



CNS Vital Signs Advancing Sleep Care

**Adding Value to Your Practice by Providing Solutions for Measuring,
Monitoring and Managing Neurocognitive and Behavioral Health...**

CNS
Vital Signs®

www.CNSVS.com

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The following pages have been assembled from various sources and publications and is meant to be a reference or roadmap guide to assist and inform how CNS Vital Signs can be used to improve clinical insight and care management, enable current guidelines, be integrated into a clinic or practice, and help improved practice revenues and performance.



Why CNS Vital Signs?

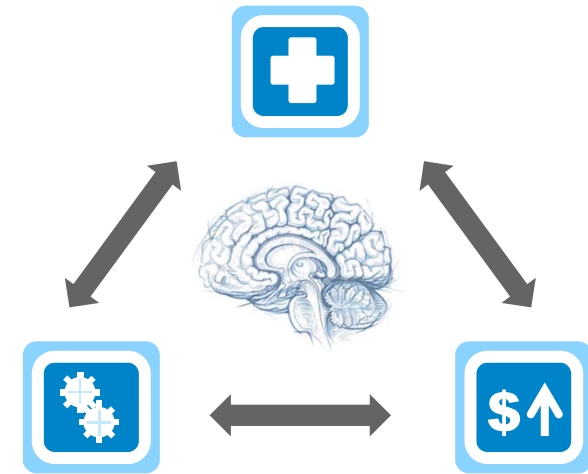
CNS Vital Signs **valid, reliable, and affordable** 'research quality' NEUROCOGNITIVE & BEHAVIORAL HEALTH assessment platform can be easily configured and deployed depending on each practices or researchers needs and goals. The CNS Vital Signs assessment platforms helps to support a practices comprehensive, state-of-the-art clinical assessment, and evidence-based treatment services for children, adolescents, and adults across the lifespan by:

- Accurately measuring and characterizing a patient's neurocognitive function based on his or her status or effort
- Facilitating the thinking about the patient's condition (50+ well known medical and health rating scales) and helping to explain the patient's current difficulties
- Optimizing serial administration which helps to monitor and guide effective intervention.
- *Systematically collecting brain function, behavioral, symptom, and comorbidity data **enabling outcomes and evidence-based medicine***



Enhanced Brain & Behavior Evaluation and Care Management

OBJECTIVE, PRECISE, and STANDARDIZED... Customizable Toolboxes or Test Panels Supporting many Neurological, Psychiatric, & Psychological Clinical Guidelines



Extend Practice Efficiency

Objective and Evidence-Based Assessments, Auto-Scored and Systematically Documented.
(HIPAA Enabled)

Enhanced Revenue Streams

Expanded Services with Well Established Billing Codes to Improve Practice Performance



Solutions for Measuring , Monitoring, and Managing Neurocognitive and Behavioral Health



Why CNS Vital Signs in Sleep Centers?

Benefits for Sleep Disorder Clinics

Improves Compliance

- Establishing a baseline can reveal to the patient what is wrong with his/her neurocognitive function motivating the sleep study and/or CPAP trial.
- *Experiencing the positive results of treatment is one of the most powerful motivators of compliance. (see case study)*

Demonstrates Treatment Efficacy and Measures Outcomes

- Making a cognitive baseline and serial assessments a part of a sleep plan allows for the longitudinal measurement of cognitive outcome values and the positive effect of adherence to CPAP therapy.
- Testing a patient's baseline and their progress creates a neurocognitive registry that can demonstrate to the insurer / HMO / employer the clinical value of your sleep program.

Improved Care Offering and New Procedure Revenues

- Contact CNS Vital Signs to learn about practice development and referral opportunities.

Fatigue resulting from reduced sleep and disrupted circadian rhythms is well established to cause significant decrements in cognitive performance (Caldwell, 1997; Dinges and Kribbs, 1995).



WHY CNS Vital Signs?

Assessing Brain Function: CNS Vital Signs is a clinical testing procedure used by clinicians to evaluate and manage the neurocognitive state of a patient. Across the lifetime, serial testing allows ongoing assessments of a patient's condition, disease progression, or clinical outcome.

About CNS Vital Signs

**Both Valid & Reliable
Neurocognitive Testing and
Evidence-Based Functional Ratings
Scales in one Platform**

Optimized for...

- **MULTI-MODAL Assessment** enabling the *efficient collection* and *systematic documentation* of important brain function and behavioral, symptom and comorbid clinical endpoints
- **Lifespan Testing** - *Rapid Neurocognitive Testing from ages 8 to 90*
- **Longitudinal View** - *CNS Vital Signs contains an Auto-Randomization Algorithm... Ideal for Serial Neurocognitive Testing with an almost unlimited number of alternate forms (others use a pseudo-randomization or limited number of alternate forms)*
- **Flexible Deployment** - *Easy Integration via Local Computer Software and Web-Based Testing Solutions... Ideal for busy clinics, hospitals, or academic research*

Clinician Benefits

- **RAPID INSIGHT...** computerized neurocognitive testing helps clinicians evaluate and describe the health of the cognitive or higher functions of the brain in a more granular and standardized fashion.
- **DASHBOARD VIEW...** Neurocognitive domain functions and functional status is presented in a summary view that is easy to interpret.
- **LONGITUDINAL VIEW...** Repeated testing allows clinicians to track disease progress and treatment/rehabilitation effects
- **DETAILED VIEW...** Each report presents the testing data in a detailed view. All results can be easily exported to EMR's or spreadsheets for clinical or research purposes.
- **VALID ACROSS the LIFE SPAN...** Peer reviewed normative data allows clinicians to examine patients from age 8 to 90.



Solutions for Measuring , Monitoring, and
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Introduction: CNS Vital Signs in Sleep

CNS Vital Signs provides clinicians and researchers with leading edge neurocognitive and behavioral health assessment technologies that efficiently collect valid and reliable brain & behavioral clinical endpoints for a more objective view of a patient's functional status, disease progression, and outcomes. The CNS Vital Signs Assessment platform supports a lifespan chronic care model and helps enable productive interactions between the family, caregivers, and a specialist practice team.

CNS Vital Signs is a clinical procedure that utilizes scientifically validated objective tests to evaluate the neurocognitive status of patients and covers a range of mental processes from simple motor performance, attention and memory, to executive functions. The CNS Vital Signs tests are computerized versions of well established neuropsychological tests. Medical professionals and researchers know that good health has many dimensions, one of the most important and yet least measured is the health of a person's brain. Outcomes based medicine seeks a quantitative estimate of the effect of impairment or disease and the effectiveness and efficiency of treatment. CNS Vital Signs provides a **standardized** and **quantitative** view of your patient's **CORE COGNITIVE FUNCTION**.

CNS Vital Signs computerized neuropsychological tests can enhance efficiency and insight in assessing cognitive status and the difference between "normal performance" and a patient's current status and provides the clinician with a normative comparison that can be paired with an interview, exam, and other valid test(s) or rating scales to help add validity to the evaluation and management of brain injuries. Re-evaluation or serial testing with CNS Vital Signs supports the effective management and tailoring of treatments e.g., CPAP or medications and assessment of outcomes. A very detailed assessment of abilities is auto-scored, and the pattern of strengths and weaknesses can be used in treatment planning and measuring progress.

One of the most robust features of the CNS Vital Signs assessment is its randomization algorithm allowing for an almost infinite number of alternate forms. This allows for retesting patients and minimal practice effects. Clinicians establish a baseline and upon re-test, compare the results to assist in decision-making regarding the observed change in the patient's condition, monitor disease or recovery progress, measure treatment results, compliance, and outcomes e.g., CPAP Therapy Management, Medication Optimization, Etc. Often Patients and families benefit from seeing testing results allowing the understanding of the status and nature of their or a loved one's neurocognitive function. CNS Vital Signs is one of many tools clinicians use in evaluating changes in a patient's condition.

If you have a question or would like to register for a free in-service webinar go to www.CNSVS.com or email support@cnsvs.com or call 1.888.750.6941.



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Why Use CNS Vital Signs to Assess Sleep?

The CNS Vital Signs VSX Assessment Platform represents a legacy of innovation and a commitment to advancing neurocognitive and behavioral clinical assessment tools.

Clinical Pathology

Measure and Monitor

Assess BRAIN FUNCTION and Determine the Existence or Level of IMPAIRMENT...

CNS Vital Signs computerized neurocognitive testing allows clinicians to **assess abnormal neurocognitive impairment** by comparing patients to a 'PEER REVIEWED' normative data set from **ages 8 to 90** across the lifespan

Provides a broad spectrum of clinical domains and the sensitivity to assess neurocognitive function to reveal abnormal cognitive function.

Comorbid Status

Measure and Monitor

Assess symptoms or COMORBID conditions...

Evidence-based rating scales and neurocognitive testing can help clinicians **sort out symptom, behavioral, and comorbid issues** and help better understand possible brain and behavior relationships.

50+ Free Rating Scales:

- Epworth Sleepiness Scale
- Pittsburgh Sleep Quality Index
- Sedation Scale
- Alertness Scale
- Zung Self-Rating Anxiety and Depression Scales
- NeuroPsych Questionnaire NPQ-207 & NPQ-45 both Child & Adult

Serial Assessment

Longitudinal View

KEY ADVANTAGE

...contains an **auto-randomization algorithm**... Ideal for serial testing with an **almost unlimited number of alternate forms** (other systems use a pseudo-randomization or limited number of alternate forms).

This allows practices to shift toward new assessment approaches that allow for monitoring of change and the reinforcement of treatment compliance.

Sleep-disordered breathing (characterized by recurrent arousals from sleep and intermittent hypoxemia) is common among older adults. Cross-sectional studies have linked sleep-disordered breathing to poor cognition; however, it remains unclear whether sleep-disordered breathing precedes cognitive impairment in older adults. Adapted from: JAMA August 2011



Solutions for Measuring, Monitoring, and Managing Neurocognitive and Behavioral Health



MANAGEMENT TEAM



Advancing Sleep Care

CNS Vital Signs Sleep Toolbox



Clinician Expertise

Brain Function: Memory,
Attentional, Executive,
Psychomotor Speed & more

Behaviors,
Symptoms, and
Comorbidities

Computerized Neurocognitive Testing

- Nine Neurocognitive Domains Measured
- Memory – Immediate and Delayed
- Frontal Lobe / Executive Control Tests
- Processing and Psychomotor Speed
- Immediate Auto – Scored Reports
- Rapid Assessment - 30 Minute Initial Assessment/Baseline, 15 Minute Follow-up for Treatment Effect
- Easy to Interpret
- Systematic & Standardized Documentation for Patient Registry/Research
- HIPAA Compliant

Computerized Medical and Health Rating Scales*

- Epworth Sleepiness Scale
- Pittsburgh Sleep Quality Index
- Sedation Scale
- Alertness Scale
- Zung Self-Rating Anxiety and Depression Scales
- NeuroPsych Questionnaire NPQ-207 & NPQ-45 both Child & Adult

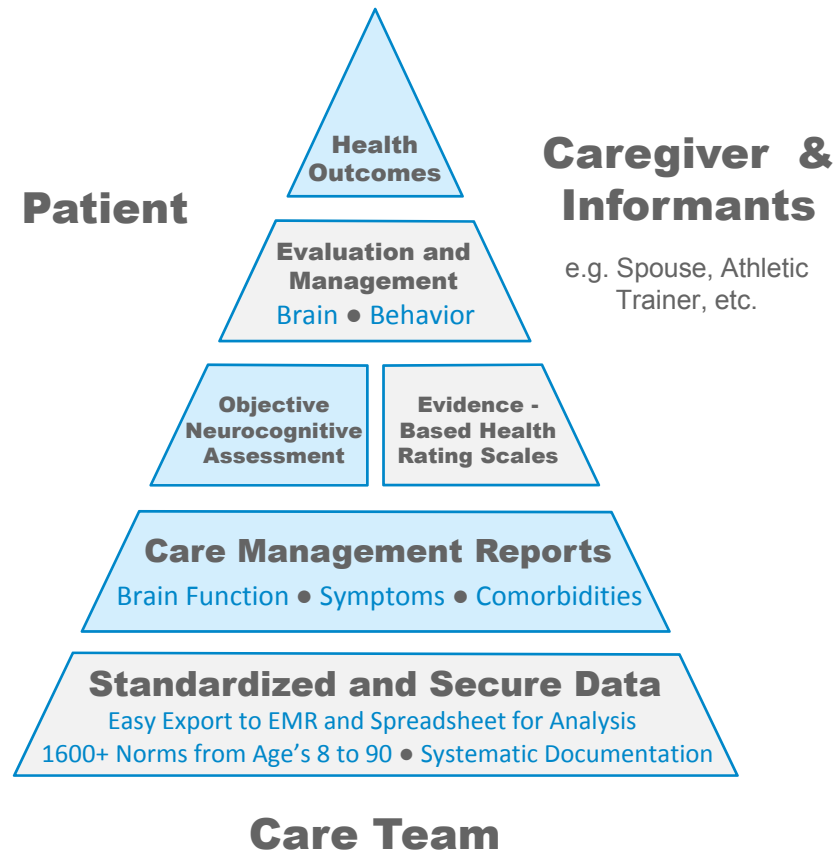
* Used with permission... Free use of rating scales



Solutions for Measuring , Monitoring, and
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Optimized for SLEEP Assessments



CNS Vital Signs Neurocognitive Battery in SLEEP

“Neurocognitive impairment is a well documented consequence of obstructive sleep apnea (OSA) but cognitive testing of OSA patients is rarely performed. This is partially due to the costly and laborious nature of traditional testing methods and an absence of test batteries with normative data on OSA patients. This study uses a validated and reliable computerized battery of standardized neurocognitive tests, which can be self-administered in approximately 30 minutes, to assess OSA patients... OSA patients in this study scored an average of 10.4 points (0.69 standard deviations) below the normative population mean. This is consistent with previous research on cognitive function using traditional testing methods and suggests that computerized neurocognitive tests may be an accessible method of evaluating cognitive performance associated with OSA. These values may provide a preliminary reference point for clinical interpretation of neurocognitive scores in OSA patients.”

Adapted from: The Utility of a Computerized Test Battery for Measurement of Cognitive Performance in Obstructive Sleep Apnea: Preliminary Normative Values; SLEEP 2011, Volume 34, Glidewell, Helm, Roby, Orr.

The CNS Vital Signs Sleep Toolbox helps clinicians systematically collect brain function, symptoms, and comorbidities data, automatically scoring and systematically documenting the resulting clinical endpoints.



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Every patient with SLEEP can have a Unique PROFILE.

1 Pre CPAP: May 12, 2011

Baseline Prior to Sleep Study

Dan, a thirty-nine year old male struggling vocationally was given CNS Vital Signs VSX BRIEF-CORE Clinical Battery... he scored low in 6 of 9 cognitive domains (pre-cpap).

After examining the H&P, the test results, and the SF-36, NPQ-45, and Epworth Sleep rating scales; Dan underwent a sleep study and was prescribed CPAP. Following four weeks of compliant CPAP therapy he was administered the CNS Vital Signs test again (post-cpap).

The CNS Vital Signs report is available seconds after the testing session ends and is a useful tool for *measuring treatment effect and helping clinicians reinforce CPAP compliance to maximize neurocognitive effect.*

Patient Profile:	Percentile Range				> 74	25 - 74	9 - 24	2 - 8	< 2
	Standard Score Range				> 109	90 - 109	80 - 89	70 - 79	< 70
Domain Scores	Subject Score	Standard Score	Percentile	VI**	Above	Average	Low Average	Low	Very Low
Neurocognition Index (NCI)	NA	81	10	Yes			x		
Composite Memory	86	75	5	Yes				x	
Verbal Memory	43	71	3	Yes				x	
Visual Memory	43	89	23	Yes			x		
Processing Speed	43	75	5	Yes				x	
Executive Function	35	78	7	Yes				x	
Psychomotor Speed	152	83	13	Yes			x		
Reaction Time*	642	95	37	Yes		x			
Complex Attention*	12	76	5	Yes				x	
Cognitive Flexibility	34	78	7	Yes				x	
Total Test Time (min: secs)	34:24				Total time taken to complete the tests shown.				

2 Post CPAP: June 24, 2011

Retest Following Four Weeks of Compliant CPAP

Patient Profile:	Percentile Range				> 74	25 - 74	9 - 24	2 - 8	< 2
	Standard Score Range				> 109	90 - 109	80 - 89	70 - 79	< 70
Domain Scores	Subject Score	Standard Score	Percentile	VI**	Above	Average	Low Average	Low	Very Low
Neurocognition Index (NCI)	NA	94	34	Yes		x			
Composite Memory	96	95	37	Yes		x			
Verbal Memory	48	87	19	Yes			x		
Visual Memory	48	106	66	Yes		x			
Processing Speed	62	103	58	Yes		x			
Executive Function	45	93	32	Yes		x			
Psychomotor Speed	178	100	50	Yes		x			
Reaction Time*	674	89	23	Yes			x		
Complex Attention*	7	94	34	Yes		x			
Cognitive Flexibility	43	91	27	Yes		x			
Total Test Time (min: secs)	28:39				Total time taken to complete the tests shown.				

"I was like "WOW what a difference" when I was able to see the benefits of the CPAP machine..."

Sleep Study Participant

"It was like getting my old husband back... he wanted to quit the CPAP machine... I said let's give it 3 weeks more... now I think he is motivated."

Sleep Study Participant Spouse



Solutions for Measuring, Monitoring, and Managing Neurocognitive and Behavioral Health



10

Sleep Case Study

1 PRE: Part of Sleep Assessment Protocol

Dan a 39 Year Old Male Office Worker: Epworth Sleepiness Scale

In contrast to just feeling tired, how likely are you to doze off or fall asleep in the following situation?		
1	Sitting and reading	3 - High chance of dozing
2	Watching TV	2 - Moderate chance of dozing
3	Sitting inactive in a public place (e.g., a theater or a meeting)	2 - Moderate chance of dozing
4	As a passenger in a car for an hour without a break	1 - Slight chance of dozing
5	Lying down to rest in the afternoon when circumstances permit	2 - Moderate chance of dozing
6	Sitting and talking to someone	0 - Would never doze
7	Sitting quietly after a lunch without alcohol	0 - Would never doze
8	In a car, while stopped for a few minutes in traffic	0 - Would never doze
Epworth Score		10

The patient is getting enough sleep if they score 6 or less. Scores of 7 or 8 are average. If the patients score is 9 or more they should seek the advice of a sleep specialist without delay

NeuroPsych Questionnaire (NPQ) SF-45

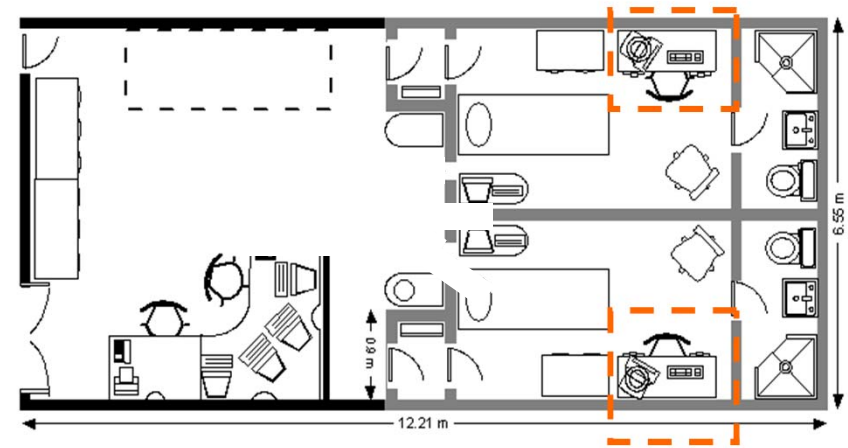
Domain	Score	Severity	Description
Attention	190	Moderate	The Neuropsych Questionnaire Short Form asks patients (or an appropriate observer) a series of questions about their clinical state. The questions are about the symptoms of various neuropsychiatric disorders. The terminology is similar to that used in the diagnostic manuals, and in many familiar clinical questionnaires and rating scales; but it has been simplified, and all symptoms are scored on the same metric. Scores are reported on a scale of 0 (not a problem) to 300 (severe). As a rule, scores above 225 indicate a severe problem; scores from 150-224 indicate a moderate problem; and scores from 75-149, a mild problem. A high score on the Neuropsych Questionnaire Short Form means that the patient is reporting more symptoms of greater intensity. It doesn't necessarily mean that the patient has a particular condition; just that he or she (or their spouse, parent or caregiver) are saying that they have a lot of intense symptoms. Conversely, a low score simply means that the patient (or caregiver) is not reporting symptoms associated with a particular condition, at least during the period of time specified. It does not mean that the patient does not have the condition. Just as some people over-state their problems, others tend to under-state their problems. The Neuropsych Questionnaire Short Form is not a diagnostic instrument. The results it generates are only meant to be interpreted by an experienced clinician in the course of a clinical examination.
Impulsive	217	Moderate	
Memory	200	Moderate	
Anxiety	220	Moderate	
Panic	120	Mild	
Depression	182	Moderate	
Mood Stability	188	Moderate	
Aggression	120	Mild	
Fatigue	233	Severe	
Sleep	300	Severe	
Suicide	40	Not a Problem	
Pain	120	Mild	



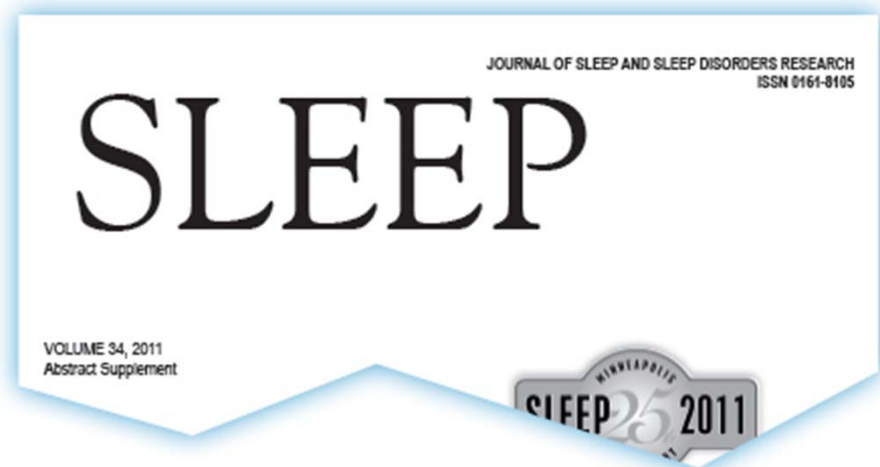
Improving Treatment Compliance while Documenting Outcomes.

The CNS Vital Signs BRIEF CORE computerized neuropsychological assessment and its autoscored sleep rating scales (*Epworth, Pittsburgh Sleep Quality Index, Sedation Scale, Alertness Scale*) can provide clarification and grading of the clinical severity of cognitive impairment for patients with subclinical or obvious cognitive deficits. CNS Vital Signs serves as an extension of the basic Neuro / Psych examination, and it employs standardized measures to quantify a performance at a given time. However, computerized neuropsychological assessments are only a part of the clinical picture by themselves and must be interpreted and integrated with other clinical, imaging, physical examination, and laboratory information.

Sleep Clinics are ideal locations for CNS Vital Signs assessments.



Valid & Reliable in Assessing Sleep



The Utility of a Computerized Test Battery for Measurement of Cognitive Performance in Obstructive Sleep Apnea: Preliminary Normative Values

AUTHORS: Robert N. Glidewell 1, Kristy Helm 2, Emily Roby 1, William Orr 3, 1;

1. Sleep Medicine, Lynn Institute of the Rockies, Colorado Springs, CO, United States. 2. Clinical Trials Research, Lynn Institute of the Rockies, Colorado Springs, CO, United States. 3. Sleep Medicine, Lynn Health Science Institute, Oklahoma City, OK, United States.

Introduction: Neurocognitive impairment is a well documented consequence of obstructive sleep apnea (OSA) but cognitive testing of OSA patients is rarely performed. This is partially due to the costly and laborious nature of traditional testing methods and an absence of test batteries with normative data on OSA patients. This study uses a validated and reliable computerized battery of standardized neurocognitive tests, which can be self-administered in approximately 30 minutes, to assess OSA patients.

Methods: We studied 47 OSA patients diagnosed by polysomnography (Apnea Hypopnea Index [AHI] ≥ 5 or Respiratory Distress Index [RDI] ≥ 15 scored using current AASM guidelines). Each patient completed the Central Nervous System-Vital Signs (CNS-VS) test battery prior to OSA treatment. The CNS-VS battery includes tests of immediate and delayed verbal and visual memory; finger tapping; symbol digit coding; Stroop test; shifting attention; and continuous performance. Results of the CNS-VS are reported as Standard Scores in which the normative sample has a mean of 100 with a standard deviation of 15.

Results: The sample was 44% male. The mean age was 47.8 years old. The mean BMI was 32.5. The mean AHI and RDI were 31.5 and 42.6 respectively. Mean Standard Scores for each neurocognitive domain are: Neurocognitive Index 87.6, Composite Memory 95.6, Verbal Memory 93.0, Visual Memory 99.9, Psychomotor Speed 85.3, Reaction Time 91.0, Complex Attention 82.6, Cognitive Flexibility 85.9, Processing Speed 91.0, and Executive Function 85.0.

Conclusion: OSA patients in this study scored an average of 10.4 points (0.69 standard deviations) below the normative population mean. This is consistent with previous research on cognitive function using traditional testing methods and suggests that computerized neurocognitive tests may be an accessible method of evaluating cognitive performance associated with OSA. These values may provide a preliminary reference point for clinical interpretation of neurocognitive scores in OSA patients.



Valid & Reliable in Assessing Sleep

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 Psychology Press
Taylor & Francis Group

Abstracts of Division 40 Annual Meeting

ARMSTRONG, L., GLIDEWELL, R. N., ROBY, E., & ORR, W.

Examining the Predictive Validity of Computer-Administered Neuropsychological Assessment on CPAP Adherence in Adults with Obstructive Sleep Apnea

<http://www.tandfonline.com/doi/pdf/10.1080/13854046.2011.586603>

The purpose of this study was to examine the utility of a computer administered neuropsychological assessment for predicting continuous positive airway pressure (CPAP) treatment adherence in adult patients diagnosed with obstructive sleep apnea (OSA). Using executive functioning and cognitive flexibility composite standard scores ($M=100$, $SD=15$) as predictors and CPAP adherence as the criterion, results from a linear regression analysis revealed that the combined scores of executive functioning and cognitive flexibility contributed significantly to the variance of CPAP adherence in adults with OSA, $R^2=.461$, $F(2)=3.37$, $p=.051$.



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CNS Vital Signs Reimbursement in Sleep?

“CNS Vital Signs is a resource that we use to help our sleep centers enhance patient care, motivate improved patient compliance to CPAP therapy, demonstrate the need for treatment, as well as, provide scientifically validated and objective outcomes on patient response to sleep therapy for insurers. The applicable Dx codes that we usually bill with are ICD-9 codes 327.23 Obstructive Sleep Apnea, 780.59 Other Sleep Disturbances, or 294.9 Cognitive Disorder, NOS. Typically on the initial patient visit we do an examination and CNS Vital Signs assessment which bills as 96116 (neurobehavioral status examination) and 96119 (CNS Vital Signs test with technician). When I compile and integrate the patient report which includes a therapy plan and implementation schedule I bill the professional component for results integration 96118. The average collection for this type of cognitive testing procedures is \$179. Example reimbursements in our area for 96116 are Medicare is \$89.63 and for our largest 3rd party \$98.08. CPT code 96119 is \$75.36 and 96118 is \$98.83 for our largest third party payer.”

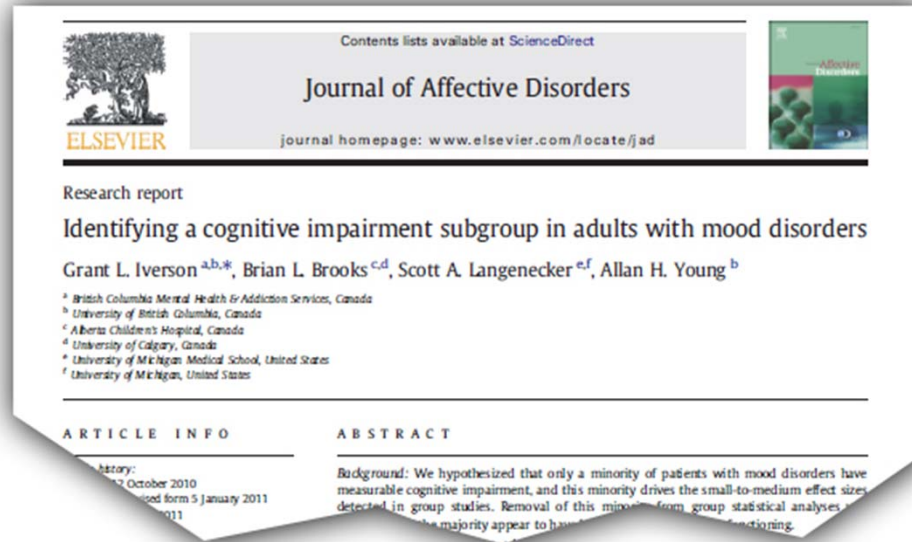
Clinical Director of Large Sleep Center

NOTE: Reimbursement will vary by Payer and Location.



Helping Assess Comorbidities

Cognition and Depression



“Indeed, there is some suggestion that cognitive or executive functioning deficits may be a trait risk factor for depression (Douglas and Porter, 2009; Frasch et al., 2009; Micco et al., 2009; Reppermund et al., 2009). Furthermore, worse neuropsychological test performance at baseline is associated with poorer response to treatment (Dunkin et al., 2000; Kampf-Sherf et al., 2004; Mohlman and Gorman, 2005), and cognitive deficits are more pronounced in patients who are unemployed (Baune et al., 2010). It is possible that treatment refractory depression is a subtype characterized in part by cognitive impairment.

The accurate identification and quantification of neurocognitive impairment are important for research relating to neurobiological underpinnings, treatment, and functional outcome in patients with mood disorders. It is essential, methodologically, that we have accurate methods for identifying those patients who are objectively cognitively impaired and separate them from patients who have the subjective experience of poor thinking skills or thinking that is easily perturbed by negative affect, but perform normally on cognitive testing in controlled conditions. The treatments and outcomes for these two groups may differ markedly, as well as the prognosis.”

Source: Identifying a cognitive impairment subgroup in adults with mood disorders. J Affect Disord. 2011 Aug;132(3):360-7. Epub 2011 Mar 25.

<http://www.ncbi.nlm.nih.gov/pubmed/21439647>



Cognition and Depression

Cognitive Flexibility

Domain scored from two venerable AD/HD tests

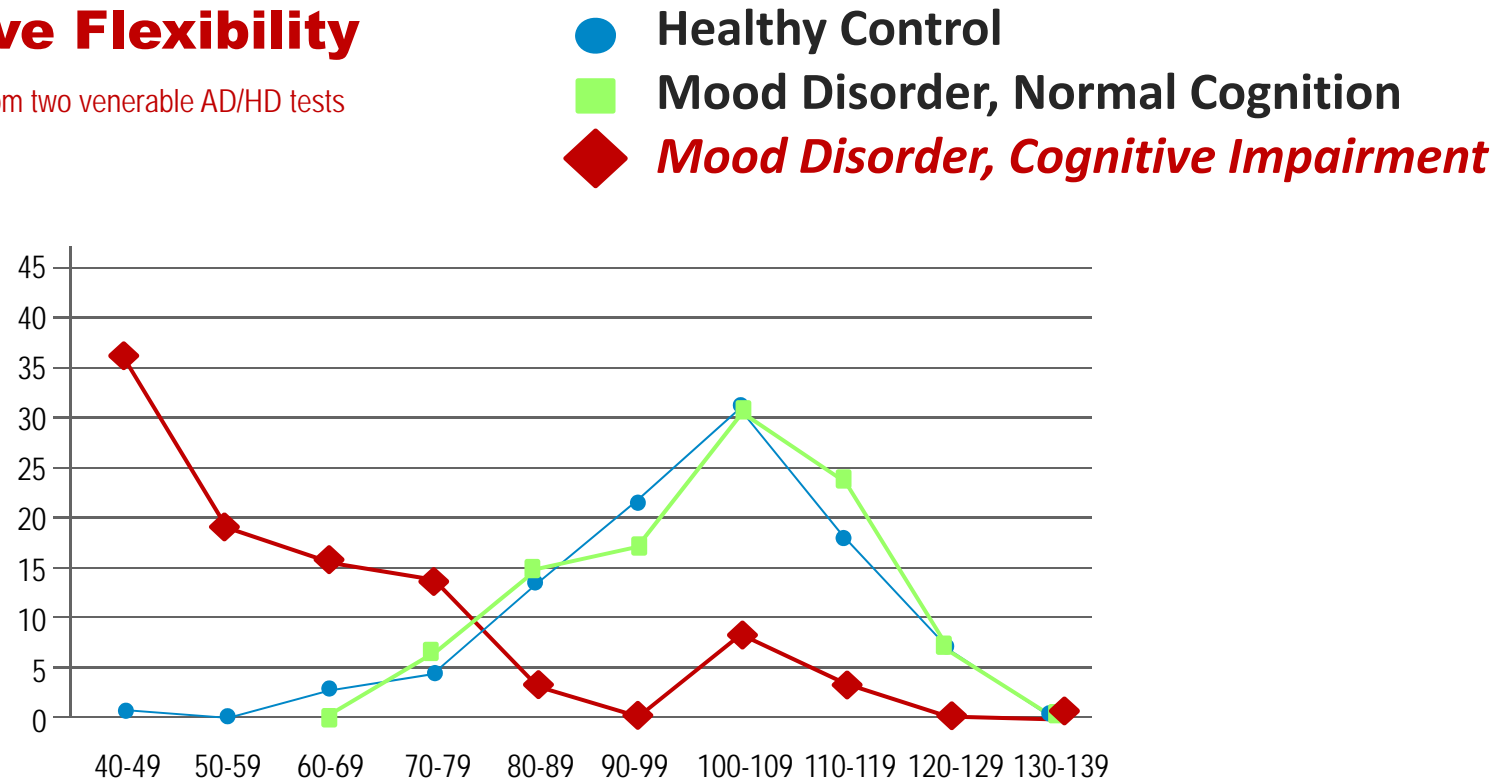
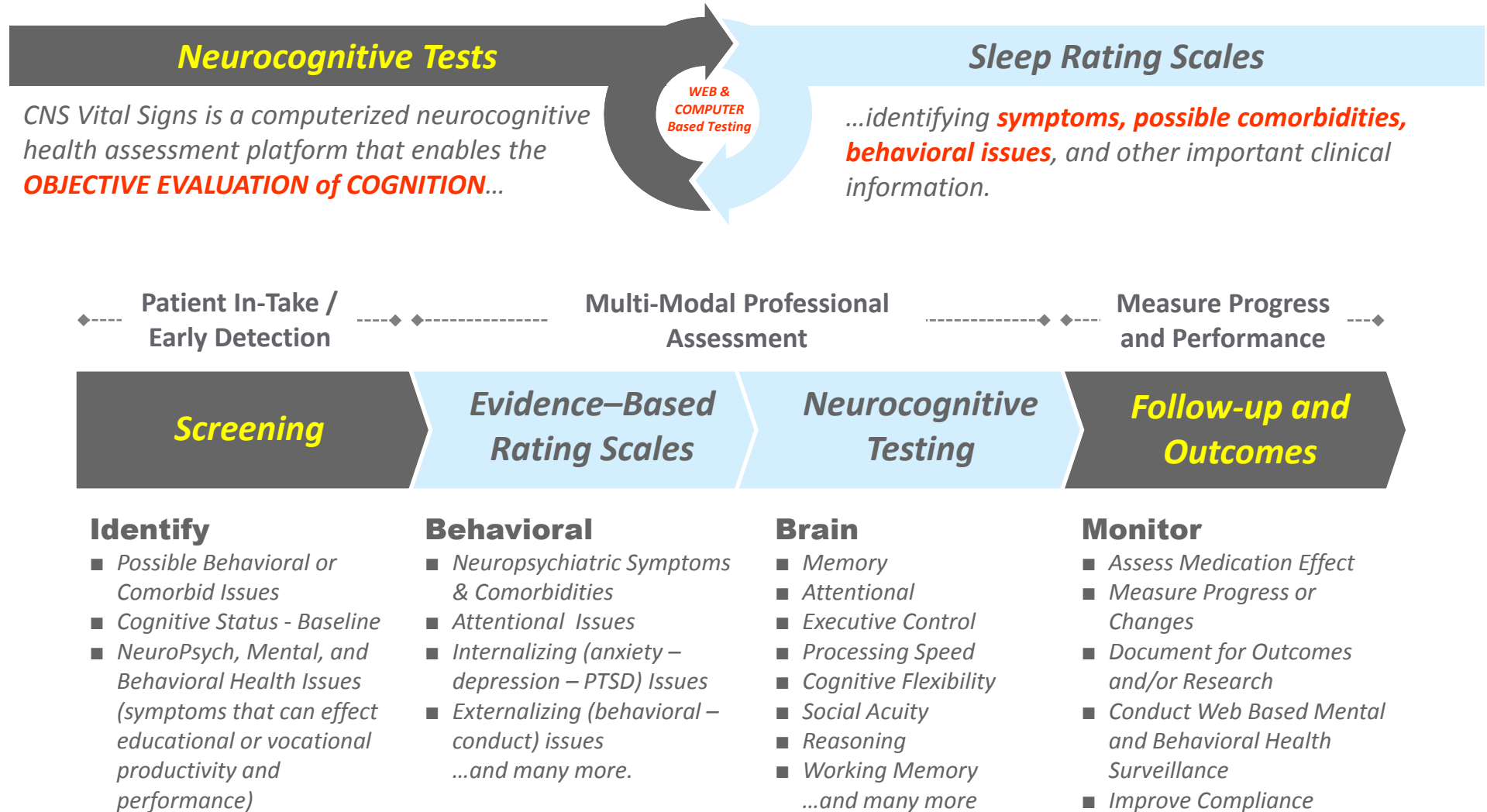


Fig. 3. Distributions of **CNS Vital Signs** *cognitive flexibility* index score in patients with or without impaired cognition. Figure note: Healthy control, N=660. Mood disorder, normal cognition, n=128. Mood disorder, cognitive impairment, n=58. *Normative scores were truncated at 40. Each value represents the percentage of subjects in that score range.



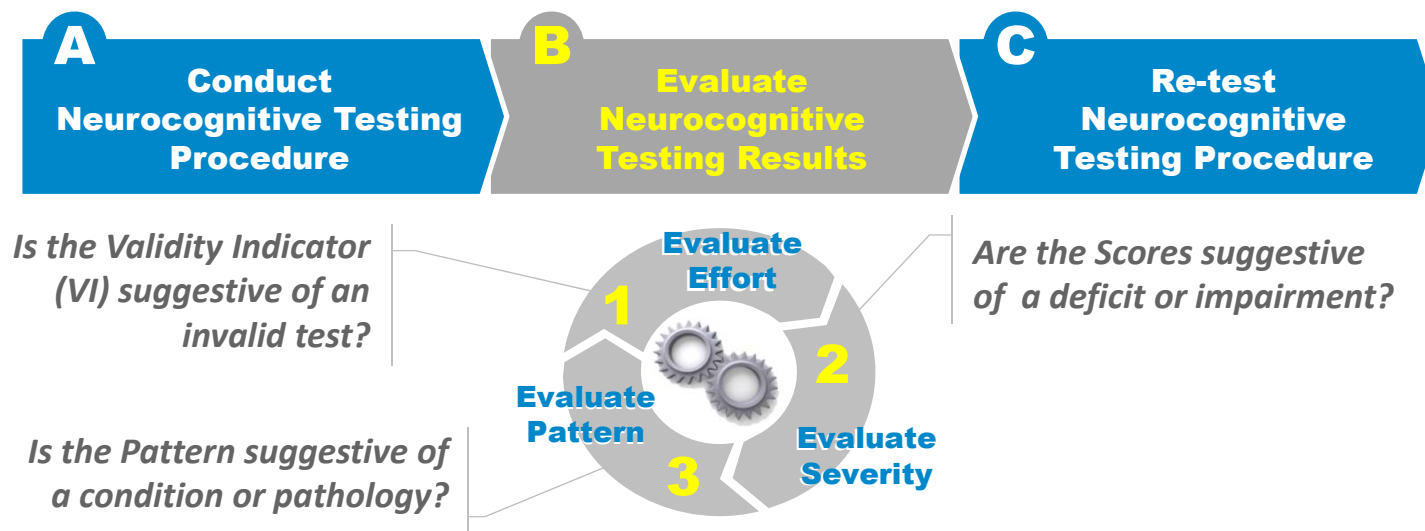
A Systems Based Approach



SOPHISTICATED... yet... SIMPLE Systems-Based approach to Screening, Assessment, & Surveillance...



HOW? CNS Vital Signs begins with...



A: Conducting a Valid Assessment (Refer to the Test Administration Guide.) To begin the staff should collect information about the CHIEF or REFERRAL COMPLAINT. This will be a primary driver for the selection of tests and rating scales. For initial evaluations or in complex presentations, a broad spectrum battery is always an appropriate starting point.

B: Review the immediately auto-scored report to **1** validate testing effort, **2** evaluate the Domain Dashboard to quickly assess the level of impairment or grade the deficit, and **3** Evaluate the Domain Pattern to help rule-in, rule-out, or confirm certain clinical conditions. Feedback to the patient on the testing results may be presented at the clinical encounter or at a subsequent patient visit.

C: If invalid test results were noted then consider re-testing the patient to confirm clinical results. If the test results were valid, then, as part a continuum of care, reschedule testing to track disease progression and measure ongoing status or outcomes.

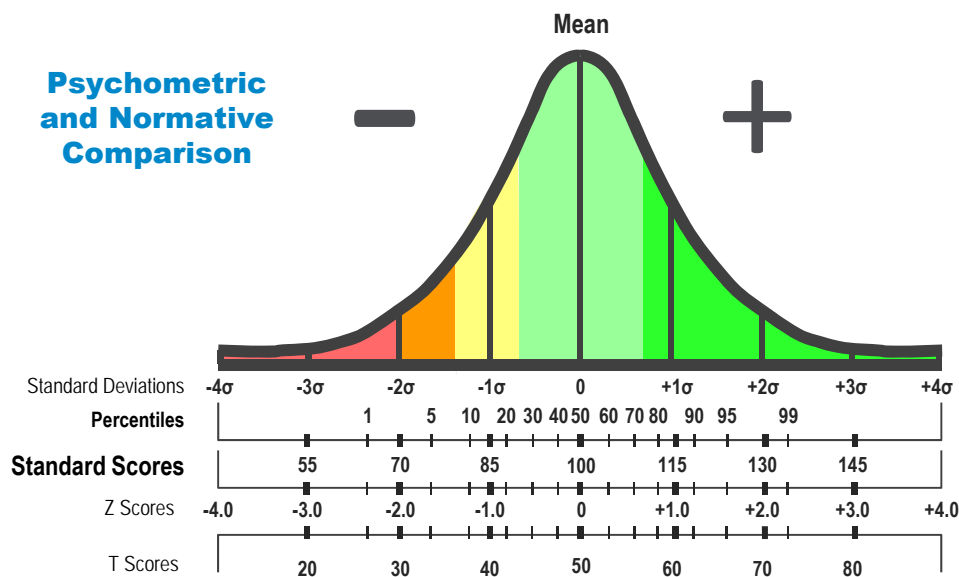
NOTE: The **Validity Indicator** denotes a guideline for representing the possibility of an invalid test or domain score. “No” means a clinician should evaluate whether or not the test subject understood the test, put forth their best effort, or has a clinical condition requiring further evaluation.



Evaluate Severity – Impairment Status

CNS Vital Signs grades *severity of impairment* based on an age-matched normative comparison database... mTBI Example

Psychometric and Normative Comparison



Above:	> 110	High Function and High Capacity
Average:	90 - 110	Normal Function and Normal Capacity
Low Average:	80 - 90	Slight Deficit and Slight Impairment
Low:	70 - 79	Moderate Deficit and Impairment Possible
Very Low:	< 70	Deficit and Impairment Likely

Standard Scores

CNS Vital Signs Clinical Report					Test Date: July 23 2011 10:48:38				
Subject ID: mTBI or AD/HD					Administrator: Technician				
Language: English (United States)					Age: 27				
Patient Profile:	Percentile Range				> 74	25 - 74	9 - 24	2 - 8	< 2
	Standard Score Range				> 109	90 - 109	80 - 89	70 - 79	< 70
Domain Scores	Subject Score	Standard Score	Percentile	VI**	Above	Average	Low Average	Low	Very Low
Neurocognition Index (NCI)	NA	85	16	Yes			X		
Composite Memory	102	103	58	Yes		X			
Verbal Memory	51	93	32	Yes		X			
Visual Memory	51	110	75	Yes	X				
Processing Speed	48	79	8	Yes				X	
Executive Function	34	75	5	Yes				X	
Psychomotor Speed	174	93	32	Yes		X			
Reaction Time*	555	107	68	Yes		X			
Complex Attention*	21	56	1	Yes					X
Cognitive Flexibility	26	63	1	Yes					X
Total Test Time (min: secs)	29:12				Total time taken to complete the tests shown.				
Domain Dashboard: Above average domain scores indicate a standard score (SS) greater than 109 or a Percentile Rank (PR) greater than 74, indicating a high functioning test subject. Average is a SS 90-109 or PR 25-74, indicating normal function. Low Average is a SS 80-89 or PR 9-24 indicating a slight deficit or impairment. Below Average is a SS 70-79 or PR 2-8, indicating a moderate level of deficit or impairment. Very Low is a SS less than 70 or a PR less than 2, indicating a deficit and impairment. Reaction times are in milliseconds. An * denotes that "lower is better", otherwise higher scores are better. Subject Scores are raw scores calculations generated from data values of the individual subtests.									
VI** - Validity Indicator: Denotes a guideline for representing the possibility of an invalid test or domain score. "No" means a clinician should evaluate whether or not the test subject understood the test, put forth their best effort, or has a clinical condition requiring further evaluation.									
Verbal Memory Test (VBM)					Score	Standard	Percentile		
Correct Hits - Immediate					13	102	55	Verbal Memory Test: Subjects have to remember 15 words and recognize them in a field of 15 distractors. The test is repeated at the end of the battery. The VBM test measures how well a subject can recognize, remember, and retrieve words e.g. exploit or attend literal representations or attribute. "Correct Hits" refers to the number of target words recognized. Low scores indicate verbal memory impairment.	
Correct Passes - Immediate					14	95	37		
Correct Hits - Delay					9	85	16		
Correct Passes - Delay					15	109	73		
Visual Memory Test (VIM)					Score	Standard	Percentile		
Correct Hits - Immediate					13	107	68	Visual Memory Test: Subjects have to remember 15 geometric figures, and recognize them in a field of 15 distractors. The test is repeated at the end of the battery. The VIM test measures how well a subject can recognize, remember, and retrieve geometric figures e.g. exploit or attend symbolic or spatial representations. "Correct Hits" refers to the number of target figures recognized. Low scores indicate visual memory impairment.	
Correct Passes - Immediate					14	117	87		
Correct Hits - Delay					13	111	77		
Correct Passes - Delay					11	93	32		
Finger Tapping Test (FTT)					Score	Standard	Percentile		
Right Taps Average					64	104	61	The FTT is a test of motor speed and fine motor control ability. There are three rounds of tapping with each hand. The FTT test measures the speed and the number of finger-taps with each hand. Low scores indicate motor slowing. Speed of manual motor activity varies with handedness. Most people are faster with their preferred hand but not always.	
Left Taps Average					60	105	63		
Symbol Digit Coding (SDC)					Score	Standard	Percentile		
Correct Responses					50	80	9	The SDC test measures speed of processing and draw upon several cognitive processes simultaneously, such as visual scanning, visual perception, visual memory, and motor functions. Errors may be due to impulsive responding, misperception, or confusion.	
Errors*					2	92	30		
Stroop Test (ST)					Score	Standard	Percentile		
Simple Reaction Time*					231	108	70	The ST measures simple and complex reaction time, inhibition / disinhibition, mental flexibility or directed attention. The ST helps assess how well a subject is able to adapt to rapidly changing and increasingly complex set of directions. Prolonged reaction times indicate cognitive slowing / impairment. Errors may be due to impulsive responding, misperception, or confusion.	
Complex Reaction Time Correct*					542	100	50		
Stroop Reaction Time Correct*					568	112	79		
Stroop Commission Errors*					8	5	1		
Shifting Attention Test (SAT)					Score	Standard	Percentile		
Correct Responses					47	82	12	The SAT measures executive function or how well a subject recognizes set shifting (mental flexibility) and abstraction (rules, categories) and manages multiple tasks simultaneously. Subjects have to adjust their responses to randomly changing rules. The best scores are high correct responses, few errors and a short reaction time. Normal subjects may be slow but accurate, or fast but not so accurate. Attention deficit may be apparent.	
Errors*					13	75	5		
Correct Reaction Time*					1003	97	42		
Continuous Performance Test (CPT)					Score	Standard	Percentile		
Correct Responses					40	104	61	The CPT measures sustained attention or vigilance and choice reaction time. Most normal subjects obtain near-perfect scores on this test. A long response time may suggest cognitive slowing and/or impairment. More than 2 errors (total) may be clinically significant. More than 4 errors (total) indicate attentional dysfunction.	
Omission Errors*					0	104	61		
Commission Errors*					0	108	70		
Choice Reaction Time Correct*					400	99	47		

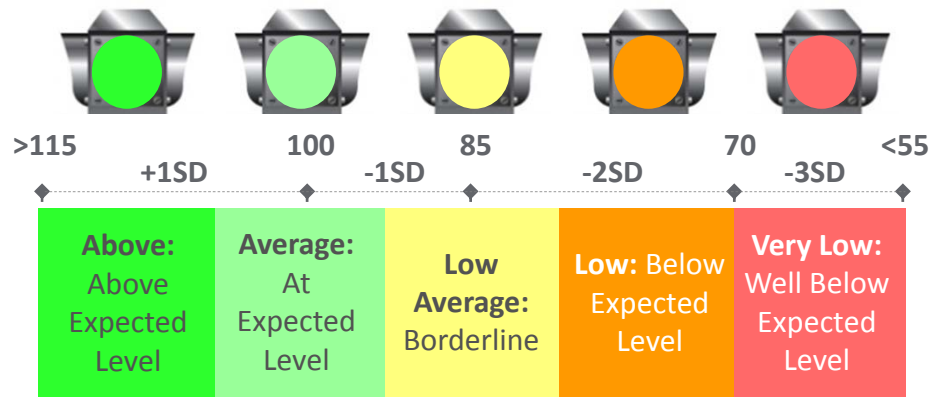


Solutions for Measuring, Monitoring, and Managing Neurocognitive and Behavioral Health



Neurocognitive Domain Dashboard mTBI Example

*CNS Vital Signs presents testing results in Subject (raw), Standard Scores, and Percentile Ranks. **NOTE: See the CNS Vital Signs Interpretation Guide for more information.***



Patient Profile:	Percentile Range				> 74	25 - 74	9 - 24	2 - 8	< 2
	Standard Score Range				> 109	90 - 109	80 - 89	70 - 79	< 70
Domain Scores	Subject Score	Standard Score	Percentile	VI**	Above	Average	Low Average	Low	Very Low
Neurocognition Index (NCI)	NA	85	16	Yes			x		
Composite Memory	102	103	58	Yes		x			
Verbal Memory	51	93	32	Yes		x			
Visual Memory	51	110	75	Yes	x				
Processing Speed	48	79	8	Yes				x	
Executive Function	34	75	5	Yes				x	
Psychomotor Speed	174	93	32	Yes		x			
Reaction Time*	555	107	68	Yes		x			
Complex Attention*	21	56	1	Yes					x
Cognitive Flexibility	26	63	1	Yes					x
Total Test Time (min: secs)	29:12				Total time taken to complete the tests shown.				

SD = Standard Deviation from the MEAN



CNS Vital Signs Embedded Indicators of Valid Effort

One factor that has been consistently shown to be related to poor outcome after a TBI is litigation/compensation. For example, a meta-analysis of 17 studies on the effects of financial incentives on recovery after TBI found that involvement in litigation for financial compensation was consistently associated with poor outcomes after MTBI (Binder & Rohling, 1996(49)). In that study the authors noted the effect was strongest for mild head injury.

A key advantage to the VSX assessment platform is the autoscoring of embedded indicators of patient testing effort. As with all psychological and neuropsychological testing neuropsychiatric patients can feign their responses due to incentives. When analyzing test data, either in research, or in clinical practice, it is important to know whether a test result is valid or not. Clinicians need to know if testing subjects are generating “dubious results” or a “non-credible response pattern.” CNS Vital Signs has developed “validity indicators” for its tests and domains that indicate whether the patient gave poor effort or generated invalid results. Should a subject test abnormally low triggering an “invalid” test (NO as displayed in the Validity Indicator section of the report) then that would be a reason for retesting the individual, unless your clinical judgment makes you believe that is the best score the patient can achieve. Additional Information is available at our website

Clinical Domains	Test Validity Indicators
Composite Memory	Both Verbal and Visual Memory valid.
Verbal Memory	Verbal Memory raw score > 30.
Visual Memory	Visual Memory raw score > 30.
Processing Speed	SDC: more than 20 correct responses.
Executive Function	SAT errors < SAT correct responses.
Psychomotor Speed	FTT: total taps > 40 & or SDC: > 20 correct responses
Reaction Time	Stroop: Simple RT < Complex RT < Stroop RT
Complex Attention	Valid Stroop, CPT, and SAT. Correct > incorrect response in all tests.
Cognitive Flexibility	Valid Stroop and SAT. Correct > incorrect responses in all tests.
Non-Verbal Reasoning	NVR correct responses > 4. Correct > incorrect responses.
Social Acuity	POET correct responses > 3. Correct > incorrect responses
Sustained Attention	Valid 4PCPT: Part 2 > 2 correct; part 3 > 5 correct; part 4 > 5 correct. Correct > incorrect responses in all
Working Memory	parts.

FTT - Finger Tapping Test; SAT – Shifting Attention Test; SDC – Symbol Digit Coding Test; RT – Reaction Time; CPT – Continuous Performance Test; POET – Perception of Emotions Test; NVR – Non-verbal Reasoning; 4PCPT – Four Part CPT



Calculating Domain Scores

VSX BRIEF-CORE Clinical Domains	Domain Score Calculations: 1900+ Norms, Ages 8 to 90
Neurocognition Index - NCI	Average of five domain scores: Composite Memory, Psychomotor Speed, Reaction Time, Complex Attention, and Cognitive Flexibility; representing a form of a global score of neurocognition
Composite Memory	VBM Correct Hits Immediate + VBM Correct Passes Immediate + VBM Correct Hits Delay + VBM Correct Passes Delay + VIM Correct Hits Immediate + VIM Correct Passes Immediate + VIM Correct Hits Delay + VIM Correct Passes Delay
Verbal Memory	VBM Correct Hits Immediate + VBM Correct Passes Immediate + VBM Correct Hits Delay + VBM Correct Passes Delay
Visual Memory	VIM Correct Hits Immediate + VIM Correct Passes Immediate + VIM Correct Hits Delay + VIM Correct Passes Delay
Processing Speed	SDC Correct Responses - SDC Errors
Executive Function	SAT Correct Responses - SAT Errors
Psychomotor Speed	FTT Right Taps Average + FTT Left Taps Average + SDC Correct Responses
Reaction Time	(ST Complex Reaction Time Correct + Stroop Reaction Time Correct) / 2
Complex Attention	Stroop Commission Errors + SAT Errors + CPT Commission Errors + CPT Omission Errors
Cognitive Flexibility	SAT Correct Responses - SAT Errors - Stroop Commission Errors
VSNP Clinical Domains	Domain Score Calculations: 700+ Norms, Ages 8 to 90
Working Memory	(4PCPT Part 4 Correct Responses) - (4PCPT Part 4 Incorrect Responses)
Sustained Attention	(4PCPT Part 2 Correct Responses + 4PCPT Part 3 Correct Responses + 4PCPT Part 4 Correct Responses) - (4PCPT Part 2 Incorrect Responses + 4PCPT Part 3 Incorrect Responses + 4PCPT Part 4 Incorrect Responses)
Social Acuity	POET Correct Responses - POET Commission Errors
Reasoning (non-verbal)	NVRT Correct Responses - NVRT Commission Errors

Abbreviations Defined:

VBM – Verbal Memory Test; VIM – Visual Memory Test; SDC – Symbol Digit Coding Test; SAT – Shifting Attention Test; FTT - Finger Tapping Test; ST – Stroop Test; CPT – Continuous Performance Test; 4PCPT – Four Part CPT; POET – Perception of Emotions Test; NVR – Non-verbal Reasoning Test.



NEXT STEPS:

Contact Us...

Getting Started

Step One: Register at www.CNSVS.com
After registering download the VSX 'Brief-Core'
Assessment Software with 5 FREE Test Sessions...
Take it for a test drive.

Step Two: *Schedule a FREE One-on-One In-Service Webinar...* Contact CNS Vital Signs Support support@cnsvs.com with dates and times that you will be available.

After the webinar the total CNS Vital Signs Assessment platform (Web & Local) can be configured to meet your practice needs.

Contact me to receive report examples, case studies, administration guides etc.

- **Website:** www.CNSVS.com
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- **Email:** support@cnsvs.com
- **Address:**
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"The webinar training was terrific... it covered the Validity & Reliability of the platform, the interpretation of results, billing and coding, testing protocol, and the integration of the CNS Vital Signs platform into our practice." Practice Administrator

