Concussion Management: From Rehab to Return to Activity

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Disclosure Statements

- The statements and opinions contained in this program are solely those of the presenter.
- Treatment options and tools presented are some of many that are available.
- All individuals in control of content disclosed no relevant financial relationships.
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Course Description

Learn how you can take an active role in helping your patients return to school and activity safely after a concussion. This course overviews how to implement academic adjustments post-concussion, explains the role of exertion and active rehabilitation, and discusses return to play recommendations and clearance.

Objectives

At the end of this course, the attendee will be able to:

- Describe the management of school-related concerns following a concussion
- Discuss the role of exertion and active rehabilitation
- Explain return-to-play recommendations, including the profession to full clearance

Speaker Biography

Tamara Valovich McLeod, PhD, ATC, FNATA

Professor and Director, Athletic Training
A.T. Still University

- Received bachelor's degree in sports medicine from Mercyhurst University and master of science in Kinesiology from the University of Colorado
- Completed doctor of philosophy degree in education with an emphasis in sports medicine from the University of Virginia
- Fellow of the National Athletic Trainers' Association
- Director of ATSU's Arizona School of Health Sciences Interdisciplinary Research Laboratory and the Athletic Training Practice Based Research Network
- Research focuses on pediatric athlete with respect to sport-related concussion
- Contributing author for NATA's position statement of the *Management of Sport Related Concussion*
- Serves as section editor for the Journal of Athletic Trainer and in on the editorial board for numerous other athletic training journals

Module 1: Academic Consequences and Managing Return to Learn Following Concussion

Comprehensive Concussion Plan

PPE

Equipment

Baseline

Post-Injury Testing

Return to School

RTP

Referral Sources

Comprehensive Concussion Plan

- PPE
- Equipment
- Baseline
- Post-Injury Testing
- Return to School
- RTP
- Referral Sour

Consensus Questions

- **What is the evidence for and efficacy of specific treatment interventions?**

- **What is the difference in concussion management in children as compared to adults?**

McCrory, 2017

Key Recommendations

- Brief period (24–48 hours) of complete rest
- Closely monitored active rehabilitation programs
  - Controlled sub-symptom threshold, submaximal exercise
- Full return to school
- Need to address academics
  - Successfully return to school first, then sport!

McCrory et al, *Br J Sport Med.* 2017

Return to Learn

Return-to-Learn Implications

35 included studies

- Academic outcomes, physician recommendations, length of RTP progression, symptom difficulties, academic accommodations

Inconsistent findings

- mall number of studies, variability in terminology and methodology

Gaps

- Consensus on RTL protocols, prescription of cognitive rest, RTL legislation, evidence-based RTL progressions, impact of RTL on academic outcomes

O'Neill, 2017

Effects of Concussion on Learning

Somatic	Cognitive	Sleep	Emotional
• Affects ability to function in class • Unsteadiness • Concentration difficulty	• Difficulty learning and retaining new information	• Results in issues with cognition, behavior, and mood • Decreased alertness in class	• Anxiety can hinder cognition • Adherence to prescribed rest

Concussion & Academic Outcomes

Negative

- Cumulative GPA significantly lower in youth with 2+ concussions & recent concussion (Moser, 2005)
- Higher academic dysfunction scores 1 week after concussion compared to extremity injured (Wasserman, 2016)
- Symptomatic students had increased level of concern for impact of concussion on academic performance and more school related problems (Ransom, 2015)
- Vision symptoms, hearing difficulty, and concentration difficulty were significantly associated with academic difficulty (Swanson, 2016)
- 79% of ATs managed patient who experienced a decrease in school and academic performance following concussion (Williams, 2015)

None

- Concussion did not alter academic outcomes when using end of year GPA (Russel, 2016)

Concussion & Academic Outcomes

Influence on school attendance and activities

- Academic accommodations
- Left school early due to symptoms
- Decrease in grades
- Wanted to be in school

Effect on school role

- Physical symptoms impact on school
- Absences
- Academic adjustments
- Inconsistency of school personnel in assisting

Valovich McLeod, In Review Iadevaia, 2015

Who Has Problems in School?

1/3 of patients presenting to specialty clinic had school problems

Higher initial 3 of symptoms

- 9.5 (6.7) vs. 2.6 (6.0)

Higher Initial Symptom Severity

- 23.3 (22.2) vs. 13.5 (17.0)

Significantly Worse SCAT2 Score (total)

- 60.8% no absence
- 24.1% missed 1-3 d
- 16.5% missed 4-21 d

Baker, 2015

Policies to Aid Return to School

Return-To-Learn Policy

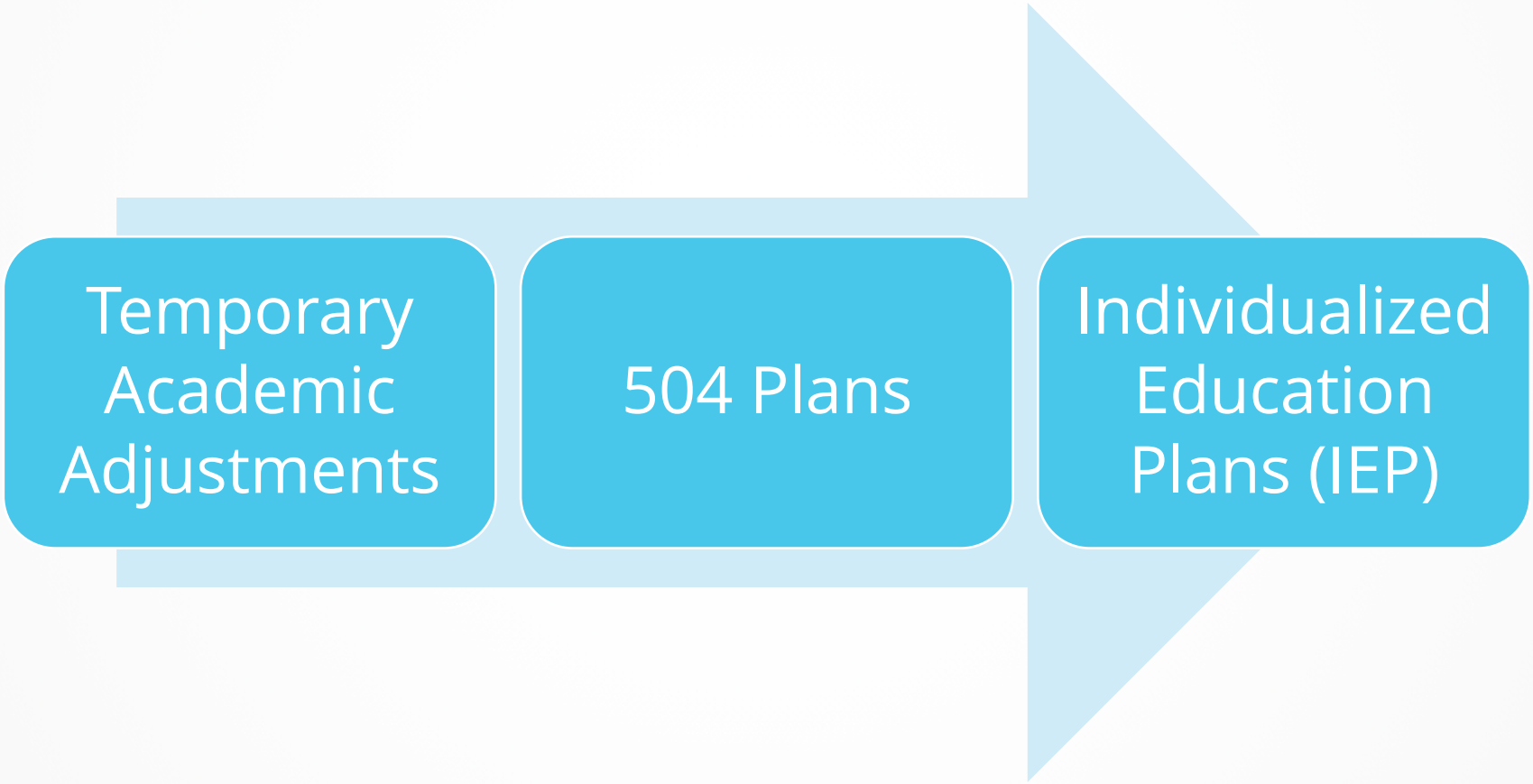
Secondary School

- 44% of ATs had RTL policy (Kasamatsu, 2016)
- 24.3% address AA in written plan (Heyer, 2015)
- 30% written policy (Wing, 2015)
- 12% had RTL Policy (Lyons, 2016)

College

- 66.6% of colleges had RTP policies (Kerr, 2016)
  - 3.1% involved academic support
- 86.4% had RTL section (Buckley, 2017)

Policies



Accommodations

Type of Accommodation	Definition	Time frame	Implementation Mechanism
Academic Adjustment	Non-formalized changes in environment	3-5 weeks	Informal negotiation with teachers and academic administrators
Academic Accommodation	Longer academic accommodation needs (i.e. alternative arrangements for standardized testing	5 weeks – 4 months	504 Plan
Academic Modification	More prolonged changes necessary (special education)	> 4- 6 months	Individualized Education Plan (IEP)

Parsons & Williams, Quick Questions in Concussion, 2015

School – Medical Partnership: Policy and Infrastructure

Activities and Responsibilities: Before School Year

Goal: Written Policy, Verification of Education, List of Resources

Activity	Responsible Party
Concussion management policies and procedures (P & P)	School administration [school nurse, counselor, psychologist]
Development of school concussion resource team	School administration; school nurse, counselor, psychologist, designated teacher, athletic trainer
Examine teaching/support methods to support recovery, maximize learning/ performance, reduce symptom exacerbation	School administration; school nurse, counselor, psychologist
Teacher/staff education and training	Teacher, school counselor, school nurse, administrators
Develop list of concussion resources for education, consultation & referral	School administrators

Sady, 2011; Gioia, 2016

Activities and Responsibilities: During School Year

Goal: Have tools available for assessment and education

Activity	Responsible Party
Review/reinforce concussion policy and procedures	School administration, school nurse/ counselor
Monitoring for injury, parent informed of injury	Coach, athletic trainer, school health personnel

Sady, 2011; Gioia, 2016

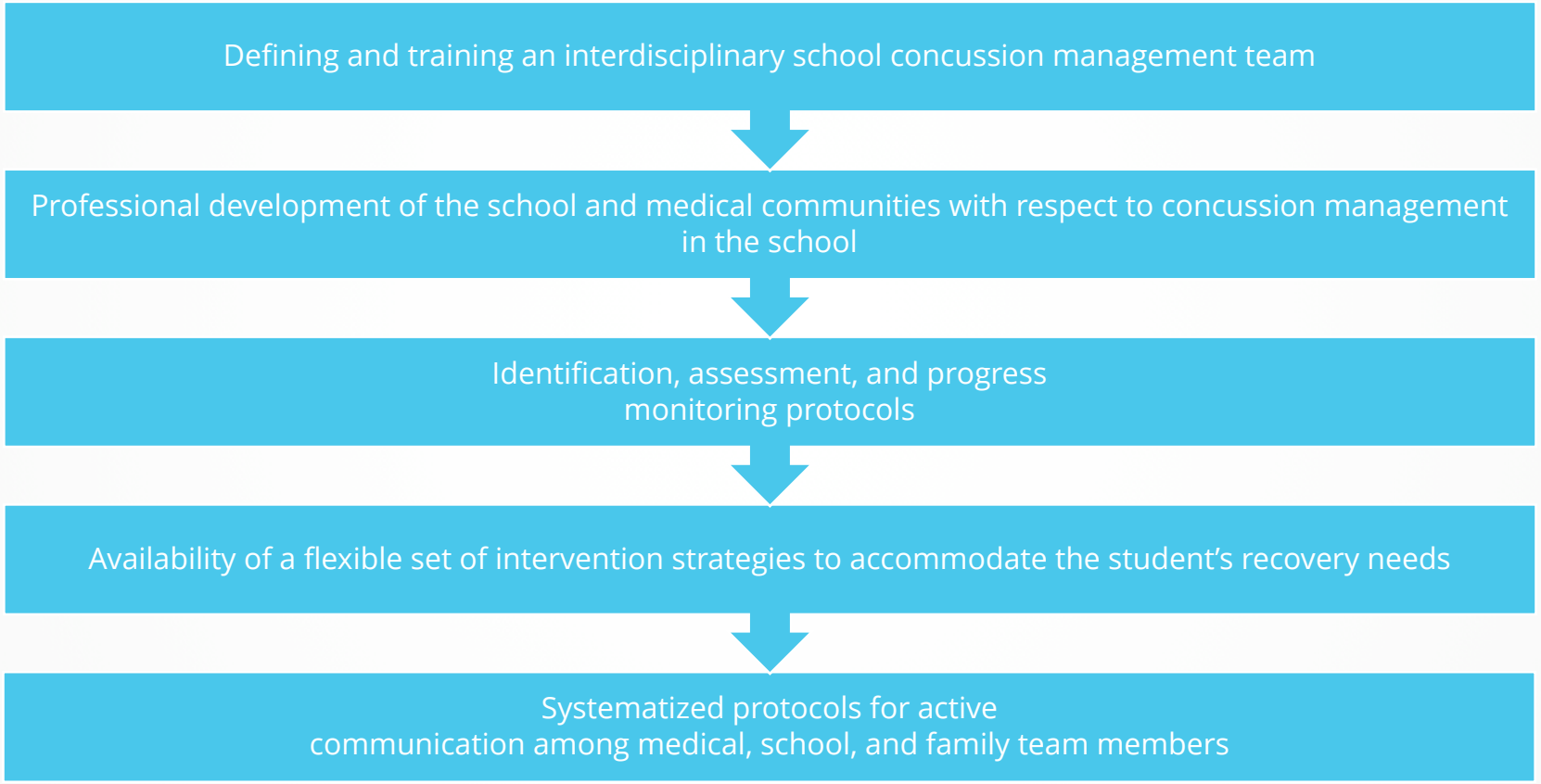
Activities and Responsibilities: Post-Injury

Goal: Proper documentation, written plans for school and activity

Activity	Responsible Party
Medical evaluation & school treatment planning	Licensed health care professional with concussion training, school concussion resource team
Gradual return to school program	Licensed health care professional with concussion training, school concussion resource team
In-school observation, monitoring, & supports	School concussion resource team
Clearance for full return to academics	Licensed health care professional with concussion training, school concussion resource team

Sady, 2011; Gioia, 2016

School Support Infrastructure



Gioia, 2016

School System Preparation

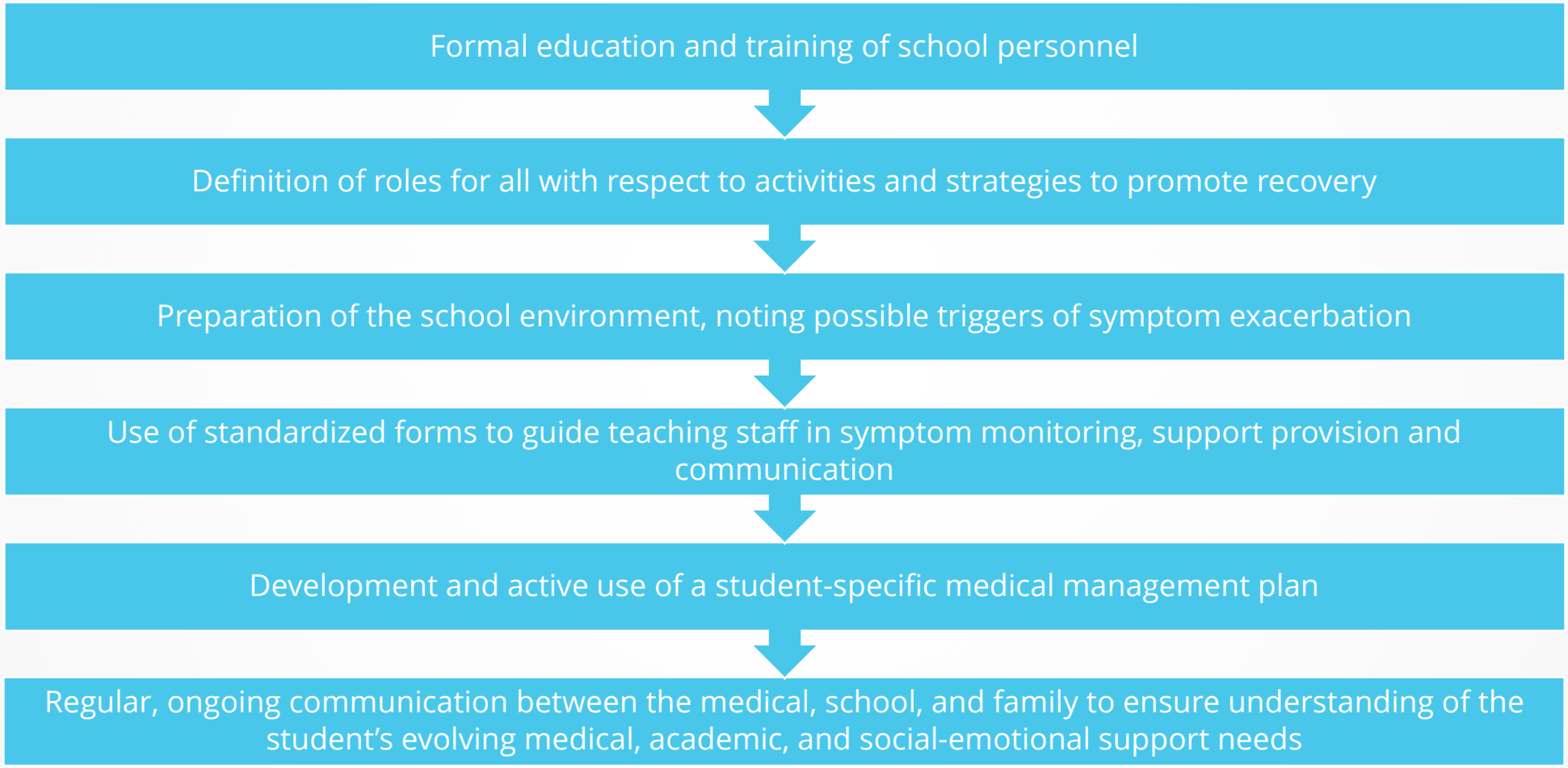
1. **Establish state and local school policies and procedures**
   - Identification and academic management of students with mild traumatic brain injury

2. **Educate school personnel about mild traumatic brain injury**
   - Formation and role definition of the school-based team

3. **Implementation of school-based concussion management action plans**

Gioia, 2016

Common Themes in Students with Mild Traumatic Brain Injury



Gioia, 2016

School System Concussion Education

- Concussion and their effects
- Each professional's role in management
- Start of the school year
- Includes teachers, counselors, administrators, coaches, and medical providers
- Staff familiarized with policy

Gioia, 2016

Medical System Preparation

- **Training Resources for Medical Providers**
  - General concussion education
  - Use of assessment tools
  - Use of TBI-specific discharge instructions and planning tools (ACE)

- **Communication with School Personnel**

Gioia, 2016

Medical – School Partnership

- Effective and efficient communication of the students' needs
- Student's symptom profile can be communicated to the team
- Periodic in-school monitoring of symptom progress can be conducted
  - Cognitive activity log

Gioia, 2016

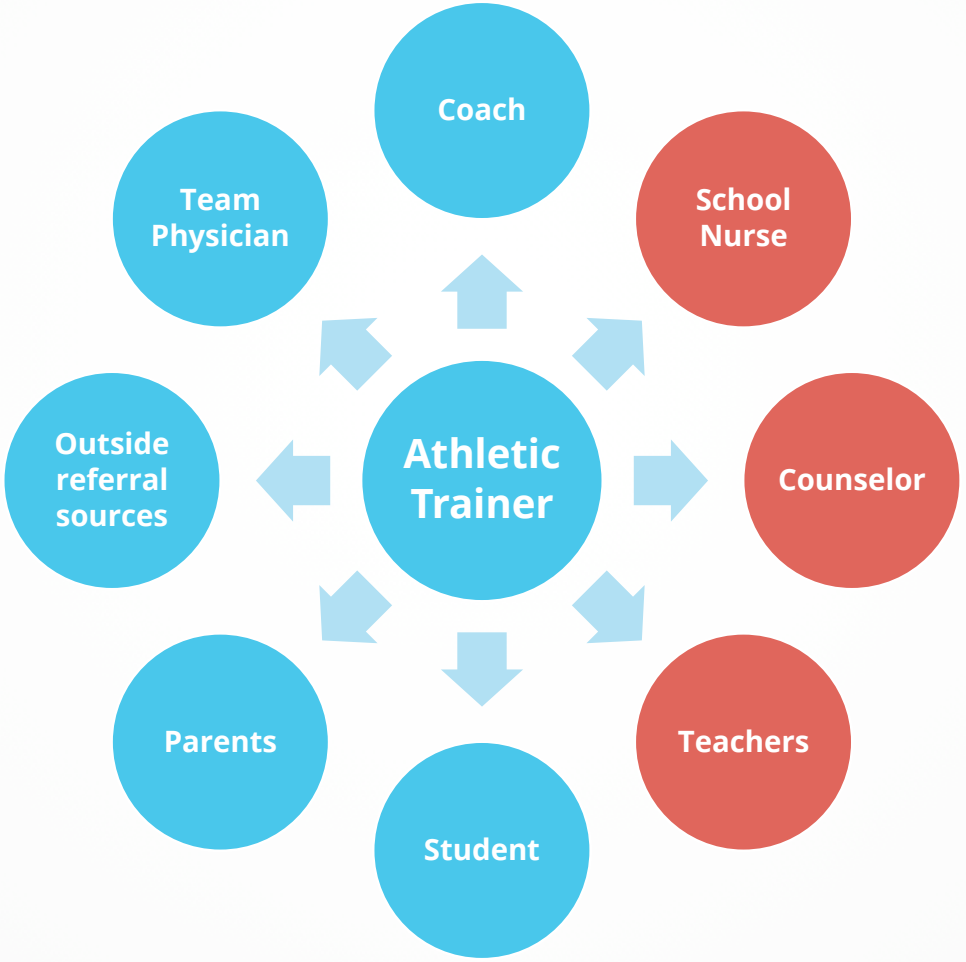
Ideal Policy

- Brief description of mild traumatic brain injury/ concussion
- Definition of the school “receiving team” to guide reentry
- The gradual process to assist the student’s return into school life (learning, social activity, etc.),
- Criteria for when students can safely return to physical activity and full cognitive activity

Gioia, 2016

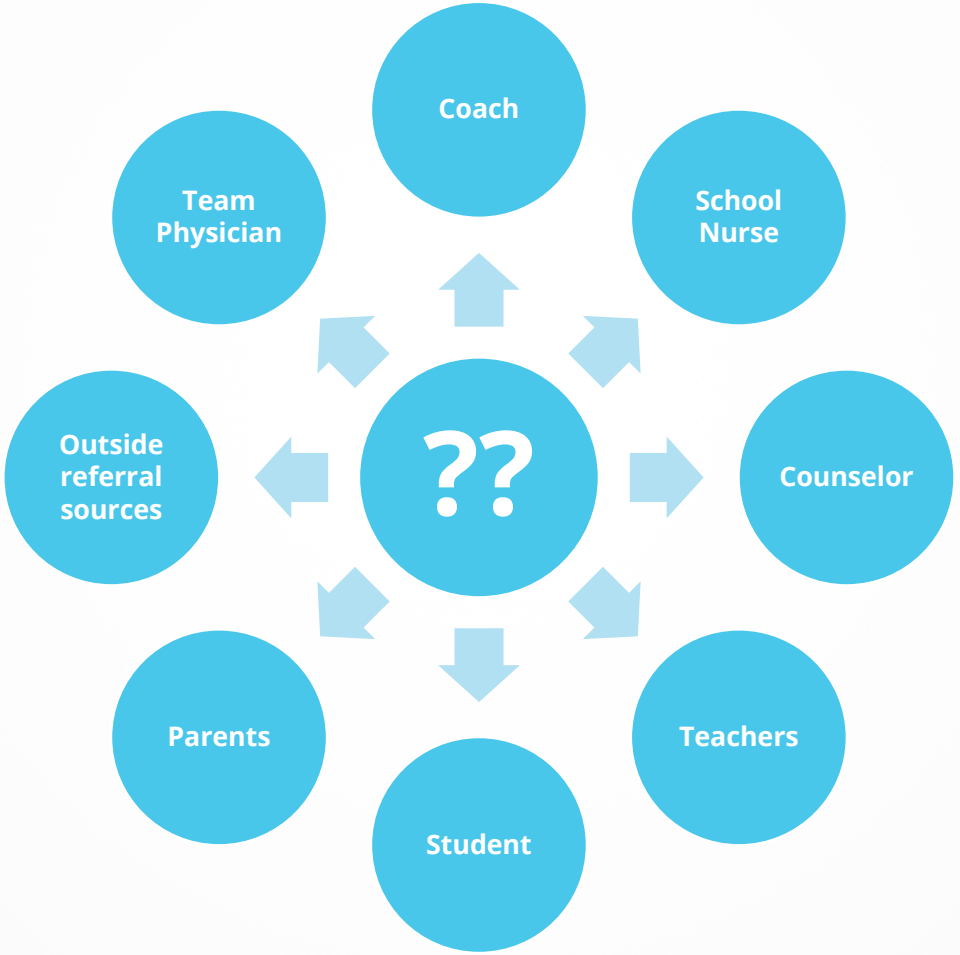
Concussion Management Team

Secondary School (AT)



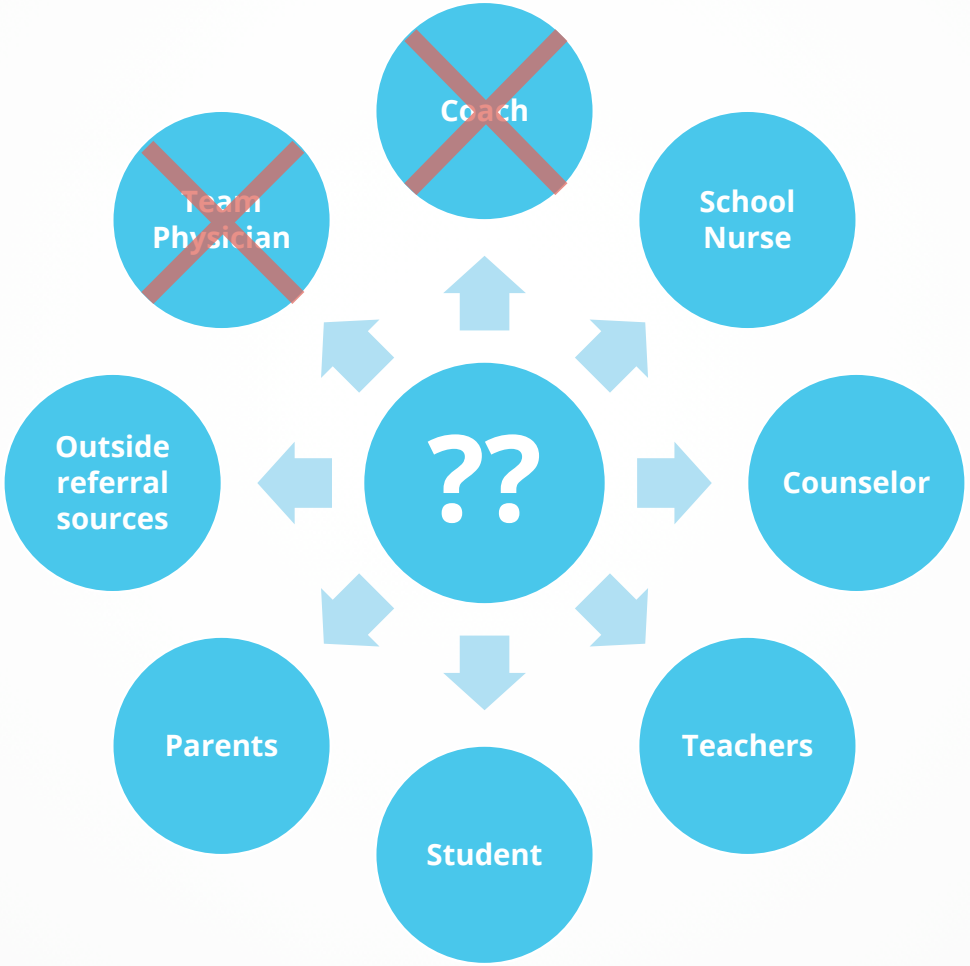
Piebes et al, *J School Nursing*, 2009

Secondary School (No AT)



Piebes et al, *J School Nursing*, 2009

Elementary School



Piebes et al, *J School Nursing*, 2009

Teams and Their Roles

Team	Team Members	Roles
Family	Patient, parents, guardians, relatives, peers, teammates, family friends	Impose rest Monitor and track symptoms at home including emotional and sleep-related symptoms daily Communicate with school teams
Medical	Primary care provider, team physician, emergency department, concussion specialist, neuropsychologist, other medical referrals	Rule out more serious injury Evaluate patient periodically Coordinate information from other teams Encourage physical and cognitive rest
School Academic	School nurse, school counselor, teachers, school psychologist, social worker, school administrator, school physician, school occupational or physical therapist	Reduce cognitive load Meet with patient to create academic adjustments Watch, monitor, and track academic and emotional issues
School Physical Activity	Athletic trainer, school nurse, coach, physical education teacher, school physician, playground supervisor	Watch, monitor, and track physical symptoms Athletic trainer should do daily follow-up examinations Ensure no physical activity

Williams & Valovich McLeod, Quick Consult: Concussion, 2015

Collaboration

- School personnel and health care providers play important and cooperative roles
- School personnel provide expertise in developing the academic adjustments
  - Need guidance from the health care providers on the specific targets toward which they should direct the school supports
- Medical evaluation and the resulting student symptom profile is the first step to constructing the plan of accommodations and adjustments

Iverson & Gioia, 20XX

Case Manager / Point Person

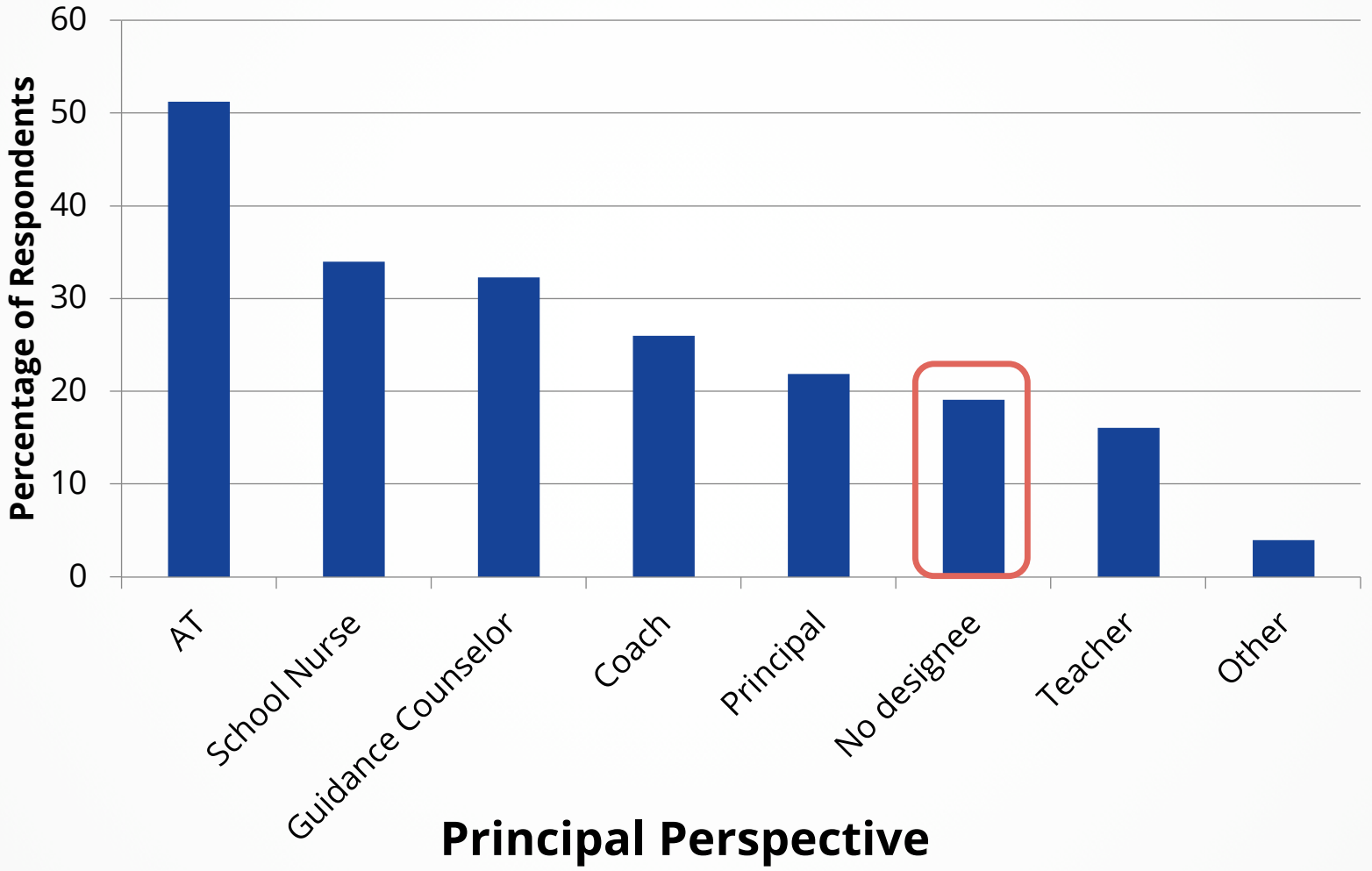
Table 4. Summary of "Point Persons" Identified to Monitor Health (n = 1037) and Academic Progress (n = 1011)

Point Person	Health and Recovery, n (%)[a,b]	Academic Progress, n (%)[b,c]
Athletic trainer	764 (73.7)	359 (35.5)
Principal or assistant principal	115 (11.1)	24 (2.4)
No one currently identified	86 (8.3)	212 (21.0)
Athletic director	27 (2.6)	26 (2.6)
School counselor	22 (2.1)	174 (17.2)
Coach	11 (1.1)	8 (0.8)
Teacher	5 (0.5)	75 (7.4)
School psychologist	4 (0.4)	13 (1.3)
Nurse or health clerk	3 (0.3)	120 (11.9)

AT Perspective

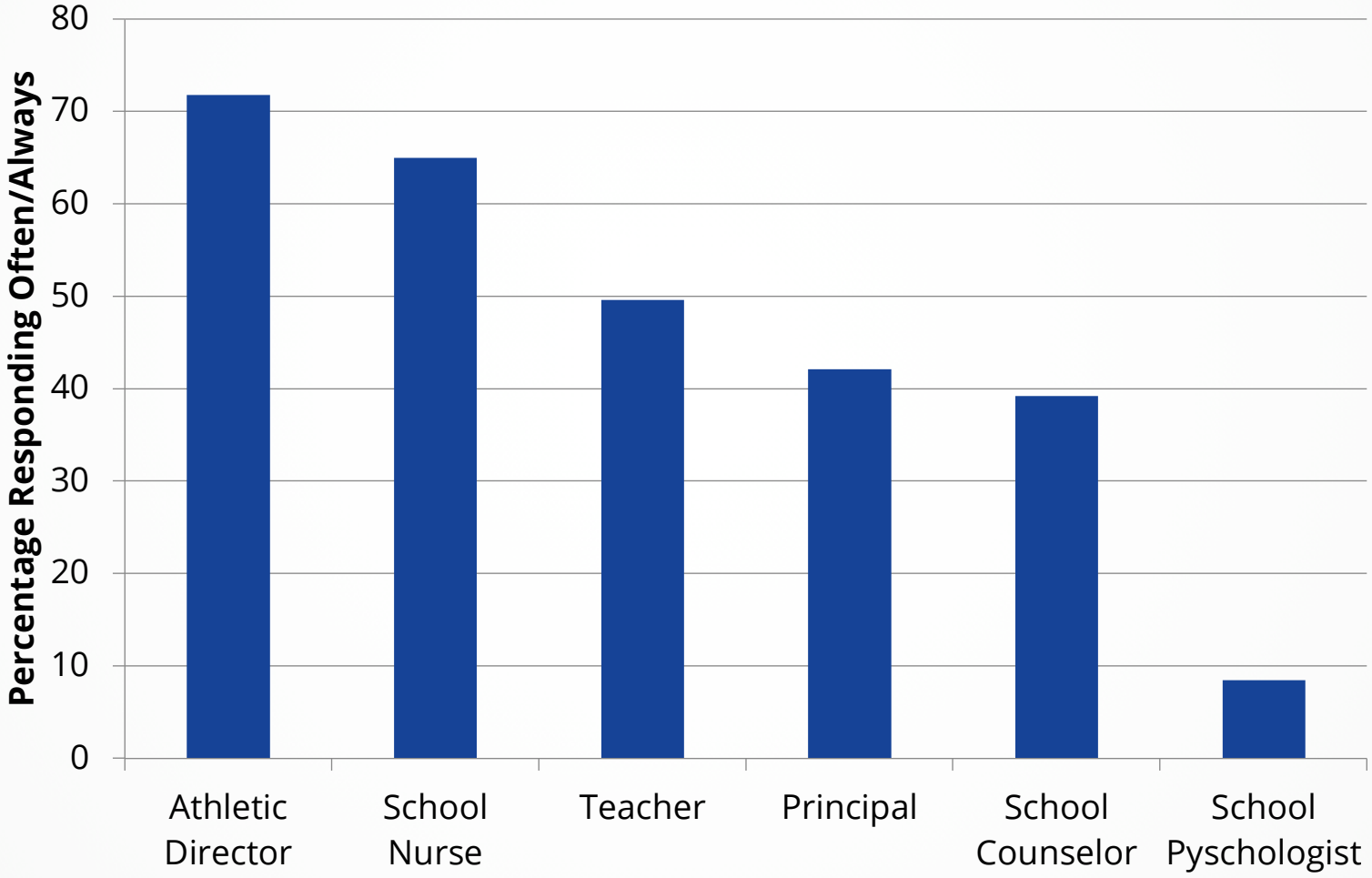
Kasamatsu, 2016

Case Manager / Point Person



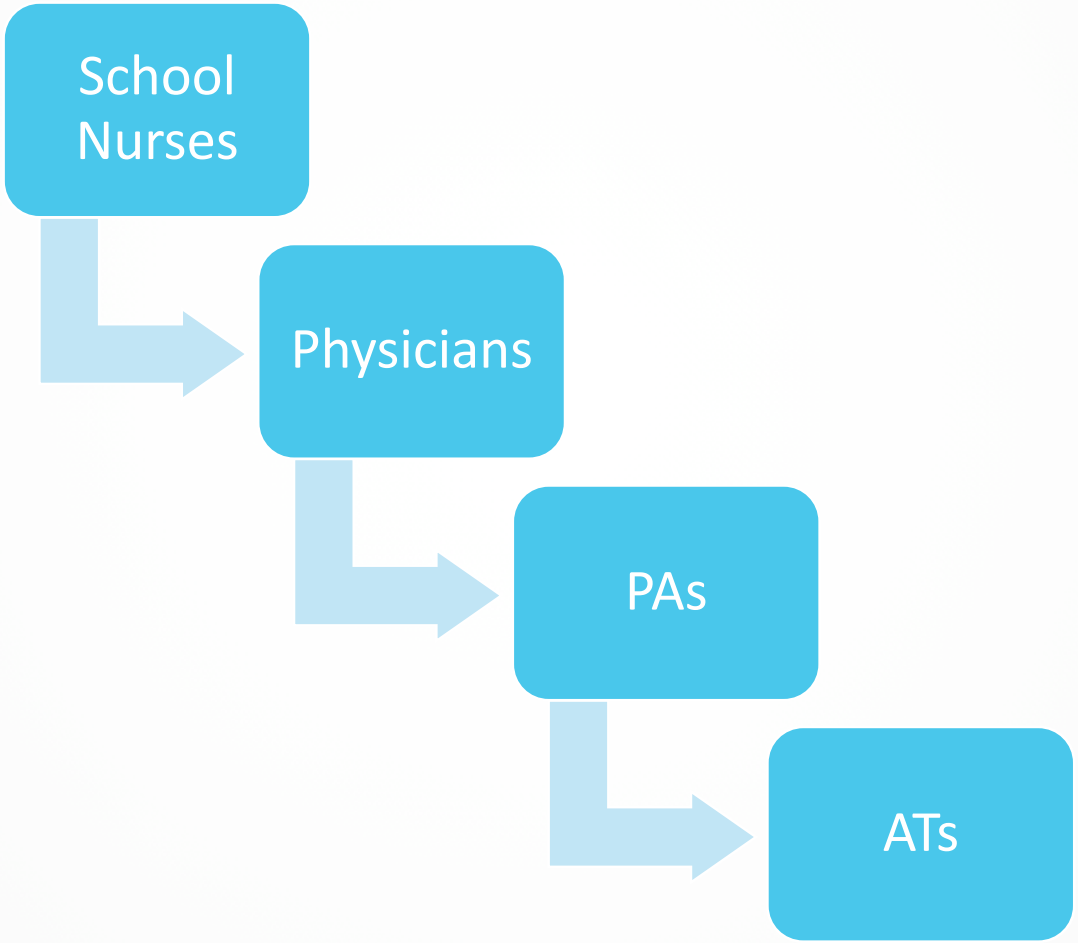
Heyer, 2014

Frequency of Communication with School Professionals



Kasamatsu, 2016

Familiarity with 504s and IEPs



Welch Bacon, 2016

School Personnel & AA

- School personnel felt minimally to moderately knowledgeable and confident in their knowledge
- Coaches had highest perceived knowledge and confidence
  - Past educational efforts regarding concussion have focused on coaches (Sarmiento, 2010)
- Educational efforts directed at school personnel are needed
  - Pediatric sports medicine providers can play a key role in facilitating education and collaboration

Valovich McLeod, PRISM, 2017

RTL Law Implementation

Qualitative Study of MA Law Implementation

- 19 school stakeholders
- Required re-entry plan for academics

At Schools of All Respondents

- SNs and ATs developed a collaborative relationship to implement the law
- Physicians were relied on for diagnosis

Challenges to Reliance on Outside Physicians

- Perception they knew little about the law

> "So...(the athletic trainer) does a good job with the paper work and the documentation and the communication between the two of us...I get an email from her all the time about...somebody had a head injury or a potential concussion.
>
> She'll give me a heads up so that we have that information at school in the morning...when kids are here for class."

Doucette, 2016

Important Factors for CMT

Years of experience (Valovich McLeod, 2014)

- Important for building collaborative relationships and understanding the intricacies of concussion management, which includes AA

Employment model (McLeod, 2015)

- Employed directly by the school more likely to have policy and greater familiarity with AA

Importance of AT Access

- **School counselors with AT access were more familiar with 504 and IEP (Johnson, 2017)**
  - 53.2% vs. 28.3%

- **School administrators with ATs agreed more strongly that they were knowledgeable about and were more confident in their knowledge regarding AA, RTL, and RTP criteria post-SRC (Johnson, 2016)**

- **AT employment was associated with more school administrators (Kasamatsu, 2016)**
  - Reported AA provided to student-athletes following concussion (73.3% vs. 26.7%)
  - Reported existence of an established academic support team (78.7% vs. 21.3%)

Barriers to Collaboration

- **Community physician knowledge** (Williams, 2015; Kay, 2015; Sleight, 2015; Erickson, 2015; Doucette, 2016; Blackwell, 2016)
- **Communication with physician** (Doucette, 2016; Blackwell 2016)
- **Lack of collaboration** (Minthorn, 2014)
  - Only half of SNs with an AT have an established professional relationship
- **Teacher knowledge and training** (Lyons, 2016; Valovich McLeod, PRISM, 2017)
- **Limited access to school counselors** (Blackwell, 2016)

Areas of Improvement

Speech Language

- Better communication
- More training in TBI
- Improved access to assessment tools

Duff, 2014

School Nurses

- Communication (73%)
- Training (38%)
- Time (30%
- Perception not SN role (15%)

Wing, 2015

School Nurses

- Communication
- Standardized protocols
- Education on managing younger patients
- Communication about non-sports concussions

Blackwell, 2016

Athletic Trainer

- Patient/Parent compliance
- Education
- Formal Policy
- Inconsistency between RTP and RTL

Welch Bacon, In Press

Plan Implementation

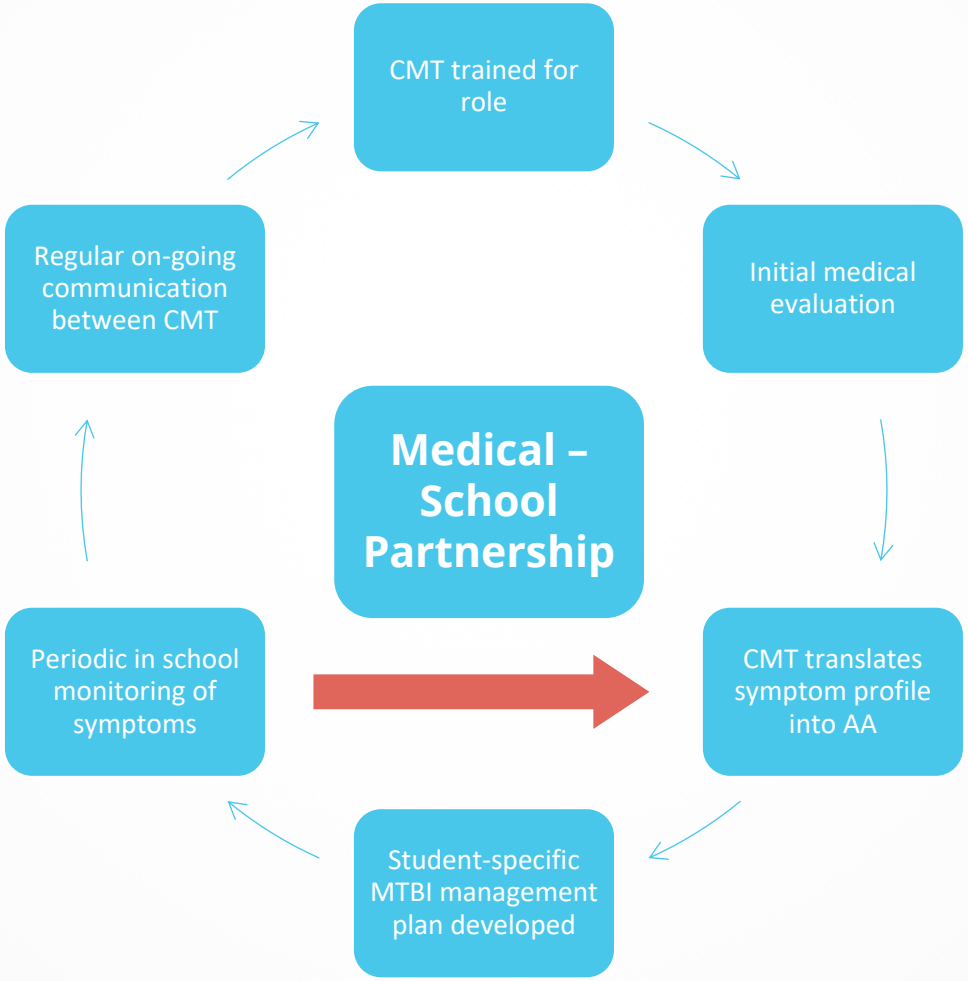
Academic Support Plan

16-36% of respondents indicated school has an academic support plan in place (Valovich McLeod, Kines Rev, 2015)

Academic Support Plan

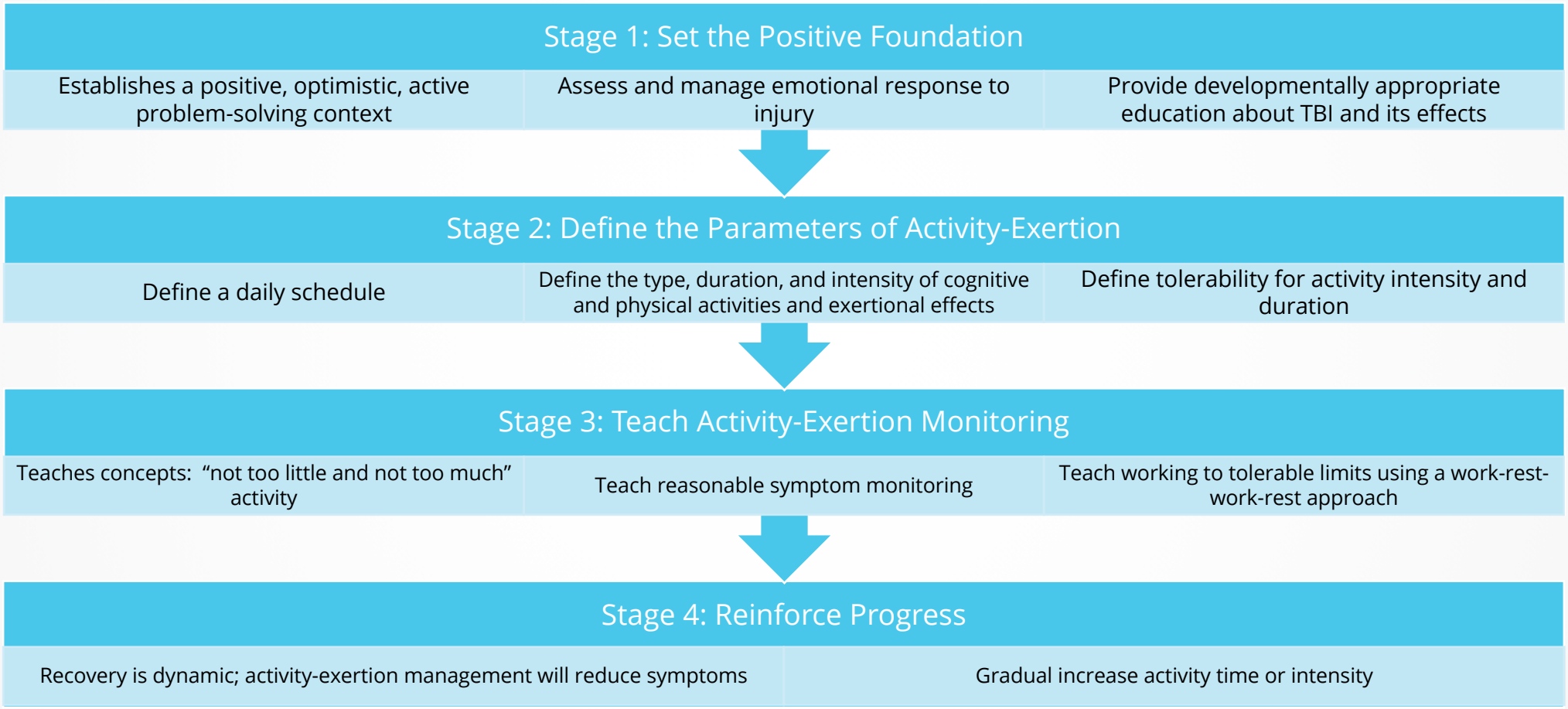
Who?	• Medical, School, Athletic, and Family
What?	• Written Concussion Play • Communication
When?	• Preseason • In-Season
Where?	• School or district level • Athletic trainer, directing physician level
How?	• In-services and educational sessions • Routine practice

Medical School Partnership



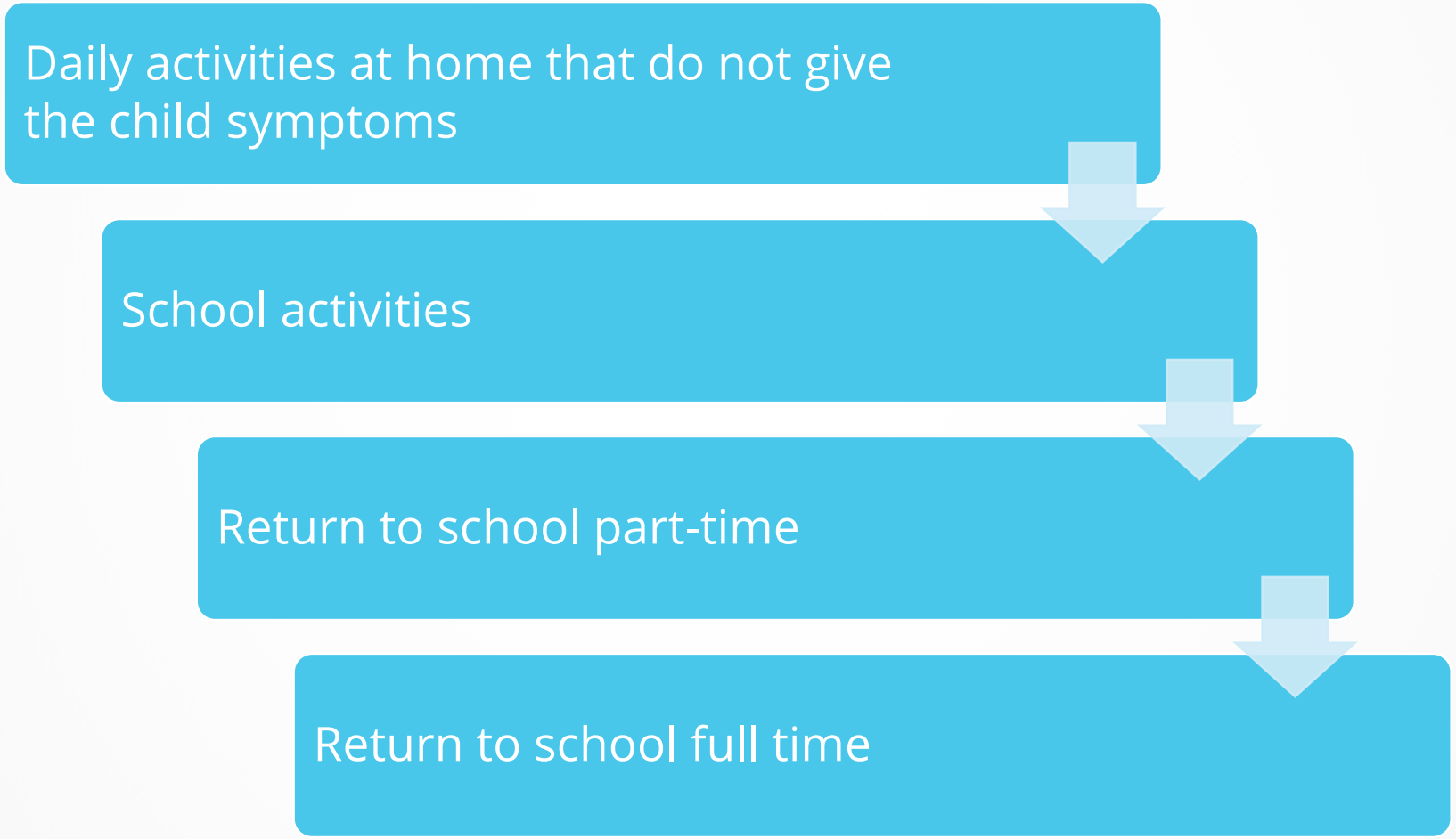
Gioia, 2016

Progressive Activities of Controlled Exertion (PACE)



Gioia, 2016

Return to School Strategy



McCrory, 2017

What Type of Adjustments?

- **Prospective study of 318 adolescent patients**
- **23.6% missed school days**
- **Reported on Day 3**
  - 66% noted changes to academic performance
  - 17.3% received AA

Changes to Academic Performance (D3)	%	n
Reported changes, but no AA received	61%	43/70
Reported changes, and received AA	34.3%	24/70
Did not report changes, but received AA	4.3%	3/70

Welch Bacon, NATA, 2017

Readiness to Return

Symptoms Affect Ability to Concentrate or Tolerate Stimulation Up to 30 min

- Should likely remain home
- May participate in light mental activities below symptom threshold
- Limit computer use and video games

Halstead, AAP, 2013

Readiness to Return

When Able to Tolerate Symptoms for 30-45 min

- Consider starting RTL progression at home or at school with adjustments
- Level of adjustments depend on severity, type and duration of symptoms

Halstead, AAP, 2013

Adjustments for Physical Symptoms

Headache	• Frequent breaks • Reduce exposure to aggravators • Rest in nurse's office
Dizziness	• Allow student to put head down • Early dismissal between classes to avoid crowded halls
Visual Symptoms	• Reduce exposure to computers, videos • Reduce brightness on screens • Allow hat or sunglasses • Audiotapes for books

Halstead, AAP, 2013; Nationwide Children's, REAP

Adjustments for Cognitive Symptoms

Difficulty Concentrating	• Avoid testing or major projects • Extra time • Consider notes, notetaker, scribe
Mentally Foggy	• Give breaks • Simplify tasks
Difficulty Paying Attention	• Have student sit in front of room • Work in quiet room

Halstead, AAP, 2013; Nationwide Children's, REAP

Adjustments for Sleep Symptoms

Sleep Disturbances	• Allow for late start or shortened day • Allow rest breaks
Fatigue	• Strategic rest • Schedule adjustments

Halstead, AAP, 2013; Nationwide Children's, REAP

Adjustments for Emotional Symptoms

Anxiety	• Reassurance • Workload reduction • Alternate forms of testing
Depression	• Time built in for socialization
More Emotional	• Have signal with teacher to leave/rest • Allow student to leave from classroom

Halstead, AAP, 2013; Sady, 2011; Nationwide Children's, REAP

Example RTL Progression

- Jane is a 15 year old soccer player
- Enrolled in AP English and Math
- Sustains a concussion in a game on Friday
- Presents with moderate headache, difficulty concentrating, and difficulty remembering on Monday morning

STAGE 0: No return, at home

- Cognitive rest
- Remain at home Monday
- Avoid strenuous mental activities
- Determine if symptoms reduce with rest

Example RTL Progression

Tuesday

- Headache decreased but still present
- Difficulty concentrating and remembering improving

STAGE 0: No return, at home

- Symptom limited mental activity
- Cognitive readiness challenge
  - Reading or math for 10-30 min
  - Assess symptoms
  - She is able to read for 30 minutes without symptom exacerbation
  - Symptoms improve with rest breaks

Example RTL Progression

Wednesday

- Headache decreased even more
- Difficulty concentrating and remembering improving, but still a concern with AP courses

STAGE 1: Return Partial Day

- Attend classes as tolerated
- Rest breaks as needed
- No homework

- She is able to make it through 4 of 6 periods taking 2 breaks

Example RTL Progression

Thursday

- Headache resolved
- Able to concentrate better
- Still concerns with remembering

STAGE 2: Full Day, maximal support

- Attend classes as tolerated
- Rest breaks as needed
- No homework or tests

- She is able to make it through all classes with only one break

Example RTL Progression

Friday

- Headache resolved
- Able to concentrate
- Still concerns with remembering

STAGE 3: Full day, moderate support

- Attend classes as tolerated
- Rest breaks as needed
- Modified assignments

- She is able to make it through all classes without symptoms

Example RTL Progression

Following Monday

- Headache resolved
- Able to concentrate
- Able to remember

STAGE 4: Full day, minimal support

- Attend classes as tolerated
- Modified assignments

- She is able to make it through all classes without symptoms

Example RTL Progression

Following Tuesday

- Headache resolved
- Able to concentrate
- Able to remember
- Did not need breaks yesterday

STAGE 5: Full day, no supports

- Full class schedule

- She is able to make it through all classes without symptoms
- Develop plan with teachers to addressed missed work

Take Home Points

- Academics are a significant stressor and consideration in managing concussion in children and adolescents
- Schools and medical provider should work together to develop appropriate plans
- Medical and school personnel should be part of the academic support team
- Returning to school should follow a stepwise progression based on the students clinical presentation

ConcussionManagement.com

Module 2

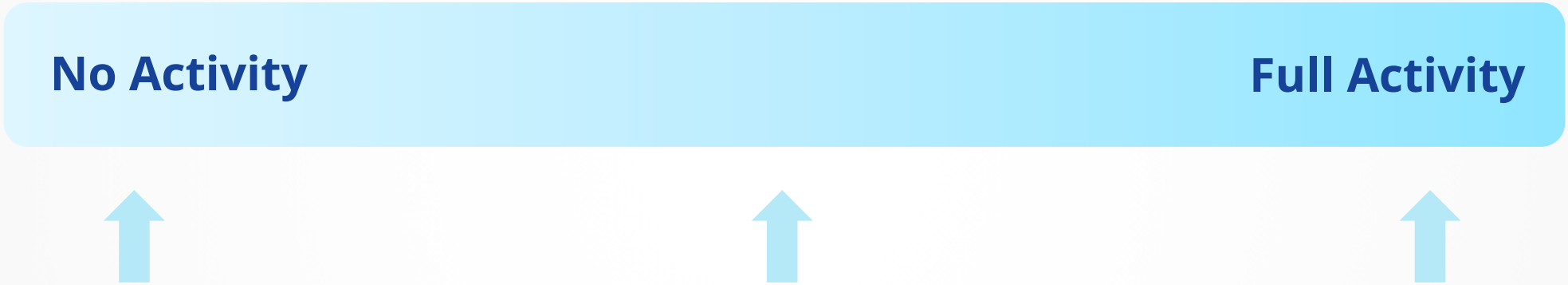
Concussion Treatment and Active Rehabilitation

REST

Physical Rest

Cognitive Rest

Cognitive Rest



Asleep or comatose

Goal: limit cognitive activity to a level that is tolerable and does not exacerbate symptoms

Normal school

Cognitive Rest Recommendations

AMSSM, 2012	• Students will require **cognitive rest** and may require academic accommodations such as reduced workload and extended time for tests while recovering from a concussion.
AAN, 2013	• LHCPs might develop individualized graded plans for return to physical and **cognitive activity,** guided by a carefully monitored, clinically based approach to minimize exacerbation of early postconcussive impairments (Level C).
NATA, 2014	• Athletic trainers should work with school administrators and teachers to include appropriate **academic accommodations** in the concussion-management plan. Strength of Recommendation: C
Berlin, 2017	• Brief period of complete rest (24-48 hr) • Gradual and progressive sub-symptom threshold activity

Clinical Questions

1. How often is cognitive and physical rest, including academic adjustments, utilized by health care providers in managing sport-related concussion?

2. In patients sustaining a concussion, does the use of physical and cognitive rest reduce the severity and duration of concussion-related impairments?

Valovich McLeod, Lewis, Whelihan, Welch Bacon, *J Athl Train. 2017.*

Study	Key Results
Arbogast, 2013	62% of physicians described awareness of CR as part of management; only 2.4% described CR in detail 11% of charts reviewed included written CR recommendations
Carson, 2014	Worsening of symptoms in 44.7% of patients following premature RTL Patients with prior history of concussion required more rest days before being cleared
Grubenhoff , 2015	Patients with PPCS missed 50% more school days than patients with no PPCS 36% of PPCS patients received AA, while 53% of no PPCS patients received AA There was an association between follow-up visits and receiving AA (RR=2.2; 95% CI = 1.4-3.5)
Olympia, 2015	58% of SN are responsible for guiding students' graduated academic re-entry process
Upchurch, 2014	CR was not recommended to any patient prior to 2008 CR was only recommended to 12% of patients by 2012
Weber, 2015	59.4% of student-athletes with concussion under SN care received AA, yet only 27.7% of SN always or almost always recommend AA following sport-related concussion
Wilkins, 2013	Instructions for RTT increased from 24% prestandardization to 98% poststandardization
Williams, 2015	41% of student-athletes with concussion under AT care received AA
Zemek, 2015	CR recommendations were limited; 40% of physicians sis not recommend school absence, 30% did not recommend schoolwork reduction, 35% did not recommend limiting screen time

Valovich McLeod, Lewis, Whelihan, Welch Bacon, *J Athl Train.* In press.

Effectiveness of Rest

3 studies showing too much activity delayed recovery = worse outcomes (Majerske, 2008; Brown, 2014; Maerlender, 2015)

2 studies show rest improves outcomes (Moser, 2012, 2015)

4 studies found no association between rest and outcomes (Gibson, 2013; Buckley, 2015; Moor, 2015; deKruijk, 2002)

1 RCT found strict rest resulted in a longer recovery (Thomas, 2015)

Clinical Bottom Line

1. **Physical and cognitive rest is underutilized by healthcare providers (SOR= B)**
   - Need to educate community providers regarding best practices for rest, treatment, and activity
   - Develop strategies to build a collaborative concussion management team

2. **Moderate physical and cognitive rest may facilitate recovery during the initial days after concussion (SOR = B)**
   - Recommendations for rest are broad and not specific for individual patients
   - An initial period of rest may be beneficial
   - Balance rest and active treatments for each patient
   - For athletic trainers, these decisions are ones that should be made in conjunction with their directing physician and in collaboration with other concussion team members

Valovich McLeod, Lewis, Whelihan, Welch Bacon, *J Athl Train.* 2017.

Activity or Rest?

No school or exercise activity

School activity only

School activity and light activity at home

School and sports practice

School and sports games

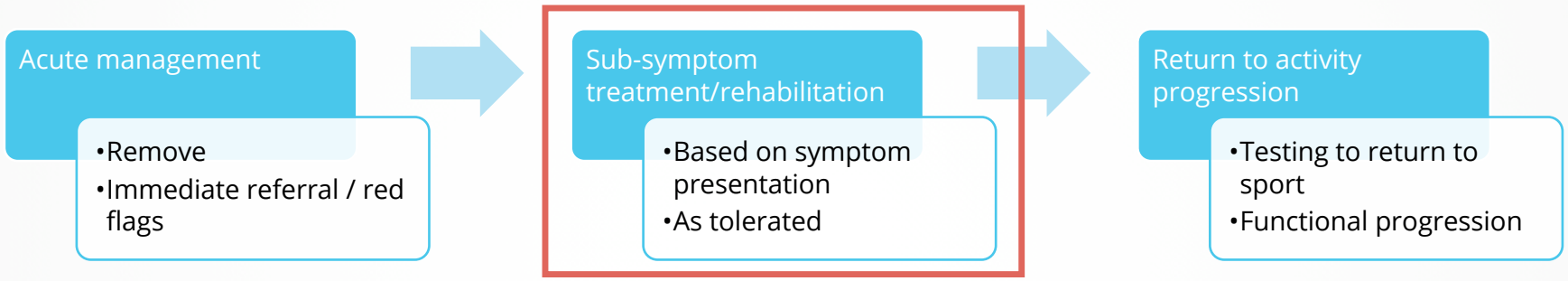
Majerske, *JAT*, 2008

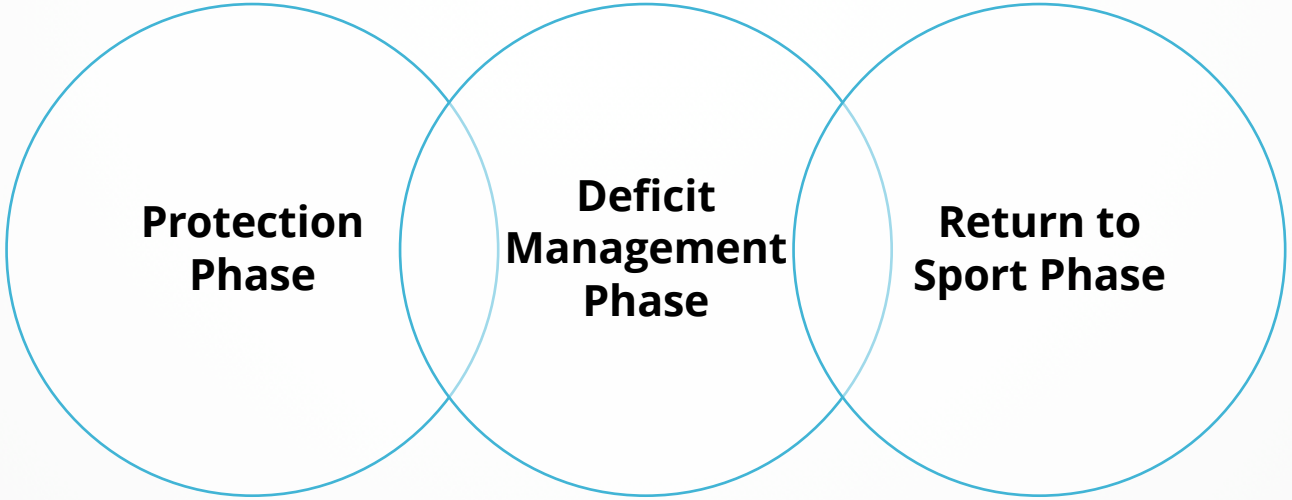
Rest

- Brief period (24–48 hours) of complete rest
- Gradually and progressively more active
  - Staying below their cognitive and physical symptom
  - Avoid heavy exertion
- The exact amount and duration of rest is not yet well defined

Schneider, BJSM, 2017

Post-Concussion Management





Lundblad, 2017

Refer: Treatment

- Preliminary evidence supporting use of active rehab and treatment
- Individualized symptom-limited aerobic exercise programs
  - Patients with persistent post-concussive symptoms associated with autonomic instability or physical deconditioning
- Targeted physical therapy
  - Patients with cervical spine or vestibular dysfunction
- Collaborative approach including cognitive behavioral therapy
  - Persistent mood or behavioral issues.

McCrory et al, *Br J Sport Med.* 2017

Rehabilitation

- A variety of treatments may be required for ongoing symptoms and impairments
- Cervical and vestibular rehabilitation
  - Persisting dizziness, c-spine pain and headaches
- Closely monitored active rehabilitation programmes
  - Controlled subsymptom threshold, submaximal exercise
- Specific treatments based on clinical examination findings and symptoms.

Schneider, BJSM, 2017

Refer: Persistent Symptoms

- Beyond expected time frames (ie, >10–14 days in adults and >4 weeks in children)
- Multimodal clinical assessment
  - Needed to identify specific primary and secondary pathologies that may be contributing to persisting post-traumatic symptoms
- Treatment should be individualized
  - Target-specific medical, physical and psychosocial factors identified

McCrory et al, *Br J Sport Med.* 2017

Concussion is Treatable

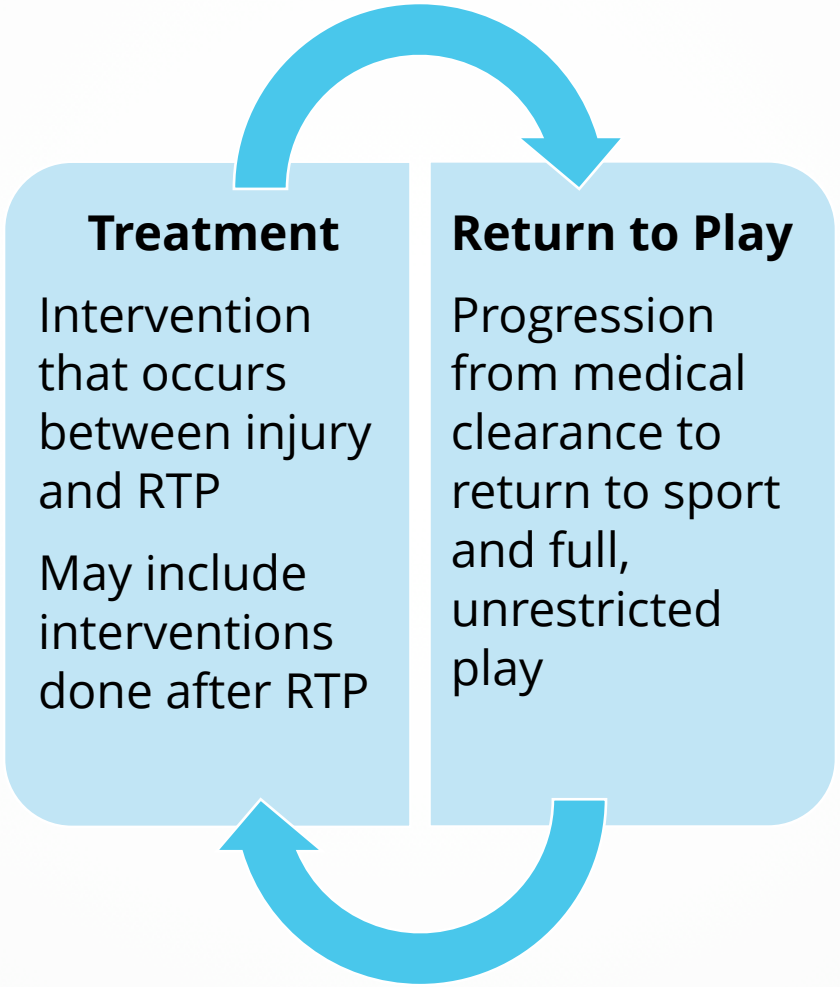
Premise for Treatment

“Rest”

- Avoidance of exacerbating activities

No need to shut down areas that do not exacerbate symptoms

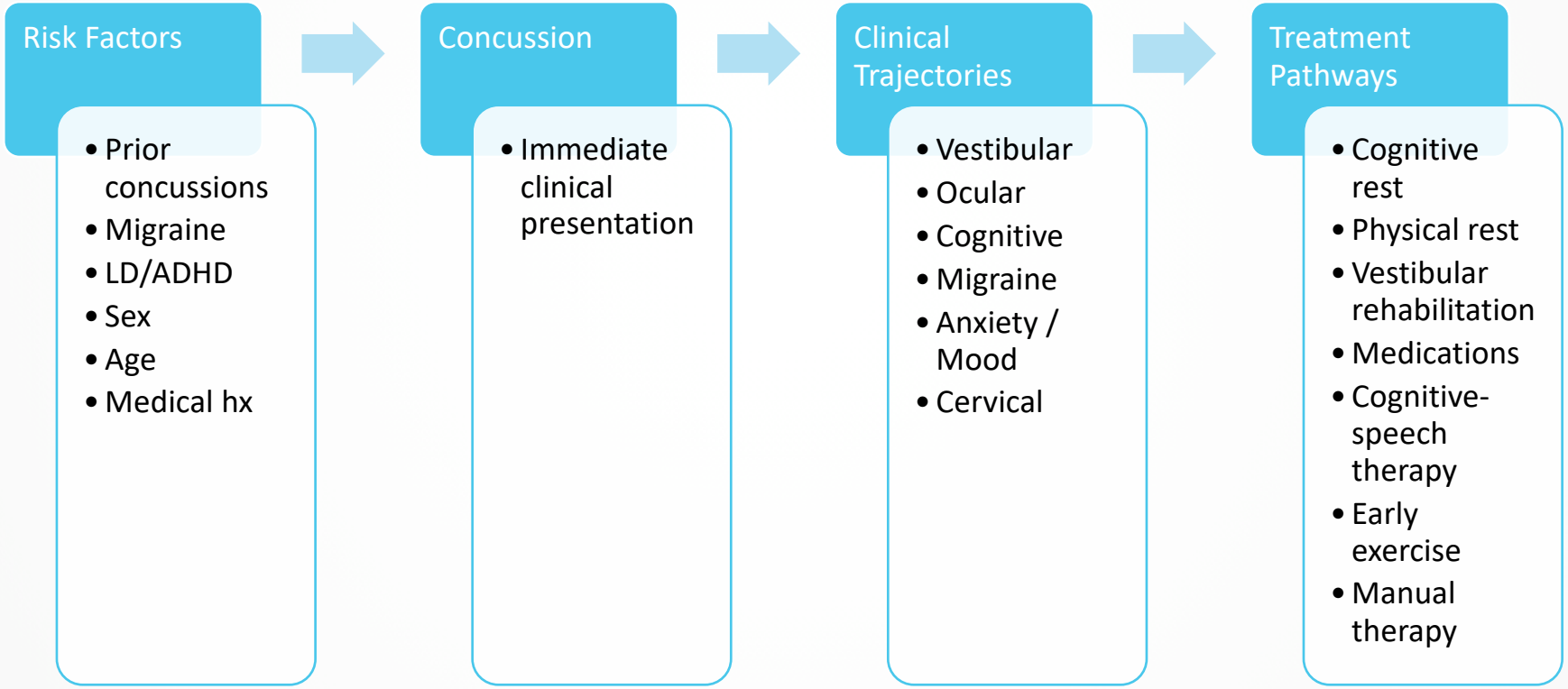
- Able to tolerate light aerobic exercise without increasing symptoms?
- Able to read without increasing symptoms?
- Able to attend school without increasing symptoms?



Clinical Pathways

- Can we predict patient outcomes?
- Can we determine the best treatments for each patient based on initial clinical presentation?

Clinical Pathways



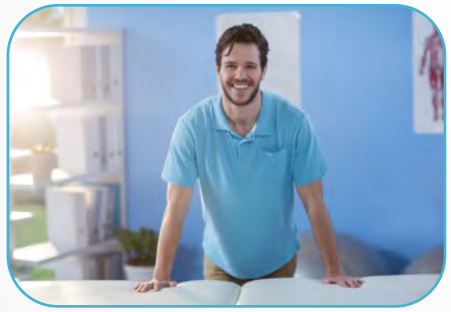
Collins, 2013

Mood / Anxiety

Nutrition

Sleep

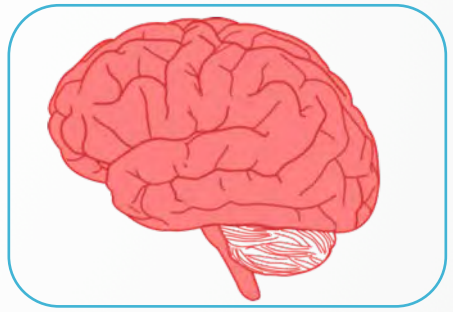
Academic Adjustments



Vestibular Therapy

Oculomotor Rehabilitation

Exercise



Cervicogenic / Migraine

Using Concussion Clinical Trajectories to Inform Targeted Treatment Pathways

Risk Factors

Previous Concussions

Migraine

LD/ADHD

Female Gender

Age

Motion Sensitivity

Ocular Hx

Concussion

Clinical Trajectories

Vestibular

Ocular

Cognitive/Fatigue

Migraine

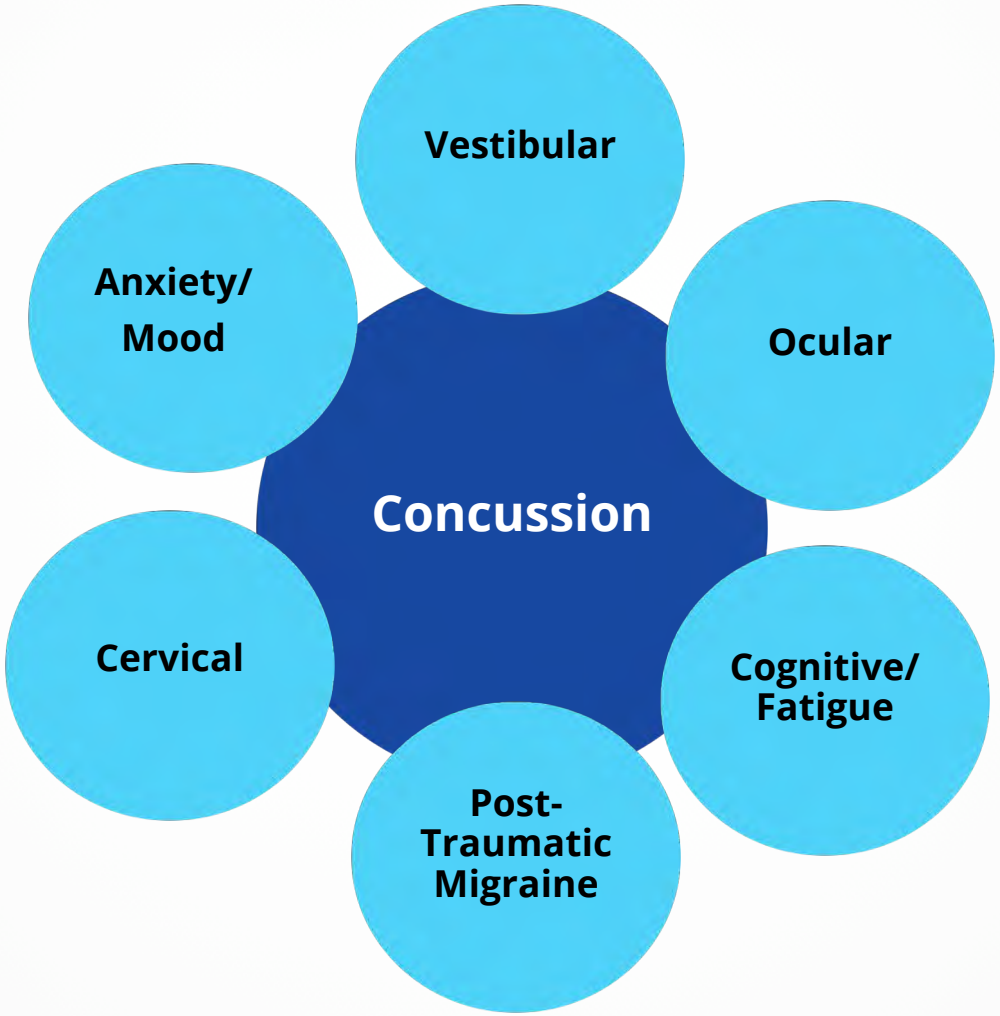
Anxiety/Mood

Cervical

Individualized Treatment

- Symptom Limited Activity
- Light Exercise
- Sports Specific Exercise
- Non Contact Training
- Medical Clearance
- Full Contact Practice
- Return to Activity

Concussion Clinical Trajectories



Collins MW, Kontos A, et al, KSST, 2014

COACH-CV

C	• Cognitive • Neuropsychological referral
O	• Oculomotor • Refer neuro-optometrist, optometrist with concussion experience, OT
A	• Affective • Refer for counseling, psychiatrist, psychologist
C	• Cervical • Refer for physical therapy
H	• Headache • Treat with analgesics, anti-migraine medications
C	• Cardiovascular • Refer for exercise testing (intolerance)
V	• Vestibular • Refer for vestibular rehabilitation

Craton, 2017

Post-Concussion Disorders

Classification	Characteristics	Treatments
Physiological	Persistent concussion symptoms Impairments caused by alterations in cerebral metabolism	Physical and cognitive rest Academic adjustments Sub-symptom threshold aerobic exercise
Vestibulo-ocular	Vestibular and oculomotor dysfunction	Vestibular and vision rehabilitation Academic adjustments Sub-symptom threshold aerobic exercise
Cervicogenic	Muscular trauma and inflammation of the cervical area Dysfunction of cervical spine proprioception	Manual therapy Proprioception retraining Balance and gaze stabilization exercises Sub-symptom threshold aerobic exercise

Ellis, 2014

Targeted Treatments

Cognitive/Fatigue	• Difficulty concentrating, overall fatigue, decreased energy levels • Reduce cognitive and physical demands • Regulate sleep, stress, diet, and mild exercise (1 short walk/day)
Vestibular	• Dizziness, fogginess, nausea, anxiety, overstimulation by complex environments • Brought on with rapid head or body movements • Vestibular rehabilitation
Ocular Motor	• Localized, frontal-based headaches, fatigue, distractibility, difficulty with vision, pressure behind eyes, trouble focusing • Consult with neuro-optometrist, vestibular therapist • Rehabilitation with vision therapy specialist

Collins, 2013

Targeted Treatments

Anxiety/Mood	• Overall increase in anxiety, perhaps with sleep disturbance and vestibular issues • Treat vestibular issues • Begin physical exertion protocols and regulate sleep
Post-traumatic Migraine	• Moderate to severe headache with nausea and photosensitivity or phonosensitivity, often exaggerated by physical activity and stress • Pharmacologic intervention
Cervical	• Headache and neck pain • ROM, manual cervical and thoracic mobilization, posture education, biofeedback, soft tissue mobilization

Collins, 2013

Treatment Team

- Athletic Trainer
- Sports Medicine/Team physician
- Sport Physical Therapist
- Vestibular Therapist
- Neurologist
- Neurosurgeon
- Neuropsychologist
- Occupational Therapist
- School Nurse
- Speech & Language Pathologist
- Physical Medicine & Rehabilitation physician
- Ocular Therapist
- Behavior Optometrist
- Psychologist
- Psychiatrist

Adjunct Team Members

Coach, Teacher, Academic Counselor, Family

Sleep

Address sleep issues first

- Systems regarding arousal, alertness, attention and sleep are vulnerable after TBI (Ponsford, 2012)
- Perceived sleep disturbance related to greater symptom burden and lower neurocognitive scores (Kostyun, 2014)

Good sleep hygiene

- Aim for similar sleep/wake times each day
- Quiet, dark environment
- Avoid visual stimulation from electronics

Mood Disturbances

- **Concussion can result in anxiety, depression, emotional disturbances (Ponsford, 2012; Hutchison, 2009; Mainwaring, 2004; Kontos, 2012)**

- **Treatment**
  - Referral to psychologist, psychiatrist, cognitive rehab
  - Cognitive Behavior Intervention (Hodgson, 2005)
  - Mood stabilizing medications
  - Structured environment (Collins, 2014)
    - Understand stress of removing from social (sport)
    - Allow some time with teammates
    - Active treatments may reduce stress

Headaches

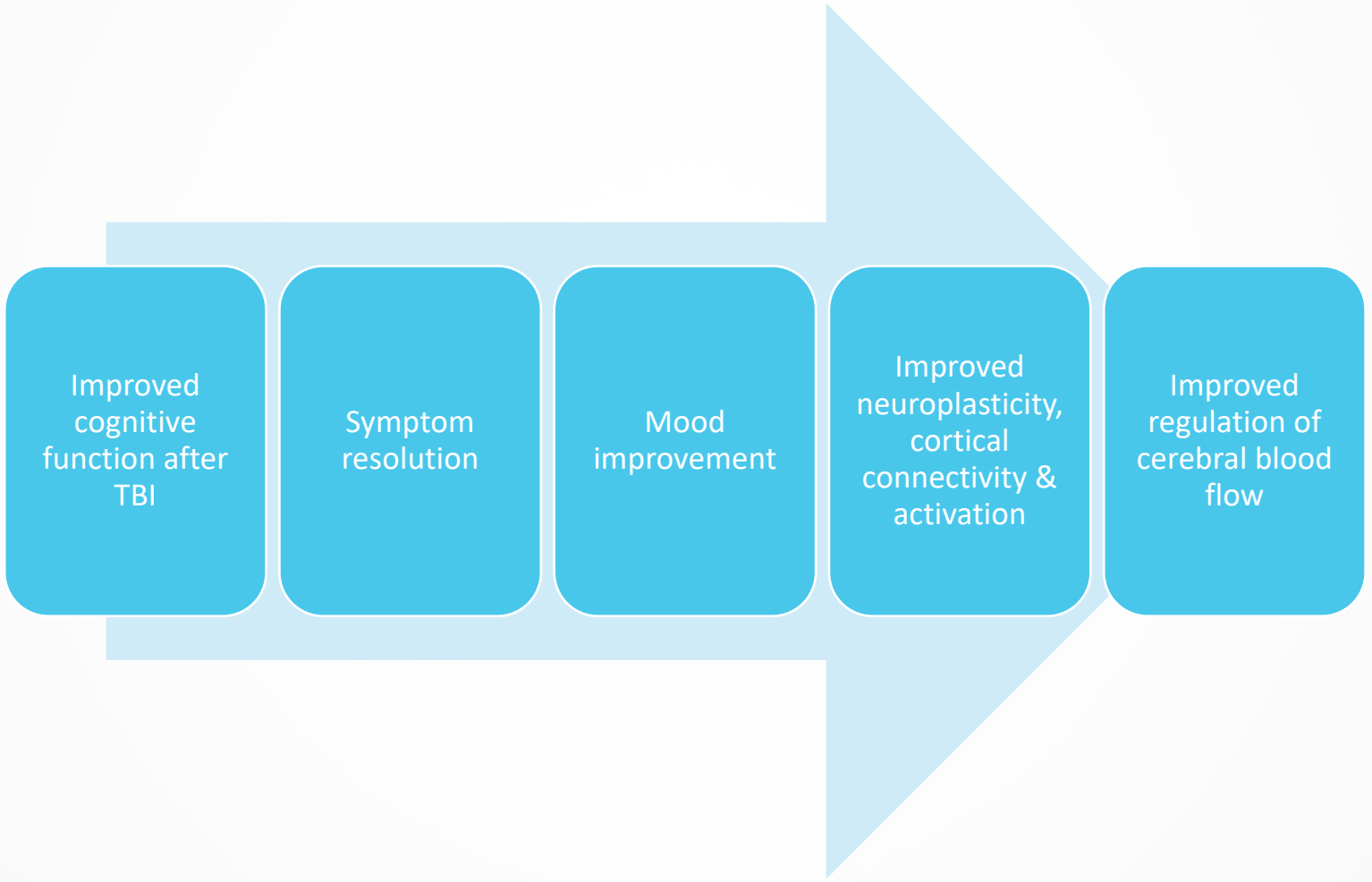
Cervicogenic

- **Hemicranial pain referred to the head by bony of soft tissue structures of the neck (Biondi, 2005)**
- **Treatment (Page, 2011)**
  - Postural correction
  - Manual therapy
  - Modalities
  - Exercise therapy
  - Breathing patterns

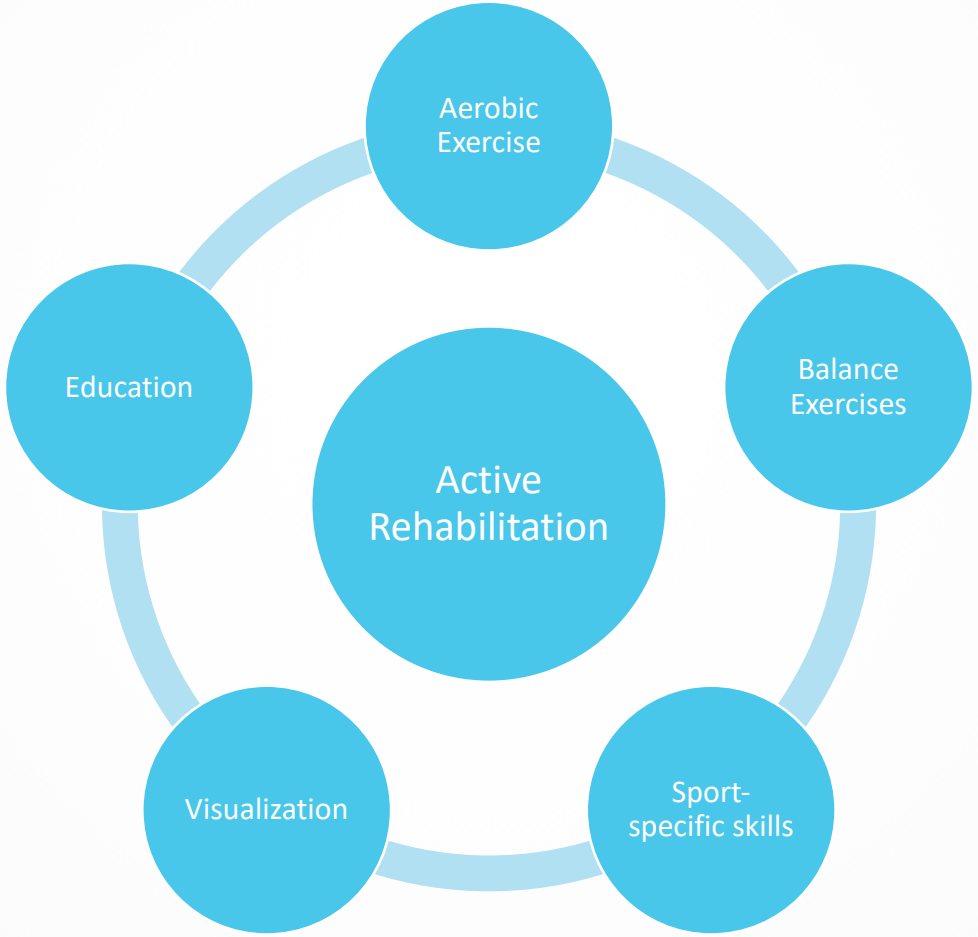
Migraine

- **Pre-existing condition may be exacerbated**
- **Migraine presentation can occur after concussion**
- **Can be caused by related vestibular dysfunction**
- **Treatment**
  - Medications
  - Vestibular rehabilitation

Exercise as an Intervention



Crane, 2012, Majerske 2008, Gomez-Pinella, 2011; Maerlender, 2015; Ahlskog, 2011; Colcombe, 2004; Lautenschlager, 2008



Active Rehabilitation

- Closely monitored rehabilitation in post-acute phase improved recovery time in adolescents who were slow to recover (Gagnon, 2009)
- Symptom reduction following active rehabilitation (Dobney, 2017)
  - Physical, cognitive, emotional, sleep
- Symptom reduction occurs regardless of when active rehabilitation is initiated (Dobney, 2017)
- Adverse events (eg. Symptom exacerbation) similar in those with active rehabilitation plus usual care compared to usual care only (Chan, 2017)

Buffalo Concussion Treadmill Test

Test to determine exercise tolerance

- Helps to establish physiological recovery
- Readiness to return to activity

Modified Balke Protocol

- 3.6mph @ 0% incline for 1 minute
- Increase incline by 1% each minute after
- Until maximal incline or patient cannot complete
- RPE, HR, BP, symptoms assessed each 2 minutes

Test is stopped with increased symptoms

- >3 points from pre-test resting symptom score

Buffalo Concussion Treadmill Test

- **Good intra-rater reliability and sufficient test-retest reliability**
  (Leddy, 2011)

Recovery in high school athletes (Darling, 2014)

- All athletes returned to sport without symptom exacerbation or recurrent symptoms
- 48% had one or more CNT sub-scores below average
- BCTT better predicted readiness to begin RTP protocol

Buffalo Concussion Treadmill Test

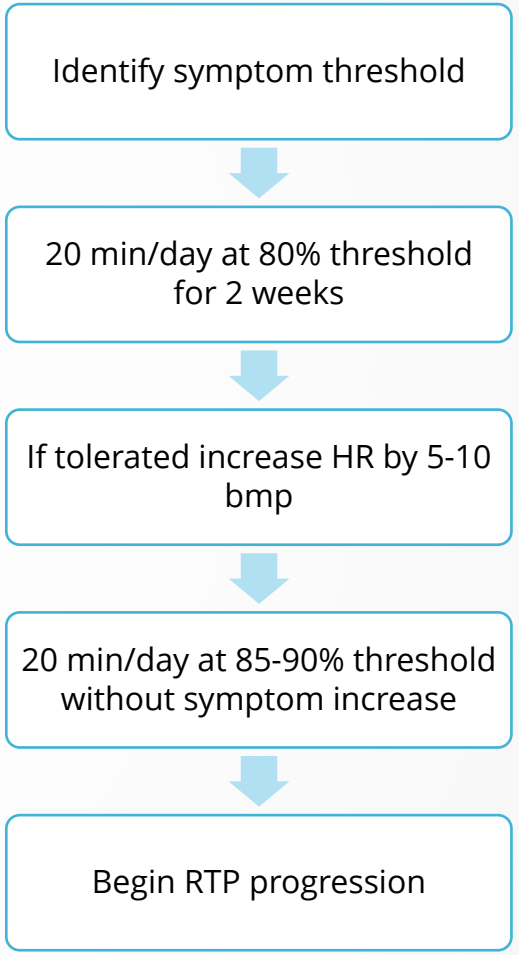
Assists with differential diagnosis (Leddy, 2013)

- Patients with concussion stop at submaximal level
- If able to exercise to exhaustion without replicating symptoms then symptoms not due to physiologic concussion
    - Cervical injury
    - Vestibular / ocular dysfunction
    - Post-traumatic headache or migraine

Buffalo Concussion Treadmill Test

Assist with exercise treatment (Leddy, 2016)

- Aerobic exercise 20 min/day @ 80% threshold HR
- 5-6 days per week
- Terminate if symptoms appear or after 20 minutes



Vestibular Rehabilitation Specialists

- Vision impairments
- Headache
- Dizziness
- Sensory organization impairments

Indications for Vestibular Therapy

Atypical Recovery

- Not back to baseline on balance assessment by 10 days post-concussion
- Impaired dynamic visual acuity tests
- Dizziness
- Motion provoked dizziness
- Nausea
- Blurred vision with head movement
- Motion sensitivity

Kevi Ames, PT, DPT

Indications for Vestibular Rehabilitation

Symptoms

- Vertigo (especially when lying in bed)
- Dizziness/ imbalance
  - No improvement over one week or is persistent beyond two weeks

Balance impairments

- Strong Romberg (after one week)
- BESS
  - ↑ BL after 1 wk or > 10 errors per set, > 30 total after 1 wk

+ Dix Hallpike

  - +/- improvement or resolution with Epley maneuver
- Patients generally like the active nature of participating in their recovery

Javier Cardenas, MD

Vestibular Rehabilitation After Concussion

Intervention	Outcomes
• Gaze stabilization (X1) • Standing balance • Walking with balance challenges • Canilith repositioning	• ↓ Dizziness rating • ↑ Activities-specific balance confidence scale • ↓ DHI • ↑ Dynamic gait index • ↑ Functional gait assessment • ↓ TUG • ↑ SOT (all conditions)

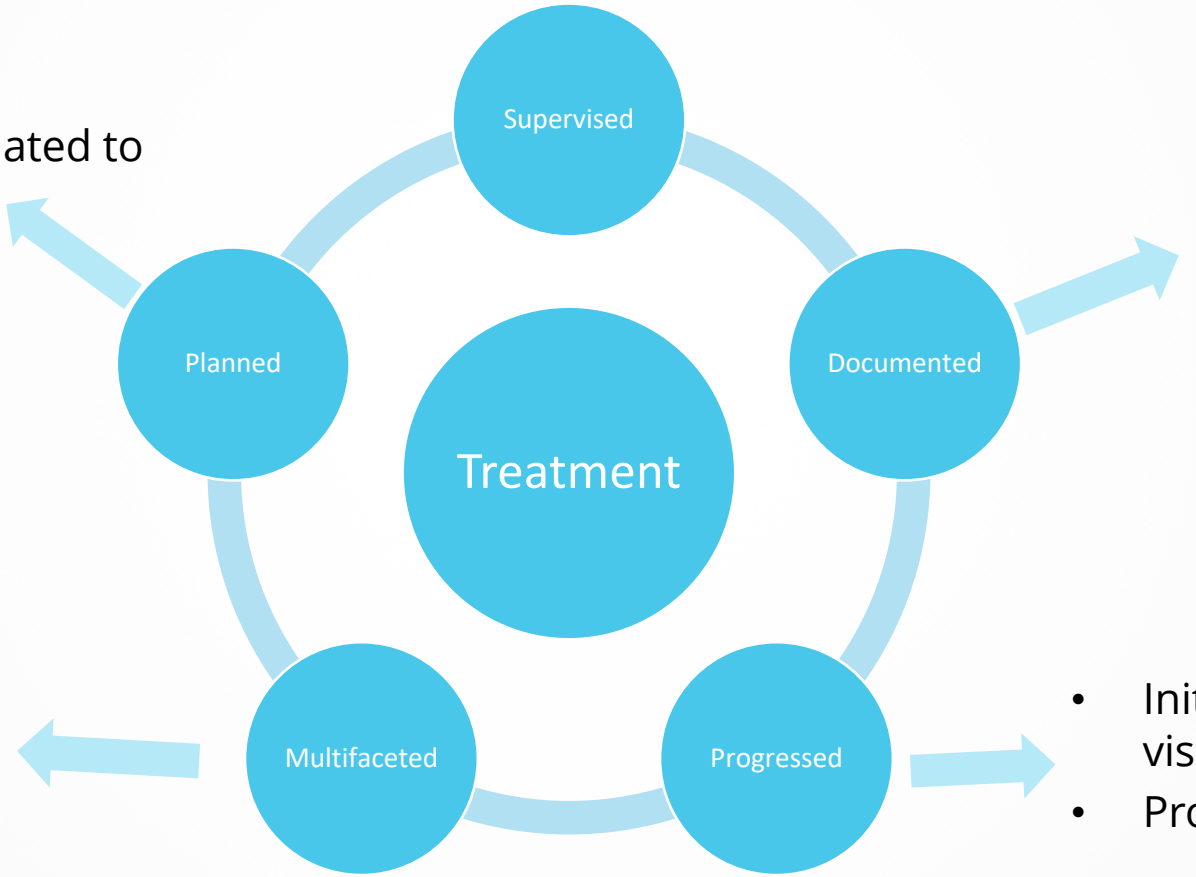
Alsalaheen, *JNPT*, 2010

Effectiveness of Oculomotor Rehab

- Patients with long term issues
- Vergence-based oculomotor rehabilitation was effective in individuals with mTBI who reported near work-related symptoms
- Overall improvement in nearly all of the critical, abnormal measures of vergence was observed both objectively and clinically (Thiagarajan, 2013)

Exercise Interventions

- Avoid stimulating brain activities that are correlated to symptoms



- Type of exercise
- Duration
- RPE
- HR
- BP
- Symptoms

- Aerobic
- Coordination
- Visualization
- Motivation
- Education

- Initially do not stimulate visual field, vestibular
- Progress to add stimuli

Case Examples

Adolescent Soccer Athlete

Symptom Reports

- Dizziness with movement
- Balance problems
- Headache
- Mild nausea
- Photosensitivity

Past Medical History

- 3 prior concussions

Clinical Exam Findings

- Symptom provocation with VOMS testing
- Balance deficits

Clinical Profile

- Vestibular
- Post-traumatic migraine

Adolescent Soccer Athlete

Treatment plan

- Vestibular rehabilitation
  - Home exercises
- Sleep regulation
- Proper hydration and nutrition
- Light physical activity
- Academic adjustments

Collegiate Volleyball Athlete

Symptom Reports

- Trouble focusing
- Fatigue
- Irritability
- Fogginess
- Anxiety

Past Medical History

- 1 concussion previous season
- Unresolved

Clinical Exam Findings

- NCT scores normal
- Mild symptom provocation with VOMS
- Increase symptoms with exertion testing

Clinical Profile

- Anxiety/Mood
- Post-traumatic migraine
- Vestibular

Collegiate Volleyball Athlete

Treatment plan

- Physical activity as tolerated, ideally with friends
- Referral to psychologist
  - Cognitive behavioral therapy
- Sleep regulation
- Appropriate hydration and nutrition
- Vestibular rehabilitation
  - Home exercises

Take Home Points

- Concussion can be treated
- Symptoms-based approach
- Treatment / rehabilitation is distinct from the graduated return to activity progression
- Treat primary, secondary, and tertiary symptom profiles
- Multidisciplinary treatment team
- Progress as symptoms resolve
- Document treatments and progression

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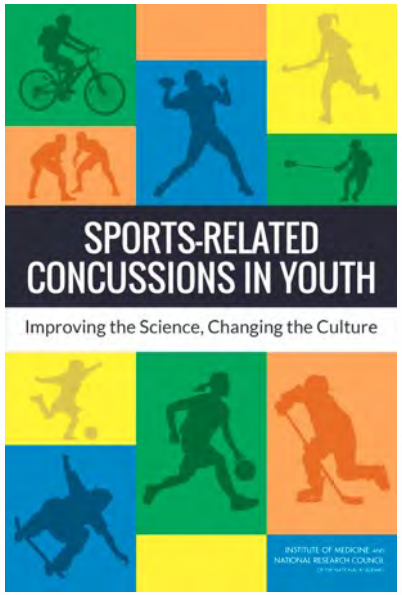
Module 3: Return-to-Activity

Return to Activity

Institute of Medicine and National Research Council of the National Academies Sports-Related Concussion in Youth October 2013:

"There is little empirical evidence for the optimal degree and duration of physical rest needed to promote recovery or the best timing and approach for returning to full physical activity."



https://iom.nationalacademies.org/~/media/Files/Report%20Files/2013/Concussions/concussions-RB.pdf

Rest and Return-to-Activity Following Sport-Related Concussion: A Systematic Review of the Literature

1. How often is cognitive and physical rest, including academic adjustments, utilized by health care providers in managing sport-related concussion?

2. In patients sustaining a concussion, does the use of physical and cognitive rest reduce the severity and duration of concussion-related impairments?

3. How compliant are healthcare providers in following current return-to-activity guidelines?

4. How effective are the graded return-to-activity protocols in improving patient outcomes following concussion?

Valovich McLeod, Lewis, Whelihan, Welch Bacon, *J Athl Train.* 2017.

Compliance With Return to Activity Guidelines

No study found full compliance with using all three recommended areas of concussion-assessment for return-to-play

- Symptoms, cognitive, balance

Significant variability among guideline use by physicians

- Clinical exam cited most for RTA clearance

Lack of compliance with NCAA guidelines

Inadequate ED discharge instructions regarding activity restrictions

Valovich McLeod, Lewis, Whelihan, Welch Bacon, *J Athl Train.* 2017.

Effectiveness of RTA Progression

- **No studies specifically evaluated the effectiveness of graded RTA progressions in improving patient outcomes**
  - 4 studies evaluated aspects of Zurich statement

- **Zurich guidelines + BCTT may provide a useful paradigm for making safe RTA decisions (Darling, 2014)**

- **Use of a SFWP did not improve clinical outcomes or decrease the risk of a same-season repeat concussion (McCrea, 2009)**

Valovich McLeod, Lewis, Whelihan, Welch Bacon, *J Athl Train.* In press.

In the Past

Colorado Medical Society guidelines for return to play

Grade	First concussion	Subsequent concussions
I	15 minutes	1 week
II	1 week	2 weeks, with physician approval
IIIa (unconscious for seconds)	1 month	6 month, with physician approval
IIIb (unconscious for minutes)	6 months	1 year, with physician approval

Based on LOC and amnesia

Cookbook approach and does not take into account individual clinical presentation.

Return to Play Today

Prohibited Same Day Return:

- NFL
- NCAA
- NFHS
- AIA
- Most state laws

- **Individualized**

- **Follows treatment/rehabilitation plan**

Post-Concussion Management

Acute management

- Remove
- Immediate referral / red flags

Sub-symptom treatment/rehabilitation

- Based on symptom presentation
- As tolerated

Return to activity progression

- Testing to return to sport
- Functional progression

Early Exercise Interventions

- **Treatment/ rehabilitation**

- **Determine symptoms and what exacerbates symptoms**
  - Allow sub-symptom threshold exercise in areas that are not effected
  - Introduce light aerobic activity early
  - Train areas without deficits

- **Gradually add challenges that may exacerbate symptoms**
  - Once symptoms appear, rest and symptoms should start to subside
  - Progress as tolerated – expose then recover

Early Exercise Interventions

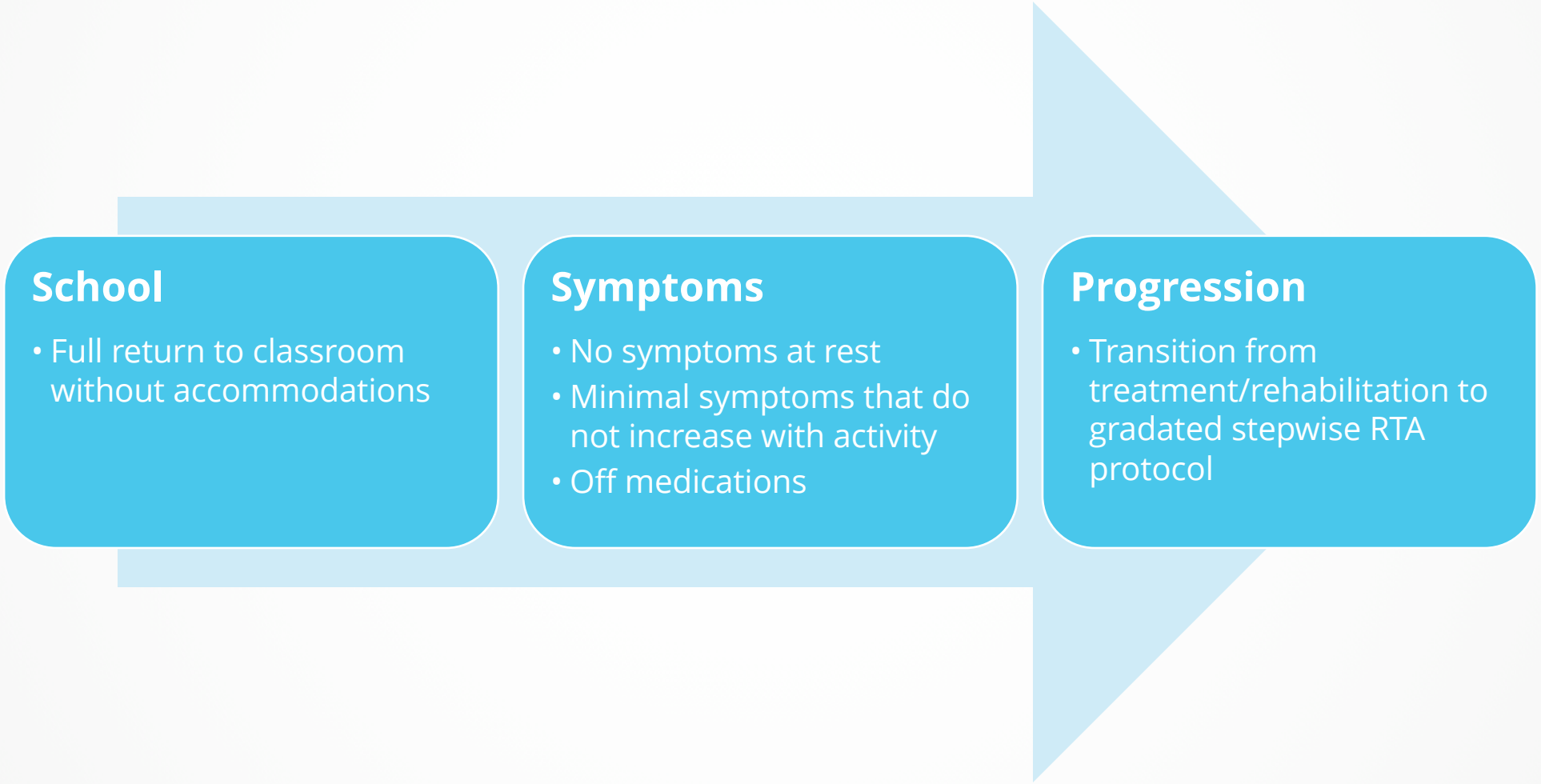
Physical

- Maintain fitness
- Physiological benefits of exercise
- Rehabilitation of affected systems

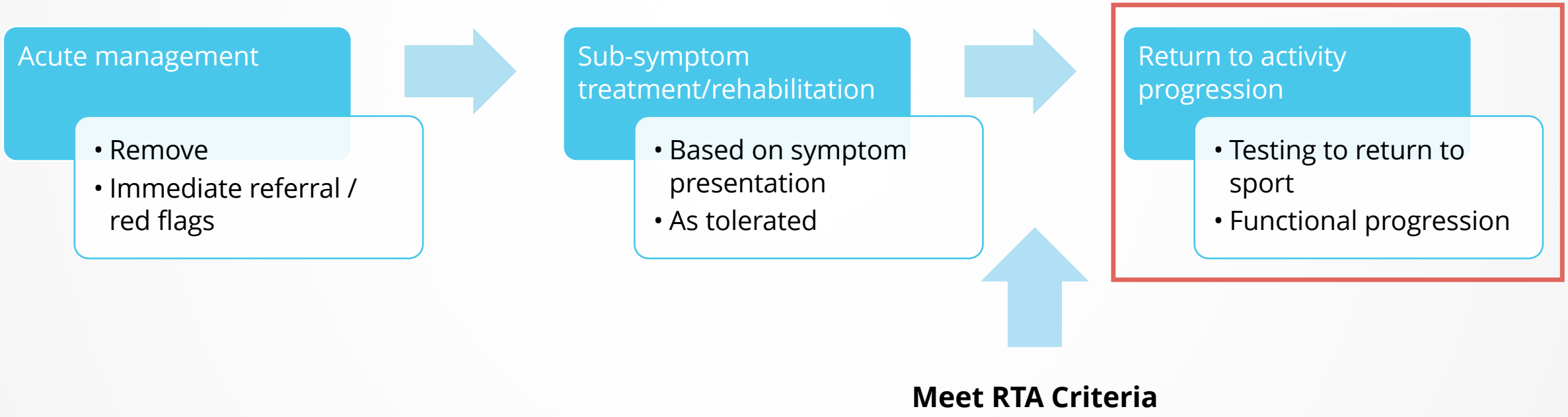
Psychological

- Improved compliance
- Remove isolation
- Reduction in anxiety
- Psychological benefits of exercise

Return to Activity Criteria



Post-Concussion Management



Return to Sport

- Graduated stepwise rehabilitation strategy
- Brief period of rest (24-48 hr)
- Symptom limited activity (Stage 1)
  - Staying below physical and cognitive symptom threshold
- Symptom resolution indicator for moving to next stage
- Proceed if able to meet criteria without recurrence of symptoms
- Can include results of adjunct assessments in decision-making
  - Neurocognitive
  - Balance
  - Oculomotor

McCrory, 2017

Return to Play

- **Consider the following:**
  - Athlete's previous history of concussion
  - Type of sport (contact vs non-contact)
  - Availability of experienced personnel
    - Observe & monitor athlete during recovery
  - Age

Guskiewicz, *J Athl Train.* 2004

Modifying Factors

More Conservative Management

TABLE 2. Concussion Modifiers

Factors	Modifier
Symptoms	Number
	Duration (>10 days)
	Severity
Signs	Prolonged LOC (>1 min), amnesia
Sequelae	Concussive convulsions
Temporal	Frequency - repeated concussions over time
	Timing - injuries close together in time
	"Recency" - recent concussion or TBI
Threshold	Repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion
Age	Child and adolescent (<18 years old)
Co- and Pre-morbidities	Migraine, depression or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disabilities (LD), sleep disorders
Medication	Psychoactive drugs, anticoagulants
Behaviour	Dangerous style of play
Sport	High-risk activity, contact and collision sport, high sporting level

McCrory, 2009

Berlin Progression

Rehabilitation/Treatment

Table 1 Graduated return-to-sport (RTS) strategy

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

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. If any symptoms worsen during exercise, the athlete should go back to the previous step.
Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (eg, more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

~24 hours between each stage

McCrory et al, 2017

Inclusive RTP Progression

Step 1: Light Exercise	Step 2: Sport-Specific Exercise	Step 3: Non-contact Practice	Step 4: Full contact Px	Step 5
• Aerobic • Balance - static VOR - seated Vision – stable head	• Aerobic - moderate • Balance – dynamic & dual tasking VOR – stand-walk-jog Vision – dynamic and add dual tasking	• Aerobic – sport-specific, strengthening, plyometrics • VOR – high speed head movement, sport-specific Vision – high demand, sport-specific	• Aerobic – BCTT • Adjunct testing •Cognitive •Balance •Vestibular •Oculomotor	• Full return to competition

Reconsider: Elite vs Nonelite

Should be Managed using the same Management Principles

McCrory et al, *Br J Sport Med.* 2017

Reconsider: Pediatric

- **Requires special paradigms suitable for the developing child and adolescent (<18)**
  - Child – ages 5-12
  - Adolescent – ages 13-18

- **Expected duration of symptoms is 4 weeks**

- **Age-specific, validated tools**
  - Questionable role and utility of computerized testing

- **Need to address academics**
  - Successfully return to school first, then sport!

McCrory et al, *Br J Sport Med.* 2017

Rehabilitation After Return

- **Musculoskeletal injury after concussion** (Lynall, 2015; Pietrosimone, 2015)
- **Decreased performance after concussion** (Kumar, 2014; Wasserman, 2015)
- **Monitoring and documenting symptoms score after the patient has returned**
- **Continue with vestibular or ocular therapy**

Sport-Specific Progressions

Football

Step	Goal	Example Activities
1	**Light aerobic exercise**	Stationary bike No resistance training
2	**Sport-specific non-contact**	Individual dynamic warm-up Sprints (5 x 20 yds) Bodyweight circuit (push-ups, sit-ups, jumping jacks) Position-specific non-contact drills (no collision or head impacts)
3	**Non-contact practice**	Resistance training Team dynamic warm-up Sprints Plyometric circuit Position-specific non-contact drills (sled and dummy contact)
4	**Unrestricted practice**	
5	**Competition**	

Soccer

Step	Goal	Example Activities
1	**Light aerobic exercise**	Stationary bike No resistance training
2	**Sport-specific non-contact**	Interval stationary bike Sprints – GK: within 18 yd box, agility, cone drills; Field: width of field, agility ladder, cone drills 15 minutes- Sport-specific non-contact drills – GK: modified warm-up, ball distribution (no diving, no gloves); Field: distance run, passing, volleys, long balls – all kicking only
3	**Non-contact practice**	30-minutes sport-specific non-contact drills No live play GK: warm-up, defend controlled shots on goal, no collision, gradual increase into diving (from sitting – kneeling – standing) Field: ball drills, shots on goal, possession (red vest), gradual increase in headers
4	**Unrestricted practice**	Full practice without restrictions
5	**Competition**	

Basketball

Step	Goal	Example Activities
1	**Light aerobic exercise**	Stationary bike No resistance training
2	**Sport-specific non-contact**	Individual dynamic warm-up Ball handling, shooting (no rebounding)
3	**Non-contact practice**	Resistance training Team dynamic warm-up Position drills 30-min practice: shell drill, ball handling, shooting drills with team
4	**Unrestricted practice**	Full participation in practice
5	**Competition**	

Cheer

Step	Goal	Example Activities
1	**Light aerobic exercise**	Stationary bike No resistance training
2	**Sport-specific non-contact**	Individual stunts –no flying or catching Individual tumbling
3	**Non-contact practice**	Resistance training Low difficulty individual stunts – basing, back spotting Low difficulty individual tumbling
4	**Unrestricted practice**	Full participation in practice
5	**Competition**	

Baseball/Softball

Step	Goal	Example Activities
1	**Light aerobic exercise**	Stationary bike No resistance training
2	**Sport-specific non-contact**	Interval stationary bike Sprints, Bodyweight circuit Throwing (no catching), hitting off tee, fielding thrown ground balls,
3	**Non-contact practice**	Progressive resistance training Limited practice with helmet – no hitting off machine, base running, live drills
4	**Unrestricted practice**	Full participation in practice
5	**Competition**	

Swimming

Step	Goal	Example Activities
1	**Symptom limited activity**	ADLs Light mental activities
2	**Light aerobic exercise**	20 minutes: kicking with board Land-based – bike or elliptical Speed no faster than aerobic speed or 65% of 100 time
3	**Sport-specific exercise**	30 minutes: limited head movement All four strokes, open turns Speed no faster than aerobic speed or 70% of 100 time
4	**Non-contact training drills**	30 minutes: More complex interval training All 4 strokes, add coordination and cognitive load, open turns Speed no faster than aerobic speed or 75% of 100 time
5	**Unrestricted practice**	Full participation in practice Introduce starts and flip turns
6	**Competition**	

USA Swimming Concussion Task Force

Legal Aspect Recommendations

- **Be aware of all governing bodies and their policies and procedures**

- **Document athlete's (and where appropriate, parent's) understanding of concussive S&S and his/her responsibility to report concussion**
  - Informed consent (80% of state laws)

Broglio, 2014

Legal Aspect Recommendations

- **Communicate status of concussed patient to managing physician on regular basis**

- **Ensure proper documentation of the evaluation, management, treatment, RTP progression, and physician communication**

Broglio, 2014

Documentation Recommendations

Document all pertinent information regarding the injury, including but not limited to:

- Mechanism of injury
- Initial signs and symptoms
- State of consciousness
- Assessment findings
- Instructions provided
- Referrals to and recommendations from other providers
- Return progression

Guskiewicz, 2004

Documentation

- Specific testing and maneuvers performed
- Dates, times, and locations of testing
- Questions asked of the patient during testing and the patient's responses

Pachman & Guskiewicz, 2010

Documentation

- **“Performed exertional maneuvers”**
  - Attorneys would argue this is NOT sufficient

- **“Athlete performed 20 minutes of treadmill running at 5mph, followed by a symptom checklist at 5 and 20 minutes post-exertion”**
  - Include notation of the symptom checklist scores

Pachman & Guskiewicz, 2010

Take Home Points

- **Think of the return to activity progression as a part of a rehabilitation continuum**
- **Sport-specific activities will better aid the patient in progressing**
  - Psychological benefits
- **Stepwise progression that is supervised, monitored, and documented**

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