“...addiction manifests clinically as compulsive drug seeking, drug use, and cravings that can persist and recur even after extended periods of abstinence. From a psychological and neurological perspective, addiction is a disorder of altered cognition. The brain regions and processes that underlie addiction overlap extensively with those that are involved in essential cognitive functions, including learning, memory, attention, reasoning, and impulse control. Drugs alter normal brain structure and function in these regions, producing cognitive shifts...”

Thomas J. Gould, PhD; Addiction Science & Clinical Practice; December 2010; Vol. 5 No. 2; DHHS - NIH
Why CNS Vital Signs in Substance Abuse?

Benefits for Substance Use Disorder Clinics

**Elements of a Comprehensive Patient Assessment:**
Mental Status: **Cognition** (e.g., attentional capacity, memory), Mood, Suicidal ideation and behavior, Medication focused, Somatic preoccupation **Co-Occurring Conditions** and Disorders: Psychological conditions (e.g., depression, anxiety, post-traumatic stress disorder [PTSD], Medical conditions, **Cognitive impairments**; Function: Activities of daily living/ability to care for oneself, Sleep, Mood, Sex. Heavy drinking can cause psychiatric symptoms such as **depression, anxiety, insomnia, cognitive dysfunction**...

**Substance Abuse and Mental Health Services Administration (SAMHSA)**

**Treating Substance Use Disorders: A Quick Reference Guide...**
Address factors that may be more likely to influence treatment adherence in individuals with co-occurring disorders (e.g., concern about medication interactions, **cognitive impairment**, limited motivation, lack of peer and social support).

**American Psychiatric Association (APA)**

**Assessment and Management of Cognitive Impairment in Substance Abuse**
“Assessment is the beginning of the therapeutic process. A comprehensive biopsychosocial assessment covers physical, cognitive, behavioral, emotional, and environmental domains. The guidelines do not exclusively endorse the use of any particular instrument as the basis for a comprehensive assessment.”

**VA/DoD Clinical Practice Guideline For Management of Substance Use Disorders**

**CNS Vital Signs Tools:**

**Etiology of Substance Abuse**

---

Performance

Validity Assessment

of Secondary Gain
e.g., Drug or Disability Seeking, etc.

**CNS Vital Signs Value Added**

Custom Configure Test Panels to Meet the Needs of your Practice... Enabling Systematic Documentation of Clinical, Quality and Outcomes Measures.
How can CNS Vital Signs Help?

(1) Automating the Rapid, Systematic, and Standardized collection of CLINICAL AND QUALITY ‘SUD’ Substance Use Disorder measures; and (2) providing the Addiction and Substance Abuse Professionals with a hospital and clinic-based solution to measure and monitor cognition and psychosocial or mental health symptoms, behaviors and comorbidities.

Measuring & Monitoring Cognition is a Key & Important Component

CNS Vital Signs computerized neurocognitive testing system is an objective, valid and reliable instrument used in the evaluation and management of patients with SUD Substance Use Disorder. Clinicians and researchers have found CNS Vital Signs sensitive in assessing cognitive function following the use of illicit and abused substances e.g., marijuana, alcohol, benzodiazepines, etc.

Tools to Measure Cognition

CNS Vital Signs computerized neurocognitive testing allows clinicians to assess cognition by comparing patients to a ‘PEER REVIEWED’ normative data set across the lifespan from ages 8 to 89 e.g., level of impairment. Certain DOMAIN Scores can be informative in confirming possible clinical condition(s) e.g., frontal lobe tests for AD/HD, and helping provide insight on possible cognitive issues and barriers a therapist may encounter as they treat the patient.

Just a few BENEFITS:

- Objective Performance Based Neurocognitive Tests – 10 Neurocognitive Tests and over 50 Rating Instruments
- Helps Assess Drug Seeking, Feigning, Malingering, etc. - Embedded Performance Validity Indicators for each test
- Efficient - Rapid Assessment and Immediate Auto-Scored Reports, Systematic & Standardized Auditable Logs and Documentation
- Easy to Interpret Reports - Generates a Cognitive Domain Dashboard (see example in following pages)
- Optimized for Continuum of Care - Easy to Longitudinally Graph and Export to Excel for Outcomes Evaluation
- Telemedicine Enabled – Remote Testing and Follow-up
- Secure – Encrypted 21CFR 11 & HIPAA Compliant

Tools to Measure Comorbidities, Symptoms, Behaviors

CNS Vital Signs assessment platform also contains over 50 well-known patient and informant rating instruments.

Easily Custom Configure a Solution

The CNS VS advanced assessment platform integrates multiple testing platforms and applications e.g., Web, Local Software that can be used on standard hardware e.g., Laptops, Desktop computers and Tablets (rating instruments). All these tools can be custom configured to a practices needs. Currently used by over 12K Clinicians and Researchers in 52 countries.

Compromised Cognitive Function in Addiction...

- **Cocaine**: deficits in cognitive flexibility (Kelley et al., 2005);
- **Amphetamine**: deficits in attention and impulse control (Dalley et al., 2005);
- **Opioids**: deficits in cognitive flexibility (Lyvers and Yakimoff, 2003);
- **Alcohol**: deficits in working memory and attention (Moriyama et al., 2006);
- **Cannabis**: deficits in cognitive flexibility and attention (Pope, Gruber, and Yurgelun-Todd, 2001);
- **Nicotine**: deficits in working memory and declarative learning (Kenney and Gould, 2008).

Evidence-Based Rating Instrument Examples

SBIRT Assessments:

- **AUDIT** - Alcohol Use Disorders Identification Test and
- **DAST** - Drug Use Questionnaire

50+ Rating Instruments Available:

- **SF – 36** Medical Outcomes
- **PHQ-9, Zung** Anxiety and Depression
- **Pain Catastrophizing**
- **The PTSD Checklist** (PCL-5)
- **Adult and Vanderbilt** AD/HD Scales
- **Epworth Sleepiness & Pittsburgh Sleep Quality Index**
CNS Vital Signs is Sensitive to Drug Effects

Medications and drugs with central nervous system (CNS) effects are widely prescribed and used. Their mechanism of actions, often poses particular risks including addiction, sedation, balance instability, slowed reaction times, etc. Neurocognitive testing can add value to the evaluation and management of patients through their assessment value in determining individual differences in drug response. Additional example of CNS Vital Signs capability in measuring drug and medication effect can be found in the Publications section at www.CNSVS.com.

Cannabis Example:
Measure Treatment Outcomes

Cognitive performance in a placebo-controlled pharmacotherapy trial for youth with marijuana dependence

- Cognitive performance was measured using CNS Vital Signs®.
- Abstinence was significantly associated with increased composite memory scores.
- Abstinence was significantly associated with increased verbal memory scores.
- Abstinence was significantly associated with modest increase in psychomotor speed.
- No significant differences in cognitive performance between placebo and control.

Conclusions: These findings suggest that some domains of cognitive performance improve significantly even in the early stages of treatment-associated abstinence.

Lorazepam Example:
Benzodiazepines


Acute Lorazepam Effects on Neurocognitive Performance

“These data demonstrate a strong LOR effect on computerized cognitive performance, with effect sizes comparable to our previous study using traditional measures of neuropsychological function... In conclusion, this study demonstrates comparable sensitivity of CNS Vital Signs to traditional neuropsychological testing after acute administration of LOR (2 mg orally) that occurs largely independent of plasma concentrations for the range of levels ...”

Ketamine Example:
The main aims of this study were: (i) to assess the effect of low-dose ketamine on pain responses and cognition during and following a 2-h infusion; and (ii) to get an estimate of the contribution of norketamine to ketamine effect in healthy subjects.

Adapted from: Anesthesiology, 2012 August; 117(2): 353-364
CNS Vital Signs is Sensitive to Drug Effects

Cannabis Example: The relationship between urine cannabinoid concentration and choice reaction time in chronic marijuana users. Participants with higher urine cannabinoid concentrations had slower reaction times. This finding suggests tests that precisely measured reaction times may identify subtle levels of marijuana-related impairment not observable using routine methods.

Alcohol Example: Recovery to Neurocognitive Baseline After Acute Ethanol Intoxication

Addiction Clinical Use: Helping Practices and Patients

CNS Vital Signs contains a set of tools that enables an Addiction, Substance Abuse and Pain practice to simplify and efficiently implement clinical guidelines and quality measure protocols (ACA) in an easy-to-use computerized assessment platform. CNS Vital Signs assessment platform enables clinicians to efficiently collect objective, valid and reliable BRAIN (cognitive stimulus response tests) and BEHAVIORAL clinical and quality measures e.g., MIPS with evidence-based medical, psychological, and outcome rating scales.

2. EXPEDITE and STANDARDIZE Psychosocial Evaluations.
3. Add an OBJECTIVE and STANDARDIZED view into a patient’s neurocognitive status and assisting in the EVALUATION and MANAGEMENT of pain and substance use disorders.
4. Help evaluate the possibility of manipulating a secondary gain e.g., academic accommodation, drug or disability seeking, malingering, symptom feigning etc. with embedded cognitive performance validity indicators.
5. Aiding in the MONITORING and MANAGEMENT of clinical conditions or disease progression by establishing a neurocognitive baseline for each patient to use in later treatment decisions and to help patients and families understand the neurocognitive status and progress of the patient.
6. Objectively measuring the response to treatments and helping to OPTIMALLY MANAGE MEDICATION.
7. Efficiently and quickly identifying and tracking possible symptoms, behaviors, and possible comorbidities and collecting important clinical and quality data e.g., MIPS.
8. Helping identify cognitive domains needing additional investigations or full neuropsychological evaluations.

The use of the CNS Vital Signs platform can also benefit the practices bottom line.
Many neurological and psychiatric practice guidelines recommend serial testing, evaluation and management of clinical conditions.

“Serial evaluation of neurocognition can help patients and caregivers navigate problems related to their daily life and their work environment. When carried out reliably, such evaluation can detect cognitive decline and serve as a guide to disease progression and treatment failure.” **
CNS Vital Signs neurocognitive testing is a non-invasive clinical procedure to efficiently and objectively assess a broad spectrum of brain function performance under challenge (cognition stress test) and enable the measuring of important clinical symptoms, behaviors, and comorbidities. The colorful auto-scored reports are designed to present and share with patients and families. The results are presented in a **DOMAIN DASHBOARD** and **DETAILED TEST** report immediately following the brief testing session.

1. **Evaluate Valid Effort:** The Validity Indicator (VI) identify an invalid test or effort. Helps evaluate the possibility of manipulating a secondary gain e.g., academic accommodation, drug or disability seeking, malingering, symptom feigning etc. with embedded cognitive performance validity indicators. Helps validate effort and identify patient testing issues e.g., understand directions?

2. **Evaluate Severity:** Are the scores suggestive of a deficit or evaluate level of impairment? Assess even slight cognitive impairment (millisecond precision) providing immediate clinical insight into a patient’s current status and level of impairment. This gives patients, family members and caregivers knowledge of cognitive domains that underpin the ability to conduct activities of daily living.

3. **Evaluate Pattern:** Is the pattern suggestive of a condition or pathology? The CNS VS cognitive pattern profiles (interpretation guide) may assist clinicians in the evaluation of neurological, psychiatric, and developmental disorders. CNS Vital Signs cognitive testing procedure provides valid and reliable clinical endpoints to help in the evaluation and management of patients.

4. **Evaluate Longitudinally:** Track disease progression, outcomes, or treatment effects. Establish a baseline and serially assess cognitive clinical endpoints to aid in the monitoring and management of many clinical conditions and treatments e.g., measure the response to disease and treatment like MS, AD/HD & stimulants, rehabilitation efforts, and used to measure clinical outcomes.

The CNS VS reports are logical and intuitive making the reports interpretation by a qualified health professional relatively straightforward. CNS Vital Signs has taken a LIFESPAN approach collecting a large neurocognitive normative reference group from ages 8 to 89. The normative comparison helps clinicians grade the level of neurocognitive impairment that can help rule-in or rule-out certain clinical conditions and/or determine the level of impairment.

**The Difference...** “CNS Vital Signs is sensitive in detecting cognitive impairment ...uses computerized forms of traditional tests such as Symbol Digit Modalities and Stroop ...are easy to use, require significantly less time to administer, produce instant scoring and can incorporate alternate forms, necessary to minimize learning effect on follow-up. **also the capacity to accurately-automatically quantify “speed factor” via multiple parameters such as reaction time, psychomotor speed, and processing speed, increasing their sensitivity in detecting even subtle changes in information processing speed.**”

**Cognitive Impairment in Relapsing Remitting and Secondary Progressive Multiple Sclerosis Patients: Efficacy of a Computerized Cognitive Screening Battery; ISRN Neurology, 2014 Mar 13;2014:**
## Normed Neurocognitive Tests

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Approx. Time</th>
<th>Subtests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Verbal Memory (VBM)</strong></td>
<td>3 Minutes</td>
<td>Learning Words, Memory for Words, Word Recognition, Immediate and Delayed Recall</td>
</tr>
<tr>
<td><strong>Visual Memory (VIM)</strong></td>
<td>3 Minutes</td>
<td>Learning Shapes, Memory for Shapes, Shapes Recognition, Immediate and Delayed Recall</td>
</tr>
<tr>
<td><strong>Finger Tapping (FTT)</strong></td>
<td>2 Minutes</td>
<td>Motor Speed, Fine Motor Control</td>
</tr>
<tr>
<td><strong>Symbol Digit Coding (SDC)</strong></td>
<td>4 Minutes</td>
<td>Complex Information, Processing Accuracy, Complex Attention, Visual-Perceptual Speed, Information Processing Speed</td>
</tr>
<tr>
<td><strong>Stroop Test (ST)</strong></td>
<td>4 - 5 Minutes</td>
<td>Simple Reaction Time, Complex Reaction Time, Stroop Reaction Time, Inhibition / Disinhibition, Frontal or Executive Skills</td>
</tr>
<tr>
<td><strong>Shifting Attention (SAT)</strong></td>
<td>2.5 Minutes</td>
<td>Executive Function, Shifting Sets: Rules, Categories, &amp; Rapid Decision Making, Reaction Time</td>
</tr>
<tr>
<td><strong>Continuous Performance (CPT)</strong></td>
<td>5 Minutes</td>
<td>Sustained Attention, Choice Reaction Time, Impulsivity</td>
</tr>
<tr>
<td><strong>Perception of Emotions (POET)</strong></td>
<td>2 Minutes</td>
<td>Social Cognition or Emotional Acuity, Choice Reaction Time</td>
</tr>
<tr>
<td><strong>Non-Verbal Reasoning (NVRT)</strong></td>
<td>3.5 Minutes</td>
<td>Reasoning, Reasoning Recognition Speed</td>
</tr>
<tr>
<td><strong>4-Part Continuous Performance (FPCPT)</strong></td>
<td>7 Minutes</td>
<td>Sustained Attention, Working Memory</td>
</tr>
</tbody>
</table>

### VBM
VBM measures recognition memory for WORDS. Fifteen words are presented, one by one, on the screen every two seconds. For immediate recognition (learning phase), the participant must identify those words nested among fifteen new words. Then, after six more tests, there is a delayed recognition memory trial. **Subjects respond using the SPACE BAR.**

### VIM
VIM measures recognition memory for ABSTRACT FIGURES or SHAPES. Fifteen geometric figures are presented, one by one, on the screen. For immediate recognition (learning phase), the participant must identify those figures nested among fifteen new figures. Then, after five more tests, there is a delayed recognition memory trial. **Subjects respond using the SPACE BAR.**

### FTT
FTT test has **subjects respond by pressing the SPACE BAR** with their right index finger as many times as they can in 10 seconds. They do this once for practice, and then there are three test trials. The test is repeated with the left hand.

### SDC
SDC test consists of serial presentations of screens, each of which contains a bank of eight symbols above and eight empty boxes below. The participant **types in the number on the NUMBER ROW that corresponds to the symbol that is highlighted.** Only the digits from 2 through 9 are used; this is to avoid the confusion between “1” and “I” on the keyboard. **The computer program does not allow a person to use a numerical pad** preventing a distinct advantage for those who are skilled at using the numerical pad or for those that are right- versus left-handed.

### ST
Stroop test has **subjects respond by pressing the SPACE BAR** with their right index finger as soon as the test subject sees the word. In the second part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. The participant is asked to press the space bar when the color of the word matches what the word says. In the third part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. **The participant is asked to press the SPACE BAR** when the color of the word does not match what the word says.

### SAT
SAT test is a measure of ability to shift from one instruction set to another quickly and accurately. Participants are instructed to match geometric objects either by shape or by color. Three figures appear on the screen, one on top and two on the bottom. The top figure is either a square or a circle. The bottom figures are a square and a circle. The figures are either red or blue (mixed randomly). The participant is asked to match one of the bottom figures to the top figure. The rules change at random (i.e., match the figures by shape, for another, by color) and **subject responds by pressing the two SHIFT KEYS.**

### CPT
CPT test is a measure of vigilance or sustained attention or attention over time. The test subject is asked to respond to the target stimulus “B” but not to any other letter. The stimuli are presented at random. **Subject responds by pressing the SPACE BAR.**

### POET
The POET measures how well a subject can perceive and identify specific emotions. “Social cognition” or “emotional acuity” has been defined as “the way in which people make sense of other people and themselves”. It is the ability to perceive and understand social information. The reaction times in POET are much longer than in the other tests, indicating the complexity of central processes governing emotional acuity. **Subjects respond using the SPACE BAR.**

### NVRT
The NVRT measures how well a subject can perceive and understand the meaning of visual or abstract information and recognizing relationships between visual-abstract concepts. The NVRT is comprised of 15 matrices, or visual analogies. The matrices are progressively more difficult. Non-verbal or visual-abstract reasoning is the process of perceiving issues and reaching conclusions using symbols or generalizations rather than concrete information. **Subjects respond using the SPACE BAR.**

### FPCPT
The 4PCPT is a four-part test that measures a subject’s working memory and sustained attention. PART ONE - is a simple reaction time test, PART TWO - is a variant of the continuous performance test, the reaction times that are generated are “choice reaction times”. PART THREE - is a “one-back” CPT. The subject must respond to a figure only if the figure immediately preceding was the same. PART FOUR - is a “two-back” CPT. It is a difficult task and is used to measure working memory. Parts two, three, and four of the tests are used to calculate sustained attention domain. **Subjects respond using the SPACE BAR.**
Physician Testimonial

"We conducted a large research program in two of our residential treatment locations. We gave CNS Vital Signs at intake to provide a baseline measure of cognition and repeated the test prior to discharge. Patients were very impressed with both how poorly they functioned on admission and by how much they improved with sobriety. When they received a copy of both tests, they were both amazed with their progress in the program and motivated to maintain their sobriety.

As an addiction physician, I have found CNS Vital Signs to be an extremely valuable resource for our Treatment Program.

We have also found it very useful to distinguish the patients with Stimulant Use Disorder who truly had AD/HD and were “self-medicating” from those who had been misdiagnosed with AD/HD in the past and were just using amphetamines to get high.”

Addiction Psychiatrist

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