CONCUSSION: UPDATE AND REVIEW FOR SCHOOL HEALTH PERSONNEL

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DISCLOSURE

- My mentor has received an unrestricted philanthropic gift from ImPACT Applications, Inc., a concussion management company to fund concussion research.
- I have been provided with salary support and travel funding to present my research findings at academic meetings through this gift.
• SCHOOL HEALTH PERSONNEL ARE CRITICAL MEMBERS OF A STUDENT’S CONCUSSION MANAGEMENT TEAM

Concussions – The Role of the School Nurse

Position Statement

SUMMARY

It is the position of the National Association of School Nurses (NASN) that the registered professional school nurse (hereinafter referred to as school nurse) is an essential member of the school health team to address student concussions. The school nurse has the knowledge and skills to provide concussion prevention education to parents/guardians, students, and school staff; identify suspected concussions and help guide the student’s post-concussive graduated academic and activity return process.
### CONCUSSION: CRASH COURSE

![Title](https://www.mass.gov/sports-related-concussions-and-head-injuries)

<table>
<thead>
<tr>
<th>Title</th>
<th>Ideal individuals to fill this role</th>
<th>Responsibilities</th>
</tr>
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</table>
| Point Person   | School nurse, Administrators, Guidance counselor | • Coordinate the CMT  
• Advocate for the student’s needs  
• Serve as the primary point of contact with the student, family, medical provider and all members of the team |
| Symptom Monitor | School nurse, Athletic trainer, Physician assistant, Nurse practitioner, Physician | • Assess the student for concussion symptoms regularly for the first two weeks or longer as necessary  
• Report assessment result to the CMT or point person |
| Academic Monitor | Teacher(s), School counselor, Other school staff person familiar with the student | • Collect teacher reports about academic performance  
• Report behaviors and academic progress to the CMT |
| Other members as necessary | Athletic director, Neuropsychologist, School psychologist, Coach, Physical therapist, Athletic trainer, Guidance counselor, Student, Parent | • Provide context to the student’s symptoms, behavior, and academic progress  
• Improve communication  
• Identify upcoming needs and challenges facing the student |
INTEREST IN CONCUSSION: PSYCHOLOGY DATABASE “HITS”

- Up to 1990
- 91 to ’00
- 01 to ’10
- 11 to present

↑ 1,350% from pre-1990
↑ 450%

STATE OF THE SCIENCE: CONCUSSION IN SPORT GROUP (CISG)

- Multidisciplinary group of international experts in concussion
- Berlin meeting, October 2016
- Published an updated Consensus Statement on Concussion in Sport
- Several systematic reviews on priority topics/questions
  - E.g., sideline concussion screening, long-term effects, strategies to reduce risk, etc.
  - Attempted to locate every study on a topic and combine/synthesize the results/findings
  - 60,000 published articles were screened for potential inclusion
WHAT IS CONCUSSION?

…“a clinical syndrome of biomechanically induced alteration of brain function, typically affecting memory and orientation, which may involve loss of consciousness.”

• Giza et al. 2012, American Academy of Neurology

Concussions disrupt normal brain functioning.
CONCUSSION: PATHOPHYSIOLOGY

- “Neurometabolic cascade”
  - Molecular
  - Hemodynamic
  - Electrophysiologic

GENERAL POINTS ABOUT CONCUSSION

- Concussion is a clinical diagnosis
  - Beyond the acute period, the diagnosis rests primarily or exclusively on patient-reported symptoms, rather than diagnostic tests.

- Tests do not diagnose concussion, they measure certain aspects of how a concussion affects a person

- Concussion can occur with head impact, but also an impact to the face, neck, or other part of the body with enough force transmitted to the head
GENERAL POINTS ABOUT CONCUSSION, CONT.

- Typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over minutes to hours.

- The acute signs and symptoms largely reflect a functional disturbance rather than a structural injury – no abnormality on standard structural neuroimaging.

ACUTE EFFECTS OF CONCUSSION (BROGLIO & PIETZ, 2008)
SYMPTOMS IN THE FIRST FEW DAYS (LOVELL ET AL., 2006)

- Most Common Symptoms:
  - Headache (79%)
  - Fatigue (70%)
  - Slowed down (67%)
  - Drowsiness (64%)
  - Concentration problems (66%)
  - Mentally “foggy” (62%)

- Least Common Symptoms:
  - Vomiting (9%)
  - Numbness/tingling (15%)
  - Sadness (15%)
  - More emotional (18%)
  - Nervousness (21%)

RED FLAGS FOR MORE SIGNIFICANT INJURY (CDC)

- One pupil larger than the other.
- Drowsiness or inability to wake up.
- A headache that gets worse and does not go away.
- Slurred speech, weakness, numbness, or decreased coordination.
- Repeated vomiting or nausea
- Convulsions or seizures
- Unusual behavior, increased confusion, restlessness, or agitation.
- Loss of consciousness (passed out/knocked out). Even a brief loss of consciousness should be taken seriously.
COGNITIVE EFFECTS OF CONCUSSION

Meta-Analytic Results

Concussion <24 hours  Mod-Severe TBI > 2 years  MCI - Early Dementia

-0.97  -0.84  -1.03

CONCUSSION

RECOVERY (NELSON ET AL. 2013)

Symptom Recovery  Cognitive Recovery  Postural Stability Recovery

Fig. 1 Copyright © (2003) American Medical Association. All rights reserved (original publication McCrean et al. 2003). Symptom, cognitive, and postural stability recovery in concussion (n=94) and control (n=50) participants. Higher scores on the Graded Symptom Checklist (CSC) indicate more severe symptoms; lower scores on the Standardized Assessment of Concussion (SAC) indicate poorer cognitive performance; higher scores on the Balance Error Scoring System (BESS) indicate poorer postural stability. Error bars reflect 95% confidence intervals. CC = time of concussion; FG = postgame/postpractice.
WHAT IS THE “NORMAL” DURATION FOR RECOVERY OF CONCUSSION IN CHILDREN?

• 24 articles reviewed by CISG

• The vast majority of children recover and return to school or play within 4 weeks of injury
  • Many in less than 2 weeks, although many remain symptomatic up to 1 month and beyond
  • Prolonged duration of symptoms is > 4 weeks.

• Some, limited evidence that adolescents may take longer to recover than children or college students.

• A definition of “recovery” has not been clearly established.

LIMITATIONS/KNOWLEDGE GAPS

• Most available evidence is based on studies of adults, collegiate athletes, and (to a lesser degree) high schoolers

• Limited to no clinical research evidence regarding concussion among middle school-age and especially among elementary school students
REST, TREATMENT, AND REHABILITATION FOLLOWING CONCUSSION

GOALS OF TREATMENT & REHABILITATION FOLLOWING A CONCUSSION

Rest & Resume Daily Activities

Return to School

Return to Sports
Rest is a frequently prescribed treatment for concussion

**Rationale:**
- Concussions appear to cause complex, interwoven cellular and vascular changes in the brain
- Early post-injury, cerebral metabolism likely dedicated to restoring function
- Thus, placing additional energy demand on the system through activity might compromise restorative events
- Rest prevents potential overlapping injuries
- Potential for significant acute symptoms post-injury, rest may ease discomfort
REST: LIMITATIONS AND CHALLENGES

- Limited scientific guidance on key issues such as,
  - How much is too much?
  - How long? Until completely symptom-free?
  - How to define “rest”?
    - How restrictive?
    - No screen exposure? No cell phones?

- Challenges with children and teens

Mom, is this really necessary?

When do I get my phone back?!

Will sending a text really cause brain damage?

I can come out when I am no longer IRRITABLE?!!

Will the light hurt my brain?
POSSIBLE HARMS OF PROLONGED REST

- Falling behind in school, leads to increased stress
- Physical deconditioning and exercise intolerance
- Nocebo effects (expectation of sickness as a cause of sickness)
- Somatic preoccupation
- Fear of cognitive exertion
- Low mood, depression

BED REST MIGHT CAUSE OR EXACERBATE CERTAIN SYMPTOMS

- After 3-6 days of bed rest, some healthy people complain of headache, restlessness, and difficulty sleeping.

Fortney, Schneider, and Greenleaf (2011)
REST: FINDINGS FROM CISG SYSTEMATIC REVIEW

- 9 studies reviewed
- Summary: Conflicting evidence on the efficacy of rest on recovery and symptom resolution
  - Greater activity level has been associated with both shorter and longer symptom duration.
- One RCT: Adolescents randomized to strict rest for 5 days after injury reported more total symptoms over 10 days and had slower symptom resolution.
  - Compared to 1-2 days followed by gradual return to activities.
  - Groups were similar on balance and cognitive outcomes.
- Large pan-Canadian study (n=2,413): Increased self-reported physical activity within the first 7 days post-concussion was associated with reduced risk of persistent symptoms at 28 days post-injury.

CURRENT CONSENSUS REGARDING REST

- Currently insufficient evidence that prescribing complete rest facilitates recovery following concussion
- Best available evidence does not support complete rest for more than a few days following concussion.
- Athletes are encouraged to gradually resume non-sport activities as tolerated, while avoiding heavy exertion and activities that have elevated concussion risk.
TREATMENTS SHOWING POSITIVE EFFECTS

- Multimodal Physical Therapy
  - Combination of several types of physical therapy: vestibular rehabilitation, manual therapy, neuromotor and sensorimotor retraining exercises

- Collaborative care
  - Advocacy/collaboration with schools, motivational interviewing, cognitive behavioral therapy, and psychopharmacology consultation

- Medical Treatments
  - Amitriptyline, amantadine, and peripheral nerve blocks

EXERCISE AS TREATMENT FOR PERSISTENT SYMPTOMS
Studies over the past decade illustrate that the large majority of athletes appear to recover clinically within one month.

Some student athletes experience persistent symptoms and problems
- Estimates range from about 10% to 30% still with symptoms at 4 weeks post-injury
- Pre-injury risk factors: e.g., mental health history, pre-injury migraines
- Injury-related risk factors: e.g., severity of initial symptoms

Comprehensive, multidisciplinary assessment can identify targets for treatment and rehabilitation

Exercise as promising treatment for symptoms lasting beyond 4 weeks

<table>
<thead>
<tr>
<th>BENEFITS OF EXERCISE</th>
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<tbody>
<tr>
<td>Improved mood and lower stress</td>
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<tr>
<td>Improved sleep quality</td>
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<tr>
<td>Positive effects on self-esteem</td>
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</table>
ACTIVE REHABILITATION FOR SLOW-TO-RECOVER CHILDREN/TEENS

- Montreal Children’s Hospital (since 2007)
- Implemented after one month post injury
- For this group of young people, significant lifestyle restrictions, including avoiding physical activity, can actually contribute to symptom maintenance over time.
- The longer a child or adolescent has symptoms, the more likely it is that other factors that are separate from or only partially related to the neurobiology of the original injury are causing or maintaining the symptoms.

- Gagnon, Galli, Friedman, and Iverson (2009)

Submaximal Aerobic Exercises
- 60% max capacity
- Treadmill or stationary bicycle
- Up to 15 min or stop if symptoms increase

Home Program
- Same Activities, Same intensity
- For 1 week

Coordination exercises
- Sport related, footwork or ball activities
- Up to 10 min or stop if symptoms increase
- (Later stages: anaerobic activities)
CLINICAL CHALLENGES AND NEED FOR A HOLISTIC PERSPECTIVE

CLINICAL CHALLENGES

- Concussion symptoms are non-specific
- Symptoms are commonly endorsed in the absence of injury
- There are tremendous individual differences in how people are affected by a concussion. For example,
  - Pre-injury difficulties
  - Injury itself
  - Symptoms
  - Recovery time

- Can make it difficult to judge if lingering symptoms are associated with the neurophysiological effects of the concussion
Co-occurring problems can mimic or magnify concussion symptoms

**HOLISTIC PERSPECTIVE OF CONCUSSION**

- Brain Injury and Disturbed Neurophysiology
- Visual-Vestibular Problems
- Migraine and Other Headache Types
- Insomnia/Sleep Disturbance
- Insomnia/Sleep Disturbance
- Fatigue
- Worry and Anxiety
- Mild Depression
- Life and School Stress
- Family Pressure and Dynamics
- Neck Pain
- Cognitive Difficulties
TREAT WHAT YOU CAN TREAT

REDUCE SYMPTOMS; IMPROVE FUNCTION; SUPPORT RETURN TO SCHOOL AND SPORTS

- Sleep Disturbance
  - Stress & Anxiety
  - Depression
- Physical Deconditioning
- Headaches
- Bodily Pain
RETURN TO SCHOOL AND SPORTS

WHAT ABOUT GOING BACK TO SCHOOL?

- Most students require only a few (2 to 5) days off from school

- Many students encounter challenges when returning to school
  - Estimates range from 35% to 73%
  - Can include worsening of symptoms

- More likely to receive accommodations if they have medical follow-up post-injury

- No research evidence regarding specific academic accommodations other than temporary school absence
CHALLENGES RELATED TO SCHOOL RETURN

- Non-specific nature of symptoms
- Can include pronounced symptoms or quite mild symptoms
- Symptoms generally resolve relatively swiftly but may persist for some time
- Symptoms can be mimic or magnified by many other factors

RETURN TO SCHOOL: KNOWLEDGE GAPS

- Limited direct, evidence-based guidance upon which to base recommendations
- Limited direct research evidence regarding key issues:
  - Impact of symptoms of objective indicators of academic performance
  - Benefit of days off, returning half-time, decreased homework, extra time, etc.
- No research samples recruited from schools
  - Emergency Departments, concussion specialty clinics
TIME TO RETURN TO SCHOOL AND SPORTS

- Head Injury Tracker (HIT)
  - Free online/smartphone application
  - Completed by athletic trainer or school nurse
- 1,265 student athletes sustained a sport-related concussion.
  - High School: 485 athletes (45.8% girls) from Maine
- Outcomes:
  - Date of return to academics (full days, no accommodations).
  - Date of return to athletics (finished return to play protocol).

<table>
<thead>
<tr>
<th>Day to return to...</th>
<th>Median</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls (n=193)</td>
<td>5</td>
<td>9.0</td>
<td>12.4</td>
</tr>
<tr>
<td>Boys (n=237)</td>
<td>5</td>
<td>8.0</td>
<td>12.9</td>
</tr>
<tr>
<td>Athletics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls (n=193)</td>
<td>15</td>
<td>21.1</td>
<td>25.3</td>
</tr>
<tr>
<td>Boys (n=237)</td>
<td>14</td>
<td>18.3</td>
<td>20.6</td>
</tr>
</tbody>
</table>

- Overall, there were no statistically significant differences in recovery times between high school girls and boys for return to school or athletics ($p > .05$).
DAYS TO RETURN TO SCHOOL

DAYS TO RETURN TO SPORTS
### GRADUATED RETURN TO SCHOOL PLANNING: SOME EXAMPLES

Table 2  Graduated return-to-school strategy

<table>
<thead>
<tr>
<th>Stage</th>
<th>Aim</th>
<th>Activity</th>
<th>Goal of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Daily activities at home that do not give the child symptoms</td>
<td>Typical activities of the child during the day as long as they do not increase symptoms (eg, reading, texting, screen time). Start with 5–15 min at a time and gradually build up</td>
<td>Gradual return to typical activities</td>
</tr>
<tr>
<td>2</td>
<td>School activities</td>
<td>Homework, reading or other cognitive activities outside of the classroom</td>
<td>Increase tolerance to cognitive work</td>
</tr>
<tr>
<td>3</td>
<td>Return to school part-time</td>
<td>Gradual introduction of schoolwork. May need to start with a partial school day or with increased breaks during the day</td>
<td>Increase academic activities</td>
</tr>
<tr>
<td>4</td>
<td>Return to school full time</td>
<td>Gradually progress school activities until a full day can be tolerated</td>
<td>Return to full academic activities and catch up on missed work</td>
</tr>
</tbody>
</table>

McCrory et al. (2017) Consensus Statement

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**AT HOME**

**STAGE 1:**

- Physical & cognitive rest
- Basic board games, crafts, talk on phone
- Activities that do not increase heart rate or break a sweat
- Limited video games, reading
- School work
- Sports
- Work
- Driving until cleared by a health care professional

**STAGE 2:**

- Start with light cognitive activity: Gradually increase cognitive activity up to 30 min. Take frequent breaks.
- Prior activities plus: Reading, TV, drawing, Lego
- Limited peer contact and social networking
- Contact school to create return to learn plan

**When light cognitive activity is tolerated:**

- Introduce school work.
- Prior activities plus: School work as per return to learn plan
- Communicate with school on student’s progression.

- No:
  - School attendance
  - Sports
  - Work

Rest

Gradually add cognitive activity including school work at home

- When symptoms start to improve OR after resting for 2 days max, BEGIN STAGE 2
- Tolerates 30 min. of cognitive activity, introduce school work at home
- Tolerates 60 min. of school work in two 30 min. intervals, BEGIN STAGE 3

Adapted from G. F. Strong School Program, G. F. Strong Rehabilitation Centre

ONTARIO NEUROTRAUMA FOUNDATION GUIDELINES

- **Policies in place to accommodate a child/adolescent who has sustained a concussion**
  - Distribute/publicize the policy to school staff
  - Allow the student enough time away from school to support recovery
  - Accommodations to support cognitive symptoms, e.g., extra time
  - Exemptions from physical activities until cleared by physician
  - Goal: preparedness, ready to promote recovery and effective return to school

- **Develop a return-to-school program/plan after acute symptoms have improved**
  - Manage gradual return on a case-by-case basis
  - Reassurance that most patients recover fully from concussion even though the recovery rate is highly variable and unpredictable

ONTARIO NEUROTRAUMA FOUNDATION GUIDELINES

- **Advise on maintaining social networks and interactions**
  - Encourage children/adolescents to participate in rewarding social activities; modified as needed
  - Reducing the risk of mental health issues and social isolation may promote recovery.

- **Assess for existing and new mental health symptoms and disorders**
  - prevent/mitigate additional persistent symptoms
  - Address any mental health difficulties early and hopefully prevent long-term problems
WHAT ABOUT RESUMING SPORTS?

- Gradual, systematic process overseen by medical provider

<table>
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<th>Aim</th>
<th>Activity</th>
<th>Goal of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Symptom-limited activity</td>
<td>Daily activities that do not provoke symptoms</td>
<td>Gradual reintroduction of work/school activities</td>
</tr>
<tr>
<td>2</td>
<td>Light aerobic exercise</td>
<td>Walking or stationary cycling at slow to medium pace. No resistance training</td>
<td>Increase heart rate</td>
</tr>
<tr>
<td>3</td>
<td>Sport-specific exercise</td>
<td>Running or skating drills. No head impact activities</td>
<td>Add movement</td>
</tr>
<tr>
<td>4</td>
<td>Non-contact training drills</td>
<td>Harder training drills, eg, passing drills. May start progressive resistance training</td>
<td>Exercise, coordination and increased thinking</td>
</tr>
<tr>
<td>5</td>
<td>Full contact practice</td>
<td>Following medical clearance, participate in normal training activities</td>
<td>Restore confidence and assess functional skills by coaching staff</td>
</tr>
<tr>
<td>6</td>
<td>Return to sport</td>
<td>Normal game play</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: An initial period of 24-48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression. There should be at least 24 hours (or longer for each step of the progression) for any symptom or symptom burden to be resolved, and no breakthroughs or exacerbations should occur. If symptoms are persistent (ie, more than 10-14 days in adults or more than 1 month in children) or exacerbate, the patient should be advised to work with a medical provider to determine the next cautious step in progression of RTS activities. McCrory et al. (2017) Consensus Statement

SPECIAL CONSIDERATIONS FOR SCHOOL HEALTH PERSONNEL
• Identifying on-site injuries.
• Documenting injury details and clinical status.
• Monitoring symptoms and recovery.
• Set a positive expectation for recovery.

• Matching time-limited accommodations to symptoms.

• Helping advise teachers regarding symptom and recovery course.

• Knowledge of students with pre-existing health problems.

MENTAL HEALTH AND PRE-INJURY SYMPTOMS (IVERSON ET AL., 2015)

• N=31,958 high school athletes, 13 to 18 (M=15.5, SD=1.3)

• Symptom reporting in the absence of recent concussion
  • No concussion within last 6 months

• Post-Concussion Scale
  • 22 symptoms, rated 0 to 6

• Clinical correlation:
  • Ex. Boy with post-injury score of 10 =
    • 90% for No Preexisting Condition (1 in 9 score that high)
    • ~50% for Prior Psychiatric Tx (1 in 2 score that high)
  • Ex. Girl with post-injury score of 20 =
    • 98% for No Preexisting Condition (1 in 44 score that high)
    • 50% for Prior Substance Abuse Tx (1 in 2 score that high)
MENTAL HEALTH AND CLINICAL RECOVERY (IVERSON ET AL., 2017)

- A few studies found that depression (before sustaining a concussion) increases risk for persistent symptoms.

NEURODEVELOPMENTAL CONDITIONS AND PRE-INJURY SYMPTOMS (IVERSON ET AL., 2015)

- N=31,958 high school athletes, 13 to 18 (M=15.5, SD=1.3)
- Symptom reporting in the absence of recent concussion
- PCS
- Clinical correlation:
  - Ex. Boy with post-injury score of 10 =
    - 90th % for No Preexisting Condition (1 in 9 score that high)
    - 75th % for ADHD (1 in 4 score that high)
  - Ex. Girl with post-injury score of 13 =
    - 90th % for No Preexisting Condition (1 in 9 score that high)
    - ~50th % for ADHD (1 in 2 score that high)
NEURODEVELOPMENTAL DISORDERS AND CLINICAL RECOVERY (IVERSON ET AL., 2017)

- Children with ADHD and learning disorders:
  - Have greater lifetime history of concussion.
  - Perform more poorly, on average, on neuropsychological testing.
  - Report more concussion-like symptoms without a concussion.

- Children with ADHD/learning disabilities may have different baseline scores, but available studies do not suggest they are at increased risk for slow recovery or poor outcome.

ADHD AND FUNCTIONAL RECOVERY: RETURN TO SCHOOL AND SPORTS (COOK ET AL., IN PREPARATION)

- 1,167 high school and college athletes (43% female), sustained concussion
- 8% (n=97) self-reported having ADHD
- Athletic trainers used a web-based injury surveillance system to track concussion recovery (Head Injury Tracker)
  - Days to return to school (no accommodations)
  - Days to return to sports

<table>
<thead>
<tr>
<th></th>
<th>ADHD</th>
<th>No ADHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to school</td>
<td>Mdn=6 days</td>
<td>Mdn=5 days</td>
</tr>
<tr>
<td>Return to sports</td>
<td>Mdn=14 days</td>
<td>Mdn=14 days</td>
</tr>
<tr>
<td>Still out of school at:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 days</td>
<td>43%</td>
<td>32%</td>
</tr>
<tr>
<td>10 days</td>
<td>29%</td>
<td>19%</td>
</tr>
<tr>
<td>14 days</td>
<td>17%</td>
<td>13%</td>
</tr>
<tr>
<td>21 days</td>
<td>8%</td>
<td>6%</td>
</tr>
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ADHD AND RETURN TO SCHOOL

Percentage Returned to School

Days Post Injury

SUMMARY

- Acute concussion symptoms: can be mild, moderate, or severe
- Recovery time: 1-30 Days
- Time-limited rest (avoid prolonged rest and activity restrictions)
- Concussion-like symptoms can be influenced by a variety of factors
  - Including pre-injury conditions
Most students who sustain a concussion experience a relatively swift clinical recovery.

For students who experience persistent symptoms (beyond 4 weeks), there are treatments that can help; pursue clinical care/rehab planning.

Most students require only a few (2 to 5) days off from school.

Students will likely need supports or accommodations when returning to school.

- Symptom-based supports
- These can often be time-limited

School health personnel are critical in managing a student’s gradual return to academics on a case-by-case basis.

**TAKE HOME MESSAGES**

**THANK YOU!**

- Google “MGH concussion”

- Email: necook@mgh.harvard.edu

- Voicemail: 617-952-6399
QUESTIONS OR COMMENTS?