Do You See the Signs?

Enhance Your Practice

CNS Vital Signs®

Objective | Valid & Reliable | Efficient
Reimbursable | Secure

A Digital Neurocognitive & Neurobehavioral Testing Platform
Coupled with 50+ Clinical & Quality (PQH9, GAD7) Rating Instruments

50+ Languages with Worldwide Use in over 50 Countries

Correlated to ApoE Polymorphisms, Metabolic Markers, Imaging
and Expert Peer-Reviewed Psychometric Properties

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& make your selection.

New to CNS VS
Take a Short Demo
Experience a 10 minute - 3 Test
Sample from Your Email

Register and
Start Now!
Test Remotely or In-Clinic Today
with 5 Trial Assessments

Simple Business Model: Free Training, Support, Software and Upgrades. No Subscriptions or Start-up Fees. *Only purchase economical assessments as needed... volume discounts available.*

World Leaders in Telehealth, Remote and In-Clinic Neurocognitive & Neurobehavioral Testing

Expand Your Clinic's Reach

In-Clinic Testing

Telehealth & Remote Testing

Digital Brain Health Assessment Tools...
CNS VS ADHD Toolset

FDA Medical Device: 3006559064

HIPAA COMPLIANT

SOC 2 CERTIFIED TYPE II

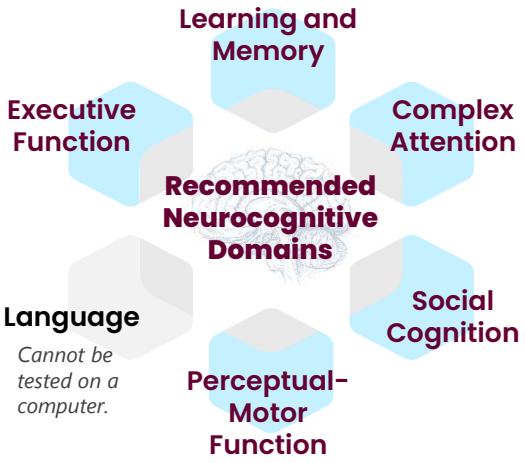
API Enabled

Over 17 Million Tests Given Worldwide!

Does your Cognitive Testing Support Professional Guidelines?

CNS Vital Signs standardized neurocognitive testing is a non-invasive, reimbursable clinical procedure to efficiently and objectively assess a broad-spectrum of brain function domain performances under challenge (cognition stress test). Aiding in the measuring of important clinical symptoms, behaviors, and comorbidities salient to the evaluation and ongoing management of many neurological, psychiatric and other conditions. Serial evaluation of neurocognition can help patients and caregivers navigate problems related to daily living, school or vocational work environment.

DSM-5 Neurocognitive Disorder, Five Key Cognitive Domains Tested



"**Neurocognitive disorders** - *are characterized by decline from a previously attained level of cognitive functioning... Objective assessments are essential... The move to evaluate neurocognitive disorders as early as possible emerged from the recognition of a long predementia stage in neurodegenerative diseases, improvements in early detection, and the increasing emphasis on early intervention to prevent or postpone dementia...*

Evaluation criteria: *Evidence of modest cognitive decline from a previous level of performance (longitudinal) in one or more cognitive domains...***"*

*** Adapted From: Perminder S. Sachdev, Deborah Blacker, Dan G. Blazer, Mary Ganguli, Dilip V. Jeste, Jane S. Paulsen & Ronald C. Petersen: Classifying neurocognitive disorders: the DSM-5 approach: Nature Reviews Neurology volume 10, pages 634–642 (2014)

Are you assessing the DSM-5 Neurocognitive Disorder Recommended Brain Domains? We can help. Also, Collect MIPS Quality Measures and Required Reimbursement Elements... Begin Today.

Collecting Required Elements for E & M Code 99483

Example

Select Testing Method

1 In-Clinic Testing

2 Telehealth "Remote" Testing

Select Tests or Test Panel

PDF 5

Easily Add Test Reports to EMR & Bill

Use CNS VS Cognitive Care Plan Template

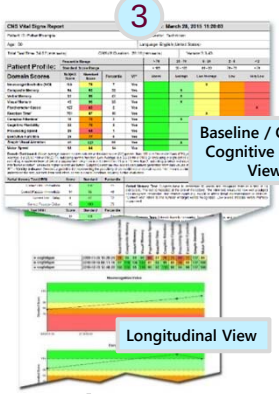
4

Create Care Plan and Provide Feedback

Rating Instruments
- Neuropsychiatric
- Daily Function
- Sleep
- Falls

Conduct Required Elements Testing

3



Custom configure test panels (cognitive tests and rating instruments) to optimize your research, clinical, and quality care activities.

Optimize Care and Add Anti-Fragile, Incremental Revenue...

Widely Reimbursed (In-Office & Telehealth) with Well Established Billing Codes.

1 Testing Codes In-Clinic & Telehealth Codes

Clinician Testing	
96136 (30 min of testing)	$42
+96137 (After 31+min of testing)	$38
Technician Testing	
96138 (30 min of testing)	$34
+96139 (After 31+ min of testing)	$35

+

2 Professional Codes In-Clinic & Telehealth Codes

Psych Evaluation	
96130	$120
+96131 (After first hour)	$86
Neuro Evaluation	
96132	$128
+96133 (After first hour)	$97

Additional Codes

Cognitive Assessment & Care Planning	99483 (In-Clinic & Telehealth Codes)	$273

Neurobehavioral Status		Developmental	
96116, 96121 (In-Clinic & Telehealth Codes)	$92	96112	$124

For more information refer to the CNS Vital Signs 'Reimbursement Guide' and schedule a **FREE TRAINING WEBINAR** at CNSVS.com or email support@cnsvs.com.

* $ Represents Estimated National Average Practice Reimbursement

The CNS Vital Signs results are presented in a **DOMAIN DASHBOARD** and **DETAILED TEST** report format immediately following the brief testing session.

Standardized evaluation of neurocognitive and behavioural issues provides a systematic and efficient method of collecting valid and reliable clinical measures currently recommended by most neuro-psych guidelines.

Altogether, CNS Vital Signs computerized testing can facilitate a more complete assessment and provide a basis for patient and family feedback. The colorful auto-scored reports are designed to present and share with patients, families, and caregivers.

Additional Clinical and Practice Benefits

- ***Millisecond Precision***
- ***Many Peer-Reviewed Publications*** *(Award Winning)*
- ***Embedded Test Validity Indicators***
- ***Millions of Tests Given*** *Worldwide Since 2006*
- ***Over 50 Languages***
- ***Unlimited Alternate Forms*** *for Serial Testing*
- ***No Ceiling Effect****... Open Ended Performance to Identify Superior Subjects*
- ***Modular****... Easily Configured Custom Testing Panels and Platform*
- ***Enhanced Auditability*** *with Automated Systematic Documentation*
- ***HIPAA Secure****, Data back-up and Data export*
- ***Broad Deployment...*** *Solutions for small, medium and large practices, integrated delivery systems, high security environments such as FDA sponsored clinical research, Military, VA Hospitals, Academic Medical Centers, across thousands of clinician and research users worldwide*

Easy to Read... Immediate Reporting

Reports available in English, Spanish, Japanese, Korean, and Dutch.

CNS Vital Signs Report						Test Date: March 28, 2021 09:20:03				
Patient ID: PatientExample						Administrator: Technician				
Age: 50						Language: English (United States)				
Total Test Time: 39:07 (min:secs)			CNSVS Duration: 36:16 (min:secs)			Version 4.0.94				
Patient Profile:	Percentile Range				> 74	25 - 74	9 - 24	2 - 8	< 2
	Standard Score Ra				> 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	78	7	Yes				X	
Composite Memory	94	93	32	Yes		X			
Verbal Memory	52	99	47	Yes		X			
Visual Memory	42	90	25	Yes		X			
Psychomotor Speed	127	69	2	Yes					X
Reaction Time*	751	87	19	Yes			X		
Complex Attention*	16	70	2	Yes				X	
Cognitive Flexibility	22	70	2	Yes				X	
Processing Speed	29	64	1	Yes					X
Executive Function	28	77	6	Yes				X	
Social Acuity	7	90	25	Yes		X			
Reasoning	10	116	86	Yes	X				
Simple Attention	40	107	68	Yes		X			
Motor Speed	98	84	14	Yes			X		

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.

DOMAIN DASHBOARD

Verbal Memory Test (VBM)	Score	Standard	Percentile
Correct Hits - Immediate	13	104	61
Correct Passes - Immediate	14	96	40
Correct Hits - Delay	9	93	32
Correct Passes - Delay	15	110	75

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.

Visual Memory Test (VIM)	Score	Standard	Percentile
Correct Hits - Immediate	12	101	53
Correct Passes - Immediate	11	98	45
Correct Hits - Delay	9	86	18
Correct Passes - Delay	10	95	37

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.

Finger Tapping Test (FTT)	Score	Standard	Percentile
Right Taps Average	50	86	18
Left Taps Average	48	85	16

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.

Symbol Digit Coding (SDC)	Score	Standard	Percentile
Correct Responses	29	64	1
Errors*	0	110	75

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.

Stroop Test (ST)	Score	Standard	Percentile
Simple Reaction Time*	231	102	55
Complex Reaction Time Correct*	542	91	27
Stroop Reaction Time Correct*	568	87	19
Stroop Commission Errors*	6	33	1

Shifting Attention Test (SAT)	Score	Standard	Percentile
Correct Responses	38	77	6
Errors*	10	84	14
Correct Reaction Time*	1360	77	6

Continuous Performance Test (CPT)	Score	Standard	Percentile
Correct Responses	40	103	58
Omission Errors*	0	103	58
Commission Errors*	0	107	68
Choice Reaction Time Correct*	491	83	13

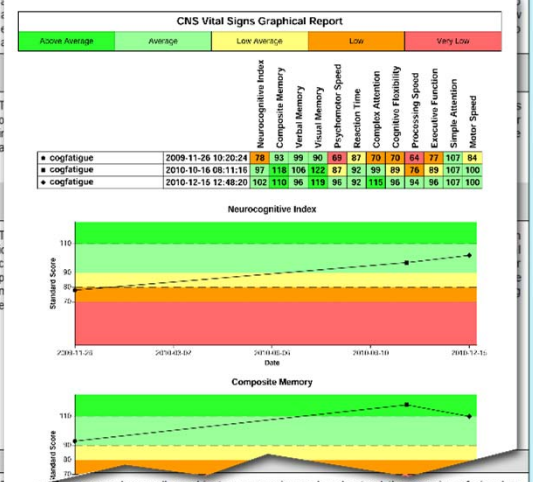
Perception Of Emotions Test (POET)	Score	Standard	Percentile
Correct Responses	11	95	37
Average Correct Reaction Time*	1361	70	2
Omission Errors*	1	95	37
Commission Errors*	4	92	30
Positive Emotions			
Correct Hits	6	106	66
Reaction Time*	1350	62	1
Negative Emotions			
Correct Hits	5	88	21
Reaction Time*	1375	82	12

Reasoning Test (RT)	Score	Standard	Percentile
Correct Responses	12	117	87
Average Correct Reaction Time*	4284	110	75
Commission Errors*	2	115	84
Omission Errors*	1	102	55

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. Each is presented for 14.5 seconds. Non-verbal or visual-abstract reasoning is the process of perceiving issues and reaching conclusions through the use of symbols or generalizations rather than concrete factual information.

DETAILED TEST RESULTS

4 Longitudinal Reports



Find CNS Vital Signs Reimbursement & Brief Interpretation Guides at www.CNSVS.com

Test, Evaluate & Manage… Optimize Your Practice Processes

Test Evaluation Criteria: The CNS VS reports are logical and intuitive making the interpretation by a health professional relatively straightforward. CNS Vital Signs has taken a LIFESPAN approach collecting a large peer neurocognitive normative reference group from **ages 8 to 90**. The normative comparison helps clinicians grade the level of neurocognitive impairment and compare the evidence of cognitive decline from a previous level of performance which can help rule-in or rule-out certain clinical conditions, help determine the level of impairment or track disease progression or improvement. Clinical insight into the cognitive status of a patient can come from impairment in one or more cognitive domains. Like any laboratory test, an abnormal result should be the occasion for further evaluation.

1 **Evaluate Validity:** **The Validity Indicator (VI) helps identify the possibility of an invalid test.** Embedded measures helps evaluate whether the patient is manipulating testing performance for a secondary gain, or they simply did not read the test instructions. Examples of secondary gain include drug or disability seeking, academic accommodation, malingering, symptom feigning, etc.

2 **Evaluate Severity:** **The scores help identify cognitive deficits and their level of impairment.** Assess even slight cognitive impairment (millisecond precision) providing immediate clinical insight into a patient's cognitive deficits 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:** **Impairment pattern helps identify pathologies and possible comorbidities.** 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.

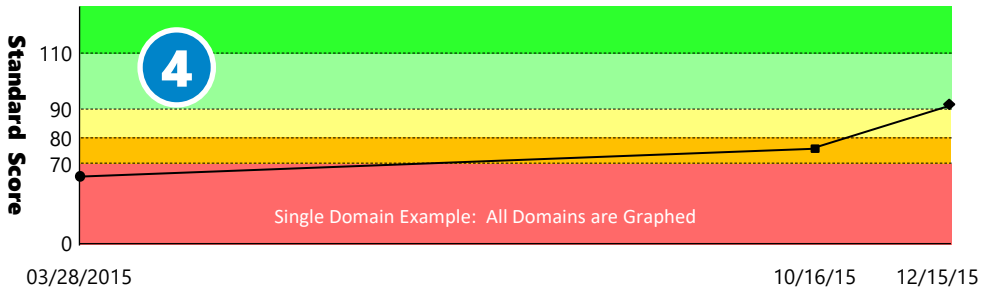
4 **Evaluate Longitudinally:** **Track disease progression, outcomes, or treatment effects.** **Establish a baseline** and serially assess cognitive clinical endpoints to aid in the monitoring and management of many clinical conditions and treatments e.g., measure the response to disease and treatment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

Testing performance should be reviewed with knowledge of a patient's history and physical or diagnostic interview, lab tests, etc. to understand the context of the possible cognitive deficits. **Examples of CNS Vital Signs use…**

- **Neurodegeneration** (Neurocognitive Disorder, MCI, Multiple Sclerosis, Parkinson's, Sleep, etc.)
- **Neurotraumatic** (mTBI, Concussion, TBI Rehabilitation)
- **Neurodevelopmental** (AD/HD, Asperger's, etc.)
- **Neuropsychiatric** (ADD, SUD, Bipolar, Depression, PTSD, Schizophrenia, Anxiety, etc.)
- **Other:** COVID, HIV-HAND, Cancer Cognition, Chronic Pain Fibro-Fog, Encephalopathy, Metabolic / Diabetes, Cardiovascular, Prion or Lyme Disease, Human Performance, Neurotoxicity, Diet & Exercise, Medication Effects, etc.

Easily Graph Longitudinal Results

Executive Function



One Key Difference – Measuring Cognitive Speed… "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:

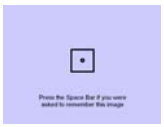
10 Normed Neurocognitive Tests... 50+ Rating Scales

Fully Integrated System with VS4 Local Computer Software and Cloud-Based Online Testing

Verbal Memory (VBM)
Approx. 3 Minutes

- Learning Words
- Memory for Words
- Word Recognition
- Immediate and Delayed Recall

Visual Memory (VIM)
Approx. 3 Minutes



- Learning Shapes
- Memory for Shapes
- Shapes Recognition
- Immediate and Delayed Recall

Finger Tapping (FTT)
Approx. 2 Minutes

- Motor Speed
- Fine Motor Control

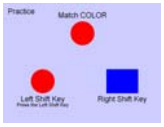
Symbol Digit Coding (SDC)
Approx. 4 Minutes

- Complex Information Processing Accuracy
- Complex Attention
- Visual-Perceptual Speed
- Information Processing Speed

Stroop Test (ST)
Approx. 4 - 5 Minutes

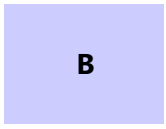
- Simple Reaction Time
- Complex Reaction Time
- Stroop Reaction Time
- Inhibition / Disinhibition
- Frontal or Executive Skills

Shifting Attention (SAT)
Approx. 2.5 Minutes



- Executive Function
- Shifting Sets: Rules, Categories, & Rapid Decision Making
- Reaction Time

Continuous Performance (CPT)
Approx. 5 Minutes

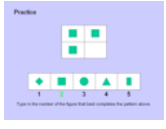


- Sustained Attention
- Choice Reaction Time
- Impulsivity

Perception of Emotions (POET)
Approx. 2 Minutes

- Social Cognition or Emotional Acuity
- Choice Reaction Time

Non-Verbal Reasoning (NVRT)
Approx. 3.5 Minutes



- Reasoning
- Reasoning Recognition Speed

4-Part Continuous Performance (FPCPT)
Approx. 7 Minutes

- Sustained Attention
- Working Memory

*Computerized versions of **VENERABLE NEUROPSYCHOLOGICAL TESTS**. Measures the **SPEED** and **ACCURACY** of a patient's response. **TOTAL TEST TIME** depends on the number of tests and rating instruments selected. Modular testing panels can be custom configured according to clinical practice or research needs.*

CNS Vital Signs assessment platform includes 50+ medical and health rating instruments helping identify and systematically document **PATIENT** and **INFORMANT** ratings of symptoms, behaviors and comorbidities.

Pediatric - Adolescent Instruments:

Developmental - Mental Health
- Pediatric Symptom Checklist (PSC-35, Youth and PSC-17)
- Vanderbilt ADHD Diagnostic Parent & Teacher Rating Scales
- Vanderbilt Assessment Follow-up Parent & Teacher Rating Scales
- PHQ-9 Depression & GAD-7 Anxiety
- DASS - Depression, Anxiety and Stress Scale 21 & 42 (14 years of age and up)
- Screen for Child Anxiety Related Disorders (SCARED) Child & Parent Version
- Social Anxiety Scale for Children and Adolescents (SASCA)

Targeted Instruments
- Child Obsessive-Compulsive Disorder Inventory (OCD-C)
- Childhood Cancer Survivor Study Neurocognitive Questionnaire (CCSS)
- Neurobehavioral Symptom Inventory (NSI)
- DSM -5 PTSD Checklist (PCL-5) & Stressor Specific (PCL-S)

Substance Abuse - SBIRT
- Drug Use Questionnaire (DAST)
- Alcohol Use Disorders Identification Test (AUDIT)

Adult Instruments:

Health Risk - Mental Health
- Patient Health Questionnaire (PHQ-9)
- General Anxiety Disorder (GAD-7)
- Mood Disorder Questionnaire (MDQ)
- DASS - Depression, Anxiety and Stress Scales 21 & 42
- Zung Self-Rating Depression & Anxiety Scales
- Stanford Geriatric Depression Scales (SGDS) 15 & 25

Targeted Instruments
- Quality of Life Medical Outcomes Survey (MOS) SF-36
- Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist
- DSM-5 PTSD Checklist (PCL-5), also the Civilian (PCL-C), Stressor Specific (PCL-S) and Military (PCL-M)
- Fall Risk Questionnaire (FRQ)
- Health Assessment Questionnaire (HAQ) Disability Scale
- Modified Fatigue Impact Scale (MFIS)
- Neurobehavioral Symptom Inventory (NSI)
- Dizziness Handicap Inventory (DHI)
- Head Injury Questionnaire (HIQ)
- Adult Obsessive-Compulsive Disorder Inventory (OCD-A)
- MHE Questionnaire
- Combat Exposure Scale (CES)
- Life Events Checklist (LEC)
- Deployment Risk and Resiliency Inventories
- Life Habits Checklist
- Medical Symptoms Questionnaire (Past 30 Days) and (Past 48 Hours)

Sleep
- Epworth Sleepiness Scale (ESS)
- Pittsburgh Sleep Quality Index (PSQI)
- Sedation Scale (SS)
- Alertness Rating Scale (ARS)

Substance Abuse - SBIRT
- Drug Use Questionnaire (DAST)
- Alcohol Use Disorders Identification Test (AUDIT)

Pain
- Numeric Pain Scale
- Pain Catastrophizing Scale (PCS)

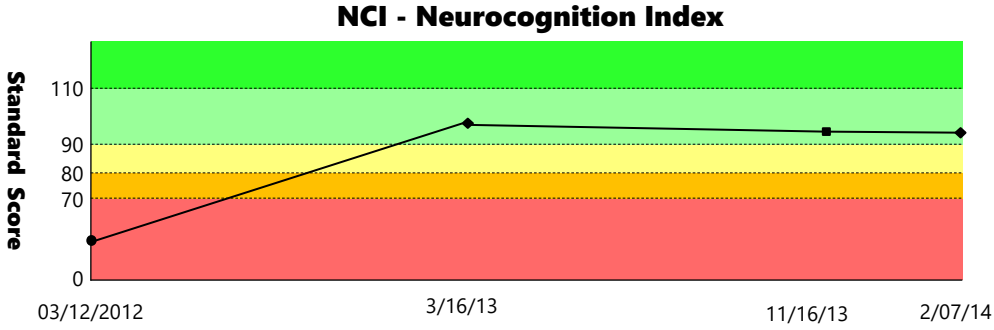
Efficient testing for your patient needs and time constraints.

Case Examples: MCI, DSM-5 Neurocognitive Disorder, Early Intervention

Amnestic MCI Baseline: 60-Year-Old Male Initial MMSE 25*

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	53	1	No					X
Composite Memory	72	60	1	Yes					X
Verbal Memory	36	57	1	Yes					X
Visual Memory	36	75	5	Yes				X	
Psychomotor Speed	178	116	86	Yes	X				
Reaction Time*	710	99	47	Yes		X			
Complex Attention*	118	-104	1	No					X
Cognitive Flexibility	27	92	30	Yes		X			
Processing Speed	47	105	63	Yes		X			
Executive Function	29	92	30	Yes		X			
Simple Visual Attention	-66	-874	1	No					X
Motor Speed	130	121	92	Yes	X				

Amnestic MCI Longitudinal View: 60-Year-Old Male

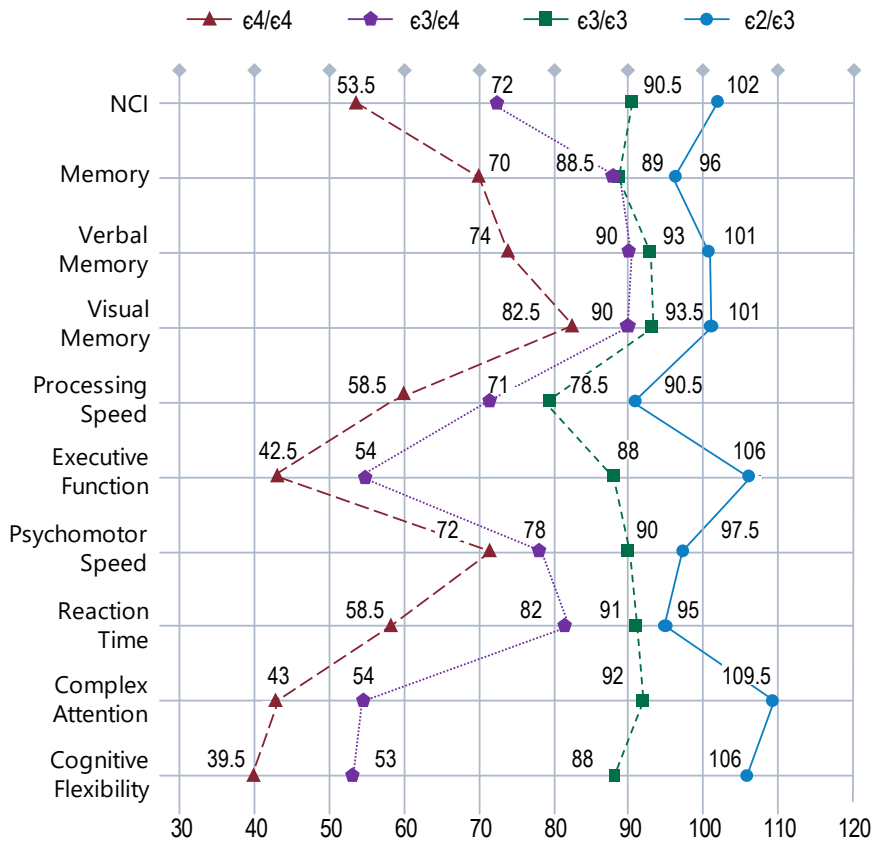


Joe, a 60-year-old male is presenting with memory and concentration concerns and was given CNS Vital Signs Clinical Battery and scored below average compared to his peers in 6 of 11 cognitive domains. His lowest scores were in domains sensitive to amnestic (memory related) MCI.

After considering the H&P, lab results, patient and informant memory questionnaire, sleep scales and the cognitive test results; Joe was referred for a sleep study. Later he was prescribed CPAP and appropriate therapy.

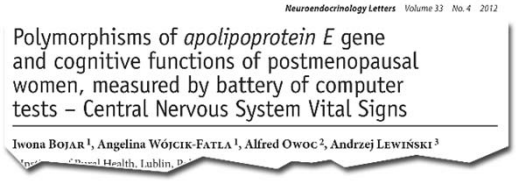
CNS Vital Signs allowed a fine characterization of Joe's clinical course, including apparent variation due to compliance with therapy. Patient and wife were positively influenced by revelation of objective cognitive testing performance, which proved useful in demonstrating probable effects of compliance.

CNS VS Correlation to Alzheimer's ApoE Polymorphisms



Average **Standard Scores** for cognitive functions in particular groups of *ApoE* gene polymorphisms.

Correlation to Biological Markers


Neuroendocrinology Letters Volume 33 No. 4 2012

Polymorphisms of *apolipoprotein E* gene and cognitive functions of postmenopausal women, measured by battery of computer tests – Central Nervous System Vital Signs

Iwona Bojar [1], Angelina Wójcik-Fatla [1], Alfred Owoc [2], Andrzej Lewiński [3]

...Study included 107 postmenopausal women between the ages of 52 and 65 (mean 56.6 ± 3.5)

...Subjects were qualified as "normal" with MOCA scores between 26 and 30

...Findings revealed ApoE polymorphisms correlated to levels of cognitive function where as expected ε3/ε4, or ε4/ε4 scored poorly while ε2/ε3 groups scored much better.

Adapted from: Bojar, Iwona & Wójcik-Fatla, Angelina & Owoc, Alfred & Lewiński, Andrzej. (2012). Polymorphisms of apolipoprotein E gene and cognitive functions of postmenopausal women, measured by battery of computer tests - Central Nervous System Vital Signs. Neuro endocrinology letters. 33. 385-92.

"...increasing emphasis on early intervention to prevent or postpone dementia..." *** ***makes CNS Vital Signs a VALUABLE TOOL for your PRACTICE!***

Case Examples: AD/HD, Medication Effects

AD/HD Baseline: 16-Year-Old Female

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	38	14	No					X
Composite Memory	95	89	23	Yes			X		
Verbal Memory	49	87	19	Yes			X		
Visual Memory	46	95	37	Yes		X			
Psychomotor Speed	173	98	45	Yes		X			
Reaction Time*	591	107	68	Yes		X			
Complex Attention*	77	-139	0	No					X
Cognitive Flexibility	2	36	1	Yes					X
Processing Speed	44	80	9	Yes				X	
Executive Function	10	47	1	Yes					X
Simple Visual Attention	0	-346	0	No					X
Motor Speed	115	100	50	Yes		X			

AD/HD Post Medication: 16-Year-Old Female

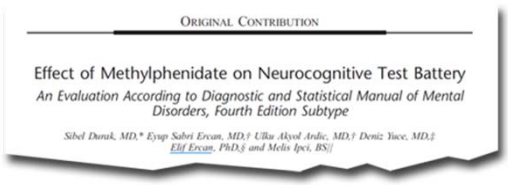
Patient Profile:	Percentile Range				> 74	25 - 74	9 - 24	2 - 8	< 2
	Standard Score Range				> 109	90 - 109	80 - 89	70 - 79	< 70
Domain Scores	Subject Score	Standard Score	Percentile	VI**	Above	Average	Low Average	Low	Very Low
Neurocognition Index (NCI)	NA	110	75	Yes	X				
Composite Memory	98	97	42	Yes		X			
Verbal Memory	60	128	97	Yes	X				
Visual Memory	38	73	4	Yes				X	
Psychomotor Speed	140	116	86	Yes	X				
Reaction Time*	801	106	66	Yes		X			
Complex Attention*	14	117	87	Yes	X				
Cognitive Flexibility	27	116	86	Yes	X				
Processing Speed	34	106	66	Yes		X			
Executive Function	28	116	86	Yes		X			
Simple Visual Attention	38	106	66	Yes		X			
Motor Speed	105	118	88	Yes	X				

Janie, a sixteen-year-old girl struggling in school was given CNS Vital Signs VS4 Clinical Battery and scored below average compared to her peers in 7 of 11 cognitive domains (pre-dose). Her lowest scores were in domains represented by venerable frontal lobe tests.

After reviewing H&P, all test results, the PCS -pediatric symptom checklist & the Vanderbilt AD/HD rating scales; Janie was given a prescription medication. Four weeks later she was administered the test again after being on medication (post dose).

The CNS Vital Signs report is available immediately after the testing session ends and provides utility as a tool for assessing academic and vocational accommodations, secondary gain, as well as measuring medication effect and helping clinicians tailor medications to achieve optimal clinical benefit.

Psychometric Measures for Treatment Response



ORIGINAL CONTRIBUTION

Effect of Methylphenidate on Neurocognitive Test Battery

An Evaluation According to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Subtype

Sibel Durak, MD,* Eyup Sabri Ercan, MD,† Ulku Akyol Ardic, MD,† Deniz Yuce, MD,‡ Elif Ercan, PhD,§ and Melis Ipci, BS||

Adapted From:
Effect of Methylphenidate on Neurocognitive Test Battery;
Journal of Clinical Psychopharmacology;
Volume 34, Number 4, August 2014

Evaluate the neuropsychological characteristics of PI - predominantly inattentive, R – restrictive, and CB - combined (inattentive & hyperactive) AD/HD subtypes...

Comparisons of CNSVS Domain Scores Between the AD/HD Groups Before MPH Medication Administration

Baseline Measurements	PI Mean (SD)	R Mean (SD)	CB Mean (SD)	Control Mean (SD)	*P*	Pairwise Comparisons
Neurocognition Index	87.62 (14.66)	90.71 (11.77)	90.25 (11.14)	96.91 (10.87)	<0.001*	(PI=R=CB) < control
Composite Memory	84.56 (21.86)	87.97 (19.5)	91.89 (20.92)	96.73 (18.82)	0.01	PI < control
Psychomotor speed	92.96 (10.49)	94.12 (10.87)	93.63 (12.54)	99.77 (16.58)	<0.001	(PI=R=CB) < control
Reaction time	78.54 (21.63)	83.15 (18.42)	81.86 (16.49)	83.26 (28.57)	0.65*	
Complex attention	91.38 (24.6)	94.92 (16.81)	90.77 (18.41)	102.15 (12.45)	<0.001*	(PI=R=CB) < control
Cognitive flexibility	90.84 (16.15)	93.32 (15.51)	91.15 (14.1)	102.82 (15.28)	<0.001	(PI=R=CB) < control
Symbol Digit Coding (***Processing Speed Domain***)						
Correct responses	41.24 (12.73)	41.82 (13.8)	40.23 (12.36)	48.18 (11.77)	<0.001	(PI=R=CB) < control
Errors	0.92 (1.18)	1.09 (1.26)	1 (2.28)	3.6 (5.53)	<0.001*	(PI=R=CB) < control
Shifting Attention Test (***Executive Function Domain***)						
Correct responses	34.44 (10.09)	35.43 (11.33)	34.07 (9.95)	42.23 (9.98)	<0.001	(PI=R=CB) < control
Errors	15.34 (7.83)	15.71 (9.41)	17.52 (8.02)	11.55 (6.06)	<0.001*	(PI=R=CB) > control
Correct reaction time	1290.6 (133.52)	1224.91(236.4)	1233.39 (175)	1188.6 (222.75)	0.01*	CB > control
CPT (***Simple Attention Domain***)						
CPT Correct	38.54 (2.61)	37.84 (5.25)	38.3 (2.71)	39.19 (1.14)	<0.001*	R > control
Omission	1.46 (2.61)	1.61 (2.15)	1.7 (2.71)	0.81 (1.14)	<0.001*	CB > control
Commission errors	3.42 (4.65)	11.59 (66.7)	3.99 (4.02)	1.71 (1.68)	<0.001*	R > control, CB > control
Choice RT correct	506.84 (79.92)	490.2 (100.28)	515.36 (81.96)	470.5 (68.55)	<0.001	PI < control

*The Welch ANOVA test was used for comparisons between diagnostic groups, and post hoc comparisons were performed with Tamhane's T2 test. All other comparisons were performed with the ANOVA test, and post hoc tests were performed with the Tukey test.

Comparisons After MPH Administration

PI Mean (SD)	R Mean (SD)	CB Mean (SD)
95.53 (11.96)	98.66 (11.62)	97.38 (10)
81.27 (22.57)	85.59 (20.44)	85.9 (17.7)
98.88 (9.77)	99.8 (11.09)	99.73 (10.52)
88.25 (19.19)	89.88 (17.98)	86.43 (17.92)
105.51 (16.27)	108.53 (17.14)	107.58 (12.63)
104.77 (15.63)	108.42 (14.14	106.58 (13.74)

...Study included 360 children and adolescents (277 boys, 83 girls) between 7 and 15 years of age who had been diagnosed with ADHD at the Department of Child and Adolescent Psychiatry using K-SADS-PL and DSM-IV

...Subjects were grouped according to ADHD subtypes as PI (n = 51), R (n = 65), and CB (n = 165). Seventy-nine healthy children were recruited into the study as the control group

...Findings revealed controls scored better than ADHD subjects and ADHD subjects scored better on MPH than with no drug

*** Attention-deficit/hyperactivity disorder (ADHD); Søren Dalsgaard; Eur Child Adolesc Psychiatry (2013) 22 (Suppl 1):S43–S48

***** ***RESTRICTIVE (DSM-V):*** If criterion A1 (inattention) is met, but no more than two symptoms from criterion A2 (hyperactivity / impulsivity) have been present for the past 6 months.

Case Examples: Concussion, mTBI, PTSD

mTBI / Concussion Post Injury: 20-Year-Old Male

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)		85	16	Yes					
Composite Memory	102	103	58	Yes		X			
Verbal Memory	51	93	32	Yes		X			
Visual Memory	18	110	75	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	28	63	1	Yes					X
Processing Speed	48	79	8	Yes				X	
Executive Function	34	75	5	Yes				X	
Simple Visual Attention	40	108	70	Yes		X			
Motor Speed	124	105	63	Yes		X			

mTBI / Concussion 2nd Post Injury: 20-Year-Old Male

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)		113	81	Yes	X				
Composite Memory	116	130	98	Yes	X				
Verbal Memory	58	118	88	Yes	X				
Visual Memory	58	130	98	Yes	X				
Psychomotor Speed	201	110	75	Yes	X				
Reaction Time*	550	108	70	Yes		X			
Complex Attention*	3	110	75	Yes	X				
Cognitive Flexibility	55	108	70	Yes		X			
Processing Speed	65	100	50	Yes		X			
Executive Function	56	108	70	Yes		X			
Simple Visual Attention	40	108	70	Yes		X			
Motor Speed	136	115	84	Yes	X				

Following a collision in a club rugby match Paul, a 20-year-old college student, visited the ER complaining of a headache and nausea. Not having a cognitive baseline Paul was given CNS Vital Signs VS4 Clinical Battery (1st post injury). Compared to his peers he scored below average in 4 of 11 cognitive domains. His lowest scores were in domains represented by frontal lobe tests.

After examining Paul, and reviewing the CT scan, symptom scale as well as the cognitive test results; Paul was started on a concussion management protocol. Two weeks later after he was symptom free, he was administered the test again (2nd post injury). The CNS Vital Signs session and longitudinal reports were available immediately after the testing session allowing the clinician to evaluate and manage Paul efficiently at the office visit.

The CNS Vital Signs testing platform is designed to support TBI, mTBI and sports concussion guidelines.

The Open Neuroimaging Journal

RESEARCH ARTICLE

Examining Microstructural White Matter in Active Duty Soldiers with a History of Mild Traumatic Brain Injury and Traumatic Stress

Correlation to Imaging Markers

Post Concussion Syndrome - PTSD

Compromised Hippocampus-Striatum Pathway as a Potential Imaging Biomarker of Mild-Traumatic Brain Injury and Posttraumatic Stress Disorder

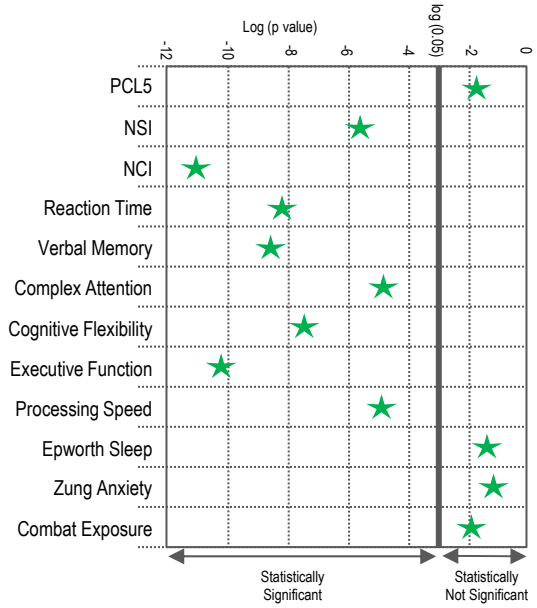
Examining Microstructural White Matter in Active-Duty Soldiers with a History of Mild Traumatic Brain Injury and Traumatic Stress

Method: Seventy-four active-duty U.S. soldiers with PTS (n = 16) and PTS with co-morbid history of mTBI (PTS/mTBI; n = 28) were compared to a military control group (n = 30). Participants received a battery of neurocognitive and clinical symptom measures. The number of abnormal DTI (diffusion tensor imaging) values was determined (>2 SDs from the mean of the control group) for fractional anisotropy (FA) and mean diffusivity (MD), and then compared between groups…

Results: The comorbid PTS/mTBI group had significantly greater traumatic stress, depression, anxiety, and post-concussive symptoms, and they performed worse on neurocognitive testing than those with PTS alone and controls. The groups differed greatly on several clinical variables, but contrary to what we hypothesized, they did not differ greatly on primary and exploratory analytic approaches of hetero-spatial whole brain DTI analyses.

Conclusion: In conclusion, our findings do not provide strong evidence of compromised white matter integrity between our clinical groups compared to controls using several analytic approaches. ***In contrast, our groups were best categorized by robust differences in clinical symptoms and neurocognitive scores (i.e., CNS Vital Signs / TOMM)***. As such, our findings suggest that psychological health conditions rather than pathoanatomical changes may be contributing to symptoms presented by soldiers with comorbid PTS and mTBI.

Adapted from: Dretsch, Michael N., Rael T. Lange, Jeffery S. Katz, Adam Goodman, Thomas A. Daniel, Gopikrishna Deshpande, Thomas S. Denney, Grant L. Iverson, and Jennifer L. Robinson. 2017. "Examining Microstructural White Matter in Active-Duty Soldiers with a History of Mild Traumatic Brain Injury and Traumatic Stress." The Open Neuroimaging Journal



*Comparing symptom severity, neurocognitive functioning, and self-report measures of the control subjects and the… PCS-PTSD group (green stars). The significance threshold (0.05) is visible as a thick horizontal line. Control subjects exhibited significantly better neurocognitive performance, less sleepiness and anxiety, and less combat exposure. ***PCS-PTSD subjects exhibited significantly worse neurocognitive performance and higher PCS symptom.***

*Adapted from: Human Brain Mapping 38:2843–2864 (2017); Compromised Hippocampus-Striatum Pathway as a Potential Imaging Biomarker of Mild-Traumatic Brain Injury and Posttraumatic Stress Disorder; Rangaprakash et al.

Add Brain Health Services *to Your Practice*

CNS Vital Signs Enabling MCI Guidelines

...and Efficient Collection of MIPS Quality Measures

SPECIAL ARTICLE

Neurology® 2019;93:705-713. doi:10.1212/WNL.0000000000008259

Quality improvement in neurology

Mild cognitive impairment quality measurement set

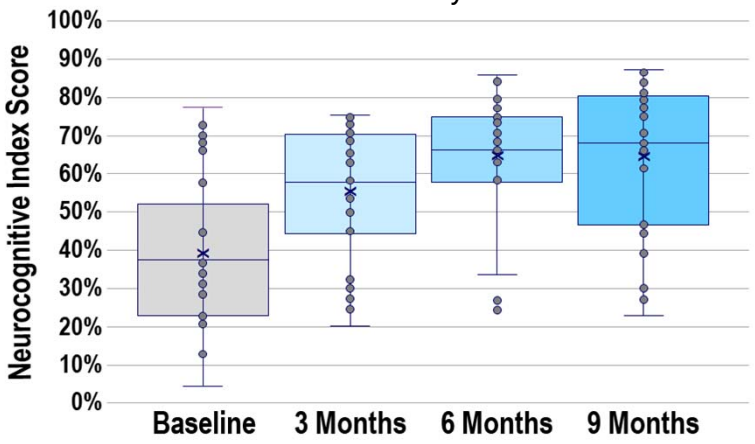
Norman L. Foster, MD, Mark W. Bondi, PhD, ABPP-CN, Rohit Das, MD, Mary Foss, Linda A. Hershey, MD, PhD, ... Koh, MD, MPH, MBA, Rebecca Logan, PA-C, MPAS, Carol Poole, Joseph W. Shega, MD, ... Thothala, MD, MB... MBA, Meredith Wicklund, MD, Melissa Yu, MD

- ***MCI is clinically important***, but often not recognized… Since ***cognition is the most sensitive indicator of brain function***, and is ***cost effectively assessed***, this creates an enormous opportunity to improve neurologic care.
- ***Annual cognitive health assessment for patients 65 years and older***
- ***Assessment*** and treatment ***of factors contributing to MCI***
- Use an ***objective measure*** of cognition
- Periodically and routinely assessing cognitive health with ***a standardized measure*** is necessary… should be documented in medical records over time to ***allow change in cognition to be recognized*** and addressed early.
- The purpose of assessing cognitive health is not limited to identifying disease. ***Cognitive impairment is a dominant comorbidity…***

Precise & Personalized Computerized Neurocognitive Testing

Adapted from: Toups, Kat et al. 'Precision Medicine Approach to Alzheimer's Disease: Successful Pilot Project'. Journal of Alzheimer's Disease, 1 Jan. 2022 : 1–11.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9484109/

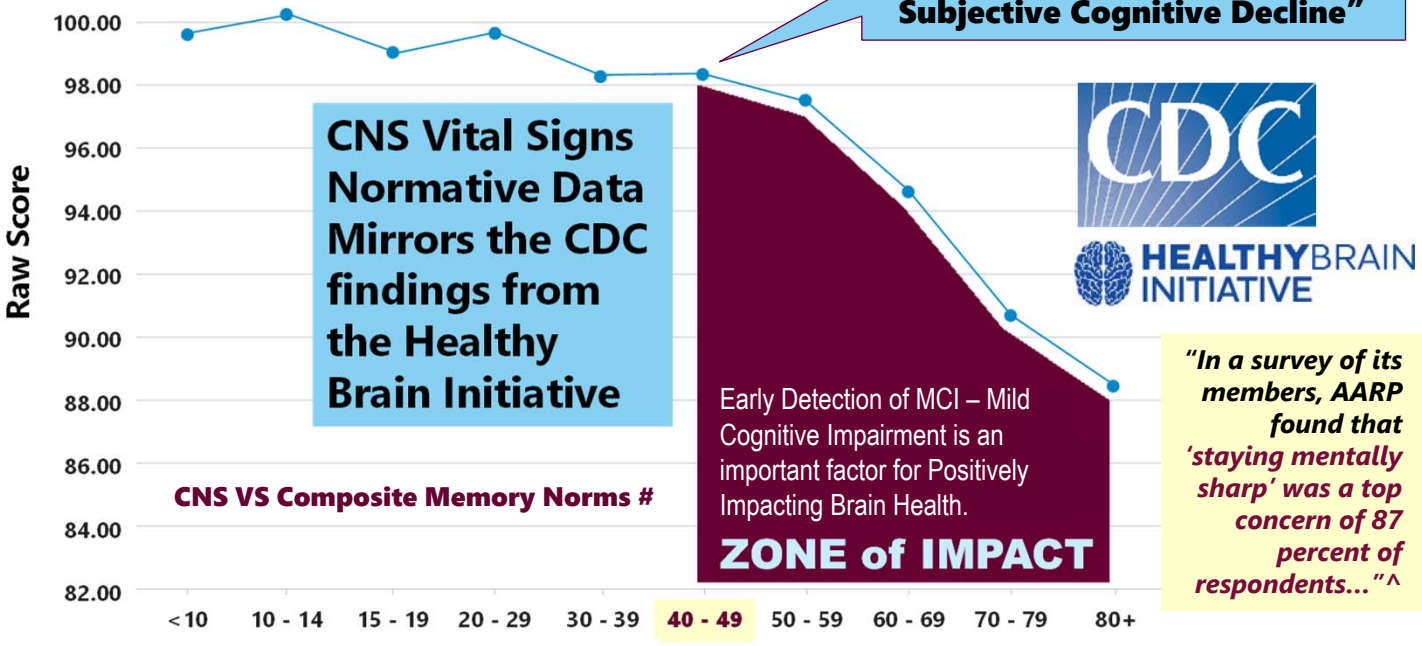
CNS Vital Signs Neurocognitive Index
from baseline to study conclusion



CNS Vital Signs Turns the Subjective into Objective Insight

"1 in 9 people aged 45 years and older are experiencing (SCD) Subjective Cognitive Decline"

Do you SEE the EARLY SIGNS?



CDC

HEALTHYBRAIN INITIATIVE

"In a survey of its members, AARP found that 'staying mentally sharp' was a top concern of 87 percent of respondents…"^

^ *Cognitive Aging: Progress in Understanding and Opportunities for Action; Institute of Medicine*

Source: Reliability and validity of a computerized neurocognitive test battery, CNS Vital Signs; Archives of Clinical Neuropsychology; Volume 21, Issue 7, October 2006, Pages 623–643

8 Ways to Help Improve Your Brain Health

https://www.cdc.gov/aging/publications/features/healthy-body-brain.html

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CNS Vital Signs is Widely Used to Measure Neurocognition

…in Neurodegenerative, Neuropsychiatric, Neurotraumatic and Neurodevelopmental Disorders and many other conditions.

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- **Brain Health Service**
  - Enables the new DSM-5 and MCI-Dementia-Alzheimer's Guidelines for Cognitive Assessment.
- **TBI – mTBI - Concussion**
  - CNS VS has a free baseline & retest for schools Sports Concussion programs. www.concussionvitalsigns.com
- **Multiple Sclerosis**
- **Parkinson's**
- **Stroke**
- **Sleep**
- **Treatment & Medication Effects**
- **Epilepsy**

Psych

- **AD/HD**
  - Helps identify frontal lobe deficits e.g., attention, executive dysfunction and many more.
- **Substance Use Disorder**
- **Treatment & Medication Effects**
- **Bipolar**
- **Schizophrenia**
- **Depression / Anxiety**
- **PTSD**
- **Asperger's**
- **High Functioning Autism**
- **Delirium**
- **Eating Disorders**
- **Chronic Pain – Fibro Fog**

Other

- **Rehabilitation**
- **Metabolic / Diabetes**
- **Infectious Disease: COVID, HIV / HAND, PANDAS, Lyme, Prion Disease, etc.**
- **Cancer Cognition – Chemo Brain**
- **Forensic**
- **Mild Hepatic Encephalopathy**
- **Cardiovascular**
- **Cardiac Surgery**
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- **Capacity**
- **Human Performance: Exercise, DIET, Brain Health Activities, Training, Etc.**
- **Environmental - Neurotoxicity**
- **Genetic Phenotype**

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