Concussion Management Skill Development for School-based Professionals

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Objectives

This session will help participants:

1. Understand the underlying dysfunction of concussion or mild traumatic brain injury, including pathophysiology, signs and symptoms, recovery trajectories, and manifestations in school.
2. Perform competent symptom-based assessments.
3. Contribute to school-based management interventions to facilitate recovery.

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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

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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

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Concussion as ADHD in 1980

ADHD

- 1980: Most kids were evaluated and treated by specialists – or not at all
- 2013: Most kids are evaluated/ treated by pediatricians and within schools
  - Refer Complex Cases

Concussion

- 2013: Most kids are evaluated and treated by specialists – or not at all
- 20??: Most kids are evaluated and treated by pediatricians and within schools
  - Refer Complex Cases

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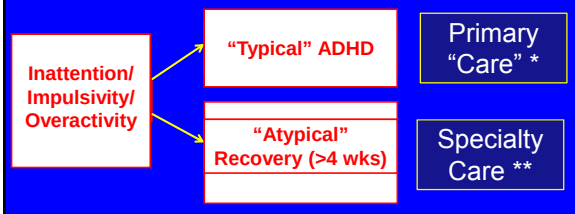
Concussion as ADHD



*School as a "primary care" setting

**School psychologist as a "specialist"

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Rewards of Working with Concussion

Typically,

- Not a long-term issue
- Not a lot of testing, functional assessment
- Intervention/ consultation oriented
- Kids get better! In direct proportion to:
  - How early their needs are identified
  - How early interventions are put in place
  - Their needs being monitored regularly and interventions modified through recovery

BUILT FOR THE SCHOOL PSYCHOLOGIST!

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CONCUSSION 101: THE FOUNDATIONS

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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

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"Mild" TBI: Facts & Figures

- Annually, more than one (3-5?) million children sustain a TBI; 80-90% " mild"
- ED: Ages 0-14 - 435,000 average annual visits
  Ages 0-19 - 564,000 (Langlois et al., 2004)
- Pediatric Office: 0-14: approx 125,000 average annual visits (1995-1997, Schootman & Fuortes, 2000)

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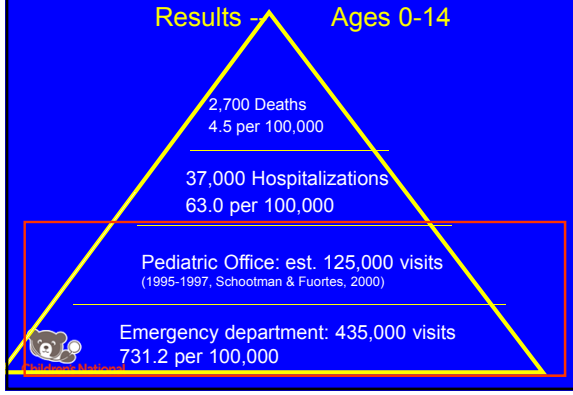
TBI in US Children

Results – Ages 0-14



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Causes

Motor Vehicle Collisions
Falls
Struck By/ Against
Assaults
Sports & Recreations

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Concussion = Traumatic Brain Injury

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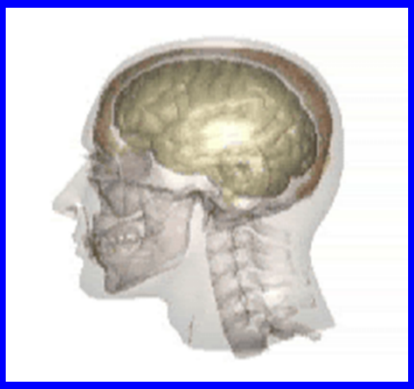

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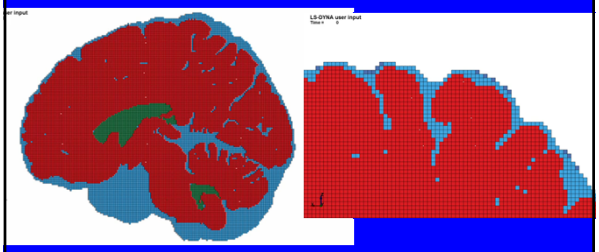
Brain Motion...



Wake Forest School of Medicine

Joel Stitzel, jstitzel@wakehealth.e

Pathophysiological Basis

- Stress and strain of force:
  - cell wall
  - diffuse axonal injury
- Massive ionic flux of potassium and calcium.
- Metabolic demands on cells exposed to ionic flux results in injury-induced diaschisis
  - loss of coupling between neuronal activation and cerebral blood flow,
  - Produces energy crisis
  - Mitochondrial dysfunction

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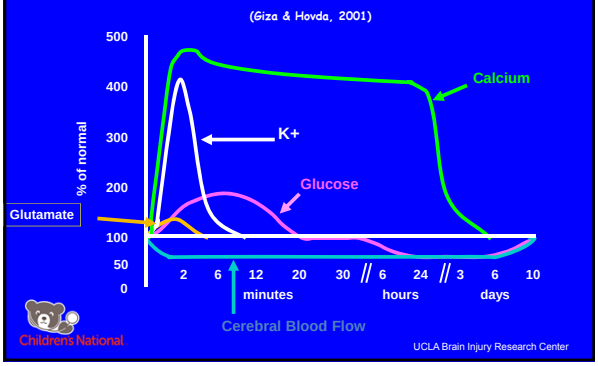
Giza & Hovda, 2001; Hovda, in press

Neurometabolic Cascade Following Traumatic Brain Injury



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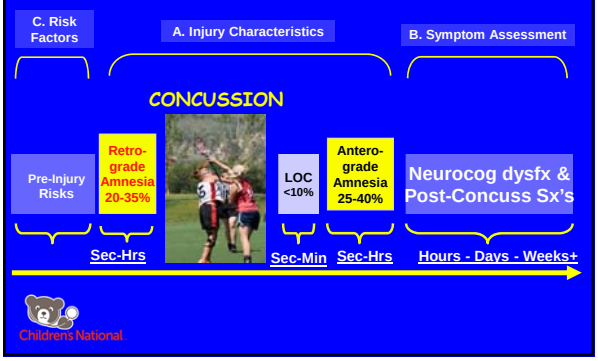
UCLA Brain Injury Research Center

Anatomical Timeline of a Concussion Defining the Key Factors



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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

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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

Sleep
- Sleeping more/less
- Trouble falling asleep
- Drowsiness

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

Emotional
- More emotional
- Irritable
- Sad
- Nervous

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Assessing Concussion

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Triggers to Concussion Evaluation

1 → 2

Blunt force or deceleration/ acceleration event

Alteration of consciousness or mental status

Blow/ Force to Head/ Body

Change in Function/ Behavior/ Performance

Post-Concussion Signs & Symptoms

Physical	Cognitive	Emotional	Sleep
Headache	Concentrate	Irritability	More
Fatigue	Memory	Emotional control	Less
Balance/ Dizziness	Speed of Thinking	Sadness	Cannot

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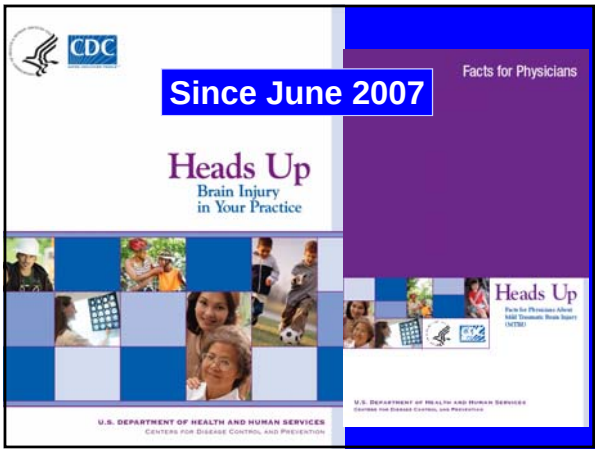

Assessing Concussion
What's My Protocol?

Acute Concussion Evaluation (ACE)

Sport Concussion Assessment Tool, 3rd Ed. (SCAT-3)

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Pediatric Assessment and Management of Concussions

Gerard A. Gioia, PhD

Concussions and mild traumatic brain injuries have become more widely recognized and understood during the past 5 to 10 years. Earlier and more active evaluation and management of this brain injury is necessary to reduce risk to the developing child and adolescent. Pediatricians play a central role in the evaluation and management of concussions and should develop a working understanding of the injury and its clinical manifestations.

An individualized approach to evaluation and management by the pediatrician requires the development of a skillset to define the characteristics of the injury, conduct a full assessment of post-concussion symptoms, and define any risk history that may modify recovery.

This evaluation forms the basis of concussion treatment, which involves the active management of the child's and performance, and sports/recreational activities. The Acute Concussion Evaluation (ACE) and ACE Care Plan, published in the CDC's "Heads Up: Concussion knowledge of the patient's post-injury status. Without the pediatrician's active and informed involvement, service coordination is not likely to be as effective, result-

Gioia, GA (2012) Pediatric Assessment and Management of Concussions. Pediatric Annuals, 41(5), 198-203.

Acute Concussion Evaluation (ACE)

- ACE is a clinical protocol to assist diagnosis of mTBI/ concussion in medical settings
- Ages 4-adult
- Elements of clinical assessment protocol are evidence-based
- Link to follow-up care via ACE Care Plan

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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

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Acute Concussion Evaluation (ACE)

A. Injury Characteristics

Injury Description

Cause

Amnesias (retrograde, anterograde)

Loss of Consciousness (LOC), Seizures

Early Signs

A. Injury Characteristics Date/Time of Injury: **Sept. 7, 2008** Reporter: __Patient ✓Parent __Spouse __Other

1. **Injury Description** **Fell to ground, hit head on ground, kneed in right temporal region; dazed initially but continued to play with bad headache. Felt sluggish and confused.**

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 __Lft Temporal ✓Rt Temporal __Lft Parietal __Rt Parietal ✓Occipital __Neck __Indirect Force
2. **Cause:** __MVC __Pedestrian-MVC __Fall __Assault ✓Sports (*specify*) **basketball** __Other
3. **Amnesia Before (Retrograde)** Are there any events just BEFORE the injury that you/ person has no memory of (even brief)? ✓Yes __No Duration
4. **Amnesia After (Anterograde)** Are there any events just AFTER the injury that you/ person has no memory of (even brief)? ✓Yes __No Duration
5. **Loss of Consciousness:** Did you/ person lose consciousness? __Yes ✓No Duration
6. **EARLY SIGNS:** ✓Appears dazed or stunned __Is confused about events ✓Answers questions slowly __Repeats Questions __Forgetful (recent info)
7. **Seizures:** Were seizures observed? No ✓Yes Detail

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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*

PHYSICAL (10)		COGNITIVE (4)		SLEEP (4)	
Headache	0 (1)	Feeling mentally foggy	0 (1)	Drowsiness	0 (1)
Nausea	0 (1)	Feeling slowed down	0 (1)	Sleeping less than usual	0 1 N/A
Vomiting	0 1	Difficulty concentrating	0 (1)	Sleeping more than usual	0 (1) N/A
Balance problems	0 (1)	Difficulty remembering	0 (1)	Trouble falling asleep	0 1 N/A
Dizziness	0 1	COGNITIVE Total (0-4)	4	SLEEP Total (0-4)	2
Visual problems	0 1	EMOTIONAL (4)			
Fatigue	0 (1)	Irritability	0 (1)		
Sensitivity to light	0 (1)	Sadness	0 1		
Sensitivity to noise	0 1	More emotional	0 1		
Numbness/Tingling	0 1	Nervousness	0 1		
PHYSICAL Total (0-10)	5	EMOTIONAL Total (0-4)	1		
(Add Physical, Cognitive, Emotion, Sleep totals) 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

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Acute Concussion Evaluation (ACE)
C. Risk Factors for Protracted Recovery

C. Risk Factors for Protracted Recovery *(check all that apply)*

Concussion History? Y___ N___	√	Headache History? Y___ N___	√	Developmental History	√	Psychiatric History
Previous # 1 2 3 4 5		Prior treatment for headache		Learning disabilities		Anxiety
Longest symptom duration Days__ Weeks__ Months__ Years__		History of migraine headache __ Personal __ Family_____		Attention-Deficit/ Hyperactivity Disorder		Depression
						Sleep disorder
If multiple concussions, less force caused reinjury? Yes__ No__				Other developmental disorder_____		Other psychiatric disorder _____

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

Research findings have linked these risk factors to longer periods of recovery

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

Physicians and parents/ patients need to be aware of signs that signal the need for emergency care.

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Test-Based Assessment

- Concussion produces impairment of neuropsychological function in children and adults
  - Attention, memory, speed, executive function
- Strengths: Assessment of neuropsychological function provides measurable outcome of injury
- Limitations: Other factors can influence performance and reporting; findings do not stand alone
- Test findings are best understood as one tool within a multidimensional, multidisciplinary model
- Training in the proper administration is critical to obtain valid results (Vaughan et al., 2014; Moser et al., 2011)
- Interpretation of findings requires higher level of training/expertise

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Tracking Symptom Status/ Recovery

Post-Concussion Symptom Conceptualization

- "Static" symptom manifestation: symptoms that are present over period of time (days, weeks)
  - Assessed by traditional graded symptom scales
- "Dynamic" symptom manifestation: symptom presentation (and change) in response to stimulation/ activity → Exertional effects
  - Assessed by dynamic symptom scale (using ecological momentary assessment-EMA)

Post-Concussion Symptom Inventory (PCSI)

Child Report
- Age 5-7 – 5 items
- Age 8-12 – 17 items
- Age 13-18 – 21 items

Parent Report
- Age 5-18 – 20 items

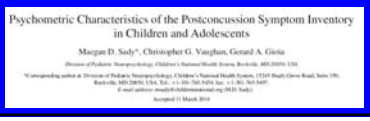
Assesses:
- 4 symptom categories
- Pre- and Post-Injury ratings to identify injury-specific effects

Developmentally sensitive

Psychometric support

Included in the NIH CDE toolkit

Used worldwide


Psychometric Characteristics of the Postconcussion Symptom Inventory in Children and Adolescents

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

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Psychometric Characteristics of the Postconcussion Symptom Inventory in Children and Adolescents

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Results

Item Analysis: examined frequency distributions of endorsements between uninjured and mTBI

Factor Analysis: examined factor loadings, residual variances, and Mplus modification indices

Parent scale: 26→20 items; 4 factors

SR13: 26→ 21 items; 4 factors

SR8: 25 → 17 items; 4 factors

SR5: 13 → 5 items; 1 factor

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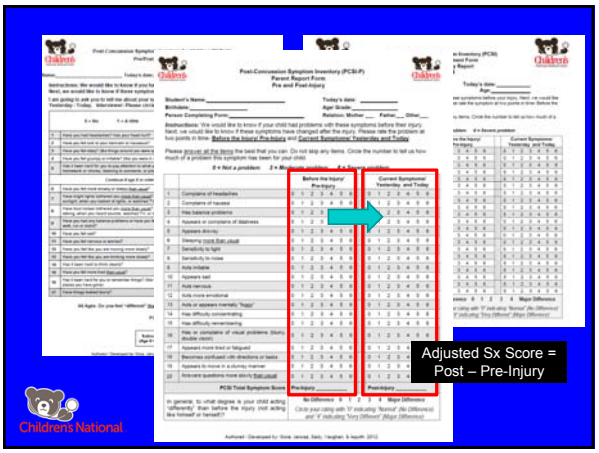

Adjusted Sx Score = Post – Pre-Injury

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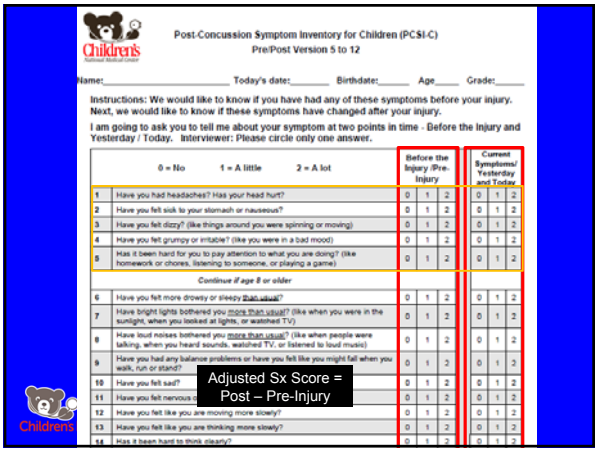

Post-Concussion Symptom Inventory for Children (PCSI-C)
Pre/Post Version 5 to 12

Name:_____ Today's date:_____ Birthdate:_____ Age_____ Grade:_____

Instructions: We would like to know if you have had any of these symptoms before your injury. Next, we would like to know if these symptoms have changed after your injury.

I am going to ask you to tell me about your symptom at two points in time - Before the injury and Yesterday / Today. Interviewer: Please circle only one answer.

	0 = No 1 = A little 2 = A lot	Before the Injury (Pre-Injury			Current Symptoms/ Yesterday and Today		
1	Have you had headaches? Has your head hurt?	0	1	2	0	1	2
2	Have you felt sick to your stomach or nauseous?	0	1	2	0	1	2
3	Have you felt dizzy? (like things around you were spinning or moving)	0	1	2	0	1	2
4	Have you felt grumpy or irritable? (like you were in a bad mood)	0	1	2	0	1	2
5	Has it been hard for you to pay attention to what you are doing? (like homework or chores, listening to someone, or playing a game)	0	1	2	0	1	2
	Continue if age 8 or older						
6	Have you felt more drowsy or sleepy than usual?	0	1	2	0	1	2
7	Have bright lights bothered you more than usual? (like when you were in the sunlight, when you looked at lights, or watched TV)	0	1	2	0	1	2
8	Have loud noises bothered you more than usual? (like when people were talking, when you heard sounds, watched TV, or listened to loud music)	0	1	2	0	1	2
9	Have you had any balance problems or have you felt like you might fall when you walk, run or stand?	0	1	2	0	1	2
10	Have you felt sad?	0	1	2	0	1	2
11	Have you felt nervous or	0	1	2	0	1	2
12	Have you felt like you are moving more slowly?	0	1	2	0	1	2
13	Have you felt like you are thinking more slowly?	0	1	2	0	1	2
14	Has it been hard to think clearly?	0	1	2	0	1	2

Adjusted Sx Score = Post – Pre-Injury

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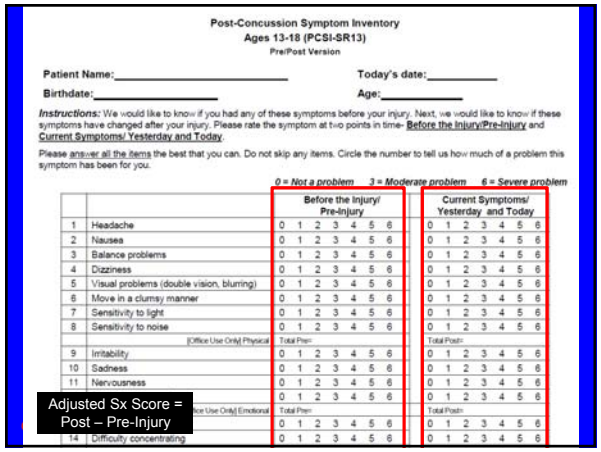


Post-Concussion Symptom Inventory
Ages 13-18 (PCSI-SR13)
Pre/Post Version

Patient Name:_____ Today's date:_____

Birthdate:_____ Age:_____

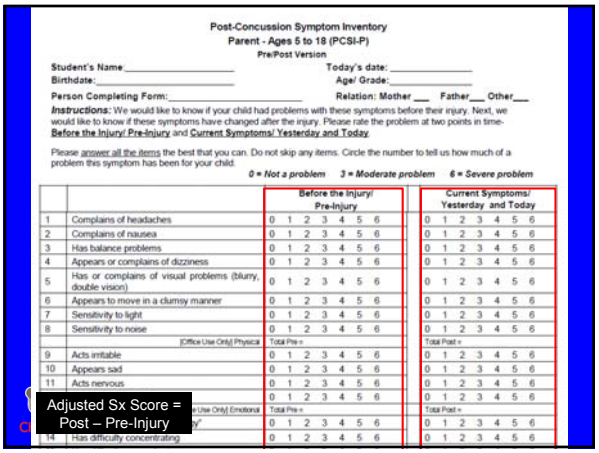
Instructions: We would like to know if you had any of these symptoms before your injury. Next, we would like to know if these symptoms have changed after your injury. Please rate the symptom at two points in time- Before the Injury/Pre-Injury and Current Symptoms/ Yesterday and Today.

Please answer all the items the best that you can. Do not skip any items. Circle the number to tell us how much of a problem this symptom has been for you.

0 = Not a problem 3 = Moderate problem 6 = Severe problem

		Before the Injury/ Pre-Injury							Current Symptoms/ Yesterday and Today						
1	Headache	0	1	2	3	4	5	6	0	1	2	3	4	5	6
2	Nausea	0	1	2	3	4	5	6	0	1	2	3	4	5	6
3	Balance problems	0	1	2	3	4	5	6	0	1	2	3	4	5	6
4	Dizziness	0	1	2	3	4	5	6	0	1	2	3	4	5	6
5	Visual problems (double vision, blurring)	0	1	2	3	4	5	6	0	1	2	3	4	5	6
6	Move in a clumsy manner	0	1	2	3	4	5	6	0	1	2	3	4	5	6
7	Sensitivity to light	0	1	2	3	4	5	6	0	1	2	3	4	5	6
8	Sensitivity to noise	0	1	2	3	4	5	6	0	1	2	3	4	5	6
	[Office Use Only] Physical	Total Pre=							Total Post=						
9	Irritability	0	1	2	3	4	5	6	0	1	2	3	4	5	6
10	Sadness	0	1	2	3	4	5	6	0	1	2	3	4	5	6
11	Nervousness	0	1	2	3	4	5	6	0	1	2	3	4	5	6
	[Office Use Only] Emotional	Total Pre=							Total Post=						
14	Difficulty concentrating	0	1	2	3	4	5	6	0	1	2	3	4	5	6

Adjusted Sx Score = Post – Pre-Injury



Post-Concussion Symptom Inventory
Parent - Ages 5 to 18 (PCSI-P)
Pre/Post Version

Student's Name:_____ Today's date:_____

Birthdate:_____ Age/ Grade:_____

Person Completing Form:_____ Relation: Mother___ Father___ Other___

Instructions: We would like to know if your child had problems with these symptoms before their injury. Next, we would like to know if these symptoms have changed after the injury. Please rate the problem at two points in time- **Before the Injury/ Pre-Injury** and **Current Symptoms/ Yesterday and Today**.

Please answer all the items the best that you can. Do not skip any items. Circle the number to tell us how much of a problem this symptom has been for your child.

0 = Not a problem 3 = Moderate problem 6 = Severe problem

		Before the Injury/ Pre-Injury							Current Symptoms/ Yesterday and Today						
1	Complains of headaches	0	1	2	3	4	5	6	0	1	2	3	4	5	6
2	Complains of nausea	0	1	2	3	4	5	6	0	1	2	3	4	5	6
3	Has balance problems	0	1	2	3	4	5	6	0	1	2	3	4	5	6
4	Appears or complains of dizziness	0	1	2	3	4	5	6	0	1	2	3	4	5	6
5	Has or complains of visual problems (blurry, double vision)	0	1	2	3	4	5	6	0	1	2	3	4	5	6
6	Appears to move in a clumsy manner	0	1	2	3	4	5	6	0	1	2	3	4	5	6
7	Sensitivity to light	0	1	2	3	4	5	6	0	1	2	3	4	5	6
8	Sensitivity to noise	0	1	2	3	4	5	6	0	1	2	3	4	5	6
	[Office Use Only] Physical	Total Pre =							Total Post =						
9	Acts irritable	0	1	2	3	4	5	6	0	1	2	3	4	5	6
10	Appears sad	0	1	2	3	4	5	6	0	1	2	3	4	5	6
11	Acts nervous	0	1	2	3	4	5	6	0	1	2	3	4	5	6
	[Office Use Only] Emotional	Total Pre =							Total Post =						
14	Has difficulty concentrating	0	1	2	3	4	5	6	0	1	2	3	4	5	6

Adjusted Sx Score = Post – Pre-Injury

Monitoring the Executive Functions

Working Memory
Emotional Control
Initiation
Task Completion
Plan & Organize

Behavior Rating Inventory of Executive Function-2
Youth Self-Report Monitoring Form (age 11+)

Name:_____ Age____ Today's Date__/__/__

Instructions: Please answer all of the items the best you can. Do not skip any items. Think about yourself as you read these statements. We would like to know if you have had any problems with these behaviors before your injury. Next, we would like to know if these problems have changed after your injury. Please rate the problems at two points in time: Before the Injury and Within the Past Week. Circle the number to tell us how much of a problem the behavior has been for you.

	0 Almost Never	1 Rarely	2 Sometimes	3 Often	4 Almost Always	Before the Injury/ Over the Past 6 Months	Within the Past Week
1	When I am given three things to do, I remember only the first or last					0 1 2 3 4	0 1 2 3 4
2	I have trouble with jobs or tasks that have more than one step					0 1 2 3 4	0 1 2 3 4
3	I have trouble remembering things, even for a few minutes (such as directions, phone numbers, etc.)					0 1 2 3 4	0 1 2 3 4
4	I forget instructions easily					0 1 2 3 4	0 1 2 3 4
5	I am absentminded					0 1 2 3 4	0 1 2 3 4
6	I have a short attention span					0 1 2 3 4	0 1 2 3 4
7	I have trouble concentrating on chores, schoolwork, etc.					0 1 2 3 4	0 1 2 3 4
v8	I forget where my bedroom is located					0 1 2 3 4	0 1 2 3 4
9	I have angry outbursts					0 1 2 3 4	0 1 2 3 4
10	I overreact to small problems					0 1 2 3 4	0 1 2 3 4
11	I have outbursts for little reason					0 1 2 3 4	0 1 2 3 4
12	My eyes fill with tears quickly over little things					0 1 2 3 4	0 1 2 3 4
13	I get upset over small events					0 1 2 3 4	0 1 2 3 4
v14	I cannot remember the names of my friends					0 1 2 3 4	0 1 2 3 4
15	I have problems completing my work					0 1 2 3 4	0 1 2 3 4
16	I have trouble finishing my tasks (such as chores, homework)					0 1 2 3 4	0 1 2 3 4
17	I have difficulty finishing a task on my own					0 1 2 3 4	0 1 2 3 4
18	I have problems finishing long-term projects (such as papers, book reports)					0 1 2 3 4	0 1 2 3 4
19	It takes me longer to complete my work					0 1 2 3 4	0 1 2 3 4
20	I am slower than others when completing my work					0 1 2 3 4	0 1 2 3 4

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"Dynamic" symptom manifestation reflects symptoms in response to stimulating/ exertional activities.

Ecological Momentary Assessment (EMA) model - involves repeated sampling of subjects' current behaviors and experiences in real time, in subjects' natural environments. EMA aims to minimize recall bias, maximize ecological validity, and allow study of microprocesses that influence behavior in real-world contexts.

EMA Dynamic Symptom Assessment

- Exertional Effects = symptom exacerbation following physical, cognitive, emotional activity
- Possible signal that brain's neurometabolism pushed beyond tolerable limits
- Child's sensitivity to symptom exacerbation / exertional effects hypothesized as indicator of injury status.
- Possible treatment/ management implications (i.e., Controlled Exertion)

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Psychosocial Impact

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Psychosocial Impact

- 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

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Psychosocial Impact

- 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

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SETTING UP THE TREATMENT PROCESS

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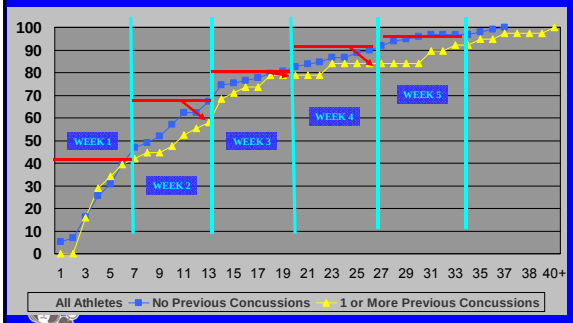
Recovery From Concussion: How Long Does it Take?



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N=134 High School athletes Collins et al., 2006, Neurosurgery

Persisting Symptom Culprits

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

Treatment (Zurich)

Concussion management

The cornerstone of concussion management is physical and cognitive rest until the acute symptoms resolve and then a graded programme of exertion prior to medical clearance and RTP. The current published evidence evaluating the effect of rest following a sports-related concussion is sparse. An initial period of rest in the acute symptomatic period following injury (24–48 h) may be of benefit. Further research to evaluate the long-term outcome of rest, and the optimal amount and type of rest, is needed. In the absence of evidence-based recommendations, a sensible approach involves the gradual return to school and social activities (prior to contact sports) in a manner that does not result in a significant exacerbation of symptoms.

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Historic Approach(es) to Concussion Treatment

- REST
- REST
- REST

TIME

(CISG, AAP, etc.)

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Is Rest After Concussion "The Best Medicine?"

- "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…"

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Silverberg & Iverson (JHTR, 2013)

PEDIATRICS

Benefits of Strict Rest After Acute Concussion: A Randomized Controlled Trial

Danny George Thomas, MD, MPH; Jennifer N. Apps, PhD; Raymond G. Hoffmann, PhD; Michael McCrea, PhD; Thomas Hammeke, PhD

were recruited. Participants underwent neurocognitive, balance, and symptom assessment in the ED and were randomized to strict rest for 5 days versus usual care (1–2 days rest, followed by stepwise return to activity). Patients completed a diary used to record physical and mental

There was no clinically significant difference in neurocognitive or balance outcomes. However, the intervention group reported more daily postconcussive symptoms (total symptom score over 10 days, 187.9 vs 131.9, $P < .03$) and slower symptom resolution.

CONCLUSIONS: Recommending strict rest for adolescents immediately after concussion offered no added benefit over the usual care. Adolescents' symptom reporting was influenced by recommending strict rest.

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Thomas et al. (2015) *Pediatrics*

General Principles of Recovery

- No additional forces to head/ brain
- Get good sleep
- Managing Activity – Exertion Relationship
  - Not over-exerting body or brain
  - Not under-exerting body or brain
  - Avoid activities that produce symptoms

Ways to over-exert

- Physical
- Cognitive! (concentration, learning, memory)
- Emotional

Managed Activity

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.

(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

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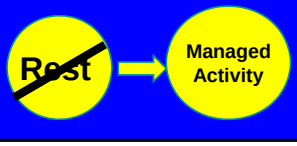
Progressive Activities of Controlled Exertion (PACE)

1. Set the Positive Foundation for Recovery
2. Define the Parameters of the Activity-Exertion Schedule
3. Skill Teaching: Activity-Exertion Monitoring/ Management
4. Reinforcing the Progressive Path to Recovery



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Active Recovery Management (ARM) Key Messages

You will get better.
You will improve and recover.
You have control of your activity.
Your efforts to control your activity and time will pay off.
Find your "sweet spot" of activity.

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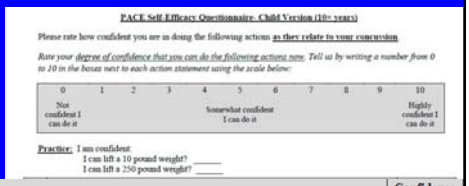
Building Self-Confidence (Efficacy) in Recovery



PACE Self-Efficacy Questionnaire: Child Version (10+ years)

Please rate how confident you are in doing the following actions as they relate to your concussion.

Rate your degree of confidence that you can do the following actions now. Tell us by writing a number from 0 to 10 in the boxes next to each action statement using the scale below:

0 1 2 3 4 5 6 7 8 9 10

Not confident I can do it — Somewhat confident I can do it — Highly confident I can do it

Practice: I am confident
I can lift a 10 pound weight? ____
I can lift a 250 pound weight? ____

		I am confident…	Confidence 0-10
III.	11.	I can speak up for myself so that I can take breaks and manage symptoms.	
	12.	I can ask an adult to help me find things that make me feel better.	
	13.	I can find the right amount of activity that is not too little and not too much.	
	14.	I can help my parents, teachers, or doctors develop and adjust a plan to help me get better.	
IV.	15.	I can see myself returning to my normal life.	
	16.	I can tell that I can do more since I was first injured.	
	17.	I can stay positive during my recovery.	

Preliminary Examination of Self-Efficacy in Concussion Recovery

- Child Self-Efficacy significantly correlated with concern for academic learning & performance (r=-.41; p=.006; n=54)
- Child Self-Efficacy significantly correlated with overall symptom burden (r=.-.88; p<.001; n=13)
- Overall sx burden associated with length of recovery (5P) & level of academic problems (Ransom et al.)
- Overall Self-Efficacy improves between Session 1 and Session 2 (F=9.6; p=.008; n=16)

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Applying Traditional 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 dysfunction: vestibular therapy

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Managed Activity

Balancing Activity-Rest
Managing Exertional Effects

Exertional "Effects" Response As Target of Interest/ Intervention

- Exertional Effects = symptom exacerbation following physical, cognitive, emotional activity
- Possible signal that brain's neurometabolism pushed beyond tolerable limits
- Child's sensitivity to symptom exacerbation / exertional effects hypothesized as indicator of injury status.
- Possible treatment/ management implications (i.e., Controlled Exertion)

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What are exertional effects?

When symptoms increase with (or shortly after) significant physical or mental (cognitive, emotional) activity.

Cognitive Intolerance: exertional effects as applied to cognitive activity, relevant to school learning & performance

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Exertional "Effects" Response As Target of Interest/ Intervention

- Exertional Effects = symptom exacerbation following physical, cognitive, emotional activity
- Possible signal that brain's neurometabolism pushed beyond tolerable limits
- Child's sensitivity to symptom exacerbation / exertional effects hypothesized as indicator of injury status.
- Possible treatment/ management implications (i.e., Controlled Exertion)

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Cognitive & Physical Intolerance
(% Reporting Exertional Effects)

	Elementary (n=88)	Middle (n=138)	High School (n=206)
Demand	*Yes*	*Yes*	*Yes*
Cognitive	47.7	52.5	62.5
Physical	12.5	20.3	16.5

Degree of intolerance/ exertional effects indicates need to manage activity demands at school

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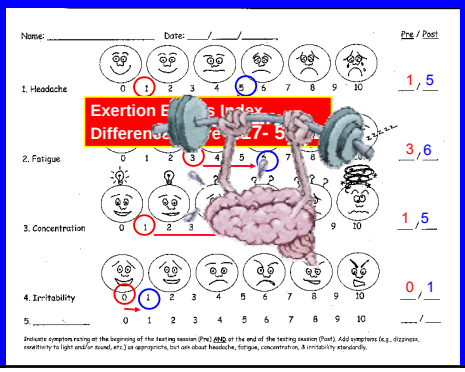
Gioia, 2010

Assessing Exertional Effects

Children's Exertional Effects Rating Scale (ChEERS)



ChEERS Validation

	Means		
	Uninjured	Recovered mTBI	Not-Recovered mTBI
Pre-test ChEERS	4.12 (3.78)	2.97 (3.5)	11.08 (7.37)
Post-test ChEERS	4.71 (4.33)	3.16 (3.97)	13.43 (8.69)
EEI	0.59 (2.59)	0.19 (2.15)	2.35 (4.01)*

*P <.001/ .001
Cohen's d = 0.68/0/93

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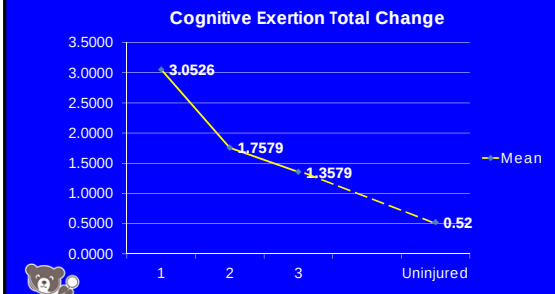
Sady et al. (in prep)

Cognitive Exertion Recovery



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"Active" Aerobic Rehabilitation

- Aerobic Activation (Gagnon et al., 2009; Leddy et al, 2010)
- Structured and monitored subsymptom threshold exercise to facilitate healing.
- Progressive "controlled" exercise below level that produces symptom occurrence or worsening.

Active rehabilitation for children who are slow to recover following sport-related concussion

ISABELLE GAGNON[1,2], CARLO GALLI[1], DEBBIE FRIEDMAN[1], LISA GRILLI[1], & GRANT L. IVERSON[3]

[1]*Montreal Children's Hospital, Montreal, Canada,* [2]*McGill University, Montreal, Canada, and* [3]*University of British Columbia and British Columbia Mental Health & Addiction Services, Vancouver, Canada*

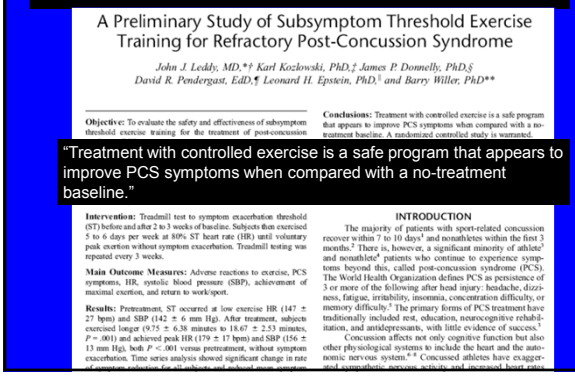
(Received 25 February 2009; revised 29 August 2009; accepted 27 September 2009)

Abstract

Primary objective: To present an innovative approach to the management of children who are slow to recover after a sport-related concussion.

Research design: The article describes the underlying principles and the development of specific interventions for a new

"Active" Aerobic Rehabilitation



A Preliminary Study of Subsymptom Threshold Exercise Training for Refractory Post-Concussion Syndrome

John J. Leddy, MD,† Karl Kozlowski, PhD,‡ James P. Donnelly, PhD,§ David R. Pendergast, EdD,¶ Leonard H. Epstein, PhD,‖ and Barry Willer, PhD***

Objective: To evaluate the safety and effectiveness of subsymptom threshold exercise training for the treatment of post-concussion

Conclusions: Treatment with controlled exercise is a safe program that appears to improve PCS symptoms when compared with a no-treatment baseline. A randomized controlled study is warranted.

"Treatment with controlled exercise is a safe program that appears to improve PCS symptoms when compared with a no-treatment baseline."

Intervention: Treadmill test to symptom exacerbation threshold (ST) before and after 2 to 3 weeks of baseline. Subjects then exercised 5 to 6 days per week at 80% ST heart rate (HR) until voluntary peak exertion without symptom exacerbation. Treadmill testing was repeated every 3 weeks.

Main Outcome Measures: Adverse reactions to exercise, PCS symptoms, HR, systolic blood pressure (SBP), achievement of maximal exertion, and return to work/sport.

Results: Pretreatment, ST occurred at low exercise HR (147 ± 27 bpm) and SBP (142 ± 6 mm Hg). After treatment, subjects exercised longer (9.75 ± 6.38 minutes to 18.67 ± 2.53 minutes, $P = .001$) and achieved peak HR (179 ± 17 bpm) and SBP (156 ± 13 mm Hg), both $P < .001$ versus pretreatment, without symptom exacerbation. Time series analysis showed significant change in rate

INTRODUCTION

The majority of patients with sport-related concussion recover within 7 to 10 days[1] and nonathletes within the first 3 months.[2] There is, however, a significant minority of athlete[3] and nonathlete[4] patients who continue to experience symptoms beyond this, called post-concussion syndrome (PCS). The World Health Organization defines PCS as persistence of 3 or more of the following after head injury: headache, dizziness, fatigue, irritability, insomnia, concentration difficulty, or memory difficulty.[5] The primary forms of PCS treatment have traditionally included rest, education, neurocognitive rehabilitation, and antidepressants, with little evidence of success.[6]

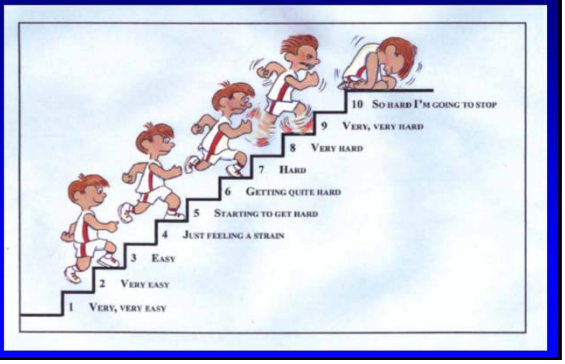
Concussion affects not only cognitive function but also other physiological systems to include the heart and the autonomic nervous system.[7–9] Concussed athletes have exaggerated sympathetic nervous activity and increased heart rate

Benefits of Aerobic Activity

I. *Aerobic Activity*
- Increase brain-derived neurotrophic factor (BDNF)
- Synaptogenesis
- Increased cardiovascular activity
- Altered cerebral vascular function and brain perfusion
- Increased endorphin release
- Improved brain autoregulation
- Improve overall fitness level
- Reduce fatigue/improve energy levels
- Reduce stress, worry and anxiety
- Improve mood
- Improve cognition
- Improve self-efficacy and performance

Gagnon et al. (2010)

Pictorial Children's Effort Rating Table (PCERT)



STR PROGRESS LOG

Name_____ Therapist:_____

Site:	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
DATE							
LOCATION (circle one)	Clinic Home	Clinic Home	Clinic Home	Clinic Home	Clinic Home	Clinic Home	Clinic Home
RESTING/ POST-ACTIV HR	___/___	___/___	___/___	___/___	___/___	___/___	___/___
Effort Rating Level (1-10)	_____	_____	_____	_____	_____	_____	_____
AEROBIC ACTIVITY:	_____	_____	_____	_____	_____	_____	_____
DURATION:	_____	_____	_____	_____	_____	_____	_____
SYMPTOM (PRE/POST)	Rate 0-10	Rate 0-10	Rate 0-10	Rate 0-10	Rate 0-10	Rate 0-10	Rate 0-10
HEADACHE	___/___	___/___	___/___	___/___	___/___	___/___	___/___
FATIGUE	___/___	___/___	___/___	___/___	___/___	___/___	___/___
DIZZY/ BALANCE	___/___	___/___	___/___	___/___	___/___	___/___	___/___
LIGHT/ NOISE SENSITIVITY	___/___	___/___	___/___	___/___	___/___	___/___	___/___
FOGGINESS	___/___	___/___	___/___	___/___	___/___	___/___	___/___
Other:_____	___/___	___/___	___/___	___/___	___/___	___/___	___/___
SPORT COORDINATION EXERCISES:	Completed? Yes / No Time:	Completed? Yes / No Time:	Completed? Yes / No Time:	Completed? Yes / No Time:	Completed? Yes / No Time:	Completed? Yes / No Time:	Completed? Yes / No Time:

(Today) A Student is Identified with a Mild TBI/ Concussion

What Do You Do (Tomorrow)?


School and the Concussed Youth: Recommendations for Concussion Education and Management

Maegan D. Sady, MD[a,*], Christopher G. Vaughan, PsyD[a,b,c], Gerard A. Gioia, PsyD[a,b,c]

PEDIATRICS

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Clinical Report-Sport-Related Concussion in Children and Adolescents

Mark E. Halstead, Kevin D. Walter and THE COUNCIL ON SPORTS MEDICINE AND FITNESS

Pediatrics published online Aug 30, 2010; DOI: 10.1542/peds.2010-2005

Building Statewide Infrastructure for the Academic Support of Students With Mild Traumatic Brain Injury

Medical-School Partnership in Guiding Return to School Following Mild Traumatic Brain Injury in Youth

Gerard A. Gioia, PhD[1]

Goals of Proper School Return

- **Prepared Systems**: trained medical & school providers
- **Initial medical evaluation** of student & communication of symptom profile to school
- **School Concussion Management Team (CMT) translates** symptom profile into necessary academic adjustments & accommodations
- **Regular monitoring** of symptom and academic progress in school, home
- **CMT (Re)Adjust accommodations** with progress/ recovery
- **Coordination / communication between** Student/ Family, Medical Provider, School, Athletics

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Who is on the Team?

Concussion Management Team

- Medical Monitor
- Academic Monitor

School nurse, psychologist, athletic trainer
Guidance counselor
Administrator
Teacher(s)
Healthcare Provider(s)
Family

Concussion Management Team

Roles

- Medical monitor:
  - monitors the symptom status of the student, using standardized symptom scale
  - Liaisons with community medical provider
  - Reports status to academic monitor
- Academic monitor:
  - oversees & guides academic support process - Day 1 to recovery
  - Links student symptom status with accommodations
  - Liaisons with, student, teachers and medical monitor

RETURN TO SCHOOL

RTS Component	Y	N
School Policy		√
CMT-Personnel & Roles Defi		
Education & Tra		
Perso		√
		√
itor & Adjust across Recovery		√

Expect Different Outcomes?

Epidemiology of Recovery Our Best Guess

- Research literature is still limited with respect to understanding concussion recovery outcomes across full age range, and for boys and girls (IOM, 2013).
- Perhaps 70 +/-% recovery within 4 weeks (Zemek et al, 2016).

Recovery Supports must plan for a window from several days to several months (school, physical, social).

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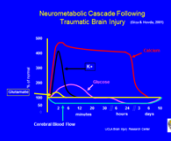
Concussion Effects

Injury



Effects

- Fatigue
- Vestibular
- Ocular Motor
- Cognitive
- P.T. Migraine
- Emotional
- Sleep

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Symptoms of a Concussion

(what they feel and report)

Physical
- Headache
- Fatigue
- Visual problems (blurry/"double")
- Nausea/vomiting
- Ba
- Se
- Nu /tingling

Sleep
- Sleeping more/less
- Trouble falling asleep
- Drowsiness

Cognitive
- Mental fogginess
- Difficulty conce ng

Emotional
- More emotional
- Irritable
- Sad
- Nervous

Targets for Supports

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Returning to School

A Student is Identified with a Mild TBI/ Concussion

What Do You Do

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Medical ⟷ School

The Handoff

Communication Coordination Collaboration

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Medical System Responsibility "Discharge" Education (Preparation): Key Components (all providers)

1. Educate about concussions (definition, risks)
2. Reasons to go/return to Emerg. Dept. (red flags)
3. Safety restrictions: sports, other risk activities
4. Activity restriction & management
5. School/ work return guidance → **Return to School Letter**
6. Medical follow up

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Return to ~~Learn~~ Life in School

School:
- Kid's Major "Job" is new learning/ acquiring knowledge
- Practicing incompletely learned knowledge (HW)
- Mental and physical exertion is essential to new learning/ practice

ALSO:
- Social with peers
- Interacting with teachers
- Managing the environment
- Academic pressure

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J Head Trauma Rehabil

Building Statewide Infrastructure for the Academic Support of Students With Mild Traumatic Brain Injury

Gerard A. Gioia, PhD; Ann E. Glang, PhD; Stephen R. Hooper, PhD; Brenda Eagan Brown, MEd, CBIS

Objectives: To focus attention on building statewide capacity to support students with mild traumatic brain injury (mTBI)/concussion. **Method:** Consensus-building process with a multidisciplinary group of clinicians, researchers, policy makers, and state Department of Education personnel. **Results:** The white paper presents the group's consensus on the essential components of a statewide educational infrastructure to support the management of students with mTBI. The nature and recovery process of mTBI are briefly described specifically with respect to its effects on school learning and performance. State and local policy considerations are then emphasized to promote implementation of a consistent process. Five key components to building a statewide infrastructure for students with mTBI are described including (1) definition and training of the interdisciplinary school team, (2) professional development of the school and medical communities, (3) identification, assessment, and progress monitoring protocols, (4) a flexible set of intervention strategies to accommodate students' recovery needs, and (5) systematized protocols for active communication among medical, school, and family team members. The need for a research to guide effective program implementation is stressed. **Conclusion:** This guiding framework strives to assist the development of support structures for recovering students with mTBI to optimize academic outcomes. Until more evidence is available on academic accommodations and other school-based supports, educational systems should follow current best practice guidelines. **Key words:** *academic outcomes, intervention strategies, mild TBI, school management, statewide infrastructure*

Five key components to building a statewide infrastructure

Who are the players?

(1) definition and training of the interdisciplinary school team

(2) professional development of the school and medical communities — What do they need to know?

(3) identification, assessment, and progress monitoring protocols — What tools to identify can they use?

(4) a flexible set of intervention strategies to accommodate students' recovery needs — What tools to intervene can they use?

(5) systematized protocols for active communication among medical, school, and family team members

What pathways should be followed to communicate, collaborate, coordinate?

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Original Article

Journal of Child Neurology
2014, Vol. 31(1) 93-108

DOI: 10.1177/0883073814555604
jcn.sagepub.com
SAGE

Medical-School Partnership in Guiding Return to School Following Mild Traumatic Brain Injury in Youth

Gerard A. Gioia, PhD[1]

Table 1. School Concussion Management Activities & Responsibilities*.

Activity	Responsible Parties	Evidence of Completion
1. Concussion management policies and procedures (P & P)	School administration [school nurse, counselor, psychologist]	Written policy in school manual; copy provided to all school staff
2. Development of school concussion resource team	School administration; school nurse, counselor, psychologist, designated teacher, athletic trainer	Written policy in school manual
3. Examine teaching/support methods to support recovery, maximize learning/ performance, reduce symptom exacerbation	School administration; school nurse, counselor, psychologist	Written policies on teaching methods
4. Teacher/staff education and training (online video training, CDC School Professional Fact Sheet)	Teacher, school counselor, school nurse, administrators	Verification of completion provided to school administration
5. Develop list of concussion resources for education, consultation & referral (medical, school, state/local Brain Injury Association)	School administration	List of resources provided in P & P; available to school staff & families

*Adapted from Sady et al 2011

Concussion Management System Planning

Building a Structure of Support in Your School

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What Berlin has to say about School Return

Five factors influence return to school post-concussion:

1. Age: Adolescents tend to take longer to recover and return to school; adolescents more concerned about the negative academic effects of concussion than younger children.
2. Symptom load/severity: Students with greater number/ severity of symptoms tend to take longer to return to school, require more academic accommodations, longer to recover
3. Course load: Certain subjects pose greater problems for students returning to school: math (#1) reading/language arts (#2), then science, social studies.

Berlin & School (cont.)

4. Medical follow-up: Students who receive RTS letter in ED, medical follow-up after ED more likely to receive academic accommodations
5. School resources: Schools with concussion policies that include student/ parent concussion education tend to…
   - practice best-practice guidelines for concussion mgt.
   - provide more accommodations and greater variety of accommodations to students
   - be more likely to form concussion management teams at school to facilitate return to school
   - have students and parents who are more knowledgeable about concussion (Glang et al. 2014)

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Berlin Recommendations

1. All schools encouraged to have concussion policy that includes education on concussion prevention and management for teachers, staff, students, parents; should offer appropriate academic accommodations and support to students
2. Upon diagnosis of concussion, students should be provided with medical RTS letter to facilitate provision/receipt of necessary academic accommodations
3. Students should have early/ongoing medical follow-up to identify symptom targets, monitor recovery and help with return to school.
4. Students may require temporary absence from school after injury
5. Clinicians should assess risk factors/modifiers that may prolong recovery and require more/prolonged/formal academic accommodations. Adolescents may require more academic support during recovery
6. Further research is required to determine the appropriate return to school accommodations for children and adolescents with prolonged symptoms.

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What the CDC Has to Say about Return to School

30. To assist children returning to school following mTBI, medical and school-based teams should counsel the student and family regarding the process of gradually increasing the duration and intensity of academic activities as tolerated, with the goal of increasing participation without significantly exacerbating symptoms. (Level B)

31. Return to school protocols should be customized based on the severity of postconcussion symptoms in children with mTBI as determined jointly by medical and school-based teams. (Level B)

Expertise within the Team

- **Healthcare Provider**: knowledge of injury, symptom manifestations, recovery path, comorbid health/developmental factors
  * TASK: DIAGNOSE, DEFINE, REDEFINE NEEDS
- **School**: Teaching/learning, school environment
  * TASK: TRANSLATE INJURY INFO INTO SUPPORTS TO OPTIMIZE LEARNING, ADJUST SUPPORTS

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Concussion Management Team

- School nurse, psychologist, athletic trainer,
- Guidance counselor
- Administrator
- Teacher(s)
- Healthcare Provider(s) (consulting)
- Family

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Concussion Management Team

Roles

– Medical monitor:
- monitors the symptom status of the student, using standardized symptom scale
- Liaisons with community medical provider
- Reports status to academic monitor

– Academic monitor:
- oversees & guides academic support process - Day 1 to recovery
- Links student symptom status with accommodations
- Liaisons with, student, teachers and medical monitor

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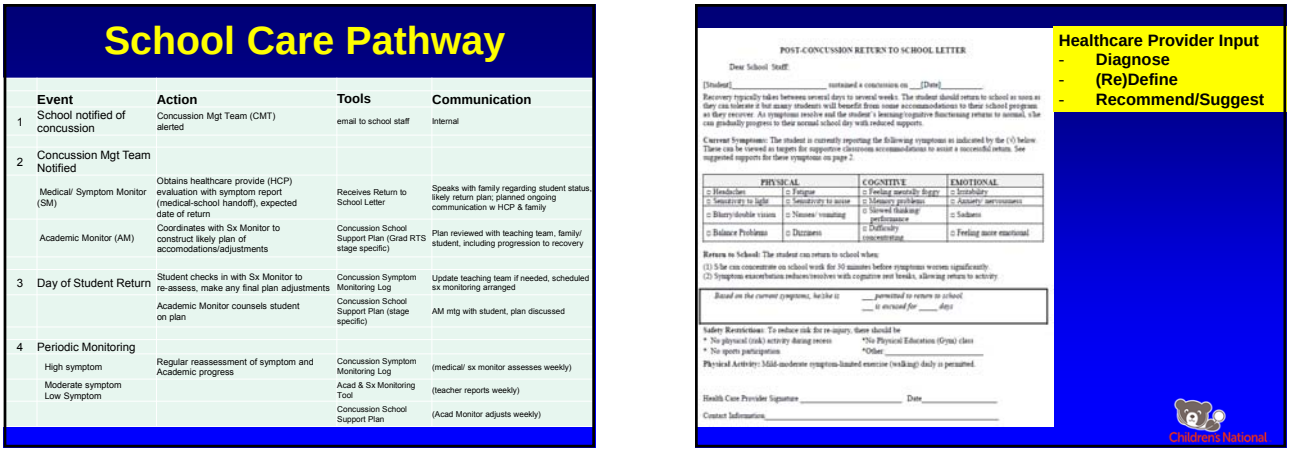
School Care Pathway

	Event	Action	Tools	Communication
1	School notified of concussion	Concussion Mgt Team (CMT) alerted	email to school staff	Internal
2	Concussion Mgt Team Notified			
	Medical/ Symptom Monitor (SM)	Obtains healthcare provide (HCP) evaluation with symptom report (medical-school handoff), expected date of return	Receives Return to School Letter	Speaks with family regarding student status, likely return plan; planned ongoing communication w HCP & family
	Academic Monitor (AM)	Coordinates with Sx Monitor to construct likely plan of accomodations/adjustments	Concussion School Support Plan (Grad RTS stage specific)	Plan reviewed with teaching team, family/ student, including progression to recovery
3	Day of Student Return	Student checks in with Sx Monitor to re-assess, make any final plan adjustments	Concussion Symptom Monitoring Log	Update teaching team if needed, scheduled sx monitoring arranged
		Academic Monitor counsels student on plan	Concussion School Support Plan (stage specific)	AM mtg with student, plan discussed
4	Periodic Monitoring			
	High symptom	Regular reassessment of symptom and Academic progress	Concussion Symptom Monitoring Log	(medical/ sx monitor assesses weekly)
	Moderate symptom Low Symptom		Acad & Sx Monitoring Tool	(teacher reports weekly)
			Concussion School Support Plan	(Acad Monitor adjusts weekly)



POST-CONCUSSION RETURN TO SCHOOL LETTER

Dear School Staff:

[Student]_____ sustained a concussion on ___[Date]_____.

Recovery typically takes between several days to several weeks. The student should return to school as soon as they can tolerate it but many students will benefit from some accommodations to their school program as they recover. As symptoms resolve and the student's learning/cognitive functioning returns to normal, s/he can gradually progress to their normal school day with reduced supports.

Current Symptoms: The student is currently reporting the following symptoms as indicated by the (√) below. These can be viewed as targets for supportive classroom accommodations to assist a successful return. See suggested supports for these symptoms on page 2.

PHYSICAL	COGNITIVE	EMOTIONAL
□ Headaches	□ Fatigue	□ Feeling mentally foggy	□ Irritability
□ Sensitivity to light	□ Sensitivity to noise	□ Memory problems	□ Anxiety/ nervousness
□ Blurry/double vision	□ Nausea/ vomiting	□ Slowed thinking/ performance	□ Sadness
□ Balance Problems	□ Dizziness	□ Difficulty concentrating	□ Feeling more emotional

Return to School: The student can return to school when:
(1) S/he can concentrate on school work for 30 minutes before symptoms worsen significantly.
(2) Symptom exacerbation reduces/resolves with cognitive rest breaks, allowing return to activity.

Based on the current symptoms, he/she is ___*permitted to return to school*
___*is excused for* ____ *days*

Safety Restrictions: To reduce risk for re-injury, there should be
* No physical (risk) activity during recess *No Physical Education (Gym) class
* No sports participation *Other_____
Physical Activity: Mild-moderate symptom-limited exercise (walking) daily is permitted.

Health Care Provider Signature _____ Date_____
Contact Information_____

Healthcare Provider Input
- **Diagnose**
- **(Re)Define**
- **Recommend/Suggest**

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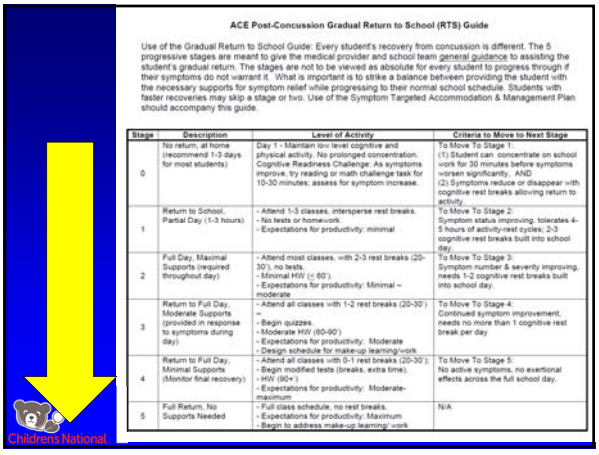

ACE Post-Concussion Gradual Return to School (RTS) Guide

Use of the Gradual Return to School Guide: Every student's recovery from concussion is different. The 5 progressive stages are meant to give the medical provider and school team general guidance to assisting the student's gradual return. The stages are not to be viewed as absolute for every student to progress through if their symptoms do not warrant it. What is important is to strike a balance between providing the student with the necessary supports for symptom relief while progressing to their normal school schedule. Students with faster recoveries may skip a stage or two. Use of the Symptom Targeted Accommodation & Management Plan should accompany this guide.

Stage	Description	Level of Activity	Criteria to Move to Next Stage
0	No return, at home (recommend 1-3 days for most students)	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.	To Move To Stage 1: (1) Student can concentrate on school work for 30 minutes before symptoms worsen significantly, AND (2) Symptoms reduce or disappear with cognitive rest breaks allowing return to activity.
1	Return to School, Partial Day (1-3 hours)	- Attend 1-3 classes, intersperse rest breaks. - No tests or homework - Expectations for productivity: minimal	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.
2	Full Day, Maximal Supports (required throughout day)	- Attend most classes, with 2-3 rest breaks (20-30'), no tests. - Minimal HW (≤ 60'). - Expectations for productivity: Minimal – moderate	To Move To Stage 3: Symptom number & severity improving, needs 1-2 cognitive rest breaks built into school day.
3	Return to Full Day, Moderate Supports (provided in response to symptoms during day)	- Attend all classes with 1-2 rest breaks (20-30') - - Begin quizzes. - Moderate HW (60-90') - Expectations for productivity: Moderate - Design schedule for make-up learning/work	To Move To Stage 4: Continued symptom improvement, needs no more than 1 cognitive rest break per day.
4	Return to Full Day, Minimal Supports (Monitor final recovery)	- Attend all classes with 0-1 rest breaks (20-30'); - Begin modified tests (breaks, extra time). - HW (90+') - Expectations for productivity: Moderate-maximum	To Move To Stage 5: No active symptoms, no exertional effects across the full school day.
5	Full Return, No Supports Needed	- Full class schedule, no rest breaks. - Expectations for productivity: Maximum - Begin to address make-up learning/ work	N/A

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Effect of Concussion on School Learning & Performance

Effect of School Learning & Performance on Concussion Recovery

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Defining Academic TARGETS

- Ransom et al. (2015) *Pediatrics* - Define types of academic challenges in concussed students 5-18 years
- Results: Non-recovered (RC-) group reported higher levels of concern, more school-related problems than RC+ group.
- High school students report higher levels of problems.
- Higher symptom burden associated with greater reported academic problems.
- Significantly greater impairment on cognitive testing in RC- group.
- Summary: empirical evidence of concussion's impact on learning/ performance reported by students. Identifies academic effects to target interventions

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What kinds of school problems are you having SINCE YOUR INJURY?

Ransom et al. (2015)

Type of Problem	Elementary (n=42)	Middle (n=78)	High School (n=120)
Headaches interfering	53%	73%	71%
Can't pay attention	47%	58%	66%
Feeling too tired	53%	61%	52%
Homework taking much longer	35%	48%	63%*
Difficulty understanding material	29%	46%	54%
Difficulty studying for tests	18%	36%	53%*
Difficulty taking Notes	18%	17%	35%*
Average # reported **Mn (SD)**	2.53 (2.1)	3.37 (1.7)	3.92 (2.1)

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* Significant (p<.05) difference across grade level

Which classes/ subjects are you having trouble with SINCE YOUR INJURY?

Type of Problem	Elementary (n=27/ 82)	Middle (n=92/ 122)	High School (n=147/ 186)
	Student	Student	Student
Reading	33.3	37.0	46.3
Math	29.6	54.3	59.2
Science	14.8	29.7	46.3
Social Studies	14.8	23.1	36.1
Foreign Language	7.4	33.7	32.0
Art	0.0	5.5	3.4
None	14.8	16.3	12.9

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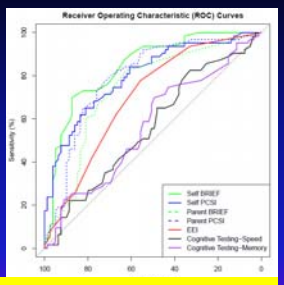
Predicting Academic Outcomes

- ROC modeling of academic outcome
- Predicting "good" vs "challenged" academic outcomes
- Post-concussion symptoms, executive dysfunction



Symptoms (post-concussion, executive functions) should be (re)assessed in planning supports

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Cognitive & Physical Demands & Symptoms (% Reporting Exertional Effects)

	Elementary (n=88)	Middle (n=138)	High School (n=206)
Demand	*Yes*	*Yes*	*Yes*
Cognitive	47.7	52.5	62.5
Physical	12.5	20.3	16.5

Degree of exertional effects indicates Need to Manage Activity Demands during School Day (w/ accommodations)

Gioia, 2010

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And don't forget the 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

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Gradual Return to School
Six Stages

Stage	Description
0	No return, at home
1	Return to School, Partial Day (1-3 hours)
2	Full Day, Maximal Supports (required throughout day)
3	Return to Full Day, Moderate Supports (provided in response to symptoms during day)
4	Return to Full Day, Minimal Supports (Monitor final recovery)
5	Full Return, No Supports Needed

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Gradual Return to School
Six Stages w Recommended Activity Level

Stage	Description	Activity Level
0	No return, at home	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.
1	Return to School, Partial Day (1-3 hours)	Attend 1-3 classes, intersperse rest breaks. No tests or homework. Minimal expectations for productivity.
2	Full Day, Maximal Supports (required throughout day)	Attend most classes, with 2-3 rest breaks (20-30'), no tests. Minimal HW (< 60'). Minimal-moderate expectations for productivity.
3	Return to Full Day, Moderate Supports (provided in response to symptoms during day)	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.
4	Return to Full Day, Minimal Supports (Monitor final recovery)	Attend all classes with 0-1 rest breaks (20-30'); begin modified tests (breaks, extra time). HW (90+') Moderate- maximum expectations for productivity.
5	Full Return, No Supports Needed	Full class schedule, no rest breaks. Max. expectations for productivity. Begin to address make-up work.

Gradual Return to School
Six Stages w Recommended Activity Level & Criteria for Movement

Stage	Description	Activity Level	Criteria to Move to Next Stage
0	No return, at home	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.	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.
1	Return to School, Partial Day (1-3 hours)	Attend 1-3 classes, intersperse rest breaks. No tests or homework. Minimal expectations for productivity.	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.
2	Full Day, Maximal Supports (required throughout day)	Attend most classes, with 2-3 rest breaks (20-30'), no tests. Minimal HW (< 60'). Minimal-moderate expectations for productivity.	To Move To Stage 3: Symptom number & severity improving, needs 1-2 cognitive rest breaks built into school day.
3	Return to Full Day, Moderate Supports (provided in response to symptoms during day)	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.	To Move To Stage 4: Continued symptom improvement, needs no more than 1 cognitive rest break per day
4	Return to Full Day, Minimal Supports (Monitor final recovery)	Attend all classes with 0-1 rest breaks (20-30'); begin modified tests (breaks, extra time). HW (90+') Moderate- maximum expectations for productivity.	To Move To Stage 5: No active symptoms, no exertional effects across the full school day.
5	Full Return, No Supports Needed	Full class schedule, no rest breaks. Max. expectations for productivity.	N/A

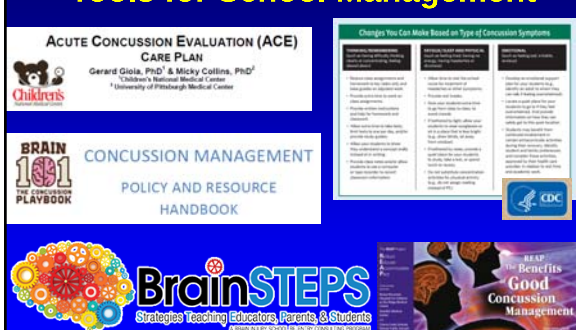
Symptom Targeted Academic Management Plan (STAMP)

Below, please see the symptoms they are currently experiencing. To promote recovery, the student will be provided with the following classroom accommodations that support their academic learning and performance:

Symptom (check)	Functional school problem	Accommodation/ management strategy (select)
Cognitive Symptoms		
Attention & concentration difficulties	Short focus on lecture, classwork, homework	points instead of full written responses) Break down tasks and tests into chunks/segments Lighter work load: Max. nightly homework (including studying): ___ min
Working memory (short-term memory)	Trouble holding instructions, lecture,	Repetition Provide student with teacher generated class notes
Memory consolidation/ retrieval	Accessing learned information	smaller chunks/segments to learn, repetition Recognition cues
Processing speed		
Cognitive Fatigue/ Fogginess		
Physical Symptoms		
Headaches	Interferes with concentration Increased irritability	Intersperse rest breaks, shortened day if symptom does not subside Allow for short naps in quiet location (e.g., nurse's office)
Light/ noise sensitivity	Symptoms worsen in bright or loud environments	Wear sunglasses/hat, seating away from bright sunlight Limit exposure to SMART board, computers, provide class notes Avoid noisy/crowded environments such as lunchroom, assemblies, chorus/music class, and hallways. Leave class early. Allow student to wear earplugs as needed
Dizziness/ balance/ nausea	Unsteadiness when walking Nausea or vomiting	Elevator pass Class transition before bell
Sleep disturbance	Decreased arousal, shifted sleep schedule, trouble falling asleep	Later start time Shortened day or rest breaks
Fatigue	Lack of energy	Periodic rest breaks, short naps in quiet location Passive participation

Targets for Student Support and Treatment

Tools for School Management



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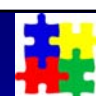
Summary



- Concussion care is a team sport. Communication, collaboration, coordination!
- Implement the Berlin/CDC recommendations for Return to School!
- Medical and school expertise <u>must be</u> coordinated and collaborative
- Return to School policy and pathway is critical!
- Understanding student's <u>unique symptom profile</u> is critical to support (STAMP).
- <u>Active, ongoing communication</u> between medical, school team, & family is essential for support
- <u>Regular monitoring</u> of student's symptoms, adjusting types & intensity of supports is critically important.

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RETURN TO SCHOOL

RTS Component	Y	N
School Policy	√	
CMT-Personnel & Roles Defi		
Education & Tra		
Perso		
	√	
Monitor & Adjust across Recovery	√	

DO NOT FUMBLE THE BALL!

Summary

- Most children & adolescents recover from concussion within 1-4 weeks

NEW TREATMENT APPROACH:

- Initial restriction of activity with good nighttime sleep
- Individualized progressive cognitive and physical activity with monitored symptom management
- Return to School requires medical-school teamwork
- Schools need Concussion Management Teams to provide systematic, coordinated support services

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Summary

- Concussions can have a significant effect on the injured student's school learning
- School learning can potentially have a significant effect on recovery from concussion
- School psychologists can play an important role in supporting the student with concussion.
- Apply your assessment expertise to define symptom targets to support
- Use your skills with interventions to understand, accommodate, monitor & readjust supports based on student's symptoms

Rewards of Working with Concussion

Typically,

- Not a long-term issue
- Not a lot of testing, f ient
- Intervention/ c ted
- Kids get h proportion to:
  - H identified
  - ions are put in place
  - being monitored regularly and
  - ions modified through recovery

BUILT FOR THE SCHOOL PSYCHOLOGIST!

Concussion/ mTBI CDC Educational Materials

www.cdc.gov/headsup

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

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