

# Helping Solve the Sports Concussion Post-Injury Puzzle



Concussion  
Vital Signs<sup>®</sup>

## Keeping Safety Top of Mind.

All sports carry the potential for injury. For student athletes' developing brains, the risk of concussion may be the greatest risk of all. Hundreds of thousands of student athletes suffer concussions each year—injuries that may lead to chronic difficulties in the everyday activities of learning, remembering, concentrating, and solving problems.

Concussion Vital Signs® (CVS), which is designed for student athletes, aligns to current sports concussion management guidelines. This scientifically based system, used as part of a medical evaluation, helps facilitate confident return-to-play decisions while helping to protect the future of student athletes in sports, academics, and life.

# Free Unlimited Testing for Schools



# Scientifically Sound and Valid

Based on neuroscientific research, CVS contains seven highly respected, standardized neuropsychological tests. This reliable system provides valuable clinical endpoints (brain function or cognition, concussion symptoms, concussion history, and sideline assessment) that add insight into an athlete's brain health status. The clinical domains, scored from the tests, measure the speed and accuracy of an athlete's brain or neurocognitive function. CVS provides easy-to-understand information on key cognitive measures, such as memory, reaction time, and executive function, to quickly assist with helping determine an athlete's readiness to return to play.

## Three stages of assessment

### Pre-season baseline testing

- Conduct neurocognitive evaluation online
- Administer balance test
- Gather concussion history from parent, guardian, or athlete
- Complete Concussion Symptom Scale

### Sideline assessment

- Use mobile-enabled pocket sideline assessment for immediate evaluation

### Post-injury assessment

- Monitor recovery with Concussion Symptom Scale
- Conduct additional post-injury assessments when needed. Order of test items is changed with each administration to help ensure accuracy of results.
- After the athlete is symptom free, clinicians can re-administer the neurocognitive test and the balance test and update the concussion history.

### **Performance validity indicator**

CVS' auto-scored validity indicators tells you at a glance if the athlete's performance or effort was adequate on each domain area, so you quickly know whether you can rely on the results or need to readminister the test.

### **Athlete health history can be completed by parents**

With CVS, parents or guardians can complete the athlete's health history, which helps ensure that you and other decision makers have reliable, up-to-date information to inform sign-offs. This approach also helps minimize testing fatigue for the athlete, which could compromise the accuracy and validity of test results.

### **Concussion Management Efficiency**

Concussion Vital Signs is optimized to make the current concussion guidelines efficient for school staff and the testing strategy can easily be administered according to each schools policy and plan. Testing takes only about 25-30 minutes.





# Coordinated Care

## Clinician's Post-Injury Testing Portal

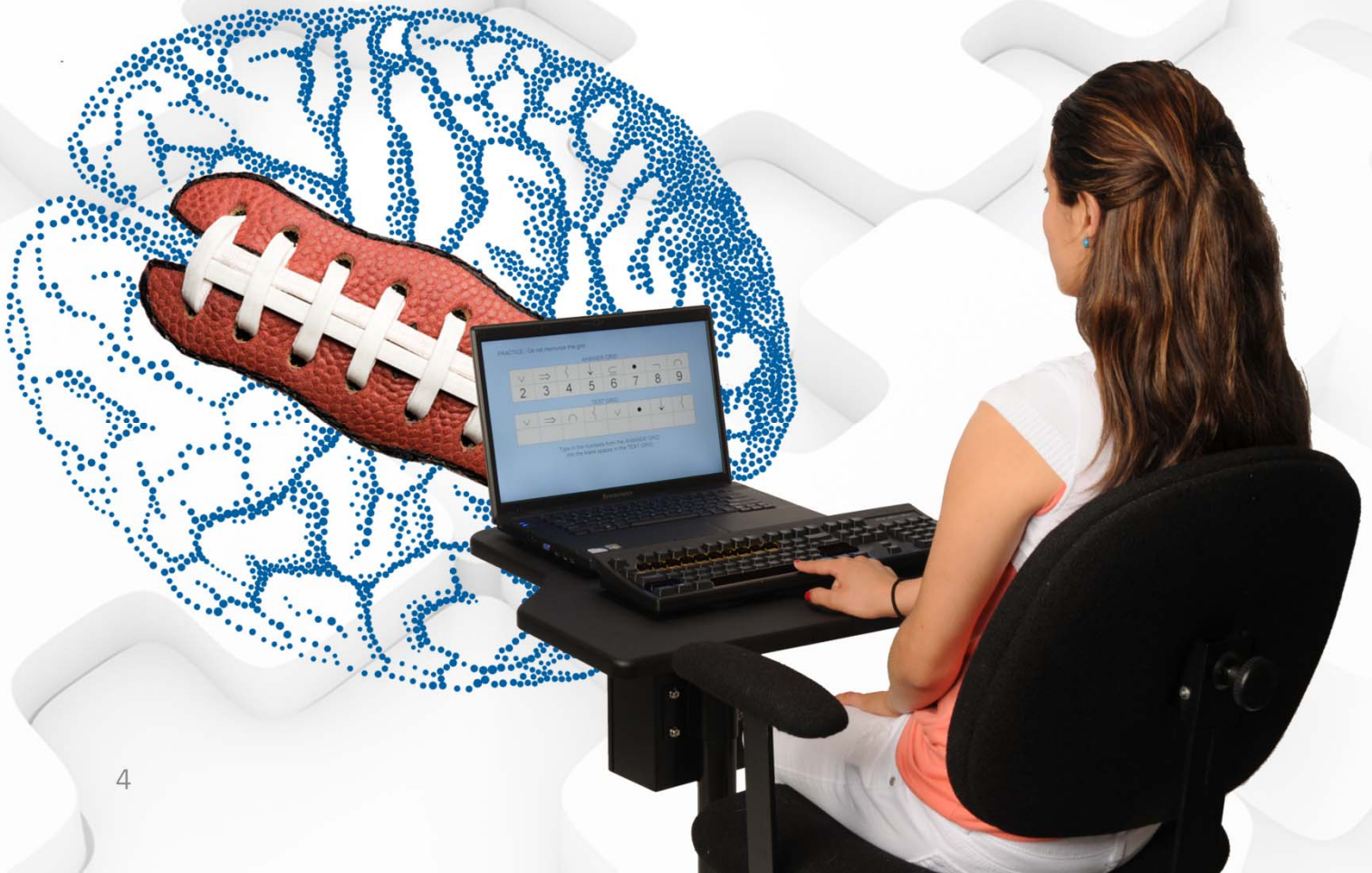
The online Return-to-Play Clinician's Portal facilitates collaboration among athletes, parents, trainers, and clinicians, which is vital for effective concussion management. This unique tool enables schools and physicians to better serve athletes and their parents.

### With this flexible, robust system:

- Physicians and other qualified health professionals can log in to view an athlete's concussion health history and test results in real time.
- Physicians can administer post-injury assessments and view reports which compare the results to previous tests to help inform their return-to-play decisions.

### Reports are clear and intuitive and do not require special training to interpret them.

- The provider, whether the athlete's personal physician or the provider of record for the school simply enters the student's id codes from the CVS report to access the athlete's records as well as allow them to do a return-to-play assessment in their office.
- Sports medicine clinics, concussion clinics, neuropsychology clinics, and other healthcare institutions can quickly review concussion testing information.
- Clinicians can manage and coordinate care for multiple patients from any number of schools who are using CVS for their concussion management platform.



## Efficient, Portable, and Free

CVS makes it easy to reliably assess and safeguard your student athletes. Online screens are user-friendly, with intuitive navigation. And, CVS offers an abundance of convenient features, such as:

### **Easy-to-use database of athlete information**

Enables you and your staff to access all athletes' return-to-play records at one website.

### **Easy rostering**

CVS provides automatic roster set-up; rosters do not need to be preloaded, which enhances testing efficiency. You can use this feature to:

- Identify and create lists of athletes who may need special attention based on test results.
- Create tailored rosters to view athletes' results by sport or other criteria.
- Access and manage team rosters.

### **Tablet-enabled sideline assessment tool**

The CVS Sideline Assessment is tablet-enabled, which allows trainers to conduct a quick concussion screen *during play* on a tablet. Paper version is also available for use on the sideline.

### **Easy-to-interpret reports**

CVS reports display results in a clear, logical format, showing the student's raw score, percentile ranks, and whether the score is valid for each domain. The post-injury report shows whether the athlete's score on each domain has returned to baseline results and if it is within 5% of baseline. The student's progress is shown in an easy-to-read graph.

### **Free un-limited use**

After signing-up you will have a Concussion Vital Signs account that will provide unlimited use of the following:

- Neurocognitive Testing
- Concussion Symptom Scale
- Athlete Concussion History
- Mobile Tablet-Enabled Sideline Assessments
- Return-to-play Testing for the Team or Family Doctor via the Clinician Portal
- Account Management Portal e.g. View Reports







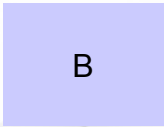
## Begin Today

[www.concussionvitalsigns.com](http://www.concussionvitalsigns.com)



# Concussion Vital Signs Test Descriptions

Concussion Vital Signs contains seven venerable neuropsychological tests and the clinical domains, scored from the tests, measures the speed and accuracy of an athletes brain or neurocognitive function.

CORE Tests	Neurocognitive Function	Test Description
<b>Verbal Memory (VBM)</b> <i>Approx. 3 Minutes</i>	 <ul style="list-style-type: none"> <li>Verbal Learning</li> <li>Memory for Words</li> <li>Word Recognition</li> <li>Immediate and Delayed Recall</li> </ul>	VBM measures recognition memory for WORDS. Fifteen words are presented, one by one, on the screen every two seconds. For immediate recognition, the participant has to identify those words nested among fifteen new words. Then, after six more tests, there is a delayed recognition trial.
<b>Visual Memory (VIM)</b> <i>Approx. 3 Minutes</i>	 <ul style="list-style-type: none"> <li>Visual Learning</li> <li>Memory for Geometric Shapes</li> <li>Geometric Shapes Recognition</li> <li>Immediate and Delayed Recall</li> </ul>	VIM measures recognition memory for FIGURES. Fifteen geometric figures are presented, one by one, on the screen. For immediate recognition, the participant has to identify those figures nested among fifteen new figures. Then, after five more tests, there is a delayed recognition trial.
<b>Finger Tapping (FTT)</b> <i>Approx. 2 Minutes</i>	 <ul style="list-style-type: none"> <li>Motor Speed</li> <li>Fine Motor Control</li> </ul>	FTT test requires athletes to press the Space Bar with their right index finger as many times as they can in 10 seconds. They do this once for practice, and then there are three test trials. The test is repeated with the left hand.
<b>Symbol Digit Coding (SDC)</b> <i>Approx. 4 Minutes</i>	 <ul style="list-style-type: none"> <li>Information Processing Speed</li> <li>Complex Attention</li> <li>Visual-Perceptual Speed</li> <li>Information Processing Speed</li> </ul>	SDC test consists of serial presentations of screens, each of which contains a bank of eight symbols above and eight empty boxes below. The participant types in the number that corresponds to the symbol that is highlighted. Only the digits from 2 through 9 are used; this is to avoid the confusion between "1" and "l" on the keyboard. The computer program does not allow a person to use a numerical pad. This prevents the potential for a distinct advantage for those who are skilled at using the numerical pad or for those that are right- versus left-handed.
<b>Stroop Test (ST)</b> <i>Approx. 4 - 5 Minutes</i>	 <ul style="list-style-type: none"> <li>Executive Function</li> <li>Simple and Complex Reaction Time</li> <li>Speed-Accuracy Trade-Off</li> <li>Information Processing Speed</li> <li>Inhibition / Disinhibition</li> </ul>	Stroop test has three parts. In the first part, the words RED, YELLOW, BLUE, and GREEN (printed in black) appear at random on the screen, and the participant presses the space bar as soon as the athlete sees the word. In the second part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. The participant is asked to press the space bar when the color of the word matches what the word says. In the third part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. The participant is asked to <i>press the space bar</i> when the color of the word does not match what the word says.
<b>Shifting Attention (SAT)</b> <i>Approx. 2.5 Minutes</i>	 <ul style="list-style-type: none"> <li>Executive Function: Shifting Sets</li> <li>Reaction Time</li> <li>Information Processing Speed</li> <li>Speed-Accuracy Trade-off</li> </ul>	SAT test is a measure of ability to shift from one instruction set to another quickly and accurately. Participants are instructed to match geometric objects either by shape or by color. Three figures appear on the screen, one on top and two on the bottom. The top figure is either a square or a circle. The bottom figures are a square and a circle. The figures are either red or blue (mixed randomly). The participant is asked to match one of the bottom figures to the top figure. The rules change at random (i.e., match the figures by shape, for another, by color).
<b>Continuous Performance (CPT)</b> <i>Approx. 5 Minutes</i>	 <ul style="list-style-type: none"> <li>Sustained Attention</li> <li>Choice Reaction Time</li> <li>Impulsivity</li> </ul>	CPT test is a measure of vigilance or sustained attention or attention over time. The athlete is asked to respond to the target stimulus "B" but not to any other letter. The stimuli are presented at random.

The entire test must be re-administered if the athlete has any "No" values in the Valid Score column. A percentile Score of 50% is AVERAGE.



# Neurocognitive Clinical Domains Measured

Concussion Vital Signs valid and reliable clinical domains assist in the evaluation and management of sports related concussions. The percentile scores come from 1900+ peer norms from ages 8 to 90.

Clinical Domains	Clinical Domain Score Calculations	Clinical Domain Description
<b>Neurocognitive Index (NCI)</b>	The average of the Composite Memory, Psychomotor Speed, Cognitive Flexibility, Reaction Time, and Complex Attention Domains.	<b>Measure:</b> An average score derived from the domain scores or a general assessment of the overall neurocognitive status of the patient. <b>Relevance:</b> Summary views tend to be most informative when evaluating a population, a condition category, and outcomes.
<b>Verbal Memory</b>	<b>Verbal Memory</b> is the score for the Verbal Memory Test. VBM Correct Hits Immediate + VBM Correct Passes Immediate + VBM Correct Hits Delay + VBM Correct Passes Delay	<b>Measure:</b> How well subject can recognize, remember, and retrieve words. <b>Relevance:</b> Remembering a scheduled test, recalling an appointment, taking medications, and attending class.
<b>Visual Memory</b>	<b>Visual Memory</b> is the score for the Visual Memory Test. VIM Correct Hits Immediate + VIM Correct Passes Immediate + VIM Correct Hits Delay + VIM Correct Passes Delay	<b>Measure:</b> How well subject can recognize, remember and retrieve geometric figures. <b>Relevance:</b> Remembering graphic instructions, navigating, operating machines, recalling images, and/or remember a calendar of events.
<b>Psychomotor Speed</b>	<b>Psychomotor Speed</b> is the combined score for both the Finger Tapping and the Symbol Digit Coding Test. FTT Right Taps Average + FTT Left Taps Average + SDC Correct Responses	<b>Measure:</b> How well a subject recognizes and processes information i.e., perceiving, attending/responding to incoming information, motor speed, fine motor coordination, and visual-perceptual ability. <b>Relevance:</b> Distractibility, fitness-to-drive, occupation issues, obsessive concern with accuracy and detail.
<b>Executive Functioning</b>	<b>Executive Function</b> reflects performance on the Shifting Attention Test. SAT Correct Responses - SAT Errors	<b>Measure:</b> How well a subject recognizes set shifting and manages multiple tasks simultaneously. <b>Relevance:</b> Ability to sequence tasks and manage multiple tasks simultaneously as well as tracking and responding to a set of simple instructions.
<b>Cognitive Flexibility</b>	<b>Cognitive Flexibility</b> reflects performance on the Shifting Attention and Stroop Tests. SAT Correct Responses - SAT Errors - Stroop Commission Errors	<b>Measure:</b> How well subject is able to adapt to rapidly changing and increasingly complex set of directions and/or to manipulate the information. <b>Relevance:</b> Reasoning, switching tasks, decision-making, impulse control, strategy formation, attending to conversation.
<b>CPT Correct Responses</b>	<b>CPT Correct Responses</b> is the number of correct responses on the Continuous Performance Test.	<b>Measure:</b> Ability to track and respond to information over lengthy periods of time and/or perform mental tasks requiring vigilance quickly and accurately. <b>Relevance:</b> Self-regulation and behavioral control.
<b>Reaction Time*</b>	<b>Reaction Time*</b> is the average reaction time on parts 2 and 3 of the Stroop Tests. (ST Complex Reaction Time Correct + Stroop Reaction Time Correct) / 2	<b>Measure:</b> How quickly the subject can react, in milliseconds, to a simple and increasingly complex direction set. <b>Relevance:</b> Driving a car, attending to conversation, tracking and responding to a set of simple instructions, taking longer to decide what response to make.
Reaction Time Detail		
<b>Simple Reaction Time*</b>	<b>Simple Reaction Time*</b> is the average reaction time on part 1 of the Stroop Tests. Time required to press the spacebar from the time a word first appears on the display. Average Reaction Time on Part 1 of the Stroop Test	
<b>Choice Reaction Time Correct*</b>	<b>Choice Reaction Time Correct*</b> is the average correct reaction time on the Continuous Performance Test. Time required to press the spacebar from the time a B first appears on the display.	
<b>Shifting Attention Correct RT*</b>	<b>Shifting Attention Correct RT*</b> is the average correct reaction time on the Shifting Attention Test.	

An \* denotes that "lower is better" in the Subject Score column, otherwise higher scores are better. With Percentile scores, higher is always better.