ False**

2. Current guidance on returning the symptomatic patient to school with a concussion is to require complete physical and cognitive rest until fully asymptomatic. **True/ False**

3. The most common post-concussion symptom is a headache. **True/ False**

4. The responsibility of the school psychologist in the concussion process is to test the student in depth. **True/ False**

5. A common intervention/ accommodation strategy is to provide periodic rest breaks during the school day as needed. **True/ False**
Objectives

1. Achieve a working understanding of the impact of concussions/mTBI on student learning and social-emotional functioning
2. Articulate knowledge of evaluation & management of concussion and tools
3. Knowledge of intervention strategies for working with students with mTBI
4. Articulate return to athletics criteria, and processes for return to school including practical accommodations to support the student
5. Define school system responsibilities, and roles for supporting the returning student
Concussion/ mTBI 10-15 Years Ago

- Little understanding of mTBI
- Few treating healthcare providers
- Few medical tests or tools
- Minimal research/ funding
- Little public awareness of risks
- No rules to protect kids
Where Are We Today?

- Increased public awareness
- Significant increase in recognition of sport-related mTBI/ concussion
- Expanding our research knowledge
- Improving our understanding of the injury
- Training more healthcare providers, clinics
- Developing more clinical tests and tools
- Implementing rules to protect kids
Concussion vs ADHD in 1980

**ADHD**
- 1980: Most kids were evaluated and treated by specialists
- 2013: Most kids are evaluated and treated by primary care physicians
  - Refer Complex Cases

**Concussion**
- 2013: Most kids are evaluated and treated by specialties
- 20??: Most kids are evaluated and treated by primary care physicians
  - Refer Complex Cases
Basic Underlying Assumptions

- The Brain is WAY/ WICKED complex!
- Brain injury is WAY/ WICKED complex!
- Brain injury often does not manifest in a single domain of functioning
- **No single score, test/ measure, discipline, person can answer ALL the clinical questions in this complex injury of brain injury.**
- Understanding brain injury requires a synthesis of multiple perspectives and clinical data sources.
When suspected injury occurs, is there an “effect” or “no effect” on child?

Effect means change in function relative to pre-injury

How do we determine the effect/change in function?

Pre → Post → Pre
Concussion Clinician’s Questions

- What tools help us to answer clinical questions?
- What research evidence supports use of tools to answer the clinical questions?
- How can the clinician assemble together the sources of evidence to answer the clinical questions?
What are my responsibilities and limitations?

How can I expand my role and function?
Tapping into Existing Skills

- Tiered approach
- Systems-level change
- Prevention
- Intervention
- Consultation and collaboration
- Data-based decision-making and progress monitoring
Systems-Level Support and Prevention

- In-services providing concussion education
  - Targeted to coaches, athletic directors, parents, teachers, athletes, administrators, school nurses, school psychologists, school counselors
- Preseason/beginning of year baseline testing
  - Provides preinjury measurement of cognitive abilities
Intervention and Consultation

- School-based support during recovery
  - Academic
  - Behavioral
  - Social/emotional

- Coordinated, medically-approved return to play decisions
  - Written policy should clarify procedures
Assessment and Progress Monitoring

• Careful individualized clinical assessment and tracking from time of injury
  • Acute Concussion Evaluation (ACE)
  • Neuropsychological Testing

• Implement active symptom progress monitoring at school
  • Assess/monitor cognitive exertional effects
  • Assess key parts of the day/ key classes where symptoms worsen
Family-School-Medical Team Collaboration

- Multiple people watching and helping the student
  - Helps inform return-to-school and return-to-play decisions
    - Parents monitor rest and reduction of activities
    - Teachers gather information on academic accommodation plan
    - School nurse assist with management of physical symptoms
    - School psychologist help all involved with the student track data and monitor signs and symptoms

- Communicate information through a concussion case manager or “point person” (e.g., school psychologist)
Concussion 101

1. What is a concussion?
2. What happens to the brain?
3. Describe the signs & symptoms
6 Action Steps Everyone Should Know and Do

1. Learn how to recognize a concussion.
2. Learn the 12 Danger Signs → 911
3. Remove child from risk if you suspect a concussion, obtain a medical evaluation
4. Support proper treatment: physical, cognitive, emotional support
5. Monitor & record child’s symptoms at home
6. Use tools to guide you
   a. CDC Heads Up materials
   b. Concussion Recognition & Response (CRR) app
   c. Acute Concussion Evaluation (ACE)
**Terms in the Literature:**

- Head injury
- Closed head injury
- Head trauma
- Closed head trauma
- Minor head injury/trauma
- Traumatic brain injury
- Concussion
- Mild traumatic brain injury

**Common Terms:**

- “Head bonk”
- “Ding”
- “Bell ringer”
Concussion/mTBI Definition

- **A concussion (or mild traumatic brain injury)** is defined as:
  - Complex pathophysiological process affecting the brain,
  - Induced by traumatic biomechanical forces secondary to direct or indirect forces to the head.
  - Disturbance of brain function is related to: neurometabolic dysfunction, rather than structural injury typically associated with normal structural neuroimaging findings (i.e., CT scan, MRI).
  - Concussion may or may not involve a loss of consciousness (LOC). (10-20%)

Concussion results in a constellation of symptoms:
- physical, cognitive, emotional and sleep-related.
- Duration of symptoms are variable may last for as short as several minutes and last as long as several days, weeks, months or even longer in some cases.
- Glasgow Coma Scale ≥ 13 (3-15 scale)
- Loss of Consciousness no longer than 60 minutes (typically no longer than 20 sec.)
- No evidence of complicated TBI/structural abnormality (skull fracture, intracranial bleed, known lesion)

What is a concussion?

- A bump, blow or jolt to the head or body that causes the brain to move rapidly back & forth
- Causes stretching of brain, causing chemical changes, and cell damage
- Causes change in how brain works (signs & symptoms)
- Once these changes occur, brain is more vulnerable to further injury and sensitive to increased stress
Types/ mechanisms of injury

- MVC
- Struck by
- Falls
- Assaults
- Sports
- Recreation

- Linear forces
- Rotational forces
- Interaction with existing brain factors
Concussion = Traumatic Brain Injury
Neurometabolic Cascade Following Traumatic Brain Injury

(Giza & Hovda, 2001)

Calcium

K+

Glucose

Glutamate

Cerebral Blood Flow

% of normal

minutes

hours
days

UCLA Brain Injury Research Center
Effects of Concussive Forces on the Brain

- Typically, the “software” of the brain is affected
  - Neurometabolic/ neurochemical processes
  - Physiological
- Not the “hardware”
  - Structure
Anatomical Timeline of a Concussion
Defining the Key Factors

A. Injury Characteristics
- LOC <10%
- Anterograde Amnesia 25-40%

B. Symptom Assessment
- Neurocog dysfx & Post-Concuss Sx’s

C. Risk Factors
- Pre-Injury Risks
- Retrograde Amnesia 20-35%
- Anterograde Amnesia 25-40%

Clock:
- Sec-Min
- Sec-Hrs
- Hours - Days - Weeks+
Signs of a Concussion
(what you observe)

Cognitive
• Appears dazed/stunned
• Confused about events (assignment or position)
• Answers questions more slowly
• Repeats questions/forgets instruction or play
• Can’t recall events prior to or after the hit/fall

Physical
• Vomiting
• Loses consciousness
• Balance problems
• Moves clumsily
• Drowsy

Behavior/Emotion
• Behavior or personality changes
Symptoms of a Concussion
(what they feel and report)

**Physical**
- Headache
- Fatigue
- Visual problems (blurry/“double”)
- Nausea/vomiting
- Balance problems/dizziness
- Sensitivity to light/noise
- Numbness/tingling

**Cognitive**
- Mental fogginess
- Difficulty concentrating
- Difficulty remembering
- Feeling slowed down

**Emotional**
- More emotional
- Irritable
- Sad
- Nervous

**Sleep**
- Sleeping more/less
- Trouble falling asleep
- Drowsiness
Recovery From Concussion: How Long Does it Take?

N=134 High School athletes  Collins et al., 2006, Neurosurgery
## Studies Reporting Individual Recovery Rates

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample Size</th>
<th>Population</th>
<th>Tests Utilized</th>
<th>Total Days Cognitive Resolution</th>
<th>Total Days Symptom Resolution</th>
<th>Individual Recovery Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCrea, Guskiewicz et al. 2003</td>
<td>94</td>
<td>College</td>
<td>Paper and Pencil</td>
<td>3-5 Days</td>
<td>7 Days</td>
<td>91% recovered w/in 7 days</td>
</tr>
<tr>
<td>Iverson et al. 2006</td>
<td>30</td>
<td>High School</td>
<td>Computer ImPACT</td>
<td>10 days</td>
<td>7 Days</td>
<td>50% recovered w/in 7 days</td>
</tr>
<tr>
<td>Collins Lovell, et al. 2006</td>
<td>134</td>
<td>High School</td>
<td>Computer ImPACT</td>
<td>NR</td>
<td>NR</td>
<td>40% recovered w/in 7 days</td>
</tr>
</tbody>
</table>

Christopher C. Giza, Jeffrey S. Kutcher, Stephen Ashwal, et al.

Neurology; Published online before print March 18, 2013; DOI 10.1212/WNL.0b013e31828d57dd

This information is current as of March 18, 2013

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://www.neurology.org/content/early/2013/03/15/WNL.0b013e31828d57dd

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Returning to Learning Following a Concussion
Mark E. Halstead, Karen McAvoy, Cynthia D. Devore, Rebecca Carl, Michael Lee, Kelsey Logan and Council on Sports Medicine and Fitness, and Council on School Health

*Pediatrics*; originally published online October 27, 2013;
DOI: 10.1542/peds.2013-2867
Sports-Related Concussions in Youth: Improving the Science, Changing the Culture

For more information visit www.iom.edu/concussions

“limitations to the existing evidence base includethe fact that relatively little research has focused specifically on concussions versus the more severe forms of traumatic brain injury, particularly in youth ages 5 to 12” (p. 5)
Institute of Medicine Report
Sports-Related Concussions in Youth
Research Recommendations

1 - Surveillance.
2 - Diagnosis and Management.
3 - Short- and Long-term Consequences.
4 - Age-Appropriate Rules and Standards.
5 - Biomechanics, Equipment, and Safety Standards.
6 - Culture Change.
<table>
<thead>
<tr>
<th>Sport</th>
<th>High School</th>
<th>College</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lincoln</td>
<td>Gessel</td>
</tr>
<tr>
<td>Football</td>
<td>6.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Ice Hockey (W)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ice Hockey (M)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lacrosse (W)</td>
<td>2.0</td>
<td>-</td>
</tr>
<tr>
<td>Lacrosse (M)</td>
<td>3.0</td>
<td>-</td>
</tr>
<tr>
<td>Soccer (W)</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Soccer (M)</td>
<td>1.7</td>
<td>2.2</td>
</tr>
<tr>
<td>Wrestling</td>
<td>1.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Field Hockey</td>
<td>1.0</td>
<td>-</td>
</tr>
<tr>
<td>Basketball (W)</td>
<td>1.6</td>
<td>2.1</td>
</tr>
<tr>
<td>Basketball (M)</td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Softball</td>
<td>1.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Baseball</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Volleyball</td>
<td>-</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<sup>a</sup> DataLys Center: 2010-2012
<sup>b</sup> Hootman: 1988-2004
<sup>c</sup> Gessel: 2005-2006
<sup>d</sup> Agel and Harvey: 2000-2007
<sup>e</sup> DataLys Center: 2004-2009
<sup>f</sup> DataLys Center: 2009-2013
If we do not properly recognize and manage concussions...

- **RISKS INCREASE!!!**

- Player is **more likely** to be re-injured.
- **Second/third... injuries:**
  - Are more likely to be more severe
  - Could cause permanent brain damage
  - Can take longer to recover from
  - Increase risk of retirement from sport
When I leave today, how can I remember all this information? Where can I go?
Concussion/ mTBI
CDC Educational Materials

www.cdc.gov/concussion

Heads Up: Concussion in High School Sports
Heads Up: Concussion in Youth Sports
Heads Up: Concussion in Your Practice
Heads Up to Schools: Know Your Concussion ABCs
Evaluation & management of concussion and tools

- “Public health” recognition: CRR
- Symptom-based:
  - Acute Concussion Evaluation (ACE)
  - Post-Concussion Symptom Inventory (PCSI)
  - BRIEF
- Performance-based:
  - CARE Sport (SAC)
  - Neuropsychological testing
  - Tests of Executive Control (TEC)
Injury to the Head Occurs

What is your Protocol?

Identification
Diagnosis
Treatment

Injury Scenario

What can You Do?

What tools can help?
Partnering to Identify

Injury Setting
- Home
- Backyard
- Neighborhood
- School
- Playground
- Athletic Field
- Road
- Woods
- ...

Identification
- Non-Medical
  - Parent
  - Teacher
  - Neighbor
  - Coach
  - Friend
  - Teammate
  - Bystander
  - ...
- Medical Provider
  - EMT
  - Emergency Dept.
  - Urgent Care
  - Primary Care
  - School Health
  - Athletic Health
  - Specialty Care

“Job”
- Recognize & Respond
  - 1+2 → “When in Doubt, Sit Them Out”

“Job”
- Diagnose & Treat

Children’s National
Four Corners Approach to Concussion
Partners in Care

Family

Medical

School

Sports/Recreation

Child / Teen
(Student, Athlete, Son/Daughter, Friend)
**SECONDS TO SAVE LIVES**

**HEADS UP CONCUSSION IN FOOTBALL**

**SIGNS AND SYMPTOMS**

Athletes who experience **one or more** of the signs and symptoms listed below after a bump, blow, or jolt to the head or body may have a concussion.

- **Signs Observed by Coaching Staff**
  - Appears dazed or stunned
  - Is confused about assignment or position
  - Forgets an instruction
  - Is unsure of game, score, or opponent
  - Moves clumsily
  - Answers questions slowly
  - Loses consciousness (even briefly)
  - Shows mood, behavior, or personality changes
  - Can’t recall events prior to hit or fall
  - Can’t recall events after hit or fall

- **Symptoms Reported by Athlete**
  - Headache or “pressure” in head
  - Nausea or vomiting
  - Balance problems or dizziness
  - Double or blurry vision
  - Sensitivity to light
  - Sensitivity to noise
  - Feeling sluggish, hazy, foggy, or groggy
  - Concentration or memory problems
  - Confusion
  - Does not “feel right” or is “feeling down”

**ACTION PLAN**

If you suspect that an athlete has a concussion, you should take the following four steps:

1. Remove the athlete from play.
2. Ensure that the athlete is evaluated by an appropriate health care professional. Do not try to judge the seriousness of the injury yourself.
3. Inform the athlete’s parents or guardians about the possible concussion and give them the fact sheet on concussion.
4. Keep the athlete out of play the day of the injury and until an appropriate health care professional says they are symptom-free and it’s OK to return to play.

**IMPORTANT PHONE NUMBERS**

- **Emergency Medical Services**
  - Name:
  - Phone:

- **Health Care Professional**
  - Name:
  - Phone:

- **School Staff Available During Practice**
  - Name:
  - Phone:

- **School Staff Available During Games**
  - Name:
  - Phone:

**WHEN IN DOUBT, SIT THEM OUT**

**CHILDREN’S NATIONAL**
Concussion Recognition & Response app
Apple & Droid smartphones
How to Recognize a Possible Concussion: Look for 1 + 2 using your tools

1. Blow / Force to Head / Body
2. Change in Function / Behavior / Performance

"I SUSPECT!"

Post-Concussion Signs & Symptoms

<table>
<thead>
<tr>
<th>Physical</th>
<th>Cognitive</th>
<th>Emotional</th>
<th>Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>Concentrate</td>
<td>Irritability</td>
<td>More</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Memory</td>
<td>Emotinal control</td>
<td>Less</td>
</tr>
<tr>
<td>Balance/ Dizziness</td>
<td>Speed of Thinking</td>
<td>Sadness</td>
<td>Cannot</td>
</tr>
</tbody>
</table>

How to Recognize a Possible Concussion:

Look for 1 + 2 using your tools.
How To Respond to a Suspected Concussion

1 + 2 = “I Suspect”

“When in Doubt, Sit Them Out”

Removal from sport
Protect from further injury
Notify Parent

Medical Evaluation
Support Recovery
Concussion App works!
(Coach/ Mom PA, July, 2013)

“Today afternoon my 6yr old was trying to keep up with her older sisters, riding her bike down a big hill in our neighborhood and apparently forgot the brakes.

Without all the gory details- thank God for her helmet - but her cheekbone, chin and chest, knuckles, knees and elbows cushioned her blow. When I arrived (2 minutes later) she was hysterical, vomiting and could not remember what had happened!!!

Last week I would have freaked out but today my first thought was... the Concussion Recognition & Response APP!

As I was consoling - my other daughter was firing off questions from the APP.
Concussion App works!

• “She emailed the results home; we printed them out and went to the ER as the APP recommended.”
• At the ER I handed them the printout and they took her in no more than 5 min after we arrived. The ER Dr. was so impressed with the info on the printout and after a quick exam sent her for a CT scan.
• He said that the APP print out saved us about 40 min of waiting for a nurse and intake questions.
• Thank God the diagnosis was mild concussion with no additional swelling but the Dr. said that coming to the ER was the right thing to do.
• He had never heard of this App but is going to recommend it from now on.”

Kelly (7/16/2013)
Clinical Methods of Concussion Assessment

- Clinical exam: Protocol to assess injury characteristics, history / risk factors, thorough symptom assessment, cognitive functioning, balance assessment
  - Acute Concussion Evaluation (ACE)
  - Sport Concussion Assessment Tool (SCAT)-3
Heads Up
Brain Injury in Your Practice
# Acute Concussion Evaluation (ACE)

**Acute Concussion Evaluation (ACE)**

**Physician/Clinician Office Version**

**Children's Hospital of Pittsburgh of UPMC**

## A. Injury Characteristics

<table>
<thead>
<tr>
<th>Data/Time of Injury</th>
<th>Pediatric</th>
<th>Parent</th>
<th>Sentinel</th>
<th>Spouses</th>
<th>Other</th>
</tr>
</thead>
</table>

### 1. Injury Description

1. Is there evidence of a fallable blow to the head (direct or indirect)?
   - Yes
   - No
   - Unknown

2. Is there evidence of impact injury or skull fracture?
   - Yes
   - No
   - Unknown

3. Location of Impact: Frontal, Temporal, Occipital, Nasal, Other

4. Impact Force: Direct, Indirect

5. Causes: MVC, Pedestrian, Fall, Assault, Sports (contact), Other

6. Have you seen any events just BEFORE the injury that you believe may have caused or contributed to this injury? Yes
   - No
   - Unknown

7. Any noticeable changes in attitude or behavior immediately after the injury? Yes
   - No
   - Unknown

### 2. Symptoms and Check List

#### B. Symptoms Check List

| Symptom/
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
</tr>
<tr>
<td>Nausea</td>
</tr>
<tr>
<td>Vertigo</td>
</tr>
<tr>
<td>Dizziness</td>
</tr>
<tr>
<td>Fatigue</td>
</tr>
<tr>
<td>Sensitivity to light</td>
</tr>
<tr>
<td>Sensitivity to noise</td>
</tr>
<tr>
<td>Communication</td>
</tr>
<tr>
<td>Physical/Emotional/Behavioral</td>
</tr>
<tr>
<td>Total (0-22)</td>
</tr>
</tbody>
</table>

**SLERP (A)**

| Symptom/
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsteadiness</td>
</tr>
</tbody>
</table>
|viz.
| SLEEP (0-4) |

**Cogwell & Chelminski, 1999**

#### C. Risk Factors for Protracted Recovery

<table>
<thead>
<tr>
<th>Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concussion History</td>
</tr>
<tr>
<td>Pediatric History</td>
</tr>
<tr>
<td>Developmental History</td>
</tr>
<tr>
<td>Psychosocial History</td>
</tr>
</tbody>
</table>

#### D. ICD-10 Codes for acute and chronic management

<table>
<thead>
<tr>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
</tr>
<tr>
<td>Ice pack</td>
</tr>
<tr>
<td>Ice glass</td>
</tr>
<tr>
<td>Ice pack</td>
</tr>
</tbody>
</table>

#### E. Diagnosis (ICD)

<table>
<thead>
<tr>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>concussion with LOC (580.0)</td>
</tr>
<tr>
<td>concussion without LOC (580.1)</td>
</tr>
<tr>
<td>concussion (undescribed) (580.9)</td>
</tr>
<tr>
<td>no diagnosis</td>
</tr>
</tbody>
</table>

#### F. Follow Up Action Plan

<table>
<thead>
<tr>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete ACE Care Plan and provide copy to patient/family.</td>
</tr>
<tr>
<td>No follow-up needed</td>
</tr>
<tr>
<td>Physician/Clinician Office Monitoring: Date of next follow-up</td>
</tr>
<tr>
<td>Nuero psychological Testing</td>
</tr>
<tr>
<td>Neurosurgery, Neurology, Sports Medicine, Psychiatry, Gastroenterology, Other</td>
</tr>
</tbody>
</table>

**ACE Completed by:** ____________________________ MD RN NP MD ATC © Copyright G. Goyal & M. Collins, 2006
Acute Concussion Evaluation (ACE) Goals

Clinical
- Improve physician’s early diagnosis of mTBI
- Guide appropriate management

Public Health
- Improved epidemiology of mTBI
Essential Elements of Clinical Concussion Assessment & Management

- Early recognition of functional difference
- Detecting reliable change from “usual” functioning
- Assessing all 4 symptom categories
- Monitor symptomatic functioning over time for change (e.g., recovery, persistent symptoms)
- Guiding recovery via care plan
- Detecting reliable change/ return to “usual” (recovery)
- Referral when symptoms persist beyond 7-14 days
Acute Concussion Evaluation (ACE)

**Description**

- ACE is a *clinical protocol* to assist diagnosis of mTBI/concussion in medical settings:
  - Emergency Departments
  - Pediatric Office settings
- Ages 4-adult
- Elements of clinical assessment protocol are *evidence-based*
- Link to follow-up care via ACE Care Plan
Acute Concussion Evaluation (ACE)

Description

- Patient or parent as reporter of signs & symptoms
- Assess for presence/absence of 22 symptoms
  - somatic
  - cognitive
  - emotional
  - sleep
- Length of time approx. 5 minutes (N=350)
Acute Concussion Evaluation (ACE) Key Elements

A. Define Injury Characteristics
B. Assess for Symptoms (22) (Lovell & Collins, 1998)
C. Identify Risk Factors for Prolonged Recovery
D. Red Flags for Neurological Deterioration
E. Establish the Diagnosis
F. Plan Follow-Up Action / Referral
Acute Concussion Evaluation (ACE) Care Plan

- Link to Treatment
- Individual guidance via data-based symptom assessment and monitoring
# ACUTE CONCUSSION EVALUATION (ACE)

**Physician/Clinician Office Version**  
Gerard Gioia, PhD & Micky Collins, PhD  
Children’s National Medical Center  
University of Pittsburgh Medical Center

## A. Injury Characteristics

**Date/Time of Injury**  
**Reporter:** Patient  
Parent  
Spouse  
Other

1. **Injury Description**
   - 1a. Is there evidence of a forcible blow to the head (direct or indirect)?  
     - Yes  
     - No  
     - Unknown
   - 1b. Is there evidence of intracranial injury or skull fracture?  
     - Yes  
     - No  
     - Unknown
   - 1c. Location of impact:  
     - Frontal  
     - Lt Temporal  
     - Rt Temporal  
     - Lt Parietal  
     - Rt Parietal  
     - Occipital  
     - Neck  
     - Direct Force
   - 2a. Cause:  
     - MVC  
     - Pedestrian/MVC  
     - Fall  
     - Assault (spicy)  
     - Other

- **Amnesia Before**  
  - Are there any events just BEFORE the injury that your person has no memory of (even brief)?  
    - Yes  
    - No  
    - Duration

- **Amnesia After**  
  - Are there any events just AFTER the injury that your person has no memory of (even brief)?  
    - Yes  
    - No  
    - Duration

- **Loss of Consciousness:**  
  - Did your person lose consciousness?  
    - Yes  
    - No  
    - Duration

- **Early Signs:**  
  - Appears dazed or stunned  
  - Is confused about events  
  - Answers questions slowly  
  - Repeats Questions  
  - Forgetful (recent info)

- **Seizure:**  
  - Seizures observed?  
    - Yes  
    - No  
    - Details

## B. Symptom Check List

Once the injury, has the person experienced any of these symptoms any more than usual today or in the past day?  
Indicate presence of each symptom:  
(0=No, 1=Yes).

<table>
<thead>
<tr>
<th>Symptom</th>
<th>PHYSICAL (1-10)</th>
<th>COGNITIVE (0-4)</th>
<th>SLEEP (0-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Nausea</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Vomiting</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Balance problems</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Visual problems</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Fatigue</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Sleeplessness</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Tinnitus</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td><strong>Physiological Total</strong></td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
</tr>
</tbody>
</table>

**Overall Rating:**  
- Do these symptoms worsen with:  
  - Physical Activity  
    - Yes  
    - No  
    - N/A
  - Cognitive Activity  
    - Yes  
    - No  
    - N/A

**Rating:**  
- How different is the person acting compared to his/her usual self?  
- (3) Very Different

**Total Symptom Score (0-22):**

## C. Risk Factors for Protracted Recovery

Check all that apply:

<table>
<thead>
<tr>
<th>Concussion History</th>
<th>1 N</th>
<th>Concussion History</th>
<th>1 N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous? 1-4 weeks</td>
<td>Yes</td>
<td>Previous? 1-4 weeks</td>
<td>Yes</td>
</tr>
<tr>
<td>Headache Frequency</td>
<td>1 N</td>
<td>Headache Frequency</td>
<td>1 N</td>
</tr>
<tr>
<td>Number of concussions</td>
<td>1 N</td>
<td>Number of concussions</td>
<td>1 N</td>
</tr>
<tr>
<td>History of migraine</td>
<td>1 N</td>
<td>History of migraine</td>
<td>1 N</td>
</tr>
<tr>
<td>Personal History</td>
<td>1 N</td>
<td>Personal History</td>
<td>1 N</td>
</tr>
<tr>
<td>Emotional History</td>
<td>1 N</td>
<td>Emotional History</td>
<td>1 N</td>
</tr>
<tr>
<td>Cognitive History</td>
<td>1 N</td>
<td>Cognitive History</td>
<td>1 N</td>
</tr>
<tr>
<td>Psychotherapy History</td>
<td>1 N</td>
<td>Psychotherapy History</td>
<td>1 N</td>
</tr>
</tbody>
</table>

| Learning Disabilities | 1 N | Attention-Deficit Hyperactivity Disorder | 1 N |
| Dyslexia               | 1 N | Depression                         | 1 N |
| Depression                | 1 N | Anxiety                          | 1 N |
| Other Developmental Disorder | 1 N |
| Other Psychiatric Disorder | 1 N |

List other comorbid medical disorders or medication usage (e.g., hypothyroid, seizures)

## D. Red Flags for acute management:  
Refer to the emergency department with sudden onset of any of the following:

- *Headaches that worsen*  
  - Looks very drowsy/can’t be awakened  
  - Can’t recognize people or places  
  - Seizures
- *Seizures*  
  - Repeated vomiting  
  - Increasing confusion or irritability  
  - Unusual behavioral change
- *Restless neurological signs*  
  - Stumbled speech  
  - Weakness or numbness in arms/legs  
  - Change in state of consciousness

## E. Diagnosis (ICD):  
- Concussion w/o LOC 850.0  
- Concussion w/ LOC 850.1  
- Concussion (Unspecified) 850.9  
- Other (854)  
- No Diagnosis

## F. Follow-Up Action Plan  
- Complete ACE Care Plan and provide copy to patient/family.
- No Follow-Up Needed
  - Physician/Clinician Office Monitoring: Date of next follow-up
  - Referral:
    - Neuropsychological Testing  
      - Physician:  
        - Neurosurgery  
        - Neurology  
        - Sports Medicine  
        - Psychiatrist  
        - Psychologist  
        - Other
      - Emergency Department

**ACE Completed by:**

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Acute Concussion Evaluation (ACE)

A. Injury Characteristics

Injury Description

Cause

Amnesias (retrograde, anterograde)

Loss of Consciousness (LOC), Seizures

Early Signs

---

Fell to ground, hit head on ground and then kneed in right temporal region; dazed initially but continued to play with bad headache. Felt sluggish and confused.
### Acute Concussion Evaluation (ACE)

#### B. Symptom Checklist

**B. Symptom Check List**: Since the injury, has the person experienced any of these symptoms any more than usual today or in the past day? Indicate presence of each symptom (0=No, 1=Yes).

*Lovell & Collins, 1998 JHTR*

<table>
<thead>
<tr>
<th>PHYSICAL (10)</th>
<th>COGNITIVE (4)</th>
<th>SLEEP (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Headache</strong></td>
<td>0 1</td>
<td>Drowsiness</td>
</tr>
<tr>
<td><strong>Nausea</strong></td>
<td>0 1</td>
<td>Sleeping less than usual</td>
</tr>
<tr>
<td><strong>Vomiting</strong></td>
<td>0 1</td>
<td>Sleeping more than usual</td>
</tr>
<tr>
<td><strong>Balance problems</strong></td>
<td>0 1</td>
<td>Trouble falling asleep</td>
</tr>
<tr>
<td><strong>Dizziness</strong></td>
<td>0 1</td>
<td></td>
</tr>
<tr>
<td><strong>Visual problems</strong></td>
<td>0 1</td>
<td></td>
</tr>
<tr>
<td><strong>Fatigue</strong></td>
<td>0 1</td>
<td></td>
</tr>
<tr>
<td><strong>Sensitivity to light</strong></td>
<td>0 1</td>
<td></td>
</tr>
<tr>
<td><strong>Sensitivity to noise</strong></td>
<td>0 1</td>
<td></td>
</tr>
<tr>
<td><strong>Numbness/Tingling</strong></td>
<td>0 1</td>
<td></td>
</tr>
<tr>
<td><strong>PHYSICAL Total (0-10)</strong></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**COGNITIVE Total (0-4)**: 4

**SLEEP Total (0-4)**: 2

**COGNITIVE Total (0-4)**: 4

**EMOTIONAL Total (0-4)**: 1

**PHYSICAL Total (0-10)**: 5

**EMOTIONAL Total (0-4)**: 1

**Total Symptom Score (0-22)**: 12

**Exertion**: Do these symptoms worsen with:
- Physical Activity: Yes ☑ No ☐ N/A
- Cognitive Activity: Yes ☑ No ☐ N/A

**Overall Rating**: How different is the person acting compared to his/her usual self? (circle)
- Normal: 0 1 2 3 4 5 6 Very Different

*Note: The symptoms are marked with a circle (○) for presence. The total scores are marked with a circle (❖) for calculation.*
Research findings have linked these risk factors to longer periods of recovery.
Acute Concussion Evaluation (ACE)
D. Red Flags for Neurological Deterioration

D. RED FLAGS for acute emergency management: Refer to the emergency department with sudden onset of any of the following:

- Headaches that worsen
- Seizures
- Focal neurologic signs
- Looks very drowsy/can’t be awakened
- Repeated vomiting
- Slurred speech
- Can’t recognize people or places
- Increasing confusion or irritability
- Weakness or numbness in arms/legs
- Neck pain
- Unusual behavioral change
- Change in state of consciousness

Physicians and parents/patients need to be aware of danger signs that signal the need for emergency care.
Acute Concussion Evaluation (ACE)

E. Diagnosis

E. Diagnosis (ICD):
- __Concussion w/o LOC 850.0__
- __Concussion w/ LOC 850.1__
- __Concussion (Unspecified) 850.9__
- __Other (854)__________
- __No diagnosis__

850.0 (Concussion, with specified duration of consciousness loss < 1 hour)
- Positive injury description, evidence of forcible direct/indirect blow to the head (A1a)
- Evidence of active symptoms (B) related to the trauma (Total Symptom Score >0)
- Positive evidence of LOC (A5)
- No skull fracture or intracranial injury (A1b)

850.1 (Concussion, with brief loss of consciousness < 1 hour)
- Positive injury description, evidence of forcible direct/indirect blow to the head (A1a)
- Evidence of active symptoms (B) related to the trauma (Total Symptom Score >0)
- Positive evidence of LOC (A5)
- No skull fracture or intracranial injury (A1b)

850.9 (Concussion, unspecified)
- Positive injury description, evidence of forcible direct/indirect blow to the head (A1a)
- Evidence of active symptoms (B) related to the trauma (Total Symptom Score >0)
- Unclear/unknown injury details; unclear evidence of LOC (A5)
- No skull fracture or intracranial injury (A1b)
Acute Concussion Evaluation (ACE)

E. Follow-Up Action Plan/ Referral

F. Follow-Up Action Plan

- Complete ACE Care Plan and provide copy to patient/family.
- No Follow-Up Needed
  - Physician/Clinician Office Monitoring: Date of next follow-up ________________
- Referral:
  - ✔ Neuropsychological Testing
  - Physician: Neurosurgery___ Neurology___ Sports Medicine___ Psychiatrist___ Other___________________________
  - Emergency Department

ACE Completed by: ____________________________ MD RN NP PhD ATC

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This form is part of the “Heads Up: Brain Injury in Your Practice” tool kit developed by the Centers for Disease Control and Prevention (CDC).

None

Office Monitor (Re-Assess in 1-2 days)

Referral: Testing, MD, ED
Psychometric Characteristics of the Postconcussion Symptom Inventory in Children and Adolescents

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*Corresponding author at: Division of Pediatric Neuropsychology, Children’s National Health System, 15245 Shady Grove Road, Suite 350, Rockville, MD 20850, USA. Tel.: +1-301-765-5454; fax: +1-301-765-5497.
E-mail address: msady@childrensnational.org (M.D. Sady).

Accepted 11 March 2014
Post-Concussion Symptom Inventory (PCSI)

- Normed on 1,273, ages 5-18
- 633 children/adolescents with mTBI
- Parent report: 20 items
- Self-report (5-7 (SR5) 5 items), 8-12 (SR8) 17 items, 13-18 (SR13) 21 items)
- 4 factors: physical, cognitive, emotional, sleep
- Internal consistency: Alpha = 0.8-0.9
- Stability: ICC = 0.65-0.89
- Parent-child concordance (r= 0.44-0.65)
- Convergent validity with ACE r=0.8
Classification Analyses*

- Most useful in clinical practice to know what a test result might mean for an individual child relative to base rates
- Likelihood that a child’s pattern of performance is consistent or inconsistent with profiles of performance by children with concussion
- Variety of statistics that inform users about properties of
  - the measure (sensitivity, specificity)
  - utility of measure for making clinical decisions (Likelihood Ratios, area under the curve)
  - degree to which using a measure enhances decision making in a clinical setting (Pretest Odds, Posttest Odds).

*Peter Isquith (Gordon Chelune, 2010)
Classification Analyses*

- Examine the diagnostic utility for identifying the presence or absence of concussion
- Two groups: Age 5-7, 21 children (9 boys, 12 girls); Age 8-12, 50 children (40 boys, 10 girls), seen in concussion clinic within 7 days of sustaining a likely concussion;
- Compared to gender- and age-matched groups of non-injured children
**Classification Analyses**

- **Positive Likelihood Ratio (LR+):** ratio of true positive cases (children with concussion) to false positive cases (children without concussion who test poorly and are incorrectly identified).

- Positive Likelihood Ratios > 1 suggest measure is more likely to detect actual concussion effects than to identify a non-injured child as having concussion effects.

- **Negative Likelihood Ratio (LR-):** likelihood that negative test result (i.e., low symptom ratings, good test performance) will incorrectly identify an injured child as non-injured versus correctly identify a non-injured child.

- LR- reflects probability of child with concussion effects performing well divided by the probability of a child without concussion effects performing well.

- Lower LR- ratios (<1) indicate reduced likelihood of misidentifying an injured child as having no injury effects.
## PCSI Classification Statistics

### Table 9. Classification statistics from discriminant function analysis

<table>
<thead>
<tr>
<th></th>
<th>Ages 13–18</th>
<th></th>
<th>Ages 8–12</th>
<th></th>
<th>Ages 5–7</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self</td>
<td>Parent</td>
<td>Both</td>
<td>Self</td>
<td>Parent</td>
<td>Both</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.51</td>
<td>0.60</td>
<td>0.61</td>
<td>0.56</td>
<td>0.63</td>
<td>0.62</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.89</td>
<td>0.89</td>
<td>0.89</td>
<td>0.79</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>PPV</td>
<td>0.82</td>
<td>0.97</td>
<td>0.98</td>
<td>0.73</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>NPV</td>
<td>0.64</td>
<td>0.71</td>
<td>0.72</td>
<td>0.64</td>
<td>0.72</td>
<td>0.72</td>
</tr>
<tr>
<td>+ Likelihood</td>
<td>4.63</td>
<td>35.00</td>
<td>53.00</td>
<td>2.66</td>
<td>24.60</td>
<td>24.40</td>
</tr>
<tr>
<td>– Likelihood</td>
<td>0.55</td>
<td>0.40</td>
<td>0.40</td>
<td>0.56</td>
<td>0.38</td>
<td>0.39</td>
</tr>
<tr>
<td>Odds ratio</td>
<td>8.35</td>
<td>86.74</td>
<td>134.06</td>
<td>4.74</td>
<td>64.36</td>
<td>62.98</td>
</tr>
<tr>
<td>Classification accuracy</td>
<td>70%</td>
<td>79%</td>
<td>80%</td>
<td>67%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Area under the curve</td>
<td>0.71</td>
<td>0.88</td>
<td>0.85</td>
<td>0.71</td>
<td>0.91</td>
<td>0.89</td>
</tr>
</tbody>
</table>

**Notes:** Sensitivity, specificity, odds ratios, classification accuracy, and area under the curve. PCSI-SR13 (ages 13–18) n = 348; -SR8 (ages 8–12) n = 392; -SR5 (ages 5–7) n = 72; base rate = 0.50.

PPV = positive predictive value; NPV = negative predictive value.

*Could not be computed because the number of false positives was zero.*
Figure 5.7. Mean PCSI Symptom Ratings for Physical, Cognitive, Emotional, Sleep and Total Symptoms (Age 8-12 year olds)
- Visits 1, 2 and 3 seen within 14 Days for Visit 1
Growth Curve Modeling of PCSI Symptom Reports

Figure 5.10. Effect of Gender on Mean PCSI Total Symptom Ratings by Days Since Injury

Age 5-12 with concussion (Visit 1 n = 270, Visit 2 n=147, Visit 3 n=69, Visit 4 n=16)
Focus on Control: The Executive Functions

Creating Independent Learners and Problem-Solvers
Components of the executive system

- Awareness/ self-appraisal of one’s strengths and weaknesses
- Ability to
  - Set realistic goals for oneself base on self-appraisal;
  - Plan and organize behavior designed to achieve the goals
  - Initiate behavior in pursuit of the goals
Executive Function components

→ **Inhibit** behavior incompatible with the goals

→ **Monitor** performance in relation the goals

→ **Flexibly and strategically, shift** behavior in the event of obstacles to achieving goals

→ **Transfer** newly acquired skills from situation to situation
# The Executive Functions in TBI

## Table 1: The BRIEF studies of children and adolescents with TBI

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Total, n</th>
<th>Age at injury, y</th>
<th>Boys, %</th>
<th>TBI sample characteristics</th>
<th>TBI severity</th>
<th>Time interval since injury, y</th>
<th>BRIEF scale elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gioia et al(^{13})</td>
<td>2002</td>
<td>67</td>
<td>9.7</td>
<td>75</td>
<td></td>
<td>Mild to severe</td>
<td>5</td>
<td>Mild/moderate = none</td>
</tr>
<tr>
<td>Mangeot et al(^{20})</td>
<td>2002</td>
<td>64</td>
<td>6–12</td>
<td>68</td>
<td></td>
<td>Moderate, severe</td>
<td>5</td>
<td>GEC, MCI, BRI</td>
</tr>
<tr>
<td>Vriezen &amp; Pigott(^{21})</td>
<td>2002</td>
<td>48</td>
<td>8.3</td>
<td>52</td>
<td></td>
<td>Moderate, severe</td>
<td>1–5</td>
<td>GEC, MCI, BRI</td>
</tr>
<tr>
<td>Karunanayaka et al(^{10})</td>
<td>2007</td>
<td>8</td>
<td>6–9</td>
<td>63</td>
<td></td>
<td>Mild to severe</td>
<td>1–5</td>
<td>GEC</td>
</tr>
<tr>
<td>Nadebaum et al(^{29})</td>
<td>2007</td>
<td>54</td>
<td>1–7</td>
<td>65</td>
<td></td>
<td>Moderate, severe</td>
<td>1–5</td>
<td>In, Mn</td>
</tr>
<tr>
<td>Power et al(^{43})</td>
<td>2007</td>
<td>36</td>
<td>1–9</td>
<td>72</td>
<td></td>
<td>Moderate, severe</td>
<td>1–5</td>
<td>In, Mn</td>
</tr>
<tr>
<td>Conklin et al(^{22})</td>
<td>2008</td>
<td>62</td>
<td>5–19</td>
<td>60</td>
<td></td>
<td>Moderate, severe</td>
<td>1–5</td>
<td>WM</td>
</tr>
<tr>
<td>Merkley et al(^{9})</td>
<td>2008</td>
<td>16</td>
<td>9–16</td>
<td>50</td>
<td></td>
<td>Moderate, severe</td>
<td>1–5</td>
<td>WM</td>
</tr>
<tr>
<td>Muscara et al(^{23})</td>
<td>2008a</td>
<td>36</td>
<td>8–12</td>
<td>64</td>
<td></td>
<td>Mild to severe</td>
<td>&gt;5</td>
<td>GEC, MCI, BRI</td>
</tr>
<tr>
<td>Muscara et al(^{26})</td>
<td>2008b</td>
<td>36</td>
<td>8–12</td>
<td>64</td>
<td></td>
<td>Mild–severe</td>
<td>&gt;5</td>
<td>GEC</td>
</tr>
<tr>
<td>Sesma et al(^{24})</td>
<td>2008</td>
<td>330</td>
<td>5–15</td>
<td>69</td>
<td></td>
<td>Mild to severe</td>
<td>&lt;1</td>
<td>GEC, MCI, BRI, WM</td>
</tr>
<tr>
<td>Donders et al(^{19})</td>
<td>2009</td>
<td>100</td>
<td>6–16</td>
<td>59</td>
<td></td>
<td>Mild to severe</td>
<td>1–5</td>
<td>GEC</td>
</tr>
<tr>
<td>Chertkoff Walz et al(^{12})</td>
<td>2008</td>
<td>10</td>
<td>3–6</td>
<td>60</td>
<td></td>
<td>Mild to severe</td>
<td>1</td>
<td>GEC</td>
</tr>
<tr>
<td>Chevignard et al(^{92})</td>
<td>2009</td>
<td>10</td>
<td>5–13</td>
<td>70</td>
<td></td>
<td>Moderate to severe</td>
<td>1–5</td>
<td>GEC</td>
</tr>
<tr>
<td>Maillard-Wermelinger et al(^{27})</td>
<td>2009</td>
<td>186</td>
<td>8–15</td>
<td>71</td>
<td></td>
<td>Mild</td>
<td>&lt;1</td>
<td>MCI, OM</td>
</tr>
<tr>
<td>Chapman et al(^{23})</td>
<td>2010</td>
<td>76</td>
<td>3–7</td>
<td>67%</td>
<td></td>
<td>Moderate, severe</td>
<td>1–5</td>
<td>GEC</td>
</tr>
</tbody>
</table>

Abbreviations: BRI, behavioral regulation index; GEC, global executive composite; In, inhibit; Int, initiate; MCI, metacognition index; Mn, monitor; OM, organizational of materials; PO, plan/organize; Sh, shift; WM, working memory.
Overall, the BRIEF stood out as the preferred caregiver rating measure in children and adolescents with ABI, with the larger number of studies (a recent review [72] listed 16 studies having used the BRIEF, with a total of 1248 children and adolescents with TBI) and the most information on psychometric properties. It has also been selected as a supplemental measure of executive functioning by the inter-agency Paediatric TBI Outcomes Workgroup [36].
BRIEF scores 1st year following Pedi TBI

Sesma, Slomine, Ding, McCarthy & CHAT Study Group, 2008, Pediatrics

N = 330
Fig. 1. Performance on BRIEF clinical scales. IH = inhibit, S = shift, EC = emotional control, IN = initiate, WM = working memory, PO = plan/organize, OM = organization of materials, M = monitor.

Vriezen & Pigott, 2002, Child Neuropsychology
BRIEF Scale Profiles in Peds TBI

Fig. 1. Performance on BRIEF clinical scales. IH = inhibit, S = shift, EC = emotional control, IN = initiate, WM = working memory, PO = plan/organize, OM = organization of materials, M = monitor.

N = 48

Vriezen & Pigott, 2002, Child Neuropsychology
Concussion produces impairment of neuropsychological function in children and adults. Attention, memory, speed, executive function, emotional response.

Assessment of neuropsychological function provides measurable outcome of injury.

Other factors can influence performance and reporting; findings do not stand alone.
Neuropsychological Testing

- Test findings are best understood as one element within a multidimensional, multidisciplinary model.
- Training in the proper administration, especially with children, is critical to obtain valid results.
- Interpretation of findings requires an even higher level of training and expertise.
CARE Sport

- Standardized Assessment of Concussion (SAC)
- Graded Symptom Checklist
- Balance Error Scoring System (BESS)
**Standardized Assessment of Concussion (SAC)**

### Orientation

<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>What month is it?</td>
<td></td>
</tr>
<tr>
<td>What is the date?</td>
<td></td>
</tr>
<tr>
<td>What day of the week is it?</td>
<td></td>
</tr>
<tr>
<td>What year is it?</td>
<td></td>
</tr>
<tr>
<td>What time of day is it? (within 1 hour)</td>
<td></td>
</tr>
</tbody>
</table>

### Immediate Memory

<table>
<thead>
<tr>
<th>Form</th>
<th>Word List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form A</td>
<td>Elbow, Apple, Carpet, Saddle, Bubble</td>
</tr>
<tr>
<td>Form B</td>
<td>Candle, Paper, Sugar, Sandwich, Wagon</td>
</tr>
<tr>
<td>Form C</td>
<td>Baby, Monkey, Perfume, Lemon, Insect</td>
</tr>
<tr>
<td>Form D</td>
<td>Monkey, Penny, Blanket, Sunset, Iron</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial</th>
<th>Word 1</th>
<th>Word 2</th>
<th>Word 3</th>
<th>Word 4</th>
<th>Word 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Trial 2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Trial 3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### Concentration: Digits Backwards

<table>
<thead>
<tr>
<th>Form</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

### Months in Reverse Order

Dec, Nov, Oct, Sept, Aug, Jul, Jun, May, Apr, Mar, Feb, Jan

### Delayed Recall

<table>
<thead>
<tr>
<th>Word</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 1</td>
<td>1</td>
</tr>
<tr>
<td>Word 2</td>
<td>0</td>
</tr>
<tr>
<td>Word 3</td>
<td>0</td>
</tr>
<tr>
<td>Word 4</td>
<td>0</td>
</tr>
<tr>
<td>Word 5</td>
<td>0</td>
</tr>
</tbody>
</table>

### Score Totals

<table>
<thead>
<tr>
<th>Component</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td></td>
</tr>
<tr>
<td>Immediate Memory</td>
<td></td>
</tr>
<tr>
<td>Concentration</td>
<td></td>
</tr>
<tr>
<td>Delayed Recall</td>
<td></td>
</tr>
</tbody>
</table>

**Overall Score**

/ 30
The Tasks of Executive Control

Peter K. Isquith, Robert M. Roth, & Gerard A. Gioia
Psychosocial Impact
Psychosocial Issues

- Invisible injury
  - TBI not appreciated
  - Look “normal”
- Cut off from social group (team)
- Loss of identity
- Pressures to be “normal”, return & contribute
- Pressure of schoolwork
Psychosocial Issues

- Role of pre-existing anxiety or mood problems (Yeates et al.)
- Family understanding, coping, and capacity for support (Yeates et al.)
- School understanding, capacity for support
- Medical system understanding, capacity for support
Emotional Symptomatology after mTBI in children & adolescents (w/ & w/o comorbid Anxiety or Depression)

F=131.4, p <.001, eta² = .19
n= 469/ 93
Emotional Symptomatology after mTBI in children & adolescents (w/ & w/o comorbid Anxiety or Depression)

F=45.9, p < .001, \( \eta^2 = .107 \)
n= 323/ 64
Emotional Symptomatology after mTBI in children & adolescents (w/ & w/o comorbid ADHD & LD)

F=52.9, p < .001, \( \eta^2 = .121 \)

n= 271/ 116
Depression Symptomatology after mTBI in children & adolescents (w/ & w/o comorbid Anxiety or Depression)

- F = 12.56, p < .002, \( \eta^2 = .143 \)
- n = 58/20

Covariates appearing in the model are evaluated at the following values: Age = 15.6964
Emotional Dysregulation after mTBI in children & adolescents

F = 66.2, p < .001, $\eta^2 = .129$

n = 366/85
Participants were divided by diagnostic group (n = 391):

- Concussion only (n = 224)
- Single co-morbidity (n = 125)
  - ADHD/LD (n = 90)
  - Anxiety/Depression (n = 35)
- Double Co-morbidity (pre-injury neurodevelopmental & internalizing Disorders; n = 42)
Pre- and Post-Injury Symptom Levels by Diagnostic Group

**Parent Report**

Pre-Injury: \( F(2,363) = 26.02, p < .001 \)
Co-morbid > Neurodev/Intern > mTBI only

Post-Injury: \( F(2,372) = 7.56, p = .001 \)
Co-morbid > Neurodev/Intern > mTBI only

**13 - 18 Year-Old Self-Report**

Pre-Injury: \( F(2,375) = 12.47, p < .001 \)
Co-morbid = Neurodev/Intern > mTBI only

Post-Injury: \( F(2,377) = 3.91, p = .02 \)
Co-morbid > Neurodev/Intern = mTBI only
Adjusting for Pre-Injury Symptom Levels

\[ F(2,361) = 2.09, \ p = .13 \]

\[ F(2,368) = 0.72, \ p = .49 \]

13 - 18 Year-Old Self-Report

Parent Report

Adjusted Post-Injury Mean PCSI Item Response

mTBI Only

0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25

Mean PCSI Item Response

Adjusted Post-Injury Mean PCSI Item Response

1.21 1.45 1.42

1.12 1.15 1.35

13 - 18 Year-Old Self-Report

\[ F(2,368) = 0.72, \ p = .49 \]
Conclusions

- Youth with a pre-injury diagnosis exhibit a greater number of pre- and post-injury symptoms.
- However, there is no significant difference between diagnostic groups when controlling for pre-injury symptom levels.
Relationship of pre-injury functioning to recovery from concussion

- Measured rate of symptom change from pre- to initial post-injury visit, and from post-injury Visit 1 to Visit 2
- Subsample of youth who were evaluated a second time within 30 days of their initial visits (n = 268):
  - Concussion only (n = 154)
  - ADHD/LD/Anx/Dep (n = 89)
  - Co-morbid Neurodevelopmental & Internalizing Disorders (n = 25)
Rate of symptom change

**Parent Report**

Time: $F(1.91, 496) = 31.88, p < .001$
Diagnostic Group: $F(2, 260) = 8.10, p < .001$
Time x Diagnostic Group: $F(3.81, 496) = .54, p = .70$

**13 - 18 Year-Old Self-Report**

Time: $F(1.91, 499) = 33.81, p < .001$
Diagnostic Group: $F(2, 261) = 4.89, p = .01$
Time x Diagnostic Group: $F(3.83, 499) = 1.34, p = .26$
Conclusions

- No significant differences between diagnostic groups in rates of symptom increase post-concussion or rates of early improvement
Saturday afternoon - Struck with soccer ball right temporal area
On field, no LOC, but severe headache
No ID, played rest of game
Sat. Evening - “spacey”, foggy, dizziness, headache, reduced energy/ fatigue
Pediatrician - “Not to worry, observe”
“Maria” 14 year old girl

- Sunday recital - Could not follow piano music
- Monday @ school: forgetful (locker combo), failed test, poor concentration
- Monday PM - Neurological exam, CT “normal”
“Maria” 14 year old girl

- 8th grade honors student
- Seen in the SCORE Concussion Clinic
  - Day 9, 16, 25, 37
- Neuropsychological Concussion Evaluation
  - Poor attention
  - Poor “working memory”
  - Slowed processing speed
  - Reduced reaction time
  - Significant symptoms
- Progressive recovery & return to “baseline” Day 37
“Maria” 14 year old girl

- Across 37 days, ongoing academic difficulties
  - Concentration on tasks, homework
  - Working Memory, Memory retrieval - difficulty with verbal lectures, and recalling learned factual info; difficulty recalling reading
  - Slow processing & performance - not following along, not completing work in time
  - Fatigue/ headaches
- Symptoms exacerbated by Cognitive Exertion
Maria, 14 yr, 8th grade, female

Memory Composite (Verbal)

Memory Composite (Visual)

Day 9 16 25 36
"Maria" 14 yr 8th grade female

Processing Speed Composite

Reaction Time Composite

Day 9 16 25 36

Day 9 16 25 36
Parent & Child Graded Symptom report (PCSI)

PCSI - Report, Maria (13, Female)

Visit Date in SCORE Clinic

Parent Report
Child Report
“Anthony”
11 yo 5th grader
Anthony

- Sat. night 2/18/06: Hit while going out for puck - head-ice contact, occipital region
- 5th grade, average student; history of fine motor difficulties (OT); (VIQ = 112, PIQ = 88)
- 4-5 day history of symptoms (Headache (5-6 severity), balance, sensitivity to light/noise, fatigue, dizziness, blurry vision, mentally foggy, feeling slowed down)
- Tuesday night: math homework “blanked out”
- Wed: “felt better” allowed to practice: no contact, felt more tired than usual skating
Anthony

- Evaluated in SCORE clinic Friday (6 days post-injury)
- Self-reporting no symptoms
- Father reporting no symptoms
- ImPACT testing revealed significant neurocognitive deficits
- Held from game play and practice; no PE; Rest
- School notified to monitor academic learning and performance
Re-evaluated in SCORE clinic Thurs (12 days post-injury)
Self-reporting no symptoms; no school problems
Mother reporting no symptoms, miserable not playing
ImPACT testing revealed normal neurocognitive functioning
Gradual RTP recommended (no ATC to supervise; parents/ coach counseled re: protocol)
Parent & Child Graded Symptom report (PCSI)

PCSI - Report, Anthony (11, male)

Visit Date in SCORE Clinic

- Baseline
- 2/24
- 3/2

Parent Report
Child Report

* Father
** Mother
Anthony Issues

- Discordance between symptom report and neurocognitive testing
- Reliability of child symptom report?
- Possible influence of premorbid issues considered with Week 1 test results
- Dramatic improvement in test performance over second week
- Benefit of Preseason Baseline Testing
Assessment Practice
Case #1

- Joe, a 3rd grade student, fell headfirst off of the 6-ft high jungle gym at recess. He was escorted into the office. Joe seemed dazed and said his head hurt a bit, but otherwise seemed okay. The school nurse is working at another building that day and the secretary calls you (the school psychologist) for guidance.

- What would you do at this point?
Management / Treatment of concussion
“New” Management Strategies
“Active” Rehabilitation

- No additional forces to head/brain
- INITIALLY, resting the brain (days) & good night sleep
- Individualized moderated, monitored symptom management
  - Managing/facilitating physiological recovery; teaching symptom monitoring, exertion concepts
  - Find the activity “sweet spot” – Optimized activity w/o over-exertion
  - Not too much BUT not too little
  - Plan of graduated physical and cognitive activation

Ways to over-exert
- Physical
- Cognitive (concentration)
- Emotional (stress)
ACE Care Plan

Linking Diagnosis With Treatment
# ACUTE CONCUSSION EVALUATION (ACE) CARE PLAN

*Gerard Glowa, PhD & Micky Collins, PhD*

**Children's National Medical Center**
*University of Pittsburgh Medical Center*

**TODAY'S DATE**

You have been diagnosed with a concussion, also known as a traumatic brain injury. To prevent further injury, do not return to any high-risk activities (e.g., sports, physical education, driving, etc.) until cleared by a qualified healthcare professional. To promote recovery, physical and cognitive activity must be carefully managed. Pay attention to your symptoms (listed below) and avoid too much of any activity that makes your symptoms worse, as this may lengthen your recovery. As symptoms improve, you can increase the level of daily activity slowly and carefully. Children and teenagers will need the help of parents, teachers, coaches, or athletic trainers to help their recovery and return to activities.

<table>
<thead>
<tr>
<th>Physical</th>
<th>Cognitive</th>
<th>Emotional</th>
<th>Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headaches</td>
<td>Sensitivity to light</td>
<td>Feeling mentally foggy</td>
<td>Irritability</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Sensitivity to noise</td>
<td>Problems concentrating</td>
<td>Sadness</td>
</tr>
<tr>
<td>Visual problems</td>
<td>Nausea</td>
<td>Problems remembering</td>
<td>Feeling more emotional</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Vomiting</td>
<td>Feeling more slowed down</td>
<td>Nervousness</td>
</tr>
<tr>
<td>Balance Problems</td>
<td>Numbness/tingling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Exertional Effects:**

Do Symptoms Worsen with Activities?
- Physical Activity: Yes___ No___ No Opportunity___
- Cognitive Activity: Yes___ No___ No Opportunity___

**NEUROCOGNITIVE TESTING (If applicable)**

| Attention/ Working Memory: | Appropriate | Impaired | Variable |
| Learning/Memory: | Appropriate | |
| Response Speed: | Appropriate | |

**KEY POINTS**

**RETURNING TO DAILY ACTIVITIES**

Sleep: Be sure to get adequate sleep at night, no late nights or overnights; keep the same bedtime on weekdays and weekends. Take daytime naps or rest breaks when you feel tired or fatigued, unless they interfere with falling asleep at night.

Activity Level: Limit physical and cognitive (mental) activity: Symptoms typically worsen or return with too much activity.

Making symptoms worse may slow down recovery.
- Physical activity includes physical education, sports practices, weight-training, running, exercising, heavy lifting, etc.
- Cognitive activity includes heavy concentration, learning, reading or writing (e.g., schoolwork, job-related mental activity).

Symptoms as your Guide: Pay attention to your symptoms. As they get better, increase your activities gradually with careful monitoring for return or worsening of symptoms. Let the worsening and/or return of symptoms be your guide to slow down.

Food and Drink: Maintain adequate hydration (drink lots of fluids) and an appropriate diet during recovery.

Emotions: During recovery, it is normal to feel frustrated, nervous or sad because you do not feel right and your activity is reduced. Seek professional help if you feel unsafe or have thoughts of self-harm.

Driving: You are advised not to drive if you have significant symptoms or cognitive impairment, as these can interfere with safe driving.

**KEY POINTS**

**RETURNING TO SCHOOL**

- Students with symptoms and/or neuropsychological dysfunction after a concussion often need support to perform school-related activities. As symptoms decrease during recovery, these supports may be gradually removed.

- Inform the teacher(s), school nurse, school psychologist or counselor, and administrator(s) about your injury and symptoms.

- School personnel should be instructed to watch for:
  - Increased problems paying attention or concentrating
  - Longer time needed to complete tasks or assignments
  - Increased in symptoms (e.g., headache, fatigue, etc.)
  - Increased problems remembering or learning new information
  - Greater irritability, less tolerance for frustration
  - Difficulty managing and completing complex assignments

Based on the above symptoms, the following supports are recommended: (Check all that apply)

- No return to school
- Return on (date) ____________
- Return to school with following supports: Monitor above symptoms, as they may increase with cognitive exertion (mental effort)
  - Shortened day. Recommend __ hours per day until (date) ____________
  - Shortened classes (i.e., rest breaks during classes). Maximum class length: ______ minutes
  - Rest breaks during school day. ___ rest breaks per day: ___ AM___ PM As needed/symptoms worsen. ___ minutes
  - Allowances for extended time to complete coursework and assignments and tests
  - Reduced homework load. Maximum length of nightly homework: ______ minutes. 20-30 study. 10-15 rest break
  - No testing at this time/Modified classroom/standardized testing - only as symptoms and preparation allow; allow breaks as needed
  - Meet with guidance counselor/academic advisor to establish reasonable timeline for make-up work (as symptoms permit)
  - Request meeting of 504 or School Management Team to discuss this plan and coordinate accommodations
Purpose of ACE Care Plan

Guide recovery
Educate
Manage exertional activity, safety

You have been diagnosed with a concussion, also known as a traumatic brain injury. To prevent further injury, do not return to any high-risk activities (e.g., sports, physical education, driving, etc.) until cleared by a qualified healthcare professional. To promote recovery, **physical and cognitive activity must be carefully managed**. Pay attention to your symptoms (listed below) and avoid too much of any activity that makes your symptoms worse, as this may lengthen your recovery. As symptoms improve, you can increase the level of daily activity slowly and carefully. Children and teenagers will need the help of parents, teachers, coaches, or athletic trainers to help their recovery and return to activities.

Today the following post-concussive symptoms are present (Circle or check).

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<th>Cognitive</th>
<th>Emotional</th>
<th>Sleep</th>
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<td>Numbness/ tingling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Neurocognitive Testing (if applicable)**

<table>
<thead>
<tr>
<th>Attention/ Working Memory:</th>
<th>Appropriate</th>
<th>Impaired</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning/Memory:</td>
<td>Appropriate</td>
<td>Impaired</td>
<td>Variable</td>
</tr>
<tr>
<td>Response Speed:</td>
<td>Appropriate</td>
<td>Impaired</td>
<td>Variable</td>
</tr>
</tbody>
</table>

**Exertional Effects:** Do Symptoms Worsen with Activities?

<table>
<thead>
<tr>
<th>Physical Activity:</th>
<th>Yes</th>
<th>No</th>
<th>No Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Activity:</td>
<td>Yes</td>
<td>No</td>
<td>No Opportunity</td>
</tr>
</tbody>
</table>
**KEY POINTS**

**Returning to Daily Activities**

Sleep: Be sure to get adequate sleep at night; no late nights or overnights; keep the same bedtime on weekdays and weekends. Take daytime naps or rest breaks when you feel tired or fatigued, unless they interfere with falling asleep at night.

Activity Level: Limit physical and cognitive (mental) activity: Symptoms typically worsen or return with too much activity. Making symptoms worse may slow down recovery.

- Physical activity includes physical education, sports practices, weight-training, running, exercising, heavy lifting, etc.
- Cognitive activity includes heavy concentration, learning, reading or writing (e.g., schoolwork, job-related mental activity).

Symptoms as your Guide: Pay attention to your symptoms. As they get better, increase your activities gradually with careful monitoring for return or worsening of symptoms. Let the worsening and/or return of symptoms be your guide to slow down.

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Emotions: During recovery, it is normal to feel frustrated, nervous or sad because you do not feel right and your activity is reduced. Seek professional help if you feel unsafe or have thoughts of self-harm.

Driving: You are advised not to drive if you have significant symptoms or cognitive impairment, as these can interfere with safe driving.
Return to School

KEY POINTS

- Students with symptoms and/or neuropsychological dysfunction after a concussion often need support to perform school-related activities. As symptoms decrease during recovery, these supports may be gradually removed.
- Inform the teacher(s), school nurse, school psychologist or counselor, and administrator(s) about your injury and symptoms.
- School personnel should be instructed to watch for:
  * increased problems paying attention or concentrating
  * increased problems remembering or learning new information
  * longer time needed to complete tasks or assignments
  * greater irritability, less tolerance for stressors
  * increase in symptoms (e.g., headache, fatigue, etc.)
  * difficulty managing and completing complex assignments

Based on the above symptoms, the following supports are recommended: (Check all that apply)

- No return to school
- Return on (date)
- Return to school with following supports. Monitor above symptoms, as they may increase with cognitive exertion (mental effort)
- Shortened day. Recommend ___ hours per day until (date)
- Shortened classes (i.e., rest breaks during classes). Maximum class length: _____ minutes
- Rest breaks during school day. _____ rest breaks per day. ___ AM ___ PM ____As needed/symptoms worsen. ______ minutes
- Allowances for extended time to complete coursework/assignments and tests
- Reduced homework load. Maximum length of nightly homework: _____ minutes. 20-30’ study, 10-15’ rest break.
- No testing at this time / Modified classroom/ standardized testing - only as symptoms and preparation allow; allow breaks as needed.
- Meet with guidance counselor/ academic advisor to establish reasonable timeline for make-up work (as symptoms permit).
- Request meeting of 504 or School Management Team to discuss this plan and coordinate accommodations.
## Return to Work

1. Planning to return to work should be based upon careful attention to symptoms and under the supervision of an appropriate health care professional.

2. Limiting the amount of work you do soon after your injury, may help speed your recovery. It is very important to get a lot of rest. You should also reduce your physical activity as well as activities that require a lot of thinking or concentration.

   - Do not return to work. Return on (date)____________________.
   - Return to work with the following supports. Review on (date)____________________.

### Schedule Considerations

- Shortened work day _____ hours
- Allow for breaks when symptoms worsen
- Reduced task assignments and responsibilities

### Safety Considerations

- No driving
- No heavy lifting or working with machinery
- No heights due to possible dizziness, balance problems

---

This form is part of the “Heads Up: Brain Injury in Your Practice” tool kit developed by the Centers for Disease Control and Prevention (CDC).
**KEY POINTS**

- **Return to exercise carefully.** Ask your healthcare provider whether you are ready to begin exercise. Some exercise may be helpful, while too much may slow down your recovery. Do not engage in any exercise that causes a significant return or worsening of symptoms.

- Be sure that the PE teacher, teacher at school recess, coach, and/or athletic trainer are aware of your injury and symptoms and that you are not asked to do activities that put you at risk for additional injury or cause you to over-exert.

  ___ No physical exercise at this time.

  ___ Begin physical exercise as indicated below (stop all activities if symptoms return or significantly worsen):

<table>
<thead>
<tr>
<th>Day/ date*</th>
<th>Physical Exertional Activity (NON-CONTACT ONLY)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Low levels of physical exertion that may include walking, light stationary biking, light weightlifting (lower weight, higher reps, no bench, no squat).</td>
</tr>
<tr>
<td></td>
<td>2. Moderate levels of exercise with body/ head movement as tolerated. Includes moderate jogging/ brief running, moderate-intensity stationary biking, moderate-intensity weightlifting (reduced time and/or weight from typical routine).</td>
</tr>
<tr>
<td></td>
<td>3. Heavy exertion. You may return to your typical, full level of exercise. This includes sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact sport-specific drills (in 3 planes of movement).</td>
</tr>
</tbody>
</table>

* Pay careful attention to your symptoms/ cognitive skills at each stage of exertion. Move to the next level of exertion only if symptoms remain absent at the current level. If your symptoms return, let your health care provider know, and reduce activities to the previous level.
KEY POINTS

Returning to Sports/ Physical Education

- You should NEVER return to play if you still have ANY symptoms. There is no return to activities involving risk of re-injury until you are symptom-free and fully recovered. In many states it is the law that you must be cleared by a licensed healthcare provider to return.
- Do not play sports in PE or at recess until you are fully recovered and cleared by your healthcare provider.
- It is normal to feel frustrated, sad and even angry because you cannot return to sports right away. With any injury, a full recovery will reduce the chances of getting hurt again. It is better to miss one or two games than the whole season.

___ Do not return to physical education (PE) class
___ Return to Physical Education on ____________________
___ Do not return to sports practices/games at this time

Restrictions ____________________

___ Complete the Gradual Return to Play Protocol under the supervision of an appropriate health care provider (e.g., athletic trainer).

This is typically a 5 step process, involving stages 1, 2, 3 of increasing exercise (described above) and stages 4 and 5 (described below). Allow 24 hours between each stage and assure that you remain symptom free before progressing. Full clearance for return to play requires a careful evaluation by a licensed healthcare provider with knowledge and training in concussion management. Cognitive functions, balance, and symptoms must return to ‘normal’ before it is safe to return to play.
Activity-Rest Balance
Symptom Management/
Managing Exertional Effects
What is exertion?

Exertion: vigorous action or effort: physical and mental exertion.

What is “rest?”

The concept of exertional activity (and rest) viewed along a continuum of activity from no activity/full rest to full activity/no rest.
Cognitive Exertion
Why Do we Care?

- Exertional Effects = Symptom exacerbation following physical or cognitive activity
- Signal that the brain’s dysfunctional neurometabolism being pushed beyond its tolerable limits
- Child’s sensitivity to symptom exacerbation / exertional effects is hypothesized to be one more indicator of its injury status.
- Possible treatment implications
Exertional Effects

Exertional Effects Index

Difference Score = 17 - 5 = 12

Indicate symptom rating at the beginning of the testing session (Pre) AND at the end of the session (Post) as appropriate, but ask about headache, fatigue, concentration, irritability, and any other symptoms (sensitivity to light and/or sound, etc.) as appropriate.
Cognitive Exertion Recovery

Cognitive Exertion Total Change

Mean

Children's National
Typical Symptom Culprits

- Headaches
- Fatigue
- Vestibular (dizziness, balance)
- Cognitive problems (attention, memory, executive function, speed)
- Anxiety/mood problems
Treatment Modalities

- Headache: behavioral medicine, lifestyle education, medication
- Cognitive problems: strategy use, environmental accommodations, medication
- Anxiety/ Mood: psychotherapy, medication
- Fatigue/ Sleep issues: behavioral sleep treatment, (medication)
- Vestibular dysfx: vestibular therapy
“Practice guidelines recommend an initial period of rest for concussion/ mild traumatic brain injury (MTBI)…

BUT, compelling evidence that other health conditions can be worsened by inactivity, improved by early mobilization/ exercise…

Best available evidence suggests that rest exceeding three days is probably more harmful than helpful…

Gradual resumption of pre-injury activities should begin as soon as tolerated…

Supervised exercise may benefit patients who are slow to recover…”

Silverberg & Iverson (JHTR, 2013)
Evidence

- Unqualified adage that rest “is the best medicine.”
- “Little agreement on the exact nature and duration of the rest period…
- Wide variability in healthcare professionals and patients interpretation of “rest”..
- Recommended duration varies, with most widely adopted timeline “until asymptomatic”…
- Being sedentary after an injury or illness is one of the most consistent risk factors for chronic disability.
Evidence

- In chronic fatigue syndrome, rest is thought to contribute to its maintenance.
- Excessive activity restrictions may play a role in maintenance of chronic pain.
- Low levels of activity may have mental health consequences.
  - Injury or illness appears to raise susceptibility to depression if patients do not engage in their regular reinforcing activities.
  - Activity restrictions has been shown to moderate the relationship between injury/illness and mental health outcome in breast cancer, limb amputation, and stroke.
  - Anxiety may also be a cause and consequence of excessive activity restriction. Fear about exacerbating symptoms and/or re-injury.
Bed rest in healthy persons

- Prescribed rest begins to adversely affect the cardiopulmonary and musculoskeletal systems in healthy people within three days.
- After 3-6 days of bed rest, they complain of headache, restlessness, and difficulty sleeping, and after a week, mood changes and vestibular sensitivity are common.
- Thus, it appears that complete bed rest beyond a few days is sufficient to cause post-concussion-like symptoms and may exacerbate symptoms after MTBI.
Activity-Rest Management

Concussion in Sports: Postconcussive Activity Levels, Symptoms, and Neurocognitive Performance

Cynthia W. Majerske, MD, MS*; Jason P. Mihalik, MS, CAT(C), ATC†; Dianxu Ren, PhD*; Michael W. Collins, PhD*; Cara Camiolo Reddy, MD*; Mark R. Lovell, PhD*; Amy K. Wagner, MD*

Objective: To examine the role postinjury activity level plays in postconcussive symptoms and performance on neurocognitive tests in a population of student-athletes.

Methods: Retrospective data from athletes with concussions (80 males, 15 females: age = 15.88 ± 1.35 years) were retrospectively assigned to 1 of 5 groups based on a postinjury activity intensity scale.

Results: Level of exertion was significantly related to all outcome variables (P < .02 for all comparisons). With multivariate analysis, activity intensity remained significant with respect to visual memory (P = .003) and reaction time (P < .001).

Conclusions: Activity level after concussion affected symptoms and neurocognitive recovery. Athletes engaging in high levels of activity after concussion demonstrated worse neurocognitive performance. For these tasks, those engaging in moderate levels of activity demonstrated the best performance.

Not too Little, Not Too Much
Activity-Rest Balance
Symptom Management/
Managing Exertional Effects
“Active” Aerobic Rehabilitation

- **Aerobic Activation** (Gagnon et al., 2009; Leddy et al., 2010)

- Structured and monitored subsymptom threshold exercise to facilitate healing in slow to recovery (>3-4 weeks).

- Progressive “controlled” exercise below level that produces symptom occurrence or worsening.
Pictorial Children’s Effort Rating Table

1. Very, very easy
2. Very easy
3. Easy
4. Just feeling a strain
5. Starting to get hard
6. Getting quite hard
7. Hard
8. Very hard
9. Very, very hard
10. So hard I’m going to stop
## STR Progress Log

**Name:**

**Therapist:**

<table>
<thead>
<tr>
<th>Site:</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCATION (circle one)</td>
<td>Clinic Home</td>
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<td>Clinic Home</td>
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<tr>
<td>RESTING/ POST-ACTIV HR</td>
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<tr>
<td>Effort Rating Level (1-10)</td>
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<tr>
<td>AEROBIC ACTIVITY:</td>
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<tr>
<td>DURATION:</td>
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<tr>
<td>SYMPTOM (PRE/POST)</td>
<td>Rate 0-10</td>
<td>Rate 0-10</td>
<td>Rate 0-10</td>
<td>Rate 0-10</td>
<td>Rate 0-10</td>
<td>Rate 0-10</td>
<td>Rate 0-10</td>
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<tr>
<td>HEADACHE</td>
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<tr>
<td>FATIGUE</td>
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<tr>
<td>DIZZY/ BALANCE</td>
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<tr>
<td>LIGHT/NOISE SENSITIVITY</td>
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<tr>
<td>Other:</td>
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<tr>
<td>SPORT COORDINATION EXERCISES:</td>
<td>Completed? Yes / No Time:</td>
<td>Completed? Yes / No Time:</td>
<td>Completed? Yes / No Time:</td>
<td>Completed? Yes / No Time:</td>
<td>Completed? Yes / No Time:</td>
<td>Completed? Yes / No Time:</td>
<td>Completed? Yes / No Time:</td>
</tr>
</tbody>
</table>
Progressive Activities of Controlled Exertion (PACE)

- Set the Positive Foundation for Recovery
- Define the Parameters of the Activity-Exertion Schedule
- Skill Teaching: Activity-Exertion Monitoring/Management
- Reinforcing the Progressive Path to Recovery
## Progressive Activities of Controlled Exertion (PACE) Ten Elements

Set the Positive Foundation for Recovery

<table>
<thead>
<tr>
<th>Treatment Component</th>
<th>Description</th>
<th>Script/ supporting materials/tools</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Positive, active problem-solving context</strong>&lt;br&gt;a. Self-efficacy, b. Locus of control, c. Outcome expectations</td>
<td>Provide the student, family, and school with a psychologically positive, active problem-solving context for rehabilitation. Use frequent statements such as “You will improve and recover.” “Your efforts to manage your activity and time will pay off.” “Recovery is the light at the end of the tunnel, and you will reach it.” “You have control of your activity.” Highlight for the child and family symptoms that may have already resolved or are improving as evidence of progress toward recovery. Framing the injury and its recovery in a positive, constructive, reassuring manner is critical.</td>
<td>“You will improve and recover.”&lt;br&gt;“Your efforts to manage your activity and time will pay off.”&lt;br&gt;“Recovery is the light at the end of the tunnel, and you will reach it.”&lt;br&gt;“You have control of your activity.”</td>
</tr>
<tr>
<td><strong>2. Assess and manage emotional response to injury</strong></td>
<td>Explore and manage the emotional response of the child and family to the injury. Assess how it has disrupted their lives. Ask what stresses or demands they are facing (school, peer, athletics). How do they typically manage stress? What do they know about mTBI and its effects? What have they heard about mTBI, and how is this affecting a positive, constructive, active approach to recovery? What fears or anxieties do they have about the injury and its effects? Correcting non-productive or incorrect thoughts/knowledge about mTBI (e.g., one injury will result in long-term brain damage) is critical. (See the developmentally appropriate education in #3.) Realigning the emotions associated with these errant thoughts in a positive, constructive direction is essential to an active approach to recovery.</td>
<td>- Anxiety, mood scale – pre-injury and post-injury&lt;br&gt;- Assess level of concern and worry about injury&lt;br&gt;- Fears &amp; worries&lt;br&gt;- Typical coping skills&lt;br&gt;- Current life stresses (social, academic, sports, family)</td>
</tr>
</tbody>
</table>
Progressive Activities of Controlled Exertion (PACE) Ten Elements

Set the Positive Foundation for Recovery

| 3. Developmentally appropriate education about mTBI and its effects | Provide developmentally appropriate education regarding mTBI and its dynamics (i.e., software injury, energy deficit), including the typical timeframes for recovery (i.e., typically days to several weeks) and the relationship between the student's level of activity and the potential for symptom exacerbation (exertional effects). Types of exertion are reviewed: physical, cognitive, emotional - and the need to manage their energy demands. This knowledge serves as the basis for teaching the concepts of moderated “optimal” activity, managing the activity-exertion relationship, and sub-exertion effects threshold. |
| - Acceleration-deceleration |
| - Software-hardware |
| - Chemical and electrical changes |
| - Gradual return to normal |
| - Energy crisis & need to manage energy |
| - Symptoms worsening with activity as signal of “too much” |
| - Problems associated with “too little” activity |
## Progressive Activities of Controlled Exertion (PACE) Ten Elements

### Define the Parameters of the Activity-Exertion Schedule

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a. Define daily schedule</td>
<td>Define the student’s typical daily schedule (before, during, after school, weekends), including the times of the day when activities might present the greatest exertional challenges (“hot spots”) and lesser challenges (“cool spots”).</td>
<td>Weekly schedule? Hot spots &amp; Cool spots</td>
</tr>
<tr>
<td>4b. Define type, intensity &amp; duration of cognitive &amp; physical activities and their exertional effects</td>
<td>Define the specific type, intensity and duration of cognitive and physical activities within the schedule and their exertional effects on symptoms (e.g., “first period is a 60 minute Algebra class, which is very hard for me because there is a long lecture and my headaches increase a lot.” vs. “second period is a 60 minute Art class where we work at our own pace on our sculpture project, and I feel fine.”). This definition allows the medical provider to target the most troublesome or symptom-eliciting activities, and can be used to teach the student the specific activity-exertion connection. - Defining triggers- sensitizing/ exacerbating environmental stimulation (sound, light)</td>
<td>Grade exertion intensity (low, moderate, high?)</td>
</tr>
<tr>
<td>5. Define tolerability for activity intensity and duration</td>
<td>Define the limits of tolerability for activity intensity/duration - i.e., where symptoms do not increase substantially/meaningfully. Ideally, this should be done for each key class. A sample question might be “How long can you typically go in your classes before you notice your symptoms become much worse and affect your learning?” Use these time/intensity limits as the frame within which to schedule the “work-rest” breaks.</td>
<td>“How long can you typically go in your classes before you notice your symptoms become much worse and affect your learning?” Time/intensity limits as the frame within which to schedule the “work-rest” breaks.</td>
</tr>
</tbody>
</table>
## Progressive Activities of Controlled Exertion (PACE) Ten Elements

### Skill Teaching: Activity-Exertion Monitoring/ Management

<table>
<thead>
<tr>
<th></th>
<th>Teach the concept of engaging in “Not too little, not too much” activity. The student’s goal is to find the activity “sweet spot” where activity time and effort are maximized without symptoms worsening. In other words, teach the related concepts of moderated activity and symptom management. It is important to emphasized to the student, parents and teachers that small increases in symptoms (e.g., where exertion ratings change by 1) are not counterproductive to recovery but large increases may be.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teach “reasonable” symptom monitoring and recording. Be aware of the child or parent that is either an overly anxious over-reporter or an oblivious under-reporter, and coach them accordingly to monitor symptoms reasonably. For example, counsel the over-reporter to tolerate a bit more of the symptoms, and the under-reporter to attend a bit more closely to their symptom exacerbation.</td>
</tr>
<tr>
<td>8. Work to tolerable limits – work-rest-work-rest</td>
<td>Instruct the student to work up to their symptom limits, but to not exceed them, by being aware of (i.e., reasonable monitoring) their symptoms. When the symptoms increase several points on their exertion monitoring scale, take a defined rest break. Emphasize that tolerating a mild increase in symptoms is OK, but too much increase is not. When symptoms return to “typical” levels, they should return to the activity.</td>
</tr>
</tbody>
</table>
|   | - Concept: too little/much  
   | - Find Sweet spot goal  
   | - Moderated activity with symptom monitor/ mgt  
   | - Reasonable tolerance, reasonable monitoring  
   | - Symptom Monitor tool: CEERS  
   | - Relaxation/ anxiety management skill training  
   | Work to limits  
   | Work-rest-work-rest |
### Progressive Activities of Controlled Exertion (PACE) Ten Elements

#### Reinforcing the Progressive Path to Recovery

| 9. Recovery is dynamic; a-e mgt will reduce symptoms | Help the student to understand that the recovery process is dynamic, and with good activity-exertion management under their control, they will feel better, and the symptoms will decrease. Highlight symptoms that may already be resolving as evidence of progress toward recovery. | - Reinforce positive control, dynamic improvement.  
- Highlight symptoms that have decreased |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 10. Gradual increase activity time/intensity.         | As the student improves (i.e., reduced symptoms and greater tolerance for activity), it is important to work constructively with the child and family (and school) to gradually increase the time/intensity of activity, while continuing to monitor the exertional symptom response. The “sweet spot” of activity-exertion management will be moving closer to their normal schedule and toward the recovery state. | - With progress comes gradual increase in activity time/intensity.  
- Positive movement of sweet spot toward normal. |
Return to School
Return to School
Kid’s Major “Job”

• **New Learning/ Acquiring Knowledge**
  – Academic
  – Social
• **Practicing incompletely learned knowledge**
• **Mental/ Cognitive exertion is essential to new learning/ practice**
Effect of Concussion on
School Learning &
Performance

Effect of School
Learning & Performance
on Concussion Recovery
School and the Concussed Youth: Recommendations for Concussion Education and Management

Maegan D. Sady, PhD,*, Christopher G. Vaughan, PsyD, Gerard A. Gioia, PhD

KEYWORDS
- Concussion • Mild traumatic brain injury • Student-athlete
- Student • School • Accommodations • Management

Learning is the centerpiece of child and adolescent development. Children’s organ of learning is their brain; any adverse event that impairs the brain’s functioning, temporarily or permanently, poses a significant threat to learning. Traumatic brain injury (TBI) of any severity is an adverse event that can threaten the developing child’s future ability to learn. Although more severe forms of TBI may be readily recognized as a threat, greater attention is being paid now to both short- and long-term effects of TBI at the milder end of the spectrum. Recent advances in concussion research have provided clinicians with numerous means to recognize and assess mild TBI, as concussion. It is now widely recognized that neurometabolic...
Heads Up to Schools: KNOW YOUR CONCUSSION ABCs

Assess the situation  Be alert for signs and symptoms  Contact a health care professional

Signs and Symptoms of a Concussion

A concussion is caused by a bump, blow, or jolt to the head. Concussions can also occur from a fall or blow to the body that causes the head to move rapidly back and forth. Even what seems to be a mild bump to the head can be serious. Be alert for any of the following signs and symptoms.

**SIGNS OBSERVED BY SCHOOL PROFESSIONALS**
- Appears dazed or stunned
- Is confused about events
- Answers questions slowly
- Repeats questions
- Can't recall events prior to hit, bump, or fall

**SYMPTOMS REPORTED BY THE STUDENT**

**Thinking/Remembering**
- Difficulty thinking clearly
- Difficulty concentrating or remembering
- Feeling more slowed down
- Feeling sluggish, hazy, foggy, or groggy

**Physical**
- Headache or “pressure” in head
- Nausea or vomiting
- Balance problems or dizziness
- Fatigue or feeling tired
- Blurry or double vision
- Sensitivity to light or noise
- Namibness or tingling
- Does not “feel right”

**Emotional**
- Irritable
- Sad
- More emotional than usual
- Nervous

**Sleep**
- Drowsy
- Sleeps less than usual
- Sleeps more than usual
- Has trouble falling asleep

*Only ask about sleep symptoms if the injury occurred on a prior day.*

What can school professionals do?

Know your Concussion ABCs:
A—Assess the situation  B—Be alert for signs and symptoms  C—Contact a health care professional
Concussion’s Effects on School Learning & Performance

- 216 students (Gr. 4-12) with concussions
- “Which specific types of problems are you experiencing in school?”
- Students reported an average of 3.4 problems below.

- Headaches interfering: 66% (HS-68%)
- Too tired: 54% (HS-58%)
- Can’t pay attn in class: 58% (HS-62%)
- HW taking much longer: 49% (HS-54%)
- Difficulty studying for test/quiz: 42% (HS-47%)
- Difficulty understanding material: 44% (HS-46%)
- Difficulty taking notes: 27% (HS-32%)
Concussion’s Effects on School Learning & Performance

Which classes are you having the most trouble with? (Percent reporting trouble in class)

<table>
<thead>
<tr>
<th>Class</th>
<th>Parent</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td>60.3%</td>
<td>73.7%</td>
</tr>
<tr>
<td>Reading/LA</td>
<td>38.1%</td>
<td>46.1%</td>
</tr>
<tr>
<td>Science</td>
<td>38.1%</td>
<td>47.4%</td>
</tr>
<tr>
<td>Soc Stud</td>
<td>38.1%</td>
<td>40.8%</td>
</tr>
<tr>
<td>Foreign Lang</td>
<td>38.1%</td>
<td>38.2%</td>
</tr>
<tr>
<td>PE</td>
<td>7.9%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Art</td>
<td>3.2%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Music</td>
<td>6.3%</td>
<td>17.9%</td>
</tr>
<tr>
<td>None</td>
<td>25.4%</td>
<td>6.6%</td>
</tr>
</tbody>
</table>
Effect of School Learning & Performance on Concussion Recovery
Cognitive Demands of School Worsen Symptoms

Cognitive Exertion - 3 Visits

- Yes: 86.6%, 83.3%, 46.8%
- No Opportunity: 3.0%, 3.0%, 3.2%

Percent Reporting

Presence of Symptom Worsening

Visit 1 (13 days) | Visit 2 (28 days) | Visit 3 (45.5 days)

N= 72  Gioia et al., 2010
Managing Concussion

**ACUTE CONCUSSION EVALUATION (ACE) CARE PLAN**

Gerard Gioia, PhD¹ & Micky Collins, PhD²

¹Children’s National Medical Center
²University of Pittsburgh Medical Center

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**KEY POINTS**

**Returning to Daily Activities**

Sleep: Be sure to get adequate sleep at night; no late nights or overnights; keep the same bedtime on weekdays and weekends. Take daytime naps or rest breaks when you feel tired or fatigued, unless they interfere with falling asleep at night.

Activity Level: Limit physical and cognitive (mental) activity: Symptoms typically worsen or return with too much activity. Making symptoms worse may slow down recovery.

- Physical activity includes physical education, sports practices, weight-training, running, exercising, heavy lifting, etc.
- Cognitive activity includes heavy concentration, learning, reading or writing (e.g., schoolwork, job-related mental activity).

Symptoms as your Guide: Pay attention to your symptoms. As they get better, increase your activities gradually with careful monitoring for return or worsening of symptoms. Let the worsening and/or return of symptoms be your guide to slow down.

Food and Drink: Maintain adequate hydration (drink lots of fluids) and an appropriate diet during recovery.

Emotions: During recovery, it is normal to feel frustrated, nervous or sad because you do not feel right and your activity is reduced. Seek professional help if you feel unsafe or have thoughts of self-harm.

Driving: You are advised not to drive if you have significant symptoms or cognitive impairment, as these can interfere with safe driving.
Managing Concussion

**KEY POINTS**

**Returning to School**

- Students with symptoms and/or neuropsychological dysfunction after a concussion often need support to perform school-related activities. As symptoms decrease during recovery, these supports may be gradually removed.
- Inform the teacher(s), school nurse, school psychologist or counselor, and administrator(s) about your injury and symptoms.
- School personnel should be instructed to watch for:
  - Increased problems paying attention or concentrating
  - Increased problems remembering or learning new information
  - Longer time needed to complete tasks or assignments
  - Greater irritability, less tolerance for stressors
  - Increase in symptoms (e.g., headache, fatigue, etc.)
  - Difficulty managing and completing complex assignments

**Based on the above symptoms, the following supports are recommended:** (Check all that apply)

- No return to school
- Return on [date]
- Return to school with following supports. **Monitor above symptoms, as they may increase** with cognitive exertion (mental effort)
- Shortened day. Recommend ___ hours per day until [date]
- Shortened classes (i.e., rest breaks during classes). Maximum class length: ___ minutes
- Rest breaks during school day. ___ rest breaks per day. ___ AM ___ PM ___ As needed/symptoms worsen. ___ minutes
- Allowances for extended time to complete coursework/assignments and tests
- Reduced homework load. Maximum length of nightly homework: ___ minutes. 20-30' study, 10-15' rest break.
- No testing at this time / Modified classroom/ standardized testing - only as symptoms and preparation allow; allow breaks as needed.
- Meet with guidance counselor/ academic advisor to establish reasonable timeline for make-up work (as symptoms permit).
- Request meeting of 504 or School Management Team to discuss this plan and coordinate accommodations.
<table>
<thead>
<tr>
<th>Postconcussion Effect</th>
<th>Functional School Problem</th>
<th>Accommodation/Management Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuropsychological deficits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention/concentration</td>
<td>Short focus on lecture, classwork, homework</td>
<td>Shorter assignments, break down tasks, lighter work load</td>
</tr>
<tr>
<td>Working memory</td>
<td>Holding instructions in mind, reading comprehension, mathematics calculation, writing</td>
<td>Repetition, written instructions, use of calculator, shorter reading passages</td>
</tr>
<tr>
<td>Memory consolidation/retention</td>
<td>Retaining new information, accessing learned information when needed</td>
<td>Smaller chunks to learn, recognition cues</td>
</tr>
<tr>
<td>Processing speed</td>
<td>Keep pace with work demand, process verbal information effectively</td>
<td>Extended time, slow down verbal information, comprehension checking</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Decreased arousal/activation to engage basic attention, working memory</td>
<td>Rest breaks during classes, homework, and examinations</td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headaches</td>
<td>Interferes with concentration</td>
<td>Rest breaks</td>
</tr>
<tr>
<td>Light/noise sensitivity</td>
<td>Symptoms worsen in bright or loud environments</td>
<td>Wear sunglasses, seated away from bright sunlight or other light. Avoid noisy/crowded environments such as lunchroom, assemblies, and hallways</td>
</tr>
<tr>
<td>Symptom</td>
<td>Description</td>
<td>Accommodations</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Dizziness/balance problems</td>
<td>Unsteadiness when walking</td>
<td>Elevator pass, class transition before bell</td>
</tr>
<tr>
<td>Sleep disturbance</td>
<td>Decreased arousal, shifted sleep schedule</td>
<td>Later start time, shortened day</td>
</tr>
<tr>
<td>Anxiety</td>
<td>Can interfere with concentration, student may push through symptoms to prevent falling behind</td>
<td>Reassurance from teachers and team about accommodations, workload reduction, alternate forms of testing</td>
</tr>
<tr>
<td>Depression/withdrawal</td>
<td>Withdrawal from school or friends because of stigma or activity restrictions</td>
<td>Time built in for socialization</td>
</tr>
<tr>
<td>Cognitive symptoms</td>
<td>Concentrating, learning</td>
<td>See specific cognitive accommodations (above)</td>
</tr>
<tr>
<td>Symptom sensitivity</td>
<td>Symptoms worsen with overactivity, resulting in any of the earlier-mentioned problems</td>
<td>Reduce cognitive or physical demands below symptom threshold, provide rest breaks, complete work in small increments until symptom threshold increases</td>
</tr>
</tbody>
</table>
Helping Students Recover from a Concussion: Classroom Tips for Teachers

Changes You Can Make Based on Type of Concussion Symptoms

<table>
<thead>
<tr>
<th>THINKING/REMEMBERING (such as having difficulty thinking clearly or concentrating, feeling slowed down)</th>
<th>FATIGUE/SLEEP AND PHYSICAL (such as feeling tired, having no energy, having headaches or dizziness)</th>
<th>EMOTIONAL (such as feeling sad, irritable, anxious)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduce class assignments and homework to key tasks only and base grades on adjusted work.</td>
<td>• Allow time to visit the school nurse for treatment of headaches or other symptoms.</td>
<td>• Develop an emotional support plan for your students (e.g., identify an adult to whom they can talk if feeling overwhelmed).</td>
</tr>
<tr>
<td>• Provide extra time to work on class assignments.</td>
<td>• Provide rest breaks.</td>
<td>• Locate a quiet place for your students to go to if they feel overwhelmed. And provide information on how they can safely get to this quiet location.</td>
</tr>
<tr>
<td>• Provide written instructions and help for homework and classwork.</td>
<td>• Give your students extra time to go from class to class, to avoid crowds.</td>
<td>• Students may benefit from continued involvement in certain extracurricular activities during their recovery. Identify student and family preferences and consider these activities, approved by their health care provider, in relation to rest time and academic work.</td>
</tr>
<tr>
<td>• Allow extra time to take tests, limit tests to one per day, and/or provide study guides.</td>
<td>• If bothered by light, allow your students to wear sunglasses or sit in a place that is less bright (e.g., draw blinds, sit away from window).</td>
<td></td>
</tr>
<tr>
<td>• Allow your students to show they understand a concept orally instead of in writing.</td>
<td>• If bothered by noise, provide a quiet place for your students to study, take a test, or spend lunch or recess.</td>
<td></td>
</tr>
<tr>
<td>• Provide class notes and/or allow students to use a computer or tape recorder to record classroom information.</td>
<td>• Do not substitute concentration activities for physical activity (e.g., do not assign reading instead of PE).</td>
<td></td>
</tr>
</tbody>
</table>
# Gradual Return to School

## Post-Concussion Gradual Return to Academics

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Activity Level</th>
<th>Criteria to Move to Next Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No return, at home</td>
<td>Day 1 - Maintain low level cognitive and physical activity. No prolonged concentration. Cognitive Readiness Challenge: As symptoms improve, try reading or math challenge task for 10-30 minutes; assess for symptom increase.</td>
<td>To Move To Stage 1: (1) Student can sustain concentration for 30 minutes before significant symptom exacerbation, AND (2) Symptoms reduce or disappear with cognitive rest breaks allowing return to activity.</td>
</tr>
<tr>
<td>1</td>
<td>Return to School, Partial Day (1-3 hours)</td>
<td>Attend 1-3 classes, with interspersed rest breaks. Minimal expectations for productivity. No tests or homework.</td>
<td>To Move To Stage 2: Student symptom status improving, able to tolerate 4-5 hours of activity with 2-3 cognitive rest breaks built into school day.</td>
</tr>
<tr>
<td>2</td>
<td>Full Day, Maximal Supports (required throughout day)</td>
<td>Attend most classes, with 2-3 rest breaks (20-30'), no tests. Minimal HW (≤ 60'). Minimal-moderate expectations for productivity.</td>
<td>To Move To Stage 3: Number &amp; severity of symptoms improving, needs only 1-2 cognitive rest breaks built into school day.</td>
</tr>
<tr>
<td>3</td>
<td>Return to Full Day, Moderate Supports (provided in response to symptoms during day)</td>
<td>Attend all classes with 1-2 rest breaks (20-30'); begin quizzes. Moderate HW (60-90'). Moderate expectations for productivity. Design schedule for make-up work.</td>
<td>To Move To Stage 4: Continued symptom improvement, needs no more than 1 cognitive rest break per day</td>
</tr>
<tr>
<td>4</td>
<td>Return to Full Day, Minimal Supports (Monitoring final recovery)</td>
<td>Attend all classes with 0-1 rest breaks (20-30'); begin modified tests (breaks, extra time). HW (90+) Moderate- maximum expectations for productivity.</td>
<td>To Move To Stage 5: No active symptoms, no exertional effects across the full school day.</td>
</tr>
<tr>
<td>5</td>
<td>Full Return, No Supports Needed</td>
<td>Full class schedule, no rest breaks. Max. expectations for productivity. Begin to address make-up work.</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Cognitive rest break: a period during which the student refrains from academic or other cognitively demanding activities, including schoolwork, reading, TV/games, conversation. May involve a short nap or relaxation with eyes closed in a quiet setting.
Gradual Return to School
Six Stages

<table>
<thead>
<tr>
<th>Stage</th>
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</tr>
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<tbody>
<tr>
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<tr>
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<td>Full Day, Maximal Supports (required throughout day)</td>
</tr>
<tr>
<td>3</td>
<td>Return to Full Day, Moderate Supports (provided in response to symptoms during day)</td>
</tr>
<tr>
<td>4</td>
<td>Return to Full Day, Minimal Supports (Monitor final recovery)</td>
</tr>
<tr>
<td>5</td>
<td>Full Return, No Supports Needed</td>
</tr>
</tbody>
</table>
# Gradual Return to School

## Six Stages w/ Recommended Activity Level

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<td>1</td>
<td>Return to School, Partial Day (1-3 hours)</td>
<td>Attend 1-3 classes, intersperse rest breaks. No tests or homework. Minimal expectations for productivity.</td>
</tr>
<tr>
<td>2</td>
<td>Full Day, Maximal Supports (required throughout day)</td>
<td>Attend most classes, with 2-3 rest breaks (20-30’), no tests. Minimal HW (≤ 60’). Minimal-moderate expectations for productivity.</td>
</tr>
<tr>
<td>3</td>
<td>Return to Full Day, Moderate Supports (provided in response to symptoms during day)</td>
<td>Attend all classes with 1-2 rest breaks (20-30’); begin quizzes. Moderate HW (60-90’) Moderate expectations for productivity. Design schedule for make-up work.</td>
</tr>
<tr>
<td>4</td>
<td>Return to Full Day, Minimal Supports (Monitor final recovery)</td>
<td>Attend all classes with 0-1 rest breaks (20-30’); begin modified tests (breaks, extra time). HW (90+) Moderate- maximum expectations for productivity.</td>
</tr>
<tr>
<td>5</td>
<td>Full Return, No Supports Needed</td>
<td>Full class schedule, no rest breaks. Max. expectations for productivity. Begin to address make-up work.</td>
</tr>
</tbody>
</table>
# Gradual Return to School

**Six Stages with Recommended Activity Level & Criteria for Movement**

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<td>Return to School, Partial Day (1-3 hours)</td>
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<td>To Move To Stage 2: Symptom status improving, tolerates 4-5 hours of activity-rest cycles; 2-3 cognitive rest breaks built into school day.</td>
</tr>
<tr>
<td>2</td>
<td>Full Day, Maximal Supports (required throughout day)</td>
<td>Attend most classes, with 2-3 rest breaks (20-30'), no tests. Minimal HW (≤ 60'). Minimal-moderate expectations for productivity.</td>
<td>To Move To Stage 3: Symptom number &amp; severity improving, needs 1-2 cognitive rest breaks built into school day.</td>
</tr>
<tr>
<td>3</td>
<td>Return to Full Day, Moderate Supports (provided in response to symptoms during day)</td>
<td>Attend all classes with 1-2 rest breaks (20-30'); begin quizzes. Moderate HW (60-90'). Moderate expectations for productivity. Design schedule for make-up work.</td>
<td>To Move To Stage 4: Continued symptom improvement, needs no more than 1 cognitive rest break per day.</td>
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<td>4</td>
<td>Return to Full Day, Minimal Supports (Monitor final recovery)</td>
<td>Attend all classes with 0-1 rest breaks (20-30'); begin modified tests (breaks, extra time). HW (90+'). Moderate- maximum expectations for productivity.</td>
<td>To Move To Stage 5: No active symptoms, no exertional effects across the full school day.</td>
</tr>
<tr>
<td>5</td>
<td>Full Return, No Supports Needed</td>
<td>Full class schedule, no rest breaks. Max. expectations for productivity.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Case #2

Middle school lacrosse team was having practice after school. During a drill, another player hit Maria in the head with a lacrosse stick. Maria briefly lost consciousness, then vomited. When the assistant coach asked Maria if she was okay, she replied that she was fine. Maria stumbled to the sideline to get a drink and asked her teammate if the game was over.

What should happen at this point?

As the school psychologist, what should you do the following day and week?
Concussion Management System Planning
Building a Structure of Support in Your School
A Student is Identified with a Mild TBI/ Concussion

What Do You Do?
The Team

- School nurse, psychologist, athletic trainer,
- Guidance counselor
- Administrator
- Teacher(s)
- Healthcare Provider(s) (consulting)
- Family
Table 1
School concussion management: activities and responsibilities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible Parties</th>
<th>Completion Date</th>
<th>Evidence of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before school year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Concussion management policies &amp; procedures</td>
<td>School administration (school nurse, counselor, psychologist)</td>
<td>Before start of school year</td>
<td>Written policy in school manual, copy provided to all school staff</td>
</tr>
<tr>
<td>2. Development of school concussion resource team</td>
<td>School administration, including school nurse, counselor, psychologist, designated teacher, athletic trainer</td>
<td>Before start of school year</td>
<td>Written policy in school manual</td>
</tr>
<tr>
<td>3. Examine teaching/support methods to support recovery, maximize learning/performance, and reduce symptom exacerbation</td>
<td>School administration, including school nurse, counselor, psychologist</td>
<td>Before start of school year</td>
<td>Written policies on teaching methods</td>
</tr>
<tr>
<td>4. Teacher/staff education &amp; training (online video training, CDC school professional fact sheet)</td>
<td>Teacher, school counselor, school nurse, administrators</td>
<td>Before start of school year</td>
<td>Verification of completion provided to school administration</td>
</tr>
<tr>
<td>5. Develop list of concussion resources for education, consultation &amp; referral (medical, school, state/local Brain Injury Association)</td>
<td>School administration</td>
<td>Before start of school year</td>
<td>List of resources provided in policies &amp; procedures, available to school staff &amp; families</td>
</tr>
</tbody>
</table>
# School Concussion Management Program

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible Parties</th>
<th>Completion Date</th>
<th>Evidence of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>During school year (preinjury)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Review/reinforce concussion policy and procedures</td>
<td>School administration, school nurse/counselor</td>
<td>First faculty meeting, parent back to school night</td>
<td>Verbal report</td>
</tr>
<tr>
<td>2. Monitoring for injury, parent informed of injury</td>
<td>Coach, athletic trainer, school health personnel</td>
<td>Day of injury</td>
<td>Concussion symptom checklist, parent provided ACE Postconcussion Home/School Instructions</td>
</tr>
<tr>
<td><strong>School management (postinjury)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Medical evaluation &amp; school treatment planning</td>
<td>Licensed health care professional with concussion training, school concussion resource team</td>
<td>Early postinjury</td>
<td>Plan for school return/activity</td>
</tr>
<tr>
<td>2. Gradual return to school program</td>
<td>Licensed health care professional with concussion training, school concussion resource team</td>
<td>When medically determined to tolerate &gt;30 minutes of cognitive activity</td>
<td>Medical documentation</td>
</tr>
<tr>
<td>3. In-school observation, monitoring, &amp; supports</td>
<td>School concussion resource team</td>
<td>Ongoing</td>
<td>Concussion symptom checklist</td>
</tr>
<tr>
<td>4. Clearance for full return to academics</td>
<td>Licensed health care professional with concussion training, school concussion resource team</td>
<td>Asymptomatic with full cognitive exertion</td>
<td>Medical documentation (provided to family and school)</td>
</tr>
</tbody>
</table>
# Post-Injury School Management Procedural Steps

## Before School Return

### A. Medical evaluation
1. Injury Diagnosed; symptom profile defined
2. School Admin/ Teacher Informed of Injury

School makes or receives initial plan for school return
- Notification of Probable Head Injury
- ACE Care Plan

### B. Gradual Return to School Decision Criteria

Return to School when:
1. Key symptoms (headache, fatigue, fogginess, sensitivity to light/noise, dizziness) are tolerable
2. Mild level at start of day, responsive to rest
3. Medically determined to tolerate 30+ minutes of cognitive activity
### Post-Injury School Management Procedural Steps

#### In-School Programming

<table>
<thead>
<tr>
<th>Activity</th>
<th>Personnel</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Concussion Team Informed</strong></td>
<td>Team leader</td>
<td>Based on symptom status, school team determines plan for reduced schedule and participation, and for gradual increase as tolerated</td>
</tr>
<tr>
<td>- Initial accommodations defined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Team Leader informs teachers of symptoms and likely accommodations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. Day of Return**
- Team member/ teacher(s) meet with student and family to review symptom status and accommodation plan

Team member
### Activity

<table>
<thead>
<tr>
<th>C. Symptom progress monitoring (daily log)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Team member periodically monitors student symptom/exertion status, and academic progress</td>
</tr>
<tr>
<td>- Emotional status assessed/monitored</td>
</tr>
<tr>
<td>- Reports progress to team, family</td>
</tr>
<tr>
<td>- Adjustments to accommodation supports made according to symptom resolution</td>
</tr>
</tbody>
</table>

### Personnel

| Team Member |

### Procedures

<p>| CDC Concussion Signs &amp; Symptom Checklist |</p>
<table>
<thead>
<tr>
<th>Activity</th>
<th>Personnel</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Team liaisons with medical providers</td>
<td>Team/ medical personnel</td>
<td>Use ACE Care Plan to communicate accommodation</td>
</tr>
<tr>
<td>regarding progress</td>
<td></td>
<td>plan adjustments</td>
</tr>
<tr>
<td>- Adjustments made as per medical instruction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Academic accommodations</td>
<td>School Team member</td>
<td></td>
</tr>
<tr>
<td>- supports continue until symptom resolution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- with gradual increase in demands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Symptom Resolution</td>
<td>Medical personnel</td>
<td>Medical clearance documentation</td>
</tr>
<tr>
<td>- Student cleared for return to full academic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and athletic schedule</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Management Practice
Case #3

Marcus is a high school student who recently obtained his driver’s license. Over the weekend, Marcus was in a car accident and went to the emergency room where he was treated for a broken arm and a concussion. You find out about the accident when you return to work on Monday and see Marcus at school. Marcus said the doctor told him to stay home from school for a few days; however, it was the week before exams and Marcus did not want to get behind.

What might you do at this point?
What do I do now?

• Leave this session with an **action plan**—do “something different when you return to work
  • ___ Plan an in-service to educate
  • ___ Order CDC “Heads-Up” materials for coaches, psychologists, nurses, counselors, administrators
  • ___ Lead your school concussion management team
  • ___ Ensure there is a written plan for return-to-school/play
  • ___ Distribute information on smartphone apps (e.g., Concussion Recognition and Response: Coach and Parent Version, published by PAR).
  • ___ Other??
1. Learn how to recognize a concussion.
2. Learn the 12 Danger Signs → 911
3. Use tools to guide you
   a. CDC Heads Up materials
   b. Concussion Recognition & Response (CRR) app
4. Remove child from risk if you suspect a concussion, obtain a medical evaluation
5. Support proper treatment: physical, cognitive, emotional support
6. Monitor & record child’s symptoms at home
Myths and truths surrounding concussions.
2. Maryland has a law promoting concussion recognition & response in sports.
3. A student should not return to school until fully asymptomatic.
4. The only way to recover from a concussion is to eliminate “screens” and rest.
5. Students with concussions frequently report multiple areas of difficulty with learning.
6. Only medical professionals can identify a suspected concussion.
7. Football is responsible for the majority of concussions in sports.

8. A CT scan or MRI is important in the diagnosis of concussion.

9. In the state of Maryland, only a physician can “clear” an athlete to return to play.

10. Recovery from a concussion is best accomplished by a balance of moderated activity and rest breaks.

11. Baseline testing is necessary for the treatment and management of a concussion.
What we still need to know

- The brain’s individual response to forces (concussive, subconcussive)
- Reasons for variability in risk for injury
- Reasons for variability in recovery outcomes
- Long-term effects of single, multiple, complex injuries
- Individualized treatment predictors, protocols
- PREVENTION
Glimpse into the Future

- Genetics
- Neuro-imaging
- Measuring the forces (accelerometers)
  - Understand the injury mechanism
  - Modify behavior
- Treatments
  - Using technology
- Connected Care systems
50 States & DC Now Have Concussion Laws
Know your State Youth Concussion Law

3 Core Principles

1. Concussion Education for Coaches to Recognize & Respond
2. Remove & Protect – When in Doubt, Sit it Out
3. Medical Clearance required for Returning Youth to Play
1. 50% percent of persons who sustain a concussion typically lose consciousness. **True/ False**

2. Current guidance on returning the symptomatic patient to school with a concussion is to require complete physical and cognitive rest until fully asymptomatic. **True/ False**

3. The most common post-concussion symptom is a headache. **True/ False**

4. The responsibility of the school psychologist in the concussion process is to test the student in depth. **True/ False**

5. A common intervention/ accommodation strategy is to provide periodic rest breaks during the school day as needed. **True/ False**
SCORE
Safe Concussion Outcome, Recovery & Education

Play Hard.
Play Safe.
Play Smart!
When Return to Play?  
Criteria for RTP

- No longer have any **symptoms**
  - No longer need medicine to control symptoms.

- **Neurocognitive function** & **balance** back to "normal."
  - After rest and gradual activity (exertion)

- Cleared by medical professional to begin gradual Return to Play (RTP) program

- RTP ideally conducted by ATC