AGENDA:
- Who: CNS Vital Signs
- Why: CNS Vital Signs baseline testing?
- Concussions, how many are really affected? Which sports?
- Baseline tests matter because of the invisible effects of concussions.
- Validity & Reliability of tests create the basis of sound decision making.
- How does a concussion affect learning?
- Complete Concussion Management System: Baseline & follow-up testing, sideline app & Clinician’s portal.
- Norms
- Test overview and orientation (www.concussionvitalsigns.com)
- Admin login & keep baseline testing conditions
- Athlete login: quick search features
- Basic report interpretation, baseline validity indicators, post-injury assessment, report graphs
- Scat-2: sideline app
- How do you improve working memory?
- Resources tab
### Priority for Offering

<table>
<thead>
<tr>
<th>#</th>
<th>Gap</th>
<th>Outcome Name</th>
<th>Outcome Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>62%</td>
<td>Baseline for All</td>
<td>Maximize Availability Of Baselines For All Athletes</td>
</tr>
<tr>
<td>2</td>
<td>47%</td>
<td>Data Access</td>
<td>Maximize Ease of Access to Relevant Historical and Current Concussion Data For Each Athlete</td>
</tr>
<tr>
<td>3</td>
<td>37%</td>
<td>Communication</td>
<td>Maximize Communication Between Concussion Decision-Makers and Influencers (Parents, Athletes, Schools, Medical)</td>
</tr>
<tr>
<td>4</td>
<td>36%</td>
<td>ID Concussive Events</td>
<td>Maximize Likelihood that all Possible Concussive Events are Detected</td>
</tr>
<tr>
<td>5</td>
<td>36%</td>
<td>R-F-P Decision</td>
<td>Maximize Correctness of Remove-From-Play (Sideline) Decision</td>
</tr>
<tr>
<td>6</td>
<td>31%</td>
<td>Concussion Education</td>
<td>Maximize Parent and Athlete Concussion Awareness Education And Compliancy</td>
</tr>
<tr>
<td>7</td>
<td>31%</td>
<td>Baseline Time</td>
<td>Minimize Amount Of Time To Administer Baseline Assessment</td>
</tr>
<tr>
<td>8</td>
<td>30%</td>
<td>Concussion Mgmt</td>
<td>Maximize Confidence in Professional Knowledge of Concussion Management</td>
</tr>
<tr>
<td>9</td>
<td>26%</td>
<td>R-T-P Test Accuracy</td>
<td>Maximize Return-To-Play Assessment Accuracy</td>
</tr>
<tr>
<td>10</td>
<td>20%</td>
<td>Reduce Costs</td>
<td>Minimize Expenses To Identify and Address Concussion Issues</td>
</tr>
</tbody>
</table>

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**Why did Pearson Get Involved?**

Trainers Spoke. Pearson Responded.

*Pearson is well-situated to bring the proper emphasis in the domain of concussions among youth:*

*"The Return to Learn" takes priority over the "Return to Play" with student-athletes. Invisible effects of concussions can extend after the visible symptoms are gone.*

If you can't handle your normal academic load are you really symptom free? This means that **VALID and RELIABLE ASSESSMENTS MATTER.** Pearson knows tests...

Simply relying upon symptom report or observation is risky.

---

**Pearson has answers**

To questions about concussions & learning

Who is talking about how, exactly, concussions affect learning?

Or, what might you need to do to remediate cognitive loss after a concussion?

With Pearson this concussion management system is the beginning.

The focus is helping student-athletes get back learning after a concussion...
Concussions, how many are really affected? Which Sports?

<table>
<thead>
<tr>
<th>Sport</th>
<th>Number of Athletic Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women's ice hockey</td>
<td>18.3</td>
</tr>
<tr>
<td>Men's ice hockey</td>
<td>8.9</td>
</tr>
<tr>
<td>Women's lacrosse</td>
<td>6.3</td>
</tr>
<tr>
<td>Men's football</td>
<td>8.0</td>
</tr>
<tr>
<td>Men's spring football</td>
<td>0.5</td>
</tr>
<tr>
<td>Women's soccer</td>
<td>5.3</td>
</tr>
<tr>
<td>Women's basketball</td>
<td>4.7</td>
</tr>
<tr>
<td>Women's softball</td>
<td>4.3</td>
</tr>
<tr>
<td>Women's field hockey</td>
<td>3.9</td>
</tr>
<tr>
<td>Men's wrestling</td>
<td>3.9</td>
</tr>
<tr>
<td>Men's basketball</td>
<td>3.3</td>
</tr>
<tr>
<td>Men's baseball</td>
<td>2.5</td>
</tr>
<tr>
<td>Women's gymnastics</td>
<td>2.5</td>
</tr>
<tr>
<td>Women's track</td>
<td>2.2</td>
</tr>
<tr>
<td>Total concussions</td>
<td>6.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sport</th>
<th>Number of Athletic Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>35,623,701</td>
</tr>
<tr>
<td>Basketball</td>
<td>13,796,973</td>
</tr>
<tr>
<td>Track</td>
<td>13,266,497</td>
</tr>
<tr>
<td>Baseball</td>
<td>10,916,754</td>
</tr>
<tr>
<td>Soccer</td>
<td>7,175,341</td>
</tr>
<tr>
<td>Wrestling</td>
<td>6,235,016</td>
</tr>
<tr>
<td>Cross country</td>
<td>6,444,218</td>
</tr>
<tr>
<td>Tennis</td>
<td>6,276,132</td>
</tr>
<tr>
<td>Swimming</td>
<td>2,242,814</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>858,712</td>
</tr>
<tr>
<td>Total (with lower ranking sports)</td>
<td>100,602,986</td>
</tr>
</tbody>
</table>
Concussions effects:
A Neurometabolic Cascade

Concussions are not structural damage, but neurochemical damage.

A simple way to think about it is the software of the brain has been disrupted. In this sense it is not observable except through symptoms.

The term cascade is a series of small waterfalls over steep rocks. The small waterfalls in this case involve ionic, metabolic and physiologic events that obviously are unseen externally. Invisible essentially, except for symptoms of concussion which are observed.

Internally there is an excitatory neurometabolic cascade:
- Calcium reflux, lasting up to 6 days.
- Glutamate response
- Potassium surge
- Ions pumps work overtime to restore homeostasis
- Cerebral blood flow decreases
- Glucose disparity
- There is an energy crisis... before normal functioning returns at about 6-10 days.

The neurochemical changes are exhausting for the brain. Rest is a critical factor in recovery. During recovery the brain is very vulnerable. Cognitive rest is even more important than physical rest.

Observable Symptoms of Concussion tell part of the story.

But how can you tell what is going on inside the brain?

Why use Baseline Neurocognitive Tests?
Invisible effects of concussion.

- Neurocognitive decrements may persist when athletes no longer report concussion-related symptoms.
- Reliance on athlete-reported, post concussion symptoms when making return-to-play decisions may expose athletes to subsequent injury if complete recovery has not occurred.
- A multifaceted approach to concussion assessment that includes evaluation of a myriad of functions is warranted.
- Risk for Second Impact Syndrome.
- The exclusive use of symptom reports in making a return-to-play decision is not advised.
Long-term residual brain dysfunctions from mTBI are often overlooked by clinical criteria (Slobounov, et al., 2009).

EEG wavelet information was used with 21 athletes (sample of 265) who suffered two concussive episodes within one athletic season and were tested on days 7, 14, and 21 post-first and second injuries.

No neuropsychological deficits (as measured by neurocognitive tests) were present in concussed subjects beyond 7 days post-injury after first and second concussions.

EEG-IQ measures were significantly reduced primarily at temporal, parietal and the occipital regions (ROIs) after first and especially after second MTBI (p < 0.01) beyond 7 days post-injury.

Rate of recovery of EEG-IQ measures was significantly slower after second MTBI compared to those after the first concussion (p < 0.01).

EEG-IQ measures may reveal alterations in the brain of concussed individuals that are most often overlooked by current assessment tools.

The exclusive use of symptom reports in making a return-to-play decision is not advised.

Concussion effects last beyond effects on the results of neurocognitive tests...

• Invisible effects of concussion #1...
• Neurpsychology's role: “neuropsychology is well positioned to provide valuable information to the forensic process about whether a defendant's cognitive abilities have been negatively affected by a disease process, a drug problem, a head injury, and the impact of cognitive problem on day-to-day functioning.” (Brodin & Sherman, 2012).
• Neurocognitive testing helps clinicians evaluate and describe the neurocognitive health or higher functions of the brain, such as the impairments seen in mild traumatic brain injuries (mTBI) or CONCUSSIONs and helps qualified health professionals collect important information used in assessing, monitoring, and managing concussions.

What is Neurocognitive Testing?

Tapping into brain functioning from the outside.

The Brain is not the same as a sore foot...

Valid tests measure what you think they are measuring.

Reliable tests show consistently similar scores over time.

Without high validity you don’t know what you are measuring. Was an athlete "sandbagging"?

Without high reliability the reason for a change in performance may not be a concussive event. It might be something different altogether.

You can’t make sound decisions on bad data.

Remember what the trainers ranked # highest priority: ID concussive events.

Learning!
Unfortunately, most athletic trainers don’t use CNTs.

<table>
<thead>
<tr>
<th>Schools employing athletic trainers</th>
<th>62%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of athletic trainers employed by schools if using a CNT</td>
<td>60% (16.9% of all schools)</td>
</tr>
<tr>
<td>Districts testing only football, boys and girls soccer</td>
<td>50%</td>
</tr>
<tr>
<td>Districts testing all athletes</td>
<td>30%</td>
</tr>
<tr>
<td>Athletic trainers &amp; Physicians interpret CNT results</td>
<td>78%</td>
</tr>
<tr>
<td>Athletes tested with CNT less likely to return to play within 10 days</td>
<td>26% vs. 56%</td>
</tr>
</tbody>
</table>

Computerized neuropsychological baseline testing is underutilized by athletic trainers. (personal letter, 2010)

CNTs preserve the health of student athletes & mitigate risk for schools (Halstead & Walker, 2010)

**3rd International conference on Concussion in Sport, Zurich**

3.1 The application of neuropsychologist (NP) testing in concussion has been shown to be of clinical value and continues to contribute significant information in concussion evaluation. Although the exact cognitive recovery largely overlaps with the time course of symptom recovery, there have been demonstrated that cognitive recovery may occasionally precede or occur concurrently with clinical symptom resolution, suggesting that a combination of clinical judgment and neuropsychological testing is recommended to guide decision-making. Neuropsychologists are in the best position to interpret NP tests as a result of their background and training. However, there are situations where neuropsychologists are not available or other medical professionals may perform or interpret NP screening tests. The ultimate return to play decision should always be medical and in which a multidisciplinary approach is desirable. Where possible, feedback should be taken on the absence of NP and other tests, formal balance assessment testing, a more comprehensive return to play protocol may be appropriate. In the majority of cases, CNT testing will be appropriate relative to prior concussions and not for new and isolated symptoms. In these situations, the patient should be symptom-free to assist in determining management. This will normally be best determined in consultation with a trained neuropsychologist.
CNS Concussion Vital Signs:  
Over 90 studies and...  
CNS Vital Signs is a world leader in the design, development and provision of interactive, computerized assessment tools to inform clinical decision-making by providing physicians and researchers leading-edge assessment technologies.

As a clinical instrument, the CNS Vital Signs neurocognitive assessment tools have been used to detect impairment, follow the course of an illness, and monitor response to treatment.

CNS is offered in over 30 languages, used by over 6000 clinicians in 52 countries.

Want to see publications?  Go here:  

Continuous Reliability:
ultimately cognitive functioning relates to learning...

Research continues into the efficacy and reliability of the CNS Vital Signs battery of tests, computerized tests, and CNS Vital Signs, conducted independently of CNS.

This research reliability (R2) was evaluated in CNS & NTS, and the entire battery of tests repeated, separated, on the same patients. The research reliability (R2) of the CNS Vital Signs battery was calculated on 120 patients, with a median interval of 27 days. The results indicate that very high levels of reliability. The CNS Vital Signs battery of tests maintains very high levels of test–retest reliability, across all patient groups.

Reliability: Correlation coefficients for CNS Vital Signs tests (Johnson, 2006)

The test–re-test reliability of the CNS Vital Signs battery of tests, conducted by physicians and neuropsychologists, is very high (r = 0.72). The CNS Vital Signs battery of tests is designed to be administered repeatedly, with a mean interval of 27 days, but will have only limited role in the medical setting, absent the active participation of consulting neuropsychologists.

Conclusion: The psychometric characteristics of this test are similar to those of the conventional tests upon which they are based, and they will not have limited role in the medical setting, absent the active participation of consulting neuropsychologists.

(Quant & Johnson, 2006)
To Summarize:
1. Memory tests: .611 to .726
2. Psychomotor speed (finger tapping tests): .776-.869
3. Reaction Time (Stroop) ranged from .554-.795
4. Cognitive flexibility, Shifting Attention Test (SAT) : .694-.744
5. Sustained Attention (CP) .452-.565
6. Complex attention (CPT, SAT & Stroop): .314-.874

Non-clinical sample, independent investigator, Test-retest reliability and effort (Jones, 2012)

- N=31 healthy college graduate adults completed select subtests of CNS VS and re-tested 30 days later.
- Intraclass correlation coefficient estimates from baseline to retest ranged from .63 to .88 on the CNS domain scores.
- Each participant also completed Green’s Medical Symptom Validity Test and the Reliable Digit Span to evaluate effort.
- All participants demonstrated adequate levels of effort according to Medical Symptom Validity Test and Reliable Digit Span interpretive guidelines.
- This data demonstrated moderate to good test-retest reliability in a nonclinical sample performing with sufficient effort, especially when compared to the test-retest reliability of other computerized neuropsychological assessment programs using pragmatic time intervals.

Test-Retest Reliability of Other Computerized concussion tests (Broglio, et al, 2007)

- n=118 healthy student volunteers.
- Tested: Baseline, Day 45, Day 50.

Conclusion: These programs show low to moderate test-retest correlation coefficients.
Concussion Vital Signs Psychometrics:
Validity (Gualtieri & Johnson, 2006)

Peer Reviewed Psychometric Standards:
Text Retest Reliability: used n=99 took the battery separated by on average 62 days. Results comparable to those achieved by equivalent conventional and computerized tests. (Results noted on earlier slide).

Concurrent Validity: n=180 subjects, normals and neuropsychiatric patients; n=141 with neuropsychiatric disorders 39 normals. Ages 10-85, mean age 34.8, mild cognitive impairment, early dementia, post-concussive syndrome, depression, other psychiatric and neurologic diagnoses, including child and adolescent ADHD (treated & untreated) & depression (treated & untreated).

Discriminant Validity: n=187, Dementia, Severe TBI, Mild MRI, Conversion disorder, Malingers. Also compared those with real cognitive impairment with those whose problems are exaggerated for psy. reasons. The test was sensitive to malingerers & patients with conversion disorders. Matched on age, race and gender of randomly selected subjects from the norms.

Concussion Vital Signs Product Training

Archives Clinical Neuropsychology
September 30, 2006

CNS Neurocognition Index
Concurrent Validity MBI...
Competitor: Validity & Reliability

Much of the published literature is on ImPACT. ImPACT’s test-retest reliability is the weakest of all the CNTs, with many of its domains below the 0.6 level considered significant for clinical decision making. CNS Vital Signs has excellent test-retest reliability and validity, sensitivity and specificity, change score, and clinical utility.

RECOMMENDATION: If baseline CNT is used, it subsequently should be done on a yearly basis in high school athletes and every 2 years for college athletes depending on the CNT in use.

ADHD has a huge impact upon learning. CNS Vital signs successfully differentiated ADHD children from non-ADHD kids. N=50 Diagnosed ADHD children (co-morbidity excluded), Rx-free during tests, Ages 7 to 18. n=50 non-ADHD kids from the CNS Vital Signs normative database.

TESTS DIFFERENTIATING ADHD FROM NORMALS:

<table>
<thead>
<tr>
<th>Test</th>
<th>ADHD (d)</th>
<th>Normal (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>.45</td>
<td>.48</td>
</tr>
<tr>
<td>Psychomotor Speed</td>
<td>.48</td>
<td>.8</td>
</tr>
<tr>
<td>Cognitive Flexibility</td>
<td>.8</td>
<td></td>
</tr>
<tr>
<td>Complex Reaction time</td>
<td>.97</td>
<td></td>
</tr>
</tbody>
</table>

Concerns of memory impairment are common after mild traumatic brain injury (mTBI). Acute effects after mTBI may include posttraumatic amnesia, which may last up to 24 hours. In the postacute phase, memory concerns are usually linked with increased distractibility, impaired attention, working memory, retrieval; and executive dysfunction.” (Flynn, 2010).
Why does the frontal lobe matter?
If learning matters, the frontal lobe matters...

Young people have a lifetime of learning left. We'd like to know how it will be affected.

Why better validity/reliability in CNS VS?
Test Design: Using established tests.

Now, you know you have a tool that works. Wouldn't you like a SYSTEM THAT WORKS? Competitors lack a System...& Access...
Learning is a lifetime endeavor. Concussion test norms should reflect that.  
Age 7 to over 90 does it.

Concussion Vital Signs normative sample of 1049 characteristics are:
- Sample subjects were in good health...
- Sample subjects had no past or present psychiatric or neurological disorders,  
  head injury, or learning disabilities...
- Sample subjects were free of any centrally acting medications.
- Due to rapid brain development at early ages those groups had more frequent subdivisions.

Concussion Vital Signs normative sample subjects range in age from 7 to 90.  
The OMEGA norms used in the automatic norms and the new, tech-friendly flexible normation tool—Memory Labs, which are based on 
age/subcategories, developmental years of education to the part in the remaining years available.

The Concussion Vital Signs normative data is presented in ten age groups: less than 10 years old, 10–14, 15–19; in decades 20–29, and finally, 30 years or older.

- 10 years
- 10–14
- 15–19
- 20–29
- 30–39
- 40–49
- 50–59
- 60–69
- 70–79
- 80+

Adaptation: Journal of Clinical Psychology 31(996-605).

Youth Friendly Administration:
FLEXIBLE Testing Order.

Most youth athletes won't give a great health history.  
We don't make them do it before taking the test.

Arguably, ImPact Normed with Pros in mind.

Can't administer just the symptom scale alone...
To have a valid test you must re-administer the history and symptom scales...
Lowest norms age 13.
They sell to pro teams.
Pros often want to play regardless of risk given the huge incentives...
Concussion Vital Signs—Components of a complete system.

Competitors lack a complete system (e.g., a sideline app, easy clinician access, etc.)

CVS Registration

After registering look for the confirmation email. Click within 24 hours to activate.

If you don’t act within 24 hours, call 800-249-0659, #7 to activate your subscription.

Check your spam folder if you don’t get it.

NOTE: You do not pay before you start testing nor do you pay with a credit card. You will be billed in about a week with an email.

CVS Registration: Form completion

Provide your own username and password as an administrator.

Separate username and password for ATHLETE TESTING.

All athletes will login with this username and password.

NOTE: Your confirmation email will not include your administrator password so record it.

Resources section:
How-to-Begin/Register, p. 3
After you click “athlete testing” this window will pop up:

All Athletes will use the same user name and password that you provided!

Important:

Athlete Reference/ID

Athlete Identification:

ENTER the Athlete Reference/ID (Initials, DOB=ddmmyy) and click the test button.

Example: CS012774 (Initials, DOB=ddmmyy)

Important:

What distinguishes an athlete’s test is this Athlete Reference/ID

You or your policies will determine how to generate Athlete Reference IDs & you will communicate this to your athletes. Example: CS012774 (Initials, DOB=ddmmyy)
Take the test!

Conditions that create highly valid test results:
- Computers with internet access.
- Time: 30-40 minutes.
- Rested, Unhurried athletes.
- Use a setting with limited distractions.
- Use similar settings across administrations.

Set the frame clearly for athletes:
- “Your Brain is Your Life. Take this seriously.”
- Do not distract each other.
- If you don’t listen to the instructions your report will be invalid.
- You will take it again until it is valid.
- ‘Until your test is valid you don’t practice for your sport…”

Note to those administering the test: Take it yourself a few times so you will know how to orient athletes to the test. Also, read: Resources: Test Administration Guide.

Athlete History Can come later by athletes or parents.

Administrative Login:
Reviewing Athletes Reports

Remember:
You created your admin user and password at registration.
You will not get your admin password in the email so remember it or write it down!
After Admin Login
The Account folder is presented.

This folder will allow for report viewing, log of account activity, viewing NCE, provides for the development of rosters...

From here you can also enable and edit the account’s profile, set up rosters, retire athletic records, and an athlete’s demography.

Administrative Features
Default Assessments in last 60 days.

Admin Features
Quick Search with Partial Name
Cool Admin Feature:
Search All Invalid Tests in last X days.

Cool Report Feature:
Which subtest was invalid?

Baseline Testing:
Quick Scan of Validity Indicators
Tells you why.

This Example:
NCI, CPT & Choice Reaction Time All Invalid!

Determining ImPACT test Invalidity
A patient in this chart will return that test is invalid, but it will not identify which individual test is invalid. You can do manual calculations:
• Repeat performance of how to do manual calculations.
• The cutoff represent scores that fall below two standard deviations for the adult population.
• These scores should be used as general guidelines. If you obtain a questionable score, we suggest that you discuss with the athlete and their coach the rationale for the cutoffs and other potential reasons for the scores.

- Suspect Invalidity if:
  • Word memory learning is below 69
  • Design memory learning is below 66
  • Total time correct (total time correct) greater than 30
  • Total time correct (total time correct) greater than 1.7
  • Quick Reaction Time Correct (Quick Reaction Time Correct) greater than 1.7
  • Total time correct (total time correct) greater than 30
  • Ifxo correct (the number of forward order)
  • Impulse Control Composite Score > 30

• NOTE: Different tests have different cutoffs.
Many Athletic trainers don’t check test validity.  

Of athletic trainers using CNT for baseline testing how many check the tests to be sure they are valid? (Covassin, et al., 2009)

• 1209 U.S. institutions listed on the Impact web site were recruited and 399 AT’s responded to a survey.
  • 91.9% AT’s examined the test for validity!  If you do puts you in top 8%!
  • 88.4% reported that they administer CNT’s to football players
  • 78.8% administer CNT’s to women’s soccer players
  • 71.2% administer CNT’s to men’s soccer players

• 95.5% stated that they would not return a symptomatic athlete to play if the athlete’s neurocognitive scores were back to baseline.

• 96.5% stated that they not return a symptom free athlete whose scores were below baseline to play.

• 9.8% responded yes they would return such an athlete.

• 3.8% said it depended upon the importance of the competition.

• AT’s in this study reported that they relied more on symptoms than neurocognitive test scores when deciding return-to-play.

Concussion Vital Signs test report:  
Making checking validity easy.

Concussion Vital Signs presents testing results in (1) Subject (raw) and (2) Percentile scores. Results can be used to evaluate or monitor an athlete’s condition. Valid score results are generated by comparing the athlete’s raw scores to known validity criteria.

Key Advantage: Auto-Scored Testing Validity

Concussion Vital Signs Product Training

Reviewing post-injury reports.
After validity, back to baseline?

See this example in resources: 1st post injury report, p. 1

1st ?: Is it valid?

2nd ?: Is he back to baseline?
Reviewing post-injury reports

Graphic clarity.

See this example in resources: 1st post injury report, p. 2.

Quick scan tells you how far the athlete is from baseline.

---

Reviewing 2nd post-injury report

Graphic clarity.

See this example in resources: "2nd Post Injury report", p. 2.

Is he back to baseline?

Again, quick scan tells you how far the athlete is from baseline.

---

Scat2 Sideline App:
Automatically accessed with smart devices.

Data goes directly to same URL as baseline and follow up tests.

Pocket Scat 2
Components of SCAT2:

Concussion Vital Signs Product Training

Concussion Evaluation: SCAT2
Standardized Assessment of Concussion: SAC
Immediate Memory
Concentration

Continuity of care made easy: Clinician’s Portal.

Additional Clinical Training not required.
How might you recover from poorer sustained attention?

Cogmed Working Memory Training has been shown to improve working memory and attention in over 25 peer-reviewed published studies.

www.cogmed.com

Go to www.concussionvitalsigns.com for more information and to try out the test for free (see ‘demo’ tab)

Resources tab:
Downloadable resources available for your info.

Publications tab:
Over 90 references that have used Concussion Vital Signs in their studies.