# CNS Vital Signs Advancing Cancer Cognition “ChemoBrain” Care

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

CNS Vital Signs

www.CNSVS.com

# Contents



***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.***



# Another Side Effect Of Chemotherapy: 'Chemo Brain'

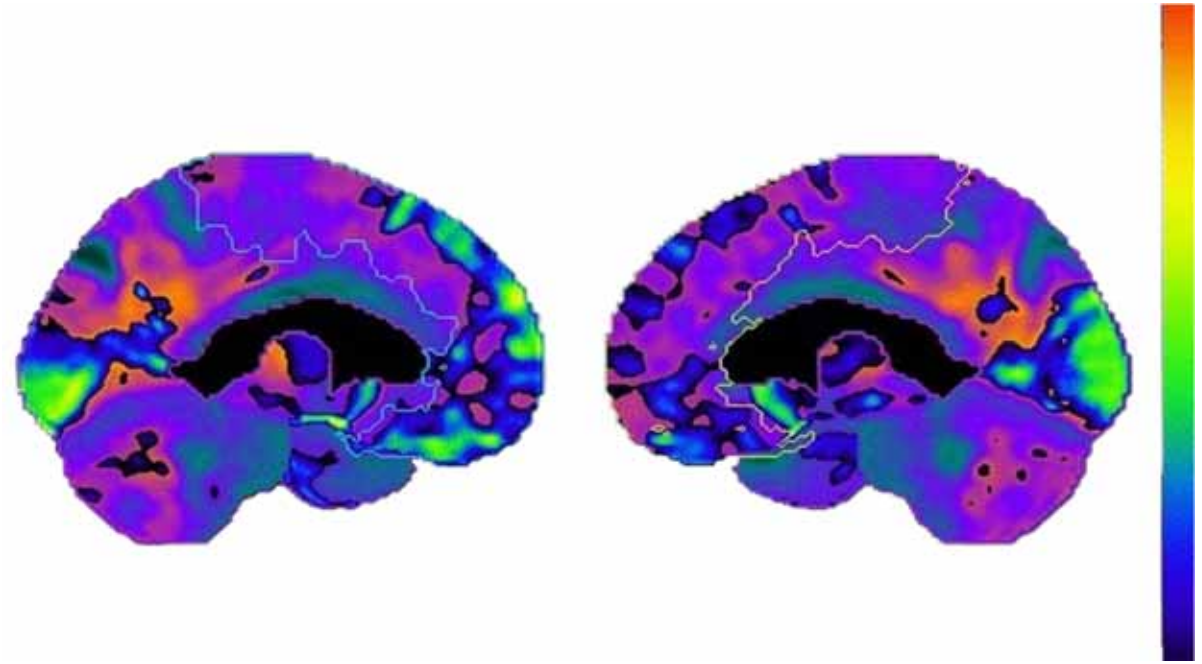
***NPR Story by PATTI NEIGHMOND***
***December 28, 2012 3:25 AM***

It's well-known that chemotherapy often comes with side effects like fatigue, hair loss and extreme nausea. What's less well-known is how the cancer treatment affects crucial brain functions, like speech and cognition…

…Before getting treated for cancer, Hunter led a busy, active lifestyle. But the effects of chemotherapy on her brain made it difficult for her to do even the most basic things.

. ... It literally felt like you were trying to fight your way through fog."

Some cancer patients call this mental fog "chemo brain." And now researchers are trying to quantify exactly what chemo brain really is.



**Dr. Jame Abraham used positron emission tomography, or PET, scans to understand differences in brain metabolism before and after chemotherapy.**

Oncologist Jame Abraham a professor at West Virginia University, says about a quarter of patients undergoing chemotherapy have trouble processing numbers, using short-term memory and focusing their attention.

Using positron emission tomography, or PET, scans to measure blood flow and brain activity, Abraham looked at the brains of 128 breast cancer patients before they started chemotherapy and then again, six months later. On the second brain scan, he found significant ***decreases in brain activity in regions responsible for memory, attention, planning and prioritizing.***

# The Issue: ICCTF – International Cognition and Cancer Taskforce


http://www.icctf.com/index.php

Many patients report changes in their cognitive function related to their illness and the treatments they receive that adversely impact aspects of occupational, social, emotional or other areas of important functioning. Changes in attention, memory, thinking speed, problem-solving and other cognitive functions have been termed "chemobrain" or "chemofog" by patients. Studies of patients with non-central nervous system cancer have demonstrated that approximately one-third of patients exhibit cognitive dysfunction prior to the administration of systemic anti-cancer treatments. Systemic anti-cancer therapy (e.g., chemotherapy) is also associated with worsening cognitive function in a subset (ranging from 0-61%) of patients The exact percentage of patients that are vulnerable to these adverse side-effects is unknown and is probably related to the type and dose of treatment a patient receives. For some patients, these alterations in cognitive function appear transient and may recover after treatment has ceased. Other patients may experience long-lasting changes in cognitive function that may benefit from supportive medical care and lifestyle modifications.

The research conducted by the ICCTF members and others around the world is devoted to increasing our understanding of the incidence, severity, individual risk factors, and causes of cognitive and behavioral dysfunction, as well as investigations into ways to prevent and intervene against these adverse symptoms.

This website is intended to serve as a resource for patients and professionals to obtain up-to-date information about research projects, and clinical resources for cancer patients and their caregivers

# Why CNS Vital Signs?

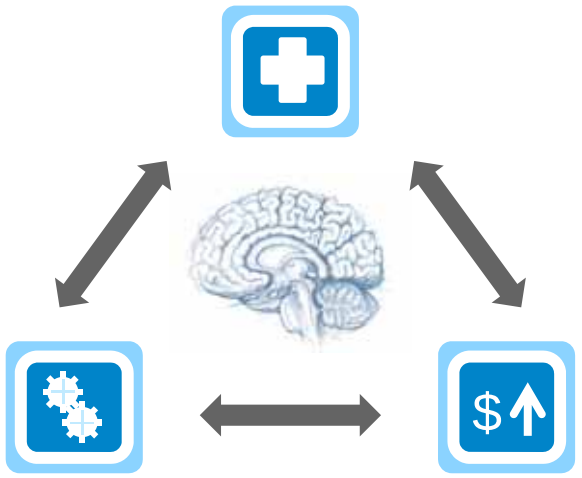
*CNS Vital Signs strives to provide clinicians a valid, reliable, and affordable, 'research quality' assessment platform. The CNS Vital Signs assessment platforms helps to support a practices comprehensive, state-of-the-art clinical assessment, and evidence-based treatment services for children, adolescents, 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 and enables evidence-based medicine and outcomes

CNS Vital Signs offers multiple assessment platform options that can be easily configured and deployed depending on each practices goals and needs.

## Enhanced Patient Insight and Care Management

OBJECTIVE, PRECISE, and STANDARDIZED Assessments that Supports many NeuroPsych Clinical Guidelines




### Extend Practice Efficiency

*Objective and Evidence-Based Assessment Data Collected, Auto-Scored and Systematically Documented.*

### Develop Enhanced Revenue Streams

*Well Established Billing Codes to Improve Practice Performance*

# 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 Neurocognitive Testing and Evidence-Based Functional Ratings Scales in one Platform

The CNS Vital Signs MULTI-MODAL assessment platform enables the ***efficient collection*** and ***systematic documentation*** of important brain function and behavioral, symptom and comorbid clinical endpoints using ***VALID & RELIABLE*** standardized neurocognitive tests and evidence-based symptom, behavioral and functional rating scales.

As a clinical instrument, the CNS Vital Signs neurocognitive testing and evidence-based rating assessment tools have been used to ***detect impairment, follow the course of an illness, and monitor response to treatment;*** it has also been used as a research tool to screen for cognitive disorders in epidemiological / surveillance and pharmaceutical studies and to follow cognitive changes.

## 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.

# Introduction: CNS Vital Signs in Cancer Cognition

CNS Vital Signs provides clinicians and researchers with leading edge neurocognitive and behavioral health assessment technologies that efficiently collects 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 computerized neuropsychological tests can add efficiency to assessment of cognition due to cancer.***

*"A thorough evaluation of a persons cognitive strengths and weaknesses can help the clinician formulate… information important in planning intervention strategies… Neuropsychological test performance and behavioral data provide complimentary information and lead to a more clearly defined view of a persons abilities and disabilities. Identifying when a breakdown in functioning occurs (behavioral data) and for what reason (neuropsychological data) can help tailor a more individualized regimen that is most likely to benefit the client."*

*Adapted from: Neuropsychology of Everyday Functioning*

CNS Vital Signs computerized neuropsychological tests can enhance efficiency and insight in assessing cognitive status and the difference between "normal performance" and a patients 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 brain injuries. Re-evaluation or serial testing with CNS Vital Signs supports the effective management and tailoring of medications or treatments 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. 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 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.

# Introduction: CNS Vital Signs in Cancer Cognition

***CNS Vital Signs is currently being used by thought leaders and academic medical centers in ChemoBrain research projects.***

There is no clear definition of chemo brain, so no one test exists to analyze the condition. However, several current guidelines at *www.guideline.gov* recommends that clinicians when conducting a history - evaluate educational and/or vocational progress. Additional, recommendations include: **Neurocognitive Testing:** ***Baseline at entry into long-term follow-up, then periodically as clinically indicated for patients with evidence of impaired educational or vocational progress.*** Clinicians may also want to collaborate with psychological professionals when establishing their ChemoBrain procedures e.g. screening and referral considerations for formal neuropsychological evaluation.

**Info Link**: Neurocognitive deficits in survivors of leukemia and lymphoma are more frequently related to information processing (e.g., learning disability). Neurocognitive deficits in brain tumor survivors treated with higher doses of cranial radiation are more global (significant decline in IQ). Extent of deficit depends on age at treatment, intensity of treatment, and time since treatment. New deficits may emerge over time. Neurosensory deficits (i.e., vision, hearing) due to tumor or its therapy may complicate neurocognitive outcomes.

**Considerations for Further Testing and Intervention**: Formal neuropsychological evaluation to include tests of processing speed, computer-based attention, visual motor integration, memory, comprehension of verbal instructions, verbal fluency, executive function and planning. Refer patients with neurocognitive deficits to school liaison in community or cancer center (psychologist, social worker, school counselor) to facilitate acquisition of educational resources and/or social skills training. Consider use of psychotropic medication (e.g., stimulants) or evidence-based rehabilitation training. Caution—lower starting dose and assessment of increased sensitivity when initiating therapy is recommended. Refer to community services for vocational rehabilitation or for services for developmentally disabled.

**Adapted from Guideline.gov:** Long-term follow-up guidelines for survivors of childhood, adolescent, and young adult cancers. Sections 6-37: chemotherapy. Bethesda (MD): Children's Oncology Group; 2006 Mar. 37 p. [191 references]; Long term follow up of survivors of childhood cancer. A national clinical guideline; Scottish Intercollegiate Guidelines Network (SIGN) Edinburgh (Scotland)

***CNS Vital Signs assessment platform contains the CORE Neurocognitive battery, the Childhood Cancer Survivor Study Neurocognitive Questionnaire, NeuroPsych Questionnaire, Medical Outcomes Survey (MOS SF-36), the Pain Catastrophizing Scale, and other well known assessment tools. The CNS Vital Signs ChemoBrain Toolbox helps a clinician systematically collect brain function data, symptoms, and comorbidities data, automatically scoring and systematically documenting the resulting clinical endpoints.***

# Why Use CNS Vital Signs to Assess ChemoBrain?

***The CNS Vital Signs VSX Assessment Platform represents a legacy of innovation and a commitment to advancing neurocognitive and behavioral clinical assessment tools that help support a TEAM MANAGEMENT concept.***

## 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 abnormality in the absence of positive findings in CT and MRI scans e.g. concussion.

## Comorbid Status

***Measure and Monitor***

Assess symptoms or COMORBID conditions…

CNS Vital Signs supports many BRAIN INJURY guidelines.

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:

- Childhood Cancer Survivor Study Neurocognitive Questionnaire (CCSS 25)
- NeuroPsych Questionnaire
- Medical Outcomes Survey (SF-36)
- Pain Catastrophizing Scale
- Zung Depression & Anxiety,

## 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/ recovery over time aiding the conventional neuropsychological examination documenting the patient's cognitive state at a point in time by adding a more efficient in-take and serial testing of the patient's ongoing recovery.

# Advancing Cancer Cognition Care

## CNS Vital Signs Cancer Cognition Toolbox


## Clinician Expertise

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

### 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

**Behaviors, Symptoms, and Comorbidities**

### Computerized Medical and Health Rating Scales*

- Childhood Cancer Survivor Study Neurocognitive Questionnaire (CCSS) SF-25

  Krull KR, Gioia G, Ness K, Ellenberg L, Recklitis C, Leisenring W, Huang S, Stovall M, Robison L, Zeltzer L. Reliability and validity of the Childhood Cancer Survivor Study Neurocognitive Questionnaire. Cancer. 2008; 113(18): 2188-97.
- NeuroPsych Questionnaire (NPQ-207) & (NPQ-45) both adolescent & adult
- Medical Outcomes Survey (SF-36)
- Pain Catastrophizing Scale
- Epworth Sleepiness Scale
- Pittsburg Sleep Quality Index
- Zung Depression Scale

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

# Childhood Cancer Survivor Study Neurocognitive Questionnaire (CCSS 25)

| Childhood Cancer Survivor Study Neurocognitive Questionnaire (CCSS) SF-25 | |
|---|---|
| Subject Reference/ID: 1234 | Test Date: October 22, 2009 21:51:13 |
| Age: 27 | Administrator: NeuroPsych Solution |
| Total Test Time: 0:28 (min:secs) for all tests in this report | Language: English (United States) |
| This scale was administered using CNS Vital Signs | Test Date GMT: October 23, 2009 01:51:40 |

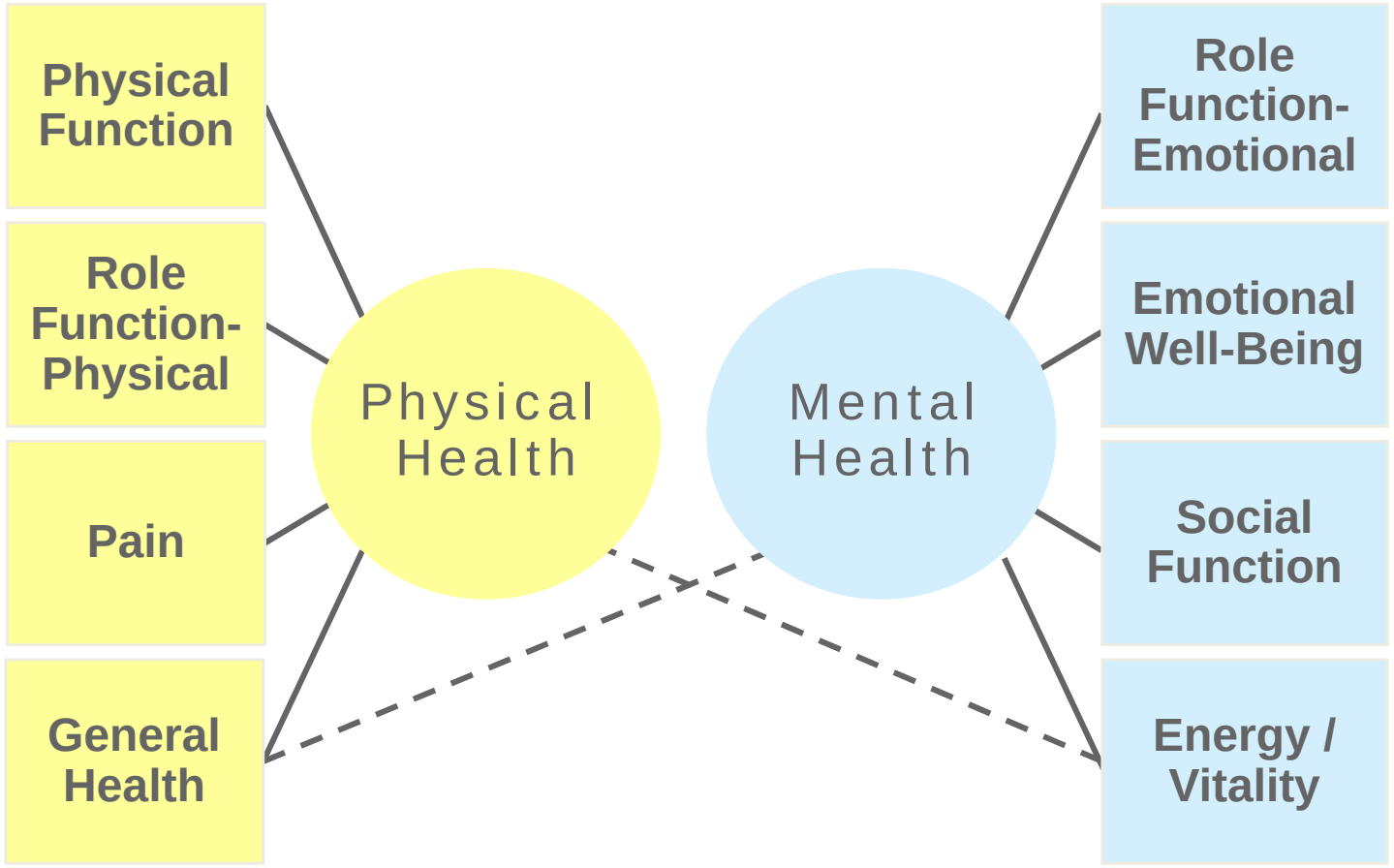
| | | | |
|---|---|---|---|
| **Task Efficiency** | **2** | **Emotional Regulation** | **2** |
| **Organization** | **2** | **Memory** | **3** |

| | | |
|---|---|---|
| 1 | I get upset easily. | 1 - Never a Problem |
| 2 | It takes me longer to complete my work. | 2 - Sometimes a Problem |
| 3 | I don't think of consequences before acting. | 3 - Often a Problem |
| 4 | I am disorganized. | 1 - Never a Problem |
| 5 | I forget instructions easily. | 3 - Often a Problem |
| 6 | I have problems completing my work. | 2 - Sometimes a Problem |
| 7 | I have difficulty recalling things I had previously learned (e.g., names, places, events, activities). | 3 - Often a Problem |
| 8 | I get frustrated easily. | 2 - Sometimes a Problem |
| 9 | My mood changes frequently. | 3 - Often a Problem |
| 10 | I have difficulty coming up with different ways of solving a problem. | 2 - Sometimes a Problem |
| 11 | I am impulsive. | 3 - Often a Problem |
| 12 | I have trouble finding things in my bedroom, closet or desk. | 2 - Sometimes a Problem |
| 13 | I forget what I am doing in the middle of things. | 3 - Often a Problem |
| 14 | I have problems getting started on my own. | 2 - Sometimes a Problem |
| 15 | I am an underachiever. | 3 - Often a Problem |
| 16 | I am easily overwhelmed. | 2 - Sometimes a Problem |
| 17 | I have trouble doing more than one thing at a time. | 3 - Often a Problem |
| 18 | I blurt things out. | 2 - Sometimes a Problem |
| 19 | My desk/workspace is a mess. | 3 - Often a Problem |
| 20 | I have trouble remembering things, even for a few minutes (such as directions, phone number, etc.). | 2 - Sometimes a Problem |
| 21 | I have trouble prioritizing my activities. | 3 - Often a Problem |
| 22 | I read slowly. | 2 - Sometimes a Problem |
| 23 | I am slower than others when completing my work. | 3 - Often a Problem |
| 24 | I have trouble solving math problems in my head. | 2 - Sometimes a Problem |
| 25 | I don't work well under pressure. | 3 - Often a Problem |

Used with permission: Krull KR, Gioia G, Ness KK, Ellenberg L, Recklitis C, Leisenring W, Huang S, Stovall M, Robison LL, Zeltzer L. Department of Epidemiology and Cancer Control, St. Jude Children's Research Hospital, Memphis, Tennessee 38105-2794, USA. kevin.krull@stjude.org

# CNS Vital Signs Toolbox

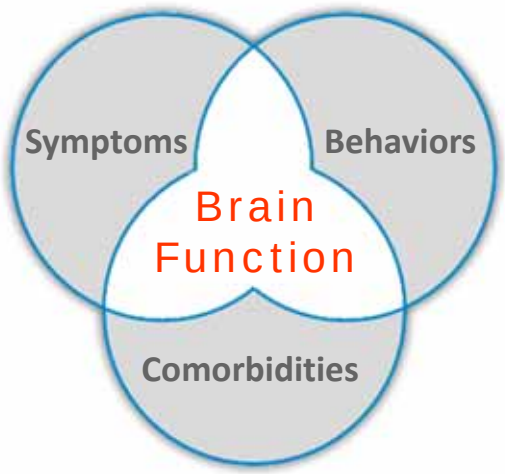
## MOS SF-36... Widely Used Measure



# Tools to Help Assess Symptoms and Comorbidities

## NPQ – 45

***Rapid In-take or Re-test to Assess the Neuro–Psych Status of a Patient***




The ***Neuropsych Questionnaire (NPQ) Short Form (SF - 45)*** provides a subjective measure of 13 neuropsych symptoms. The symptoms are ***Attention, Impulsive, Memory, Anxiety, Panic, Depression, Mood Stability, Oppositional*** *(child – adolescent),* ***Aggression, Fatigue, Sleep, Suicide, and Pain.*** The shorter NPQ version is used to monitor or follow-up with the patient before or during their visit. The NPQ 45 can be used when the longer version is either impractical or inappropriate e.g. the physician wants a quick view of their patients core symptoms. ***Both versions are automatically scored and the data stored.***

## NPQ – 45 (Adult Patient & Informant Version)

***Rapid In-take or Re-test to Assess the Neuro–Psych Status of a Patient***

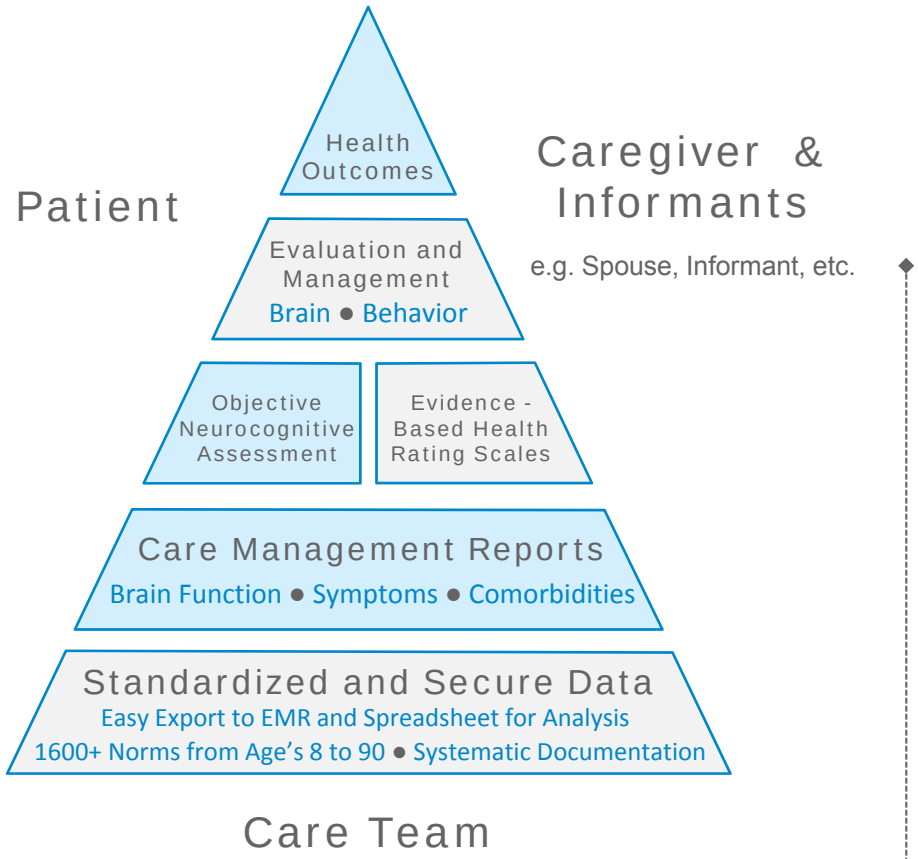
**NeuroPsych Questionnaire (NPQ) SF-45 (Page 1 of 2)**

| | |
|---|---|
| Subject Reference/ID: NPQ45SymptomAdult | Test Date: March 29, 2009 15:35:40 |
| Age: 64 | Administrator: Neuropsych Solutions |
| Total Test Time: 0:28 (min:secs) for all tests in this report | Language: English (United States) |
| This scale was administered using CNS Vital Signs | |

| Domain | Score | Severity | Description |
|---|---|---|---|
| Attention | 100 | Mild | 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 | 160 | Moderate | |
| Memory | 125 | Mild | |
| Anxiety | 167 | Moderate | |
| Panic | 100 | Mild | |
| Depression | 160 | Moderate | |
| Mood Stability | 125 | Mild | |
| Aggression | 200 | Moderate | |
| Fatigue | 167 | Moderate | |
| Sleep | 100 | Mild | |
| Suicide | 100 | Mild | |
| Pain | 225 | Severe | |

| | | |
|---|---|---|
| **Attention Questions** | | |
| 1 | Difficulty concentrating | 1 - A mild problem |
| 2 | Easily distracted | 1 - A mild problem |
| 3 | Feeling scattered, disorganized | 1 - A mild problem |
| 4 | Forgetful, I need constant reminding | 0 - Not a problem |
| 5 | Short attention span | 2 - A moderate problem |
| **Impulsive Questions** | | |
| 1 | Feeling restless | 3 - A severe problem |
| 2 | Fidgety, I can't sit still | 1 - A mild problem |
| 3 | Impatient | 3 - A severe problem |
| 4 | Impulsive, act without thinking | 0 - Not a problem |
| 5 | Overly active | 1 - A mild problem |
| **Memory Questions** | | |
| 1 | Forgetful, I need constant reminding | 0 - Not a problem |
| 2 | My mind goes blank | 2 - A moderate problem |
| 3 | Problems with memory | 3 - A severe problem |
| 4 | Putting something down and then forgetting where you put it. | 0 - Not a problem |
| **Anxiety Questions** | | |
| 1 | Feeling anxious | 0 - Not a problem |
| 2 | Feeling nervous | 2 - A moderate problem |
| 3 | Feeling restless | 3 - A severe problem |
| 4 | Feeling tense | 2 - A moderate problem |
| 5 | Fidgety, I can't sit still | 1 - A mild problem |
| 6 | Worrying too much | 2 - A moderate problem |
| **Panic Questions** | | |
| 1 | Attacks of intense anxiety | 0 - Not a problem |
| 2 | Feeling so nervous it's hard to breathe | 2 - A moderate problem |
| 3 | Panic attacks | 1 - A mild problem |
| **Depression Questions** | | |
| 1 | Feeling depressed | 1 - A mild problem |
| 2 | Feeling discouraged about the future | 3 - A severe problem |
| 3 | Feeling irritable | 0 - Not a problem |
| 4 | Feeling little or no interest in things | 1 - A mild problem |
| 5 | Not enjoying things as much as before | 3 - A severe problem |
| **Mood Stability Questions** | | |
| 1 | Anger | 3 - A severe problem |
| 2 | Easily frustrated | 2 - A moderate problem |
| 3 | Feeling irritable | 0 - Not a problem |
| 4 | My moods change quickly | 0 - Not a problem |

# Optimized for Cancer Cognition Assessments




## CNS Vital Signs Neurocognitive Battery in Cancer Cognition

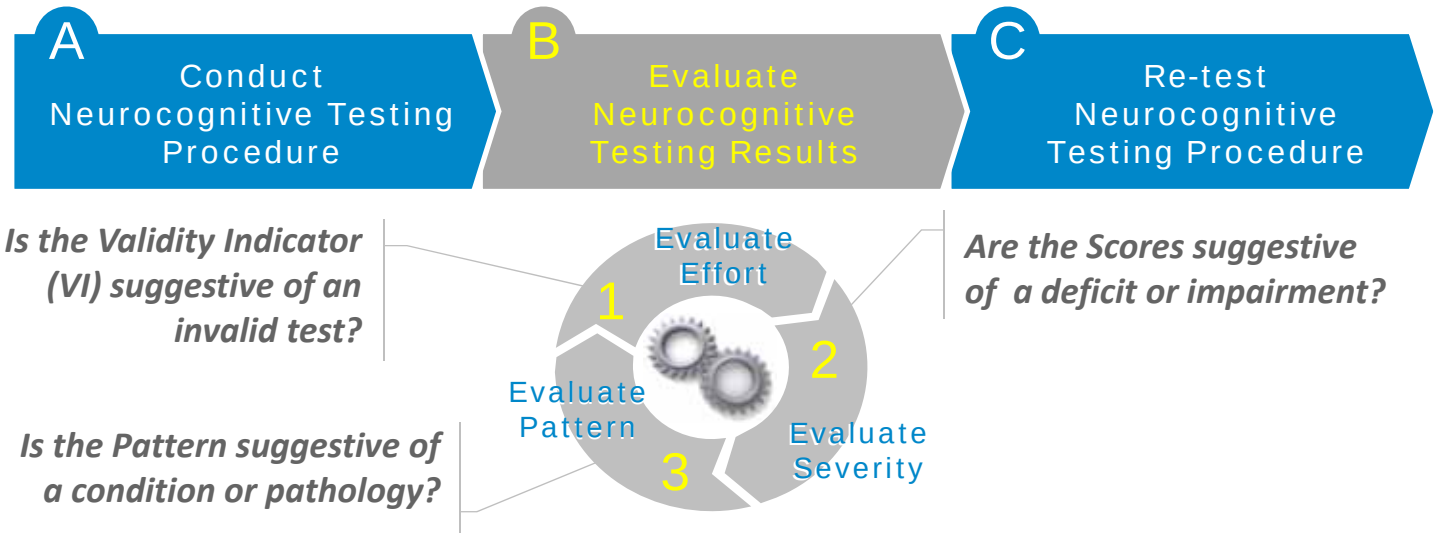
*"2.1 Neuropsychological assessments*

All participants completed baseline psychometric tests as well as an MRI scanning session. The 2 ½ hour baseline psychometric battery was comprised of: social / medical history, classic pencil-and-paper tests, and a 30 minute computerized cognitive test (CNS Vital Signs; https://www.cnsvs.com/). This computerized test battery has been validated in a broad age range and across clinical and non-clinical populations (including cancer patients), as well as proven sensitive in monitoring patient's cognitive status over time (Gualtieri& Johnson, 2006). In particular, it measures: attention, reaction time, working memory, executive function as well as visual and verbal episodic memory. Raw neuropsychological data were converted to standardized scores based on the means and standard deviations of the matched healthy control group. Summary scores for several cognitive domains were computed as well as an overall cognitive summary calculated by averaging all of the cognitive scores."

Adapted from: Structural Brain Differences in Breast Cancer Patients Compared to Matched Controls Prior to Chemotherapy; International Journal of Biology Vol. 4, No. 2; April 2012

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

# 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.

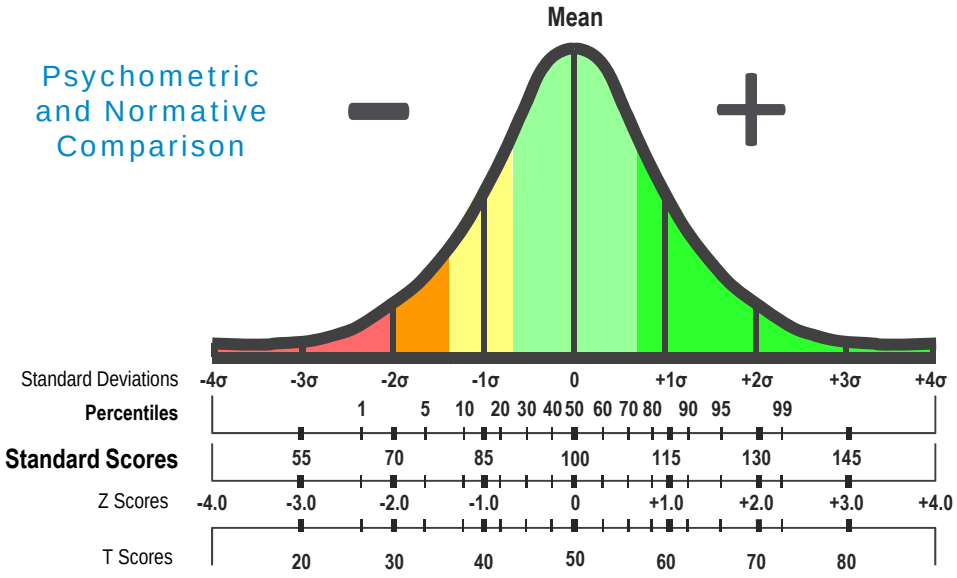
C: If invalid test results were noted then consider re-testing the patient to confirm clinical results. If the test results were valid, then, as part a continuum of care, reschedule testing to track disease progression and measure ongoing status or outcomes.

**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…

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

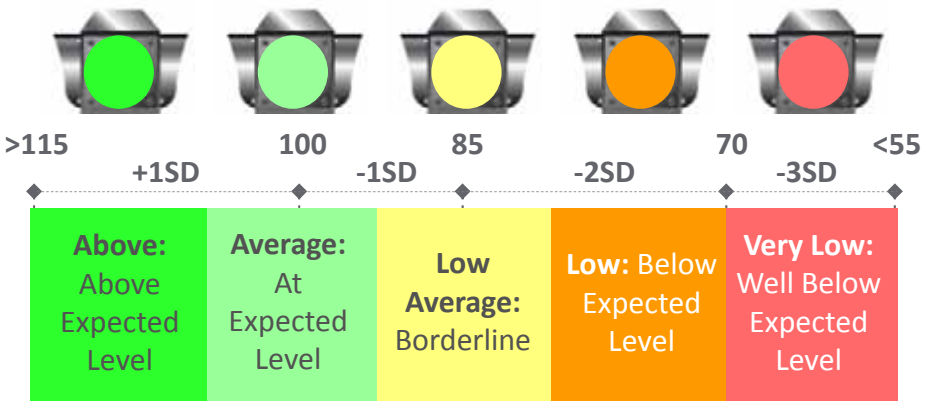
| CNS Vital Signs Clinical Report | | | | | Test Date: July 23 2011 10:48:38 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Subject ID: mTBI or AD/HD | | | | | Administrator: Technician | | | | |
| Language: English (United States) | | | | | Age: 27 | | | | |
| Patient Profile: | Percentile Range | | | | > 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 | |

# Neurocognitive Domain Dashboard

*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: fewer 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.

# HOW can CNS Vital Signs Benefit My Practice?

Ask about our NO COST Practice Evaluation!

## CNS Vital Signs Benefits

- Enhanced Patient Insight and Care Management
- Enables Evidence-Based Medicine and Outcomes
- Improved Practice Efficiencies and Documentation
- Improved Practice Revenues and Performance

***Solution Example***

CNS Vital Signs Mobile Test Station
ULTRA Series


***$1,400.00 Testing Station with 40 test sessions.***

## Potential Return On Investment

Based on Established Billing Codes*

**40 Patient Test Sessions ROI:**

$2,400 to $10,000+
Possible Yearly IMPACT... $80K to $160K depending on patient volumes...

*Based on a survey of Payers. Contact support@cnsvs.com for billing information.

***Popular with Clinics and Hospitals:*** *Engineered with BUSY PRACTICES in mind (roll into exam rooms), the Ultra Series combines the ultimate in practical functionality, ergonomic ease-of-use, and remarkable durability.*

# 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.***

## Learn More

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

- Website: www.CNSVS.com
- Phone: 888.750.6941
- Email: support@cnsvs.com
- Address:
  598 Airport Blvd.
  Suite 1400
  Morrisville, NC 27560

**"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***