## Outcome Domain:

Sports-Related Studies

## Domain Description and Relevance in TBI:

Additional measures specifically designed for and/or in widespread use in sports are included in this domain. If an instrument/measure is already categorized using another outcome domain it is NOT included in this domain to prevent listing instruments/measures multiple times within the same population.

Table CDE Classification by Type of TBI Study and Relevant Population for Recommended Sports-Related Studies Outcome Measures.

| Outcome Measure Name | Relevant TBI Population | Acute Hospitalized | Moderate/ Severe Rehabilitation | Concussion/ Mild TBI | Epidemiology |
| --- | --- | --- | --- | --- | --- |
| Axon Sports Computerized Cognitive Assessment Tool (CCAT) | Adult and Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| CNS Vital Signs | Adult and Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| Headminder Concussion Resolution Index | Adult and Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| Immediate Post-Concussion Assessment and Cognitive Testing (imPACT) | Adult and Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |
| Sport Concussion Assessment Tool (SCAT-2) | Adult and Pediatric | Supplemental | Supplemental | Supplemental | Supplemental |

## Axon Sports Computerized Cognitive Assessment Tool

### DESCRIPTION:

TheAxon Sports Computerized Cognitive Assessment Tool (CCAT) uses computerized card games to test cognitive ability. Four simple tasks test processing speed, attention, learning and working memory. A baseline test represents the participant’s best effort pre-injury. The post-injury report shows whether there was significant decline in test performance post-injury.

### PERMISSIBLE VALUES:

Standard scores in processing speed, attention, learning, and working memory (M=100, SD=10) pre- and post-injury

### PROCEDURE:

The test can be completed in 8 to 10 minutes via computer. Participant responds to a series of tests in a convenient location. Children should take the test under the supervision of a responsible adult.

### COMMENTS:

The CCAT does not screen for concussion but may be used to compare cognitive ability pre- and post-injury.

### RATIONALE:

The Axon CCAThasbeen validated for use in sports populations.

### REFERENCES:

CogState. (1999). CogSport [Computer software]. Parkville, Victoria, Australia: CogState, Ltd.

Collie, A., Darby, D., & Maruff, P. (2001). Computerized cognitive assessment of athletes with sports related head injury. British Journal of Sports Medicine, 35, 297–302.

Collie A, Maruff P, Makdissi M, et al, CogSport: reliability and correlation with conventional cognitive tests used in postconcussion medical evaluations. Clin J Sport Med 2003 Jan; 13(1): 28-32

## CNS Vital Signs

**DESCRIPTION:** CNS Vital Signs is a web-based platform. The CNS Vital Signs battery consists of 7 tests: Verbal Memory (VBM), Visual Memory (VIM), Finger Tapping (FTT), Symbol Digit Coding (SDC), Stroop Test (ST), Shifting Attention Test (SAT) and the Continuous Performance Test (CPT). These tests capture a patient’s composite memory, verbal memory, visual memory, executive function, processing speed, psychomotor speed, reaction time, complex attention and cognitive flexibility. In total, 10 normed neurocognitive tests and 26 unnormed tests and over 50 rating scales are available for the researcher’s use.

### PERMISSIBLE VALUES:

Raw scores, standard scores (M=100, SD=15) and percentile ranks are provided for each domain.

**PROCEDURE:** The test battery can be administered via the web under supervision of non-clinical staff.

### COMMENTS:

CNS Vital Signs isnormed for ages 8-90

### RATIONALE:

CNS Vital Signs has proven validity and reliability in TBI. It is available in many languages and patients can be retested using alternate forms.

### REFERENCES:

Gualtieri, CT, Johnson LG (2006). Reliability and validity of a computerized neurocognitive test battery, CNS Vital Signs. Archives of Clinical Neuropsychology 21 623–643

Gualtieri, CT, Johnson LG (2008). CNS Vital Signs: A Computerized Test Battery Sensitive to Mild and Severe Brain Injury. Medscape J Med. 10(4): 90.

## Headminder Concussion Resolution Index

### DESCRIPTION:

TheHeadminder Concussion Resolution Index is an Internet-based assessment program that measures neurocognitive function. Six tests measure simple reaction time, complex reaction time, processing speed index, simple reaction time errors, and complex reaction time errors. The Concussion Resolution Index obtained from testing can be compared pre- and post-injury. Additional follow-up tests using alternate forms may be administered to monitor recovery of cognitive ability.

### PERMISSIBLE VALUES:

Standard scores (M=100, SD=15)

### PROCEDURE:

The test is administered at baseline and post-concussion via a computer with an Internet connection. It takes approximately 25 minutes to complete.

### COMMENTS:

### RATIONALE:

The Concussion Resolution Index has proven validity and reliability and minimizes practice effects.

### REFERENCES:

Erlanger, D., Feldman, D., & Kutner, K. (1999). Concussion Resolution Index. New York: HeadMinder, Inc.

## Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT)

### DESCRIPTION:

Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) is a computerized neuropsychological battery used to make return to play decisions in cases of sports concussion. It includes six test modules that measure verbal and visual memory, reaction time, processing speed, and impulse control: Word Memory, Design Memory, X’s and O’s, Symbol Match, Color Match, and Three Letters. Baseline and post-concussion testing can be performed to help evaluate when an athlete has recovered from a concussion.

### PERMISSIBLE VALUES:

Scaled scores (M=10, SD=3), index scores (M=100, SD=15), T-scores (M=50, SD=10), and percentile ranks are available for composite scores (Verbal Memory, Visual Memory, Reaction Time, Processing Speed, and Impulse Control) and a Postconcussion Scale Total Score.

### PROCEDURE:

ImPACT is computerized and takes approximately 20 minutes to complete. It can be administered by an athletic trainer, doctor or psychologist, or school nurse who has completed training in ImPACT test administration.

### COMMENTS:

ImPACT was developed for use in athletes following a concussion.

### RATIONALE:

ImPACT is widely used and has been validated for use in cases of sports concussion.

### REFERENCES:

Iverson GL, Lovell MR, Collins MW. Validity of ImPACT for measuring processing speed following sports-related concussion. Journal of Clinical and Experimental Neuropsychology, 2005;27(6):683-99.

Maroon, J.C., Lovell, M.R., Norwig, J., Podell, K., Powell, J.W. & Hartl, R. (2000). Cerebral concussion in athletes: evaluation and neuropsychological testing. Neurosurgery, 47, 659-672.

## Sport Concussion Assessment Tool (SCAT-2)

### DESCRIPTION:

The Sport Concussion Assessment Tool -2 (SCAT2) is a standardized sideline assessment of sport concussion developed by consensus at the 3rd International Conference on Concussion in Sport in 2008. It consists of a Symptom Evaluation, screen of Physical Signs, Glasgow Coma Scale score, Balance Examination, and Coordination Examination, as well as the components of the Standardized Assessment of Concussion (SAC): a cognitive assessment of orientation, immediate memory, concentration, and delayed recall. The Sideline Assessment Maddocks score evaluating orientation is included as a validated measure for concussion diagnosis but does not figure into the total SCAT-2 score. Preseason baseline testing can be performed to allow comparison with pre-injury scores. There is no currently defined cut-off score for diagnosis of concussion; however the SCAT-2 should be a component of a medical professional’s evaluation of whether an athlete is safe to return to play.

### PERMISSIBLE VALUES:

The maximum SCAT2 score is 100, where lower scores are more indicative of concussion. Other scores that can be calculated are a symptom severity score (up to 132, with higher score indicating more severe symptoms); SAC score (up to 30, lower more suggestive of concussion); and Maddocks score (up to 5, lower more suggestive of concussion).

### PROCEDURE:

The SCAT-2 is administered in interview-format to an athlete with suspicion of sustaining a concussion. It may be used by physicians, therapists, certified athletic trainers, health professionals, or coaches trained in the care of injured athletes.

### COMMENTS:

For use in athletes age 10 and older.

### RATIONALE:

The SCAT-2 supersedes the SCAT. It is free for distribution and use.

### REFERENCES:

McCrory P, et al. Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich, November 2008. Clin J Sport Med 2009; 19:185-200

McCrory P et al. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. British Journal of Sports Medicine. 2005; 39: 196-204