Ancillary Tests in Cognitive Impairment

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Newcastle University
Institute of Neuroscience

MRC Medical Research Council

COGFAST Memory After Stroke Study

Learning Objectives

At the end of this lecture, participants should be able:

To understand the concept of cognition and classification of neurocognitive disorders

To understand principles of assessment of cognitive function, particularly instruments relevant to SSA

To highlight ancillary tests in cognitive impairment

Cognition

- The mental processes of:

✓ acquisition, organization, storage and retrieval of knowledge

✓ thinking, understanding, and engaging with self and the environment

Importance of Cognition

"Cogito ego sum"

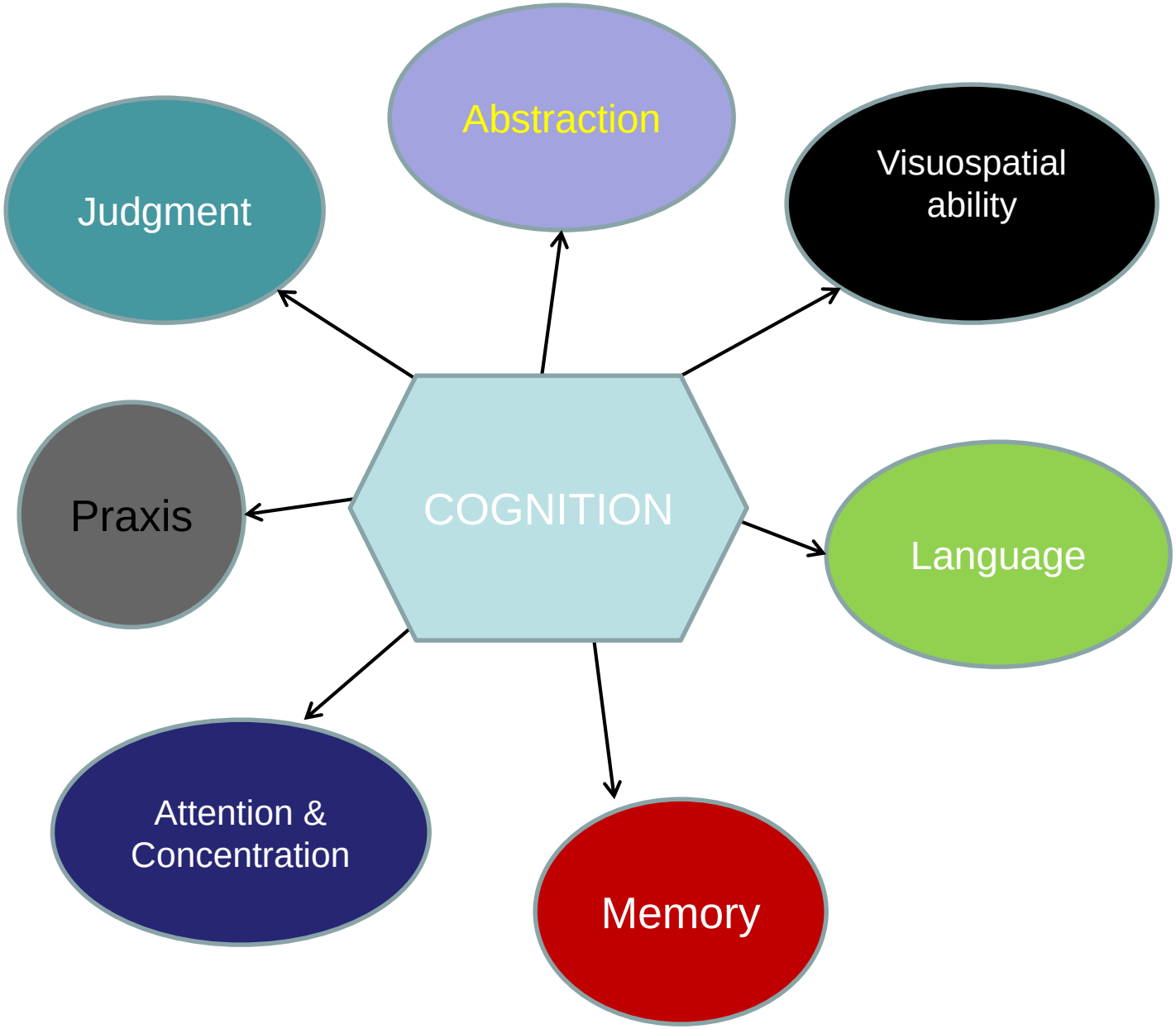
Rene Descates

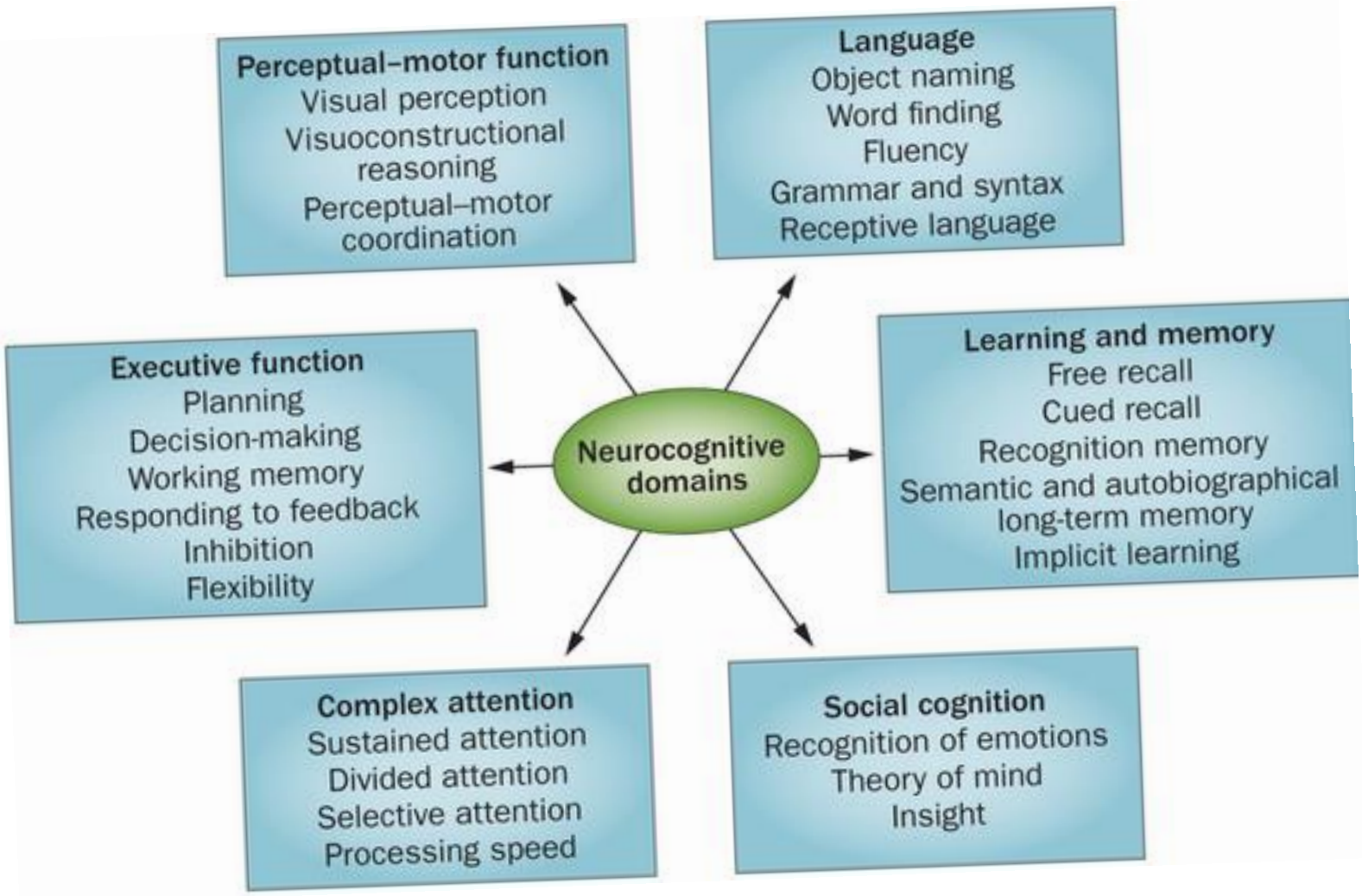
"I think, therefore, I am"

Essentials of cognitive ability

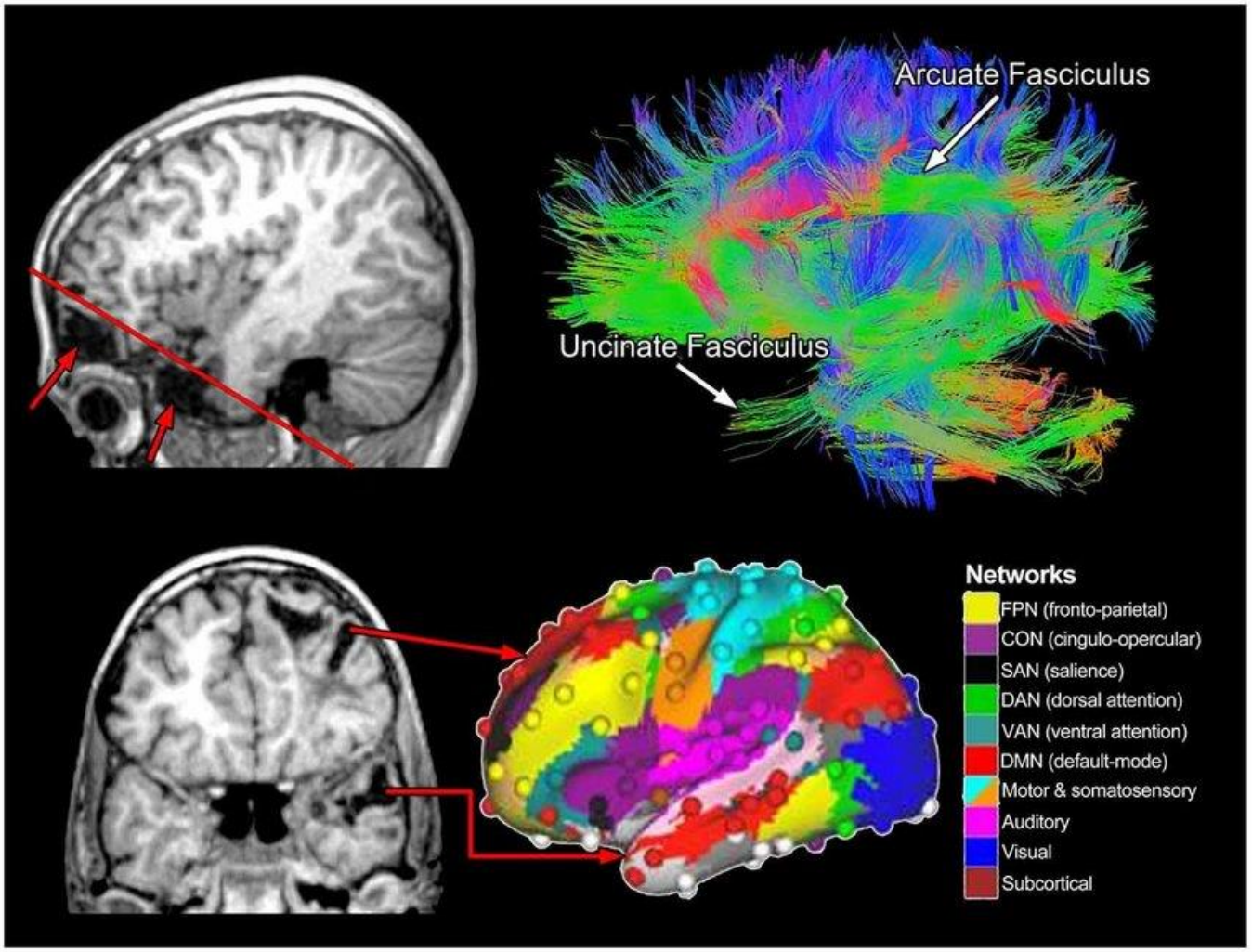
Alert mind / awareness of self
in contact with the environment
Being able to think and reason

Cognitive Domains


Abstraction
Judgment
Visuospatial ability
COGNITION
Praxis
Language
Attention & Concentration
Memory


Perceptual–motor function
Visual perception
Visuoconstructional reasoning
Perceptual–motor coordination
Language
Object naming
Word finding
Fluency
Grammar and syntax
Receptive language
Executive function
Planning
Decision-making
Working memory
Responding to feedback
Inhibition
Flexibility
Neurocognitive domains
Learning and memory
Free recall
Cued recall
Recognition memory
Semantic and autobiographical long-term memory
Implicit learning
Complex attention
Sustained attention
Divided attention
Selective attention
Processing speed
Social cognition
Recognition of emotions
Theory of mind
Insight

Brain Networks



Bigler ED. 2016. Systems Neuroscience;10:35

Neurocognitive Disorders

Group of diseases characterized by decline/impairment in one or more cognitive domains

Diagnosis can be clinically overt or may be asymptomatic

May be combined with loss of independence/ loss of capacity to do activities of daily living

The most severe form is Dementia

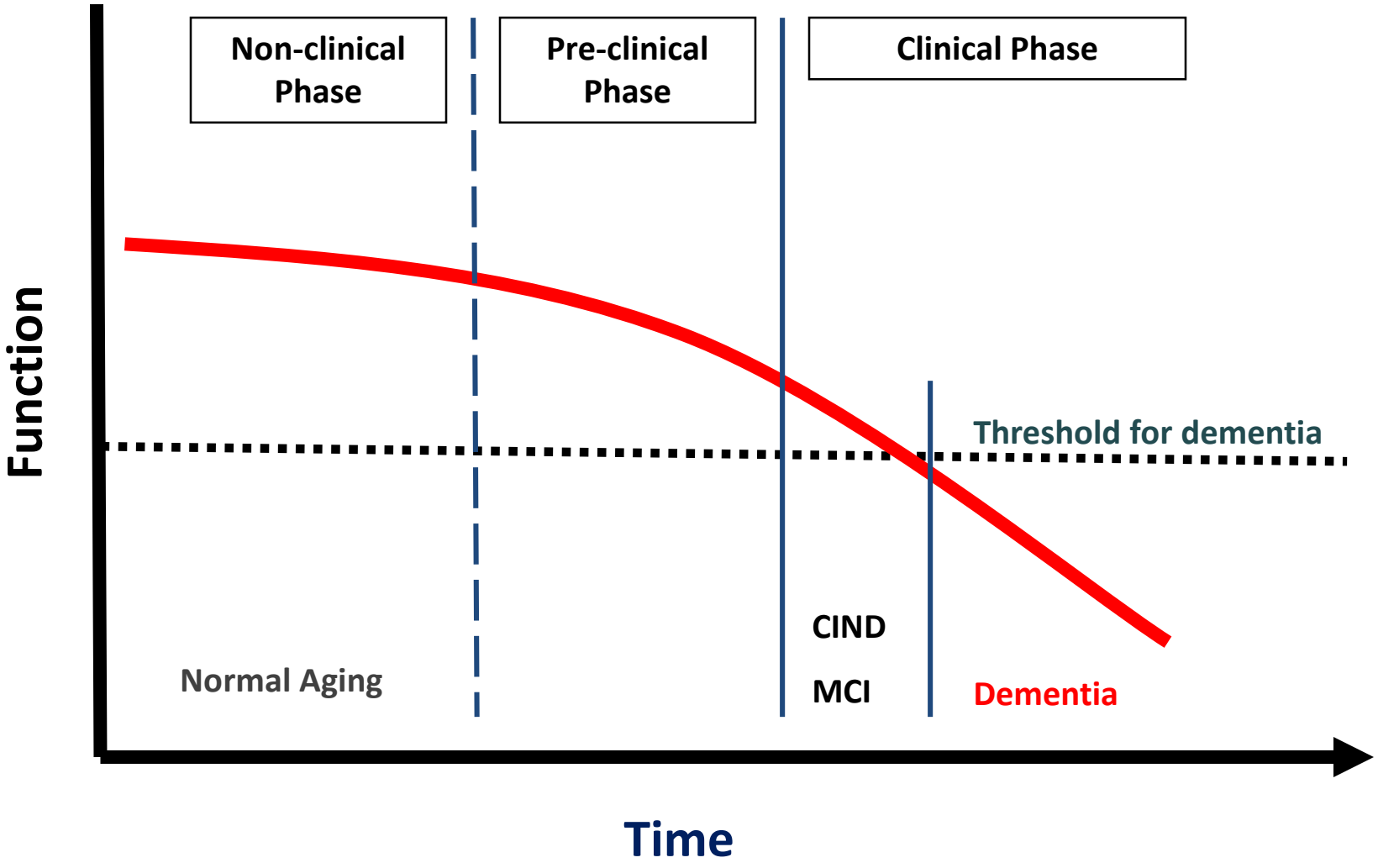
Cognitive Profile

Normal Cognition → **Cognitive Impairment** → Dementia

ADL normal, Cognitive decline

Severe cog. deficits
Impaired ADL
Need for super-vision

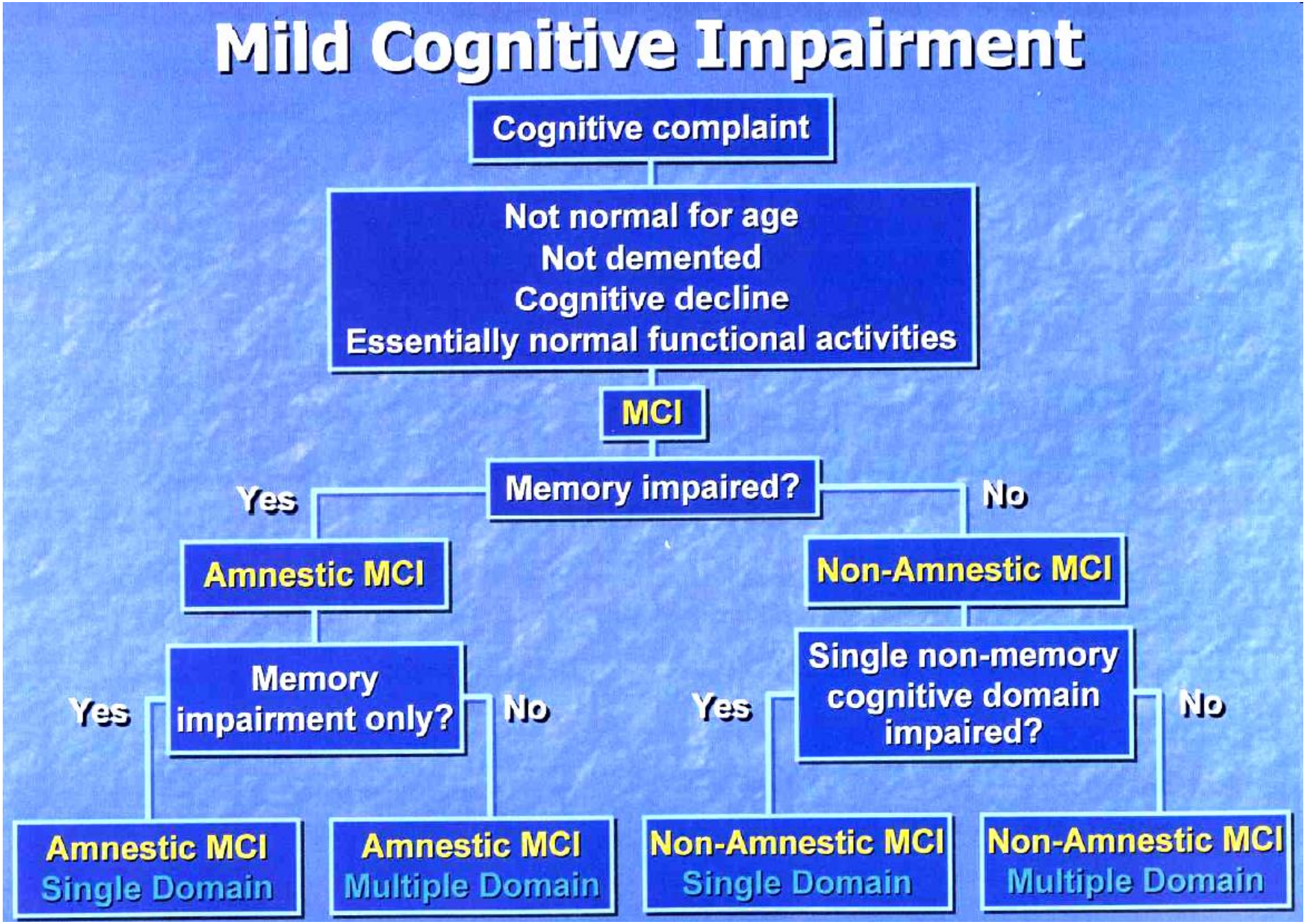
Trajectory of Cognition



Mild Cognitive Impairment

- Transitional state between normal aging and dementia
- Cognitive deficits present but functioning preserved
- Inherently ‘unstable condition’ at both extremes
- Divided into amnestic and non-amnestic types
- Amnestic type at greater risk of developing AD

Mild Cognitive Impairment



Petersen RC, Continuum 2004 10:9-28

Dementia

Clinical syndrome characterized by cognitive decline in one or more domain(s)[memory, language, judgment etc.], sufficiently severe to cause impairment in social or occupational functioning, in the conscious and alert state.

Approach to the patient with dementia

History:

- Try and speak to the patient and also a relative
- Ask about:
  - Symptoms at onset
  - Pattern and speed of evolution
  - Impact on work/family life/ Family history
  - Risk factors (e.g. vascular, alcohol)
  - Past medical history
  - Treatment history

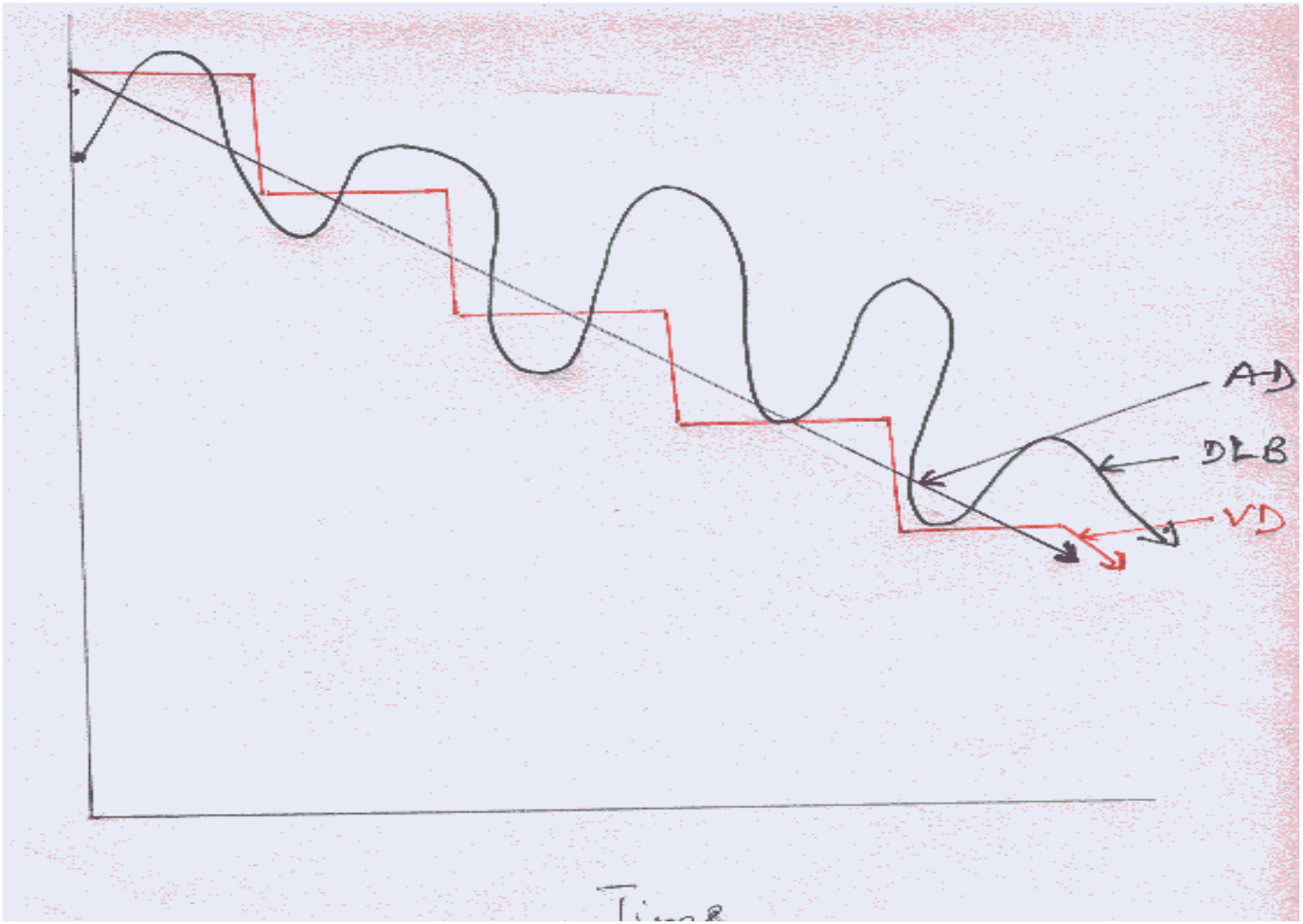
Approach to the patient with dementia

- Determine dominant cognitive features and stage of disease
- Determine pattern of progression
- Exclude treatable causes (trauma, infection, drugs, metabolic diseases etc)
- Examine for focal signs
- Examine for movement disorders
- Investigate and initiate treatment

Cognitive deficits in dementia

- Memory problems – typical of Alzheimer's disease
- Disturbed language functions (aphasia) – FTD, AD
- Problems with recognition of objects previously perceived (agnosia)
- Impaired reasoning, judgment, slow mental processing (Executive function impairment) – VCI, HAND

Pattern of presentation of some dementia syndromes



ICD-10 Dementia criteria

- **G1- Decline in memory** (first, inability to learn new information then loss of previously learned information)
- This should be supported by cognitive testing and interview of a reliable informant
- AND
- **Decline in other cognitive areas** such as judgement and thinking and planning and organising (must be decline from previous level of functioning NB learning disability)
- **G2 - no clouding of consciousness (i.e. no delirium)**
- **G3 Decline** in social functioning, motivation or emotional control (apathy, coarsening of social behaviour, irritability) Essentially evidence of a change in functional ability
- **G4 Present for at least 6 months**
- Mild/Moderate/Severe
- **With additional symptoms** (behavioural and psychological symptoms of dementia (depression, delusions, psychosis) Up to 90% have these

DSM-V Major Neurocognitive Disorder (Dementia)

- 1. Evidence of significant cognitive decline from a previous level of performance in **one or more** cognitive domains – such as complex attention, executive function, learning, memory, language, perceptual-motor or social cognition
- Evidence should consist of history of significant decline (from patient, reliable informant or clinician)

AND

- Impairment in cognitive performance from standardised neuropsychological testing (or another assessment if this is not available

- 2. The cognitive deficits interfere with independence in everyday (functional) activities (at a minimum, assistance with complex activities of daily living such as paying bills)
- 3. Not occurring only in delirium and not better explained by another mental disorder

- Specify subtype (see criteria for subtypes of dementia)

Differences with DSM-V criteria

- NCD – acquired, rather than developmental disorders -represent decline. Due to underlying brain pathology.
- 'Dementia' typically refers to degenerative diseases in older people, whereas NCD expands category to diseases in younger people.
- Allows for one area of deficit only (i.e. amnestic syndrome, cognitive impairment post head injury) except in Alzheimers disease
- **For degenerative dementias, use consensus guidelines for dementia subtype in addition to DSM-V.**

NOT dementia

- **DELIRIUM**: an acute confusional state (causes include infection, malignancy, etc.)

- **PSYCHIATRIC PROBLEMS ("pseudodementia"):** e.g. depression, anxiety. Relatively abrupt onset often with identifiable trigger. Should not progress

Delirium: definition

A complex disorder typically of acute onset and fluctuating course which manifests as

- attention deficit or disturbance of awareness

- impaired cognition that may involve any or all of the following domains: memory, orientation, visuospatial and executive functions

- sleep wake cycle disturbance

. Psychomotor disturbances (hypo- or hyperactivity and mixed forms with unpredictable shifts from one to the other

Perceptual disturbances

- of enough severity to have a negative impact on the individual

Delirium: “off the track”

‘Acute confusional state’

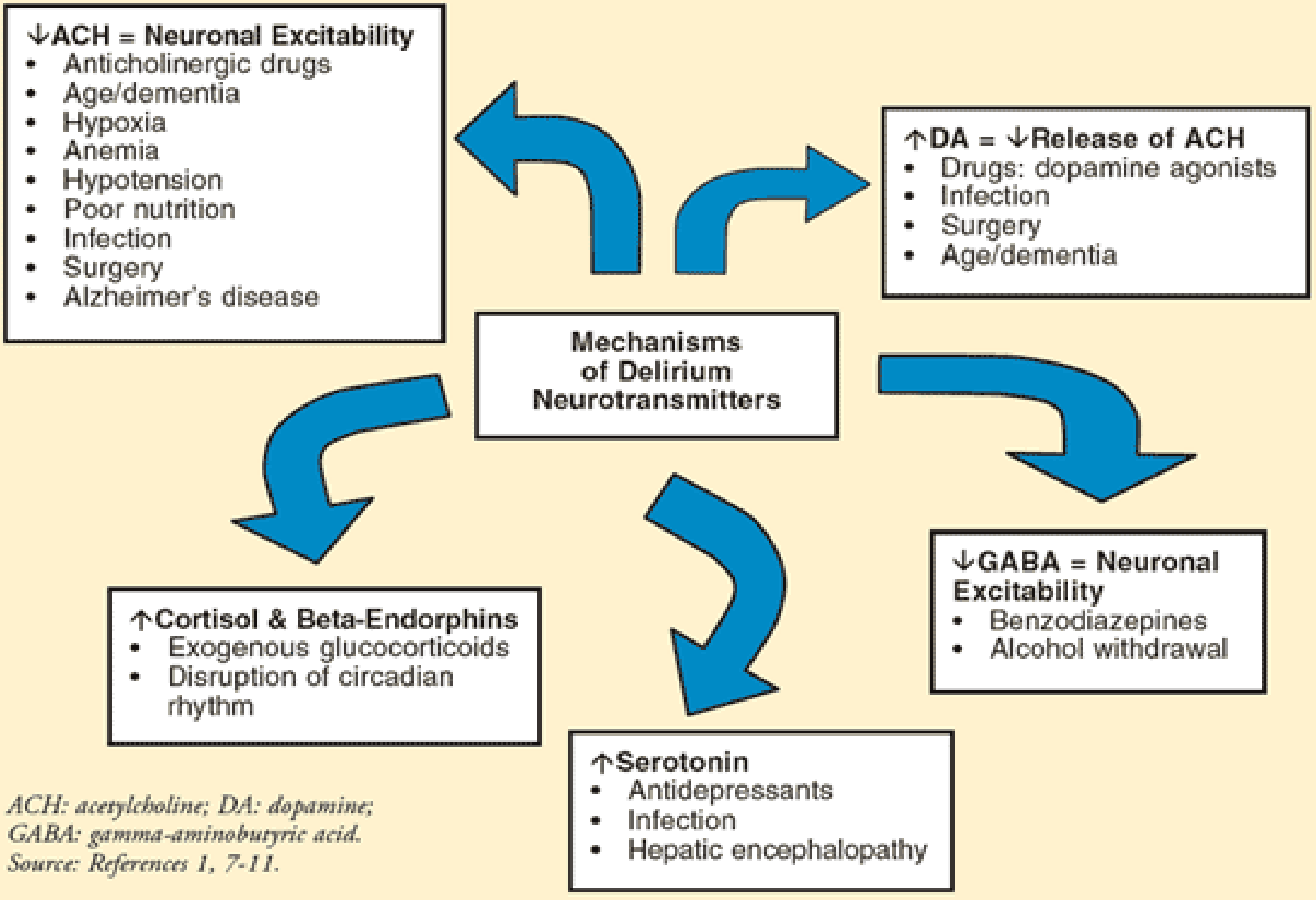
Major Causes of Delirium (HIDE)

- Hypoxia
- **Infections**
- Drugs
- Electrolyte disturbances

Delirium vs. Cognitive impairment/Dementia

Feature	Delirium	Dementia
Onset	Acute	Gradual (insidious)
Duration	Hours- weeks	Months-years
Course	Fluctuating	Progressive deterioration
Consequences	Impaired	Motor skills
Perceptual disturbance	Common	Occurs late stage
Sleep-wake cycle	Disrupted	Usually normal (except late stages)
Prognosis	Potentially reversible	Irreversible
Primary effects	Attention	Memory (Working / amestic)
Medical Emergency	Yes	No

Figure 1. Factors Contributing to Changes in Neurotransmitters, Leading to Delirium



ACH: acetylcholine; DA: dopamine; GABA: gamma-aminobutyric acid.
Source: References 1, 7-11.

How to diagnose delirium without investigations?

- **Single Question in Delirium (SQiD):** 'Do you think [*name of patient*] has been more confused lately? Sensitivity and specificity of 80% (95% CI 28.3-99.49%) and 71% (41.90-91.61%) respectively compared to CAM

Ask family members "Is this a change?"

Sands MB et al, Palliat Med 2010; 24:561-5

Cognitive Function Assessment

Neuropsychometric Assessment

- Cognitive function tests have been used and developed over several years

- Neuropsychometric batteries may contain several components to test different cognitive abilities, e.g. CANTAB, CAMCOG, ADAS-Cog etc.

- The Mini-Mental State Examination (MMSE)- widely used. Montreal Cognitive Assessment (MoCA) test.

- Value of informant questionnaires eg IQCODE

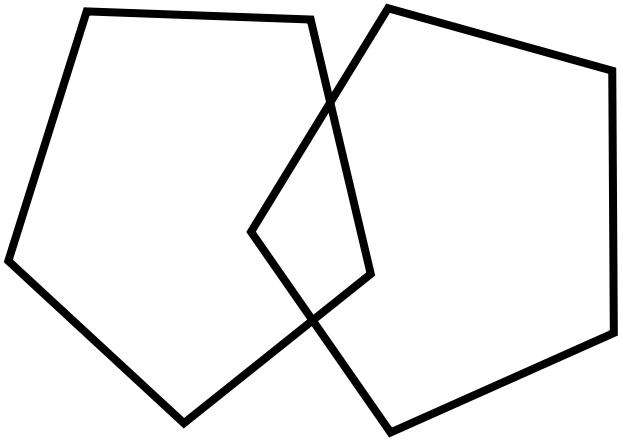
Neuropsychological Test Criteria: General considerations

- Quality of the standardization sample
- Psychometric qualities
- Portability
- Brevity
- Cost
- Ease of use
- Domain specificity (for 1-hour battery)
- Availability of multiple forms
- International or cross-cultural capability
- The lack of ceiling and floor effects

Hachincki V et al, 2006

Mini-Mental State Examination

- MMSE is a short test which measures general cognitive status including short-term memory (Folstein, et al, 1975)



- MMSE includes tests for orientation (e.g. year, season, etc.), registration, attention and calculation, recall, and language

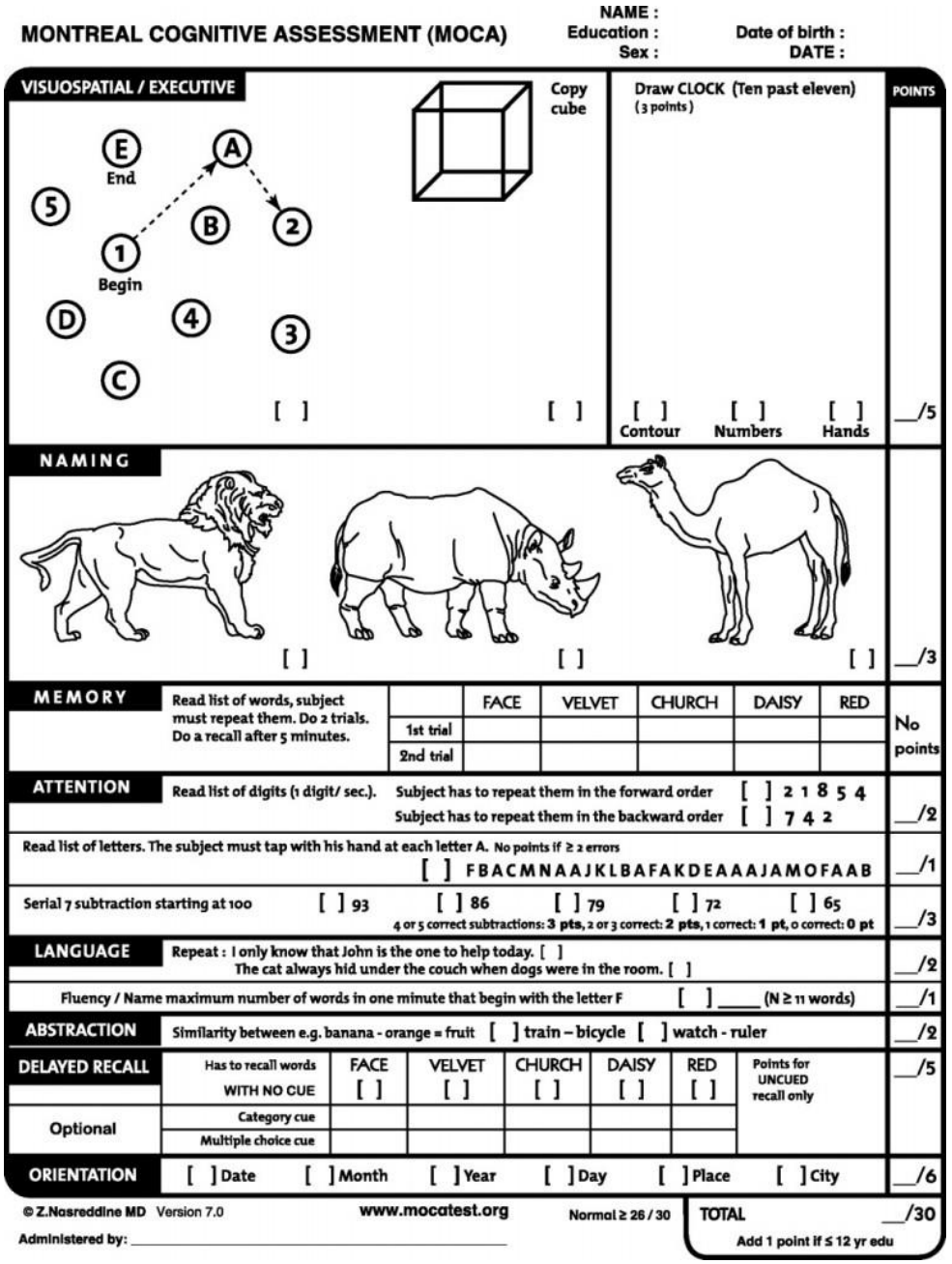
- MMSE is a 30 points score test. Mildly cognitively impaired subjects can have scores 26 to 21

Montreal Cognitive Assessment (MoCA)

MoCA
MONTREAL
COGNITIVE ASSESSMENT

- MoCA also includes tests for orientation (e.g. year, season, etc.), registration, attention and calculation, recall, and language biased towards **Executive Dysfunction**

- MoCA a 30 points score test. Mildly cognitively impaired subjects can have scores 26 to 21



VCI and Cognitive Function after Stroke

Stroke
Journal of the American Heart Association

American Heart Association | American Stroke Association

MoCA, ACE-R, and MMSE Versus the National Institute of Neurological Disorders and Stroke–Canadian Stroke Network Vascular Cognitive Impairment Harmonization Standards Neuropsychological Battery After TIA and Stroke

Sarah T. Pendlebury, Jose Mariz, Linda Bull, Ziyah Mehta and Peter M. Rothwell

Stroke. 2012;43:464-469; originally published online December 8, 2011;
doi: 10.1161/STROKEAHA.111.633586
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0039-2499. Online ISSN: 1524-4628

MoCA = Montreal Cognitive Assessment (30 point test)

ACE-R= Addenbrooke's Cognitive Examination– Revised (100 point test)

MoCA and ACE-R had good sensitivity and specificity for MCI defined using the NINDS-CSN Battery (Hachinski et al, 2006) 1 year after TIA and stroke but MMSE showed a ceiling effect

CogFAST – Nigeria: Vascular Neuropsychological Battery

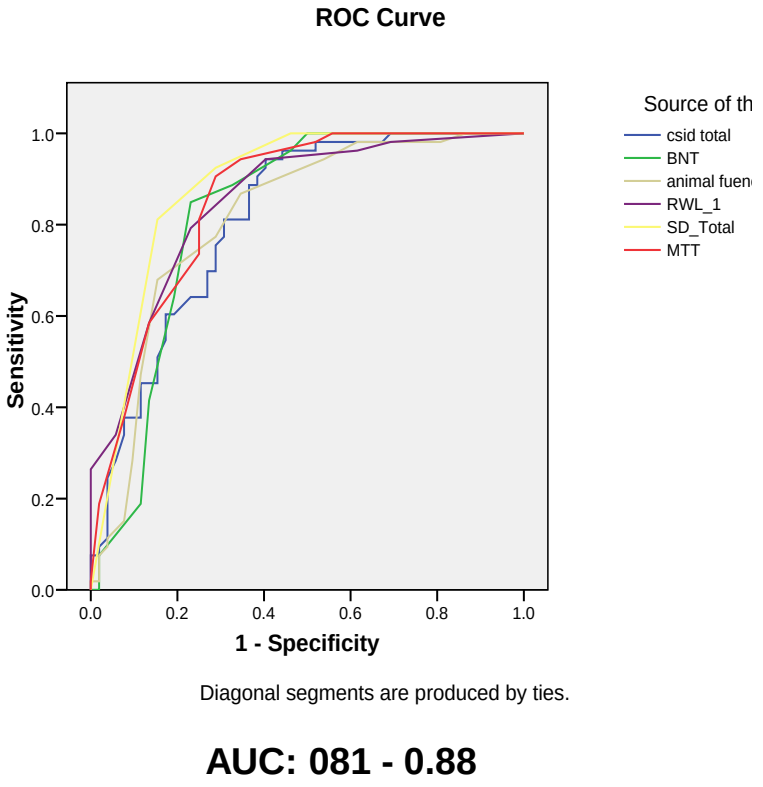
Cognitive Domain	Test
Executive Function	Category (Animal) Fluency Test
/Activation	
	Phonemic (Letter) Fluency Test
	Verbal Reasoning (Similarities Test)
	Ideational Fluency Test
Language/	Boston Naming Test (2nd version)
Lexical Retrieval	
Memory/ Learning	Word List Test (Learning, Recall,
	Recognition)
	Delayed Recall of Stick Design
Visuospatial/	Stick Design Test
Visuoconstruction	Modified Tokens Test
	(IU Token Test)
General Cognitive	Community Screening Instrument
Functioning	for Dementia (CSID
	Minimental State Examination
	(MMSE)

- Based on the 60 min VCI Harmonization Standards – Neuropsychological Protocol proposed by the NINDS – CSN (Hachinski et al, 2006).
- Multiple test items assessing each cognitive domain were selected in consonance with the recommendations of the Harmonization standards
- Utility of tests in previous cognitive evaluations in environment of study population

Refs: Folstein, 1995; Hall et al, 1993; 2000; Gureje et al., 1995; Blessed et al, 1991; Unverzagt et al., 1999; Ballard et al, 2002; Baiyewu et al., 2005; Akinyemi et al., 2008

The Vascular Neuropsychological Battery

- **CAMCOG –Executive Function/Activation**
  - i Category (Animal) Fluency Test
  - ii. Phonemic (Letter) Fluency Test
  - iii. Verbal Reasoning (Similarities Test)
  - iv. Ideational Fluency Test
  - v. Visual Reasoning Test
- **Language/Lexical Retrieval**
  - Boston Naming Test (2nd version)
- **Memory/ Learning**
  - Word List Test (Learning, Recall, Recognition)
  - Delayed Recall of Stick Design
- **Visuospatial/Visuoconstruction**
  - Stick Design Test
  - Modified Tokens Test
- **Computerized test items** (Choice Reaction Time)



AUC: 081 - 0.88

Hachinski et al, Stroke. 2006;37:2220-2241
Akinyemi et al, J Neurol Sci. 2014 ;346(1-2):241-9.

Screening tools for dementia designed for use in SSA?

- **MMSE is still the most widely used test – but almost useless in those with low education**

Test	Questions	Sensitivity	AUROC
CSI-D	**30 + 30**	**92**	**0.9191 (90–92)**
TEST OF SENEGAL	**39**		**0.967**

- CSI-D validated in >2000 older people in LMICs (but only 20 from SSA)
- False positive rate still 25% in low edu.
- Both tests take over 30-40 min to complete – too long for screening

The IDEA six-item cognitive screen

- Developed for low-literacy settings in sub-Saharan Africa
- Takes 5-10 minutes to administer
- Validated for dementia screening in community and geriatric OPD (Tanzania)
- Validated for major cognitive impairment (dementia or delirium) in older inpatients (Tanzania, Nigeria and Zambia)

Paddick et al. BMC Geriatr. 2015; 15: 53.

The IDEA study brief screening test

- 6 item screening test
- Designed for non specialists and low literacy population
- Designed to cover all lobes of the brain
- Most discriminating questions from CSI-D (used in Hai dementia prevalence study)
- CERAD 10 word list learning
- Baiyewu matchstick test

	First attempt	Second attempt	Third attempt
Siagi			
Mkono			
Barua			
Mfalme			
Tikiti			
Nyasi			
Kona			
Jiwe			
Kitabu			
Fimbo			

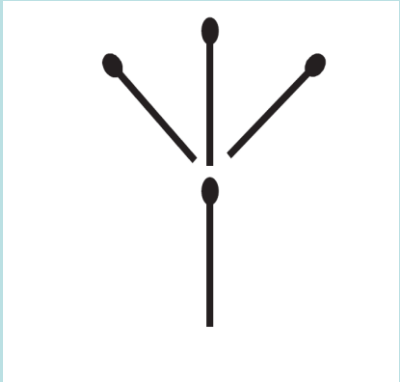
Paddick et al. BMC Geriatr. 2015; 15: 53.

IDEA Screening tool -2

I will tell you the name of something and I want you to describe what it is. **What is a bridge? (correct answer: something that goes across a river, canyon or road)**	**0 if incorrect** **2 if correct**	**Score:____/2**
I want you to name as many different animals as you can in one minute.	**Number of animals named:____** **0 for 0-3 animals named** **1 for 4-7 animals named** **2 for 8 or more animals**	**Score: ____/2**
Who is the chief/head/leader of this village?	**0 if incorrect** **1 if correct**	**Score:____/1**
What day of the week is it?	**0 if incorrect** **2 if correct**	**Score:____/2**
Can you tell me any of the words you learned earlier?	**1 one word** **2 two words** **3 three words** **4 four words** **5 5 or more words**	**Score:____/5**

Paddick et al. BMC Geriatr. 2015; 15: 53.

IDEA screening tool - 3

6	**Can you make the design shown below using these four matchsticks. I will show you once and then you have to copy exactly)** **.** 	**Score 1 for each part of the design that is performed correctly** **1 Middle two matchstick heads pointing same way** **1 Outside two matchsticks pointing at an angle** **1 Matchstick heads are orientated correctly**	**Totalpoints:__ /3**
			Total Score: ____/15

Paddick et al. BMC Geriatr. 2015; 15: 53.

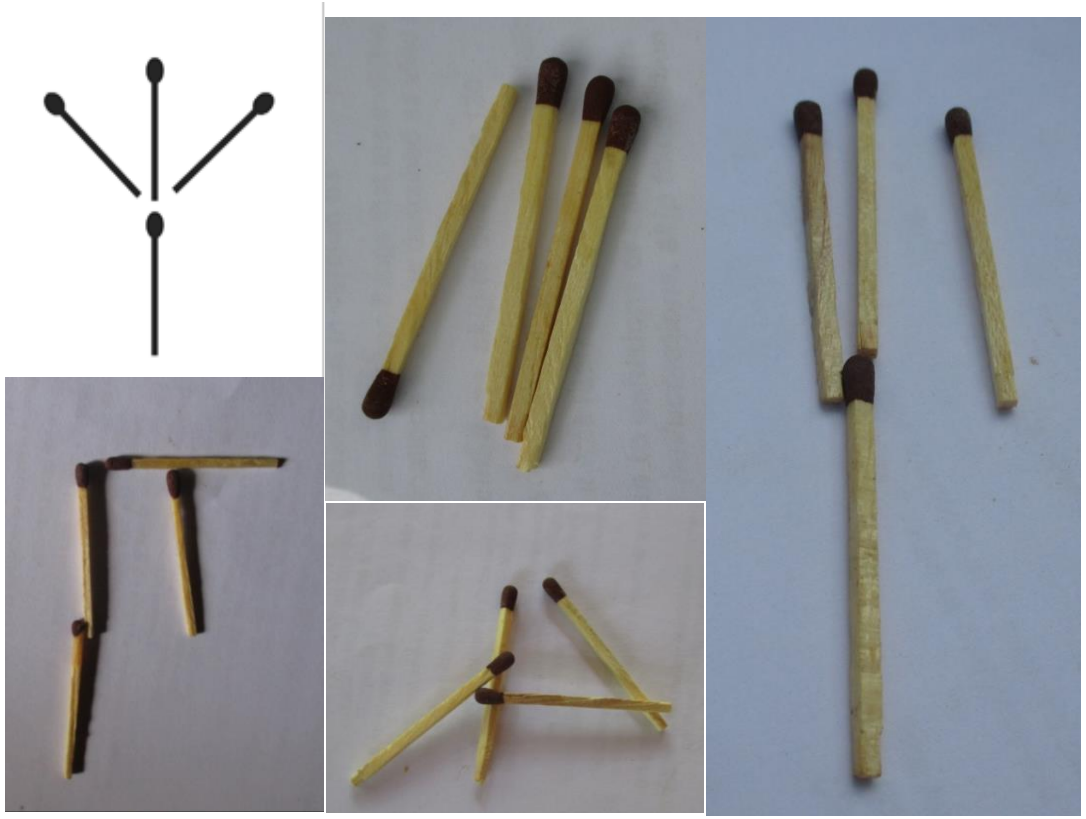
IDEA Study Screening Tools

Matchsticks (Orientation) Test

(Baiyewu et al 2003)

Subject asked to make the design shown above using four matchsticks. He/She is shown once and then they have **to** copy exactly

Score 1 for each part of the design that is performed correctly



Comparison with other cognitive screening tools commonly used in high income countries

TEST	Sensitivity	Specificity	Area under ROC
MMSE – specialist clinic (meta-analysis 34 studies)	79.8	81.3	
MMSE - mixed hospital (meta-analysis)	71.1	96.6	
RUDAS	89	98	0.95
Addenbrookes (meta-analysis 5 studies	96.7	77.4	
Six-item screener (for ER)	63	81	0.77
IDEA inpatients Tanzania	90.9	87.5	0.917
IDEA outpatients Tanzania > 8	84.6	89.1	0.919
IDEA inpatients Nigeria	100	96.3	0.990

Instrumental Activities of Daily Living in high-income countries

Instrumental Activities of Daily Living (IADL)

Instructions: Circle the scoring point for the statement that most closely corresponds to the patient's current functional ability for each task. The examiner should complete the scale based on information about the patient from the patient him-/herself, informants (such as the patient's family member or other caregiver), and recent records.

A. Ability to use telephone	Score
1. Operates telephone on own initiative; looks up and dials numbers, etc.	1
2. Dials a few well-known numbers	1
3. Answers telephone but does not dial	1
4. Does not use telephone at all	0

B. Shopping	
1. Takes care of all shopping needs independently	1
2. Shops independently for small purchases	0
3. Needs to be accompanied on any shopping trip	0
4. Completely unable to shop	0

C. Food preparation	
1. Plans, prepares, and serves adequate meals independently	1
2. Prepares adequate meals if supplied with ingredients	0
3. Heats and serves prepared meals, or prepares meals but does not maintain adequate diet	0
4. Needs to have meals prepared and served	0

D. Housekeeping	
1. Maintains house alone or with occasional assistance (e.g., "heavy work domestic help")	1
2. Performs light daily tasks such as dishwashing, bed making	1
3. Performs light daily tasks but cannot maintain acceptable level of cleanliness	1
4. Needs help with all home maintenance tasks	1
5. Does not participate in any housekeeping tasks	0

E. Laundry	Score
1. Does personal laundry completely	1
2. Launders small items; rinses stockings, etc.	1
3. All laundry must be done by others	0

F. Mode of transportation	
1. Travels independently on public transportation or drives own car	1
2. Arranges own travel via taxi, but does not otherwise use public transportation	1
3. Travels on public transportation when assisted or accompanied by another	1
4. Travel limited to taxi or automobile with assistance of another	0
5. Does not travel at all	0

G. Responsibility for own medications	
1. Is responsible for taking medication in correct dosages at correct time	1
2. Takes responsibility if medication is prepared in advance in separate dosages	0
3. Is not capable of dispensing own medication	0

H. Ability to handle finances	
1. Manages financial matters independently (budgets, writes checks, pays rent and bills, goes to bank), collects and keeps track of income	1
2. Manages day-to-day purchases, but needs help with banking, major purchases, etc.	1
3. Incapable of handling money	0

(Lawton & Brody, 1969)

Scoring: The patient receives a score of 1 for each item labeled A – H if his or her competence is rated at some minimal level or higher. Add the total points circled for A – H. The total score may range from 0 – 8. A lower score indicates a higher level of dependence.

Sources:

- Cromwell DA, Eagar K, Poulos RG. The performance of instrumental activities of daily living scale in screening for cognitive impairment in elderly community residents. *J Clin Epidemiol.* 2003;56(2):131-137.
- Lawton MP. The functional assessment of elderly people. *J Am Geriatr Soc.* 1971;19(6):465-481.
- Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist.* 1969;9(3):179-186.
- Polisher Research Institute. Instrumental Activities of Daily Living Scale (IADL). Available at: http://www.abramsoncenter.org/PRI/documents/IADL.pdf. Accessed February 15, 2005.

Instrumental Activities of daily living (IADL) Scale

- 1. **Wanatoa Historia/**They give histories of the family, their life, past events
- 2. **Wana suluhisha/**They settle conflicts
- 3. **Wanasaidia shughuli ndogo ndog**o/They assist in small works in the home
- 4. **Wanatoa ushauri/**They give advice
- 5. **Wanadumisha na kufundisha mila/unyago/**They teach traditions of society
- 6. **Ni walinzi wa nyumban**i/They watch over the house when others are out.
- 7. **Wanatunza wajukuu/**they look after the grandchildren
- 8. **Wanatoa ushawishi/**Persuasion, or changing people's ideas for the better.
- 9. **Wanasaidia katika maswala mazito kama sherehe/**They preside over feasts and ceremonies
- 10. **Wanapangia watu majukumu/**Delegation of responsibilities to others.
- 11. **Wanasimamia haki/**They ensure fairness.

Results of combined screening, Hai Dementia screening programme

Assessment	Auroc
IDEA 6 item screen, used alone	0.846 (0.776-0.915)
IADL –SSA scale, used alone	0.896 (0.842-0.951)
IDEA 6 item screen and IADL-SSA used together	0.937 (0.896-0.979)

- Conclusions
  - The IDEA brief dementia screening tool performed well in hospital inpatient, outpatient and community settings
  - This screening test should prove useful in screening for dementia in SSA
  - Less educationally biased than existing tools
  - Performance in the community was improved by addition of a functional assessment tool
  - Further testing in of this system of dementia screening in other low-resource and community settings is required

Ancillary Investigations

Goals of Ancillary Tests in Neurocognitive Disorders

- To:

- Detect potentially reversible causes of cognitive impairment and dementia
- Detect co-morbidities that impact on outcomes
- Demonstrate in vivo degree of pathology in dementia subtypes.
- Map changes in brain structure and function

Investigations

- Brain Imaging Studies
- Full Blood Count
- Folate/Vitamin B12
- Thyroid Stimulating Hormone
- Blood Glucose
- Renal and Liver Function Tests
- Serological tests for Syphilis, Borelia – VDRL
- HIV Serology
- CSF for Biomarkers and to exclude infections
- Electroencephalography

Blood Tests

- Folate
- Vitamin B12
- Thyroid Stimulating Hormone
- Calcium
- Glucose
- Full Blood Count
- Renal and Liver Function Tests
- Serological tests for Syphilis, Borelia – VDRL
- HIV Serology

CSF analysis

- Indicated when vasculitis, inflammatory, haematological and demyelinating diseases are suspected
- Elevation of 14-3-3 protein +/- neuron specific enolase reflecting acute neuronal loss suggests CJD
- Elevated total tau or phospho-tau with decreased beta-amyloid 42 (Aβ42) suggest AD [sensitivity 86%; specificity 90%]
- CSF neurofilament light (nFL) protein in TBI and VCI

Neuroimaging

- Structural Imaging:

- MRI better than CT in demonstrating structural lesions and monitoring changes over time

- Hippocampal atrophy

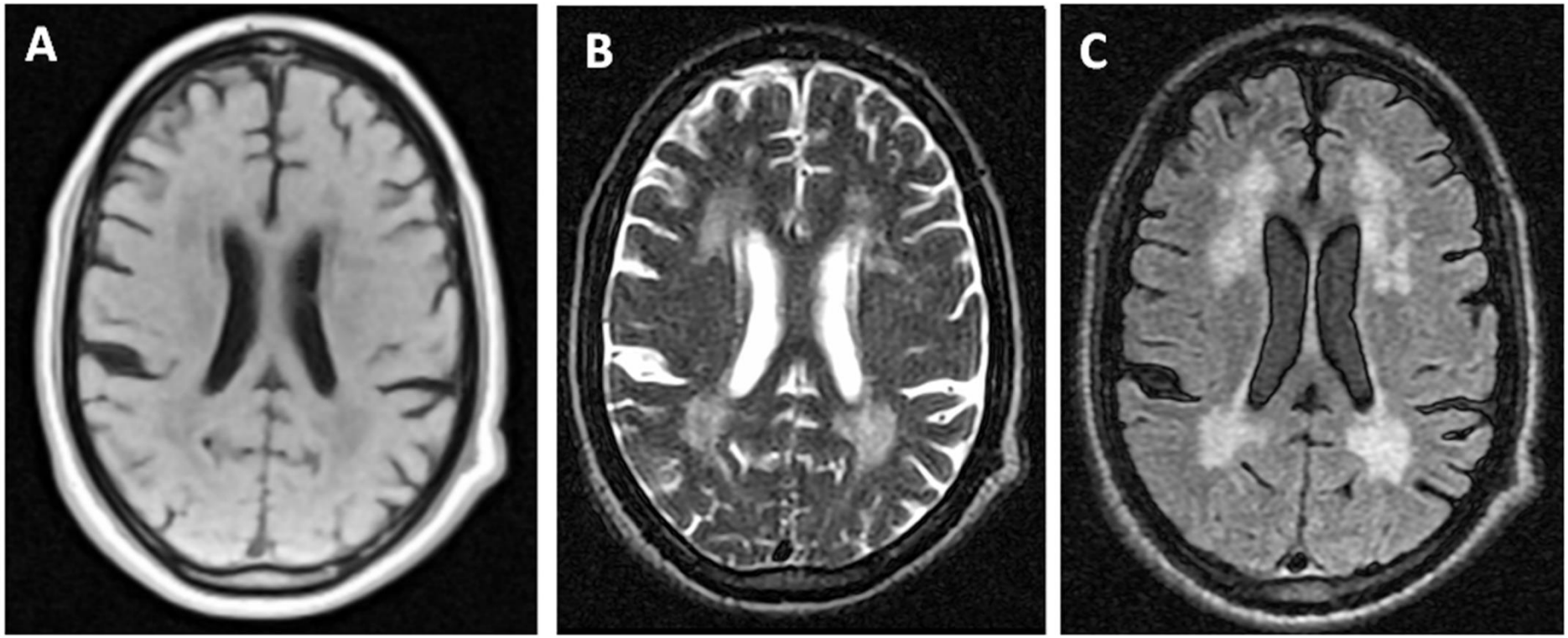
- Vascular lesions including microbleeds, WMH, infarcts

- Diffusion Tensor Imaging – disconnection syndromes

- Functional imaging – fMRI, PET, SPECT

- To detect and measure cerebral blood flow, metabolic levels, receptor binding and pathological depositions

Figure 1



MRI Study in Older Nigerian Stroke Survivors

Medial temporal lobe atrophy (MTLA) was independently associated with VCI/VaD in PS survivors at 12 months

MTLA correlated significantly with cognitive performance and **white matter hyperintensities (WMH**s) on T2W MRI

Akinyemi et al. BMC Res Notes (2015) 8:625
DOI 10.1186/s13104-015-1552-7

BMC Research Notes

RESEARCH ARTICLE Open Access

Medial temporal lobe atrophy, white matter hyperintensities and cognitive impairment among Nigerian African stroke survivors

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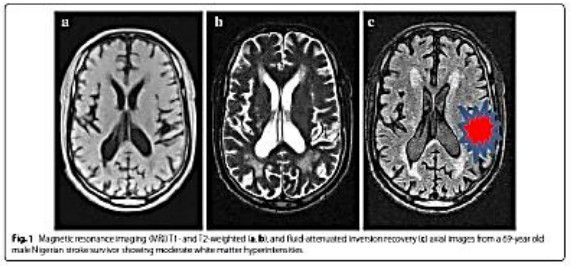


Fig. 1 Magnetic resonance imaging (MRI) T1- and T2-weighted (a, b), and fluid attenuated inversion recovery (c) axial images from a 69-year old male Nigerian stroke survivor showing moderate white matter hyperintensities.

**MTLA vs WMH score showed positive correlation (r =0.461, p = 0.002) supporting a vascular basis for MTLA.

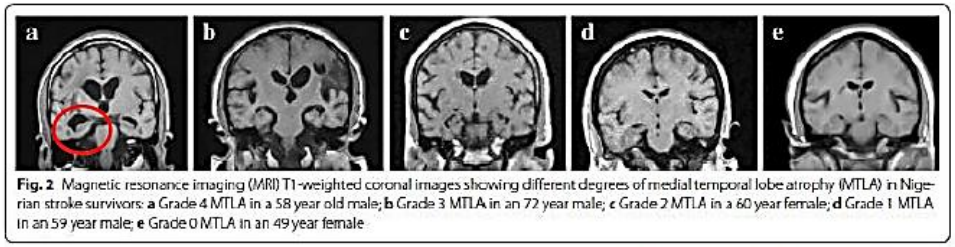


Fig. 2 Magnetic resonance imaging (MRI) T1-weighted coronal images showing different degrees of medial temporal lobe atrophy (MTLA) in Nigerian stroke survivors: **a** Grade 4 MTLA in a 58 year old male; **b** Grade 3 MTLA in an 72 year male; **c** Grade 2 MTLA in a 60 year female; **d** Grade 1 MTLA in an 59 year male; **e** Grade 0 MTLA in an 49 year female

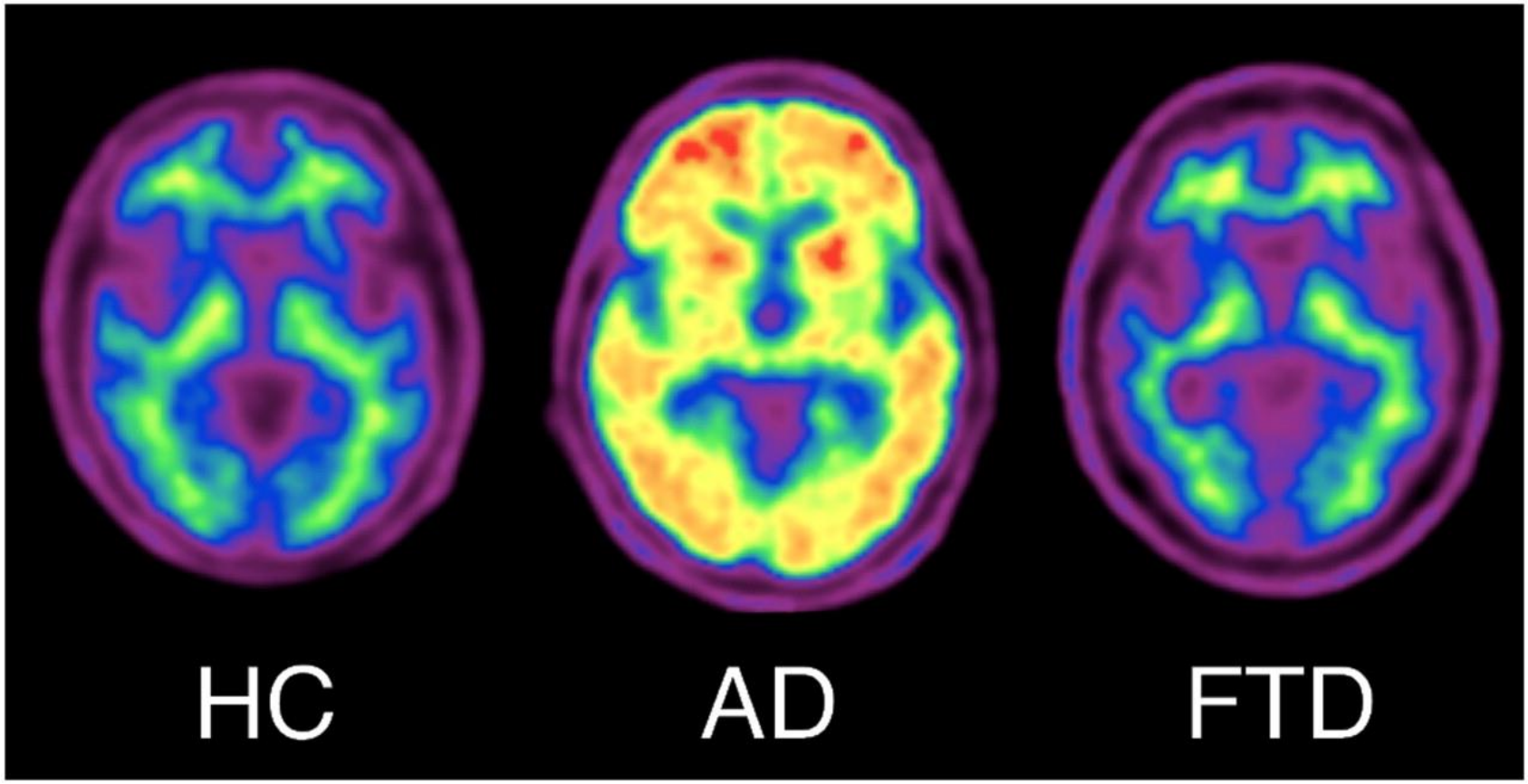
Akinyemi et al, BMC Res Notes. 2015 ;8:625

	Normal vs vCIND			vCIND vs PSD			Normal vs (vCIND + PSD)		
Variable	**OR**	**95%CI**	***p value**	**OR**	**95%CI**	**p value**	**OR**	**95%CI**	***p value**
MTLA rating	2.02	1.05 – 3.87	**0.035**				2.25	1.16 – 4.35	**0.016**
Log _ TBV							0.01	0- 1996.50	0.260

Functional Imaging: PET and SPECT Tracers

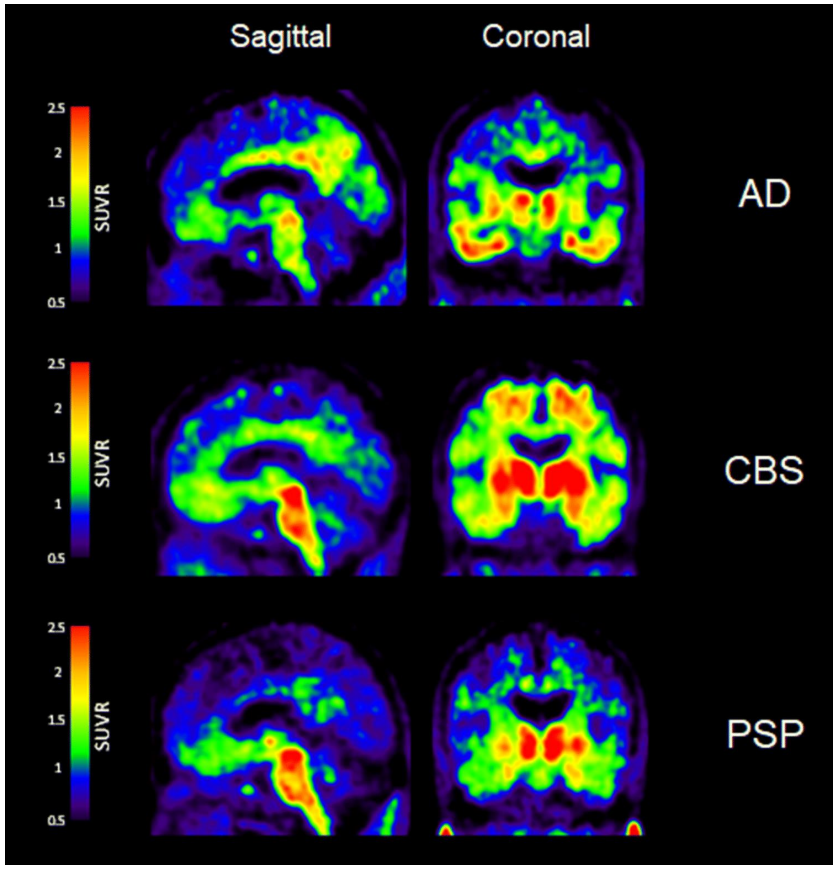
Tracer	Target
[99mTc] ethylcysteinatedimer	Cerebral blood flow
[18F] 2-fluoro-2-deoxy-D- glucose	Cerebral glucose metabolism
[123I] iodobenzamide	Dopamine D2/D3 receptor
[11C] Pittsburg compound B	Amyloid – beta plaques
[18F]Flortaucipir (AV1451)	Neurofibrillary tangles

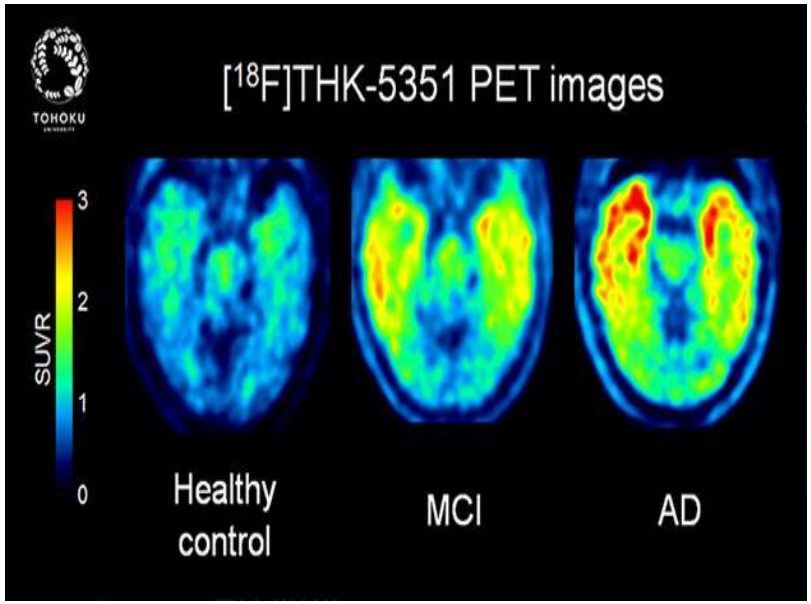
Brain Amyloid Imaging



Rowe et al. J Nucl Med 2011; 52:1733–1740

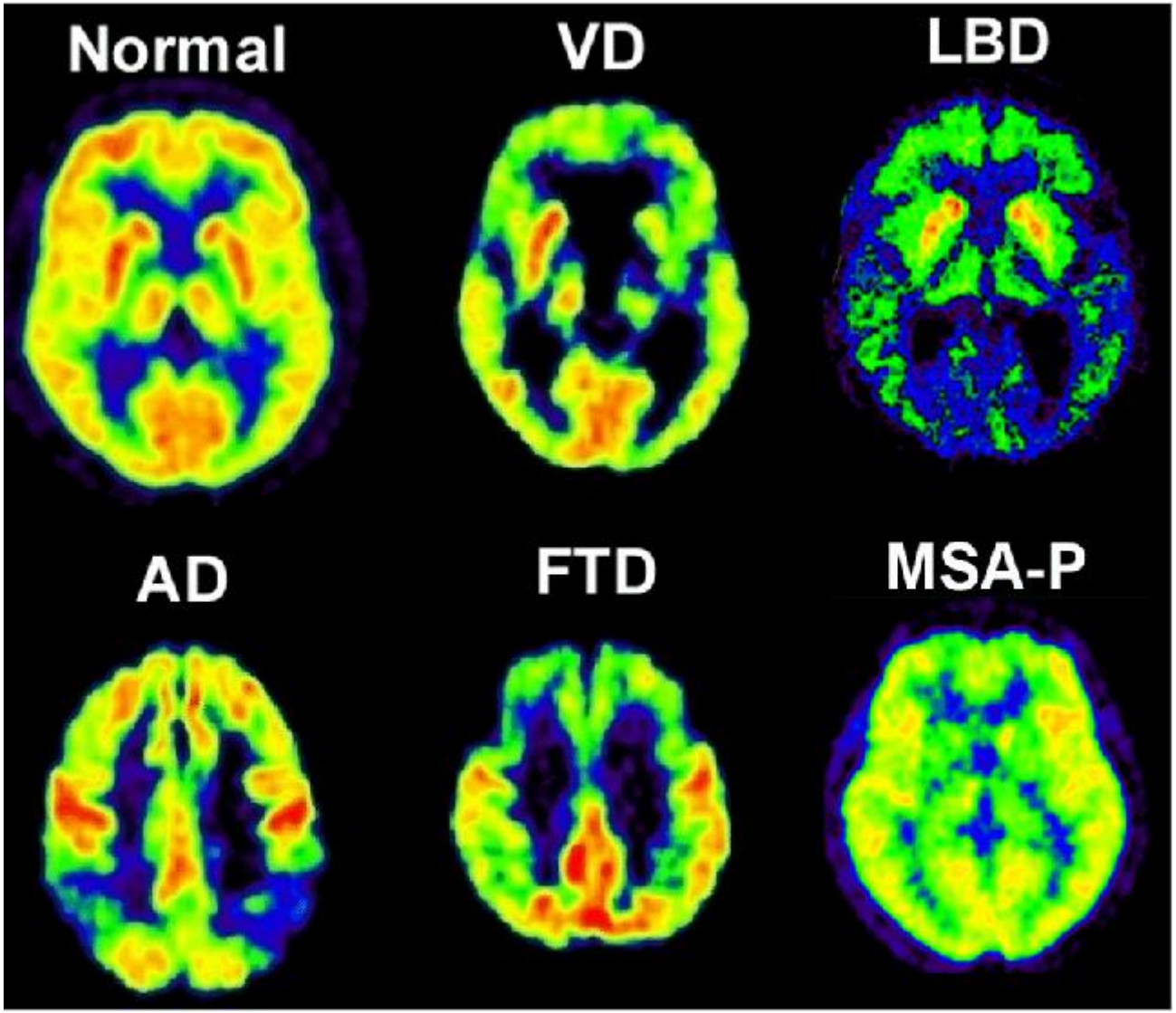
PET Imaging of Tau Deposits





Okamura et al. Clin and Transl Neuroimaging. 2018; 6(4); 305-16

FDG PET Imaging Metabolic Patterns in Different Dementia Phenotypes



Heiss et al. BMC Medicine. 2016;14:174

Take Home Points

- Evaluation of subjects with cognitive and dementia requires formal cognitive testing
- Useful cognitive tools exist in SSA
- Ancillary tests are useful in detecting reversible dementias, co-morbidities and evaluating pathological deposits and metabolic activities.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