

COMPUTERIZED NEUROCOGNITIVE TEST BATTERIES FOR DEMENTIA SCREENING

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AD, even in its earliest stages, is not just a disease of memory. Long before any clinical signs are apparent, there are signs of cognitive weakness in various cognitive areas. The earliest “detectable cognitive deficits” are not only tests of verbal and visual memory but also measures of complex attention, executive control and reaction time/information processing speed. The diversity of the dementias, and the diversity of the neuropsychological symptoms of dementia, means that **no single test** is sufficient for the purpose of diagnosis or screening. Rather, a battery of neurocognitive tests is necessary. The commonality shared by all forms of dementia, however, indicates that an appropriate battery can comprise only a few well-chosen tests. This is important, because the major issue in dementia diagnosis is not necessarily to sub-type the various forms of the condition, but, rather, to make the diagnosis as early as possible.

In the past couple of years, highly precise and reliable instruments have come available to screen for mild cognitive dysfunction in general, and early, presymptomatic dementia in particular. They are computerized neurocognitive test batteries. They are derived from the PC-based neuropsychological batteries that have been used for 20 years in military and aerospace medicine, in the pharmaceutical industry, in industrial and in sports medicine. In those settings, they are used to detect mild cognitive dysfunction related to many different causes. Now, several computer-based test batteries have been introduced as clinical screening tools (**Table 1**).

COMPUTERIZED BATTERIES FOR DEMENTIA SCREENING						
BATTERY	SOURCE	TIME	#TESTS	OS	ACTIVE INTERNET REQUIRED	EST. COST
MicroCog	Psychological Corporation	30-60'	12-18	DOS	NO	\$184/10
CogState	www.cogstate.com	18'	9	WIN	YES	22.50
CNS Vital Signs	www.cnsvs.com	30'	7	WIN	NO	5-25
Cantab-PAL	www.bioportfolio.com/cantab.html	10'	1	WIN	NO	£2495/20
Headminder	www.headminder.com	25'	4	WIN	YES	1995/18
NeuroTrax	www.neurotrax.com	45'	11	WIN	YES	40

The thrust of research indicates that, in general, computerized tests are well accepted by patients and trusted by the psychologists who use them. They are as reliable on test-retest as conventional tests are, and they correlate with conventional tests to the same degree as conventional tests do to each other. Most important, whenever a straight-up comparison is done, the computerized tests prove to be more sensitive to mild cognitive dysfunction than paper-and-pencil tests.

Computerized neurocognitive tests have been used in research, and in specialized areas of medicine, for more than 25 years. Although many different test batteries have been developed, and new batteries are introduced, every year, for clinical screening, there is a remarkable degree of commonality among the different test batteries, the tests they use, the scores they generate, and their general psychometric properties. It is clear that computerized testing ought to be part of the medical screening process for cognitive impairment in general, and dementia in particular. The choice of which battery to use may well be made on the basis of test familiarity, price and ease of use. We strongly recommend, however, that batteries with multiple tests be used, rather than relying simply on one test, or only a few short tests.

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CNS VITAL SIGNS: A COMPUTERIZED TEST FOR DEMENTIA SCREENING

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“CNS Vital Signs” is an internet-based neurocognitive screening battery, comprised of seven familiar tests: Verbal and Visual Memory, Tapping, Coding, the Stroop, Shifting Attention and the CPT. The seven tests generate summary scores in five domains (memory, psychomotor speed, reaction time, cognitive flexibility and vigilance attention). The five domains, in turn, generate a summary score, the cognitive function index (CFI).

The test battery is self-administered on an ordinary PC, and takes about 30 minutes. The Vital Signs battery is suitable to screen for mild cognitive dysfunction of various origins.

The tests in the “Vital Signs” battery are highly reliable (test-retest, $r = 0.45-0.85$). Normative data from >500 normal subjects, age 8-89, indicates typical performance differences by age and gender. Concurrent validity is demonstrated in studies comparing the Vital Signs battery to conventional neuropsychological tests.

Clinical data in the CNSVS database includes more than 2,000 patients with neurocognitive and psychiatric disorders. The battery generates distinct profiles for ADHD, brain injury and dementia. It is sensitive to cognitive deficits associated with depression and bipolar disorder, and to the effects of various drugs.

CNSVS performance was compared in four groups: 35 patients with dementia (mean age 62.7), 23 patients with mild cognitive impairment (65.3), 34 psychiatric patients with depression or anxiety (61.5) and 28 normal controls. The four groups differed, to a significant degree, on all of the seven tests (ANOVA, Kruskal-Wallis).

Stepwise discriminant function analysis indicated that four summary scores discriminated best among the four groups: the CFI, and domain scores for memory, vigilance attention and cognitive flexibility. Sensitivity/specificity analysis addressed the relative merits of three scores: the CFI, a “dementia quotient” comprised of memory, attention and cognitive flexibility (DQ3), and DQ2, a “dementia quotient” comprised of memory and attention domain scores. The best sensitivity and specificity data were generated by the CFI (7 tests) and the DQ3 (five tests). The DQ3 successfully differentiated demented patients from psychiatric patients. At a cutoff of 90, the DQ3 correctly identified 71% of patients with MCI.

These data support the contentions that: computerized screening batteries have a role to play in dementia screening; and that batteries testing several different cognitive domains are better than tests that address only one area of cognitive function.

NML	CFIss	MEMss	MSss	RTss	CFss	Avss	DQ3	DQ2
>90	0.91	0.77	0.81	0.86	0.86	0.73	0.88	0.84
>80	0.91	0.88	0.88	0.93	0.89	0.96	0.96	0.96
>70	1.00	1.00	0.96	0.93	0.93	0.96	1.00	1.00
PSYCH	CFIss	MEMss	MSss	RTss	CFss	Avss	DQ3	DQ2
>90	0.56	0.58	0.56	0.73	0.65	0.50	0.91	0.72
>80	0.68	0.82	0.74	0.73	0.74	0.83	0.91	0.88
>70	0.82	0.85	0.82	0.79	0.84	0.92	0.91	0.94
MCI	CFIss	MEMss	MSss	RTss	CFss	Avss	DQ3	DQ2
<90	0.63	0.59	0.55	0.43	0.62	0.62	0.71	0.70
<80	0.38	0.50	0.40	0.26	0.43	0.48	0.43	0.40
<70	0.25	0.32	0.20	0.13	0.29	0.48	0.38	0.35
DEM	CFIss	MEMss	MSss	RTss	CFss	Avss	DQ3	DQ2
<90	0.94	1.00	0.74	0.63	0.88	0.79	0.96	0.91
<80	0.78	0.79	0.42	0.51	0.67	0.68	0.83	0.73
<70	0.50	0.63	0.32	0.34	0.48	0.54	0.57	0.59

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