



Cognitive Screening in Risk Assessment



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Outline of Talk

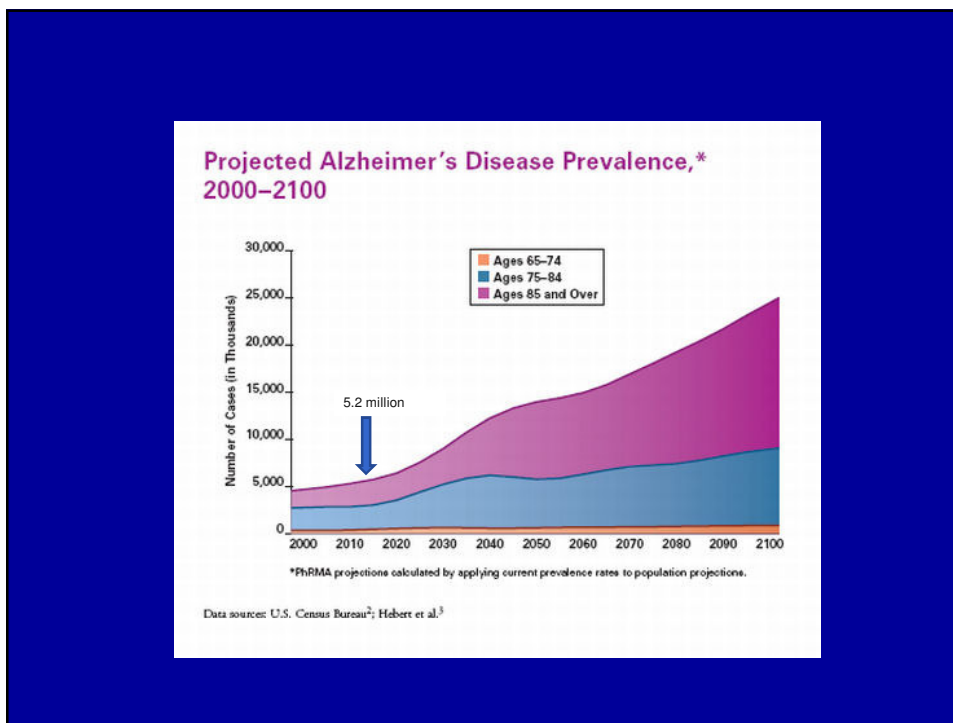
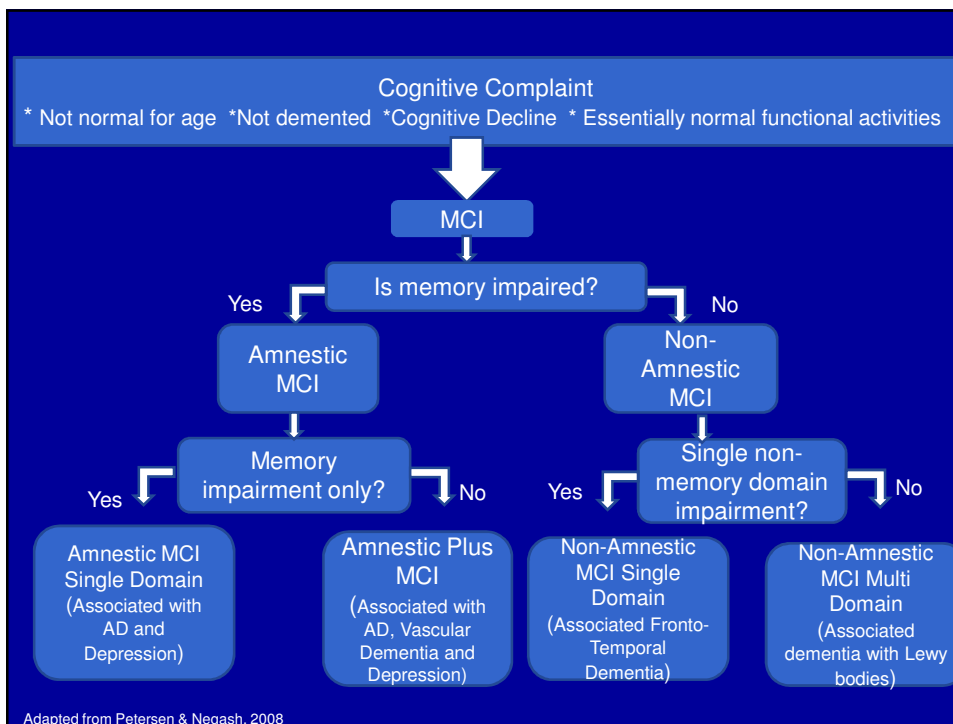
- Definition of Dementia and MCI
- Incidence and Prevalence of Dementia and Mild Cognitive Impairment
- Cognitive Screening Tests
- Factors that Impact Screening Tests
- Review Strengths and Weaknesses of Specific Screening Tests

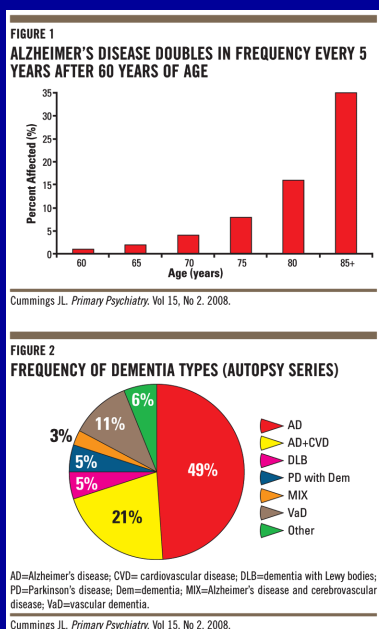
Diagnostic Criteria for Dementia of the Alzheimer's Type (DSM-IV)

- Development of multiple cognitive deficits including
 - Memory impairment
 - One or more of the following
 - Aphasia
 - Apraxia
 - Agnosia
 - Executive dysfunction
 - Cognitive deficits cause significant impairment in social or occupational functioning and represent a significant decline from a previous level of functioning
 - Gradual onset and continuing cognitive decline
 - Not due to
 - Other CNS conditions (e.g., cerebrovascular disease, Parkinson's disease)
 - Systemic conditions (e.g., thyroid, B-12 deficiency)
 - Substance-induced conditions

Diagnostic Criteria Mild Cognitive Impairment (MCI; Peterson et al. 2001)

- Memory complaint – best if corroborated by informant
- Objective evidence of cognitive impairment (>1.5 SDs normative data)
- Minimal or no functional decline
- Subtypes
 - Amnestic
 - Amnestic plus
 - Non-Amnestic Single domain
 - Non-Amnestic Multi-domain
- Conversion to dementia 12-15% per year (1-2% normal elderly; 5-10 times normal risk)
- 80% of MCI may eventually develop dementia





MCI Prevalence

- Not clear because of varying definitions
 - Age-Associated Memory Impairment
 - Cognitive Disorder NOS
 - Cognitive Disorder, No Dementia
- Study of 1,969 individuals 70-89 years old (Petersen et al., 2010)
 - 16% MCI
 - 11.1% amnesic MCI
 - 4.9% non-amnesic MCI
 - Higher in older, men, non-married, APOE 3,4 or 4,4
 - Higher risk associated with lower levels of education

Dementia Risk Factors

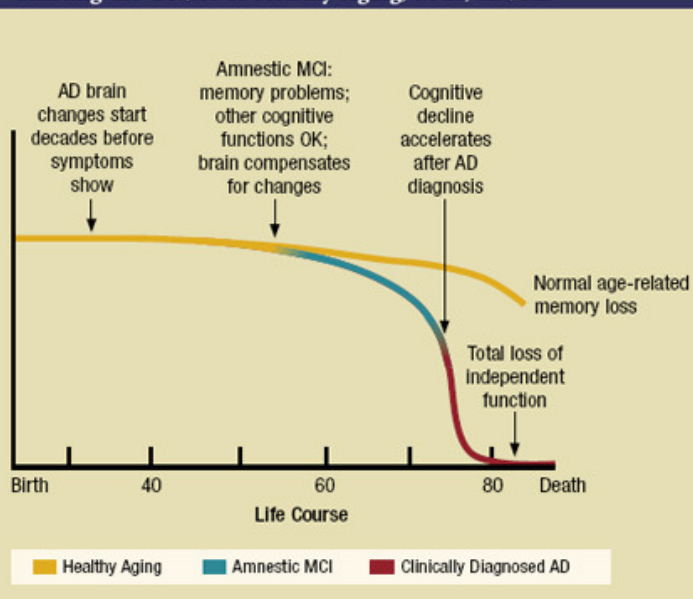
Increase Risk

- Age
- Family history
- APOE e4 allele
- Mild Cognitive Impairment
- Cardiovascular disease risk
 - smoking, diabetes, obesity, high cholesterol, hypertension
- Traumatic Brain Injury (moderate-severe)

Decrease Risk

- Education
- APOE e2 allele
- Physical Activity
- Diet (Mediterranean)

Charting the Course of Healthy Aging, MCI, and AD



Life Expectancy in Dementia

- 500,000 die each year
- 6th leading cause of death for 65 and older
- Kills more than prostate and breast cancer
- 65 and older survive 4-8 years after diagnosis
- Some can live 20 years or more

COGNITIVE SCREENING FOR MCI AND DEMENTIA

Cognitive Screening Test

- Brief measure to identify individuals with cognitive impairment
 - Efficiency
 - Convenience
 - Early identification
 - Easy to administer by non-professional personnel
 - Could be implemented on a wide scale or in routine practice

US Preventive Services Task Force

- Routine screening for dementia in older adults
 - *“found good evidence that some screening tests have good sensitivity but only fair specificity in detecting cognitive impairment and dementia...the accuracy of diagnosis, the feasibility of screening and treatment in routine clinical practice, and the potential harms of screening are unknown. The Task Force therefore could not determine whether the benefits of screening for dementia outweigh the harms.”*

Limitations of Screening Tests

- Not necessarily well validated in intended population (base rates)
- May not fully cover important cognitive domains (emphasize memory and do not address other domains – executive function, language, etc.)
- Not as accurate for mild impairment
- Implications of false positive errors
- Reliance on cut score rather than pattern of performance
- Not a substitute for a neuropsychological evaluation

Key Cognitive Domains

- Attention/Working memory
 - Digit Span
- Verbal/Visual learning and recall
 - List learning
- Language
 - Naming/Word Finding
- Visual construction
 - Design copy
- Executive function & Abstract Reasoning
 - Similarities

Test Accuracy

	Impaired	Not Impaired
Test +	A True Positive	B False Positive
Test -	C False Negative	D True Negative

Sensitivity = $A/A+C$; proportion of individuals with impairment who test positive

Specificity = $D/B+D$; proportion of individuals without impairment who test negative

Overall Accuracy = $A+D/N$; weighted average of sensitivity and specificity

Positive Predictive Value = $A/A+B$; proportion of individuals who are classified as impaired who actually are impaired

Negative Predictive Value = $D/C+D$; proportion of individuals who are classified as not impaired who actually are not impaired

Test Accuracy cont.

- Maximize sensitivity and specificity
- Emphasize one over the other depending on situation and costs of false positive or false negative errors
- Sensitivity and specificity are intrinsic to test (not dependent on prevalence of condition)
- PPV and NPV depends on prevalence
 - Lower PPV with lower prevalence

EXAMPLES

Sensitivity = 90% Specificity = 90% Prevalence = 30% N = 100

	Impaired	Not Impaired
Test +	27	7
Test -	3	63

PPV = 84% NPV = 95%

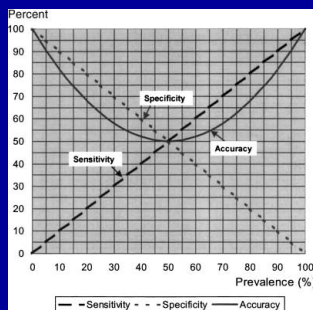
Sensitivity = 90% Specificity = 90% Prevalence = 5% N = 100

	Impaired	Not Impaired
Test +	4	10
Test -	1	85

PPV = 29% NPV = 99%

Overall Accuracy

- Misleading when:
 - difference between sensitivity and specificity increase
 - When prevalence deviates from 50%



Adapted from Alberg et al., 2004; J Gen Intern Med

Common Cognitive Screening Measures

Factors that Impact Screening Test Performance

- Age (begin at age 55; accelerates at 75)
- Education (IQ; low levels can result in misclassification)
- Gender (little impact)
- Race/Language/Culture/Background
- Psychiatric/Mood (anxiety, depression)
- Medications

AGE and EDUCATION WEIGHTED NORMS TABLE FOR MINI-MENTAL STATE EXAMINATION
Ages 18 - 85+ and Education Level 0 - 13+ YEARS
 Source: Crum R, Anthony JC et al. (1993) Population-based norms for the Mini-Mental State Examination by age and educational level. *JAMA* [May 12, 1993], 269(18), 2386-2391.

Compiled by: Dr. Bill Lynch - BIRU [262-PAD]

AGE:	EDUCATIONAL LEVEL [Yrs]:							
	0 - 4		5 - 8		9 - 12		13 or more*	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
18-24	22 (N = 17)	2.9	27 (N = 84)	2.7	29 (N = 132)	2.2	29 (N = 783)	1.8
25-29	25 (N = 22)	2.0	27 (N = 88)	2.5	29 (N = 359)	1.3	29 (N = 1712)	0.9
30-34	25 (N = 41)	2.4	26 (N = 74)	1.8	29 (N = 362)	1.3	29 (N = 196)	1.0
35-39	23 (N = 38)	2.5	26 (N = 101)	2.8	29 (N = 698)	1.8	29 (N = 641)	1.0
40-44	23 (N = 36)	2.8	27 (N = 100)	1.8	28 (N = 491)	1.9	29 (N = 354)	1.7
45-49	23 (N = 36)	3.7	26 (N = 101)	2.5	28 (N = 452)	2.4	29 (N = 309)	1.6
50-54	23 (N = 36)	2.8	27 (N = 148)	2.4	28 (N = 492)	2.2	29 (N = 202)	1.9
55-59	22 (N = 48)	2.7	26 (N = 205)	2.9	28 (N = 825)	2.2	29 (N = 231)	1.5
60-64	23 (N = 88)	1.9	26 (N = 315)	2.3	28 (N = 628)	1.7	29 (N = 273)	1.3
65-69	22 (N = 102)	1.9	26 (N = 322)	1.7	28 (N = 814)	1.4	29 (N = 368)	1.0
70-74	22 (N = 139)	1.7	26 (N = 338)	1.8	27 (N = 901)	1.6	28 (N = 352)	1.8
75-79	21 (N = 117)	2.0	25 (N = 437)	2.1	27 (N = 915)	1.5	28 (N = 352)	1.6
80-84	20 (N = 105)	2.2	25 (N = 241)	1.9	25 (N = 315)	2.3	27 (N = 191)	0.9
85 and up	19 (N = 81)	2.9	23 (N = 192)	3.3	26 (N = 363)	2.0	27 (N = 401)	1.3
ALL AGES	22 (N = 486)	2.3	26 (N = 3073)	2.2	28 (N = 8040)	1.8	29 (N = 5701)	1.3

*College experience or higher degree

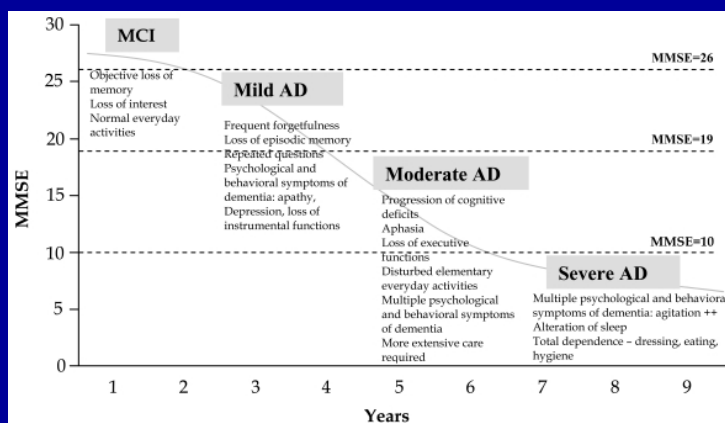
Mini Mental State Examination (MMSE)

- Strengths
 - Commonly used and best studied
 - Quick and easy to administer (7-8 min)
 - Good normative data
- Weaknesses
 - Does not address executive dysfunction
 - Accuracy dependent on age and education
 - Over-reliance on orientation and memory
 - Heavily dependent on language
 - Can misclassify individuals with low education
 - Cost? Copyrighted?

MMSE cont.

- Dementia Sensivity = 71-92% Specificity = 56-96% PPV = 15-72% (10% prevalence)
- MCI Sen = 73-82% Spec = 55-73%
- Can improve MCI detection
 - Combine other measures (e.g., verbal fluency)
 - Use longer forms (3MS)

MCI and Dementia Progression associated with Different MMSE levels



MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 (Original) - Version 7.1

NAME: _____ Education: _____ Date of birth: _____
Sex: _____ Age: _____ DATE: _____

VISUOSPATIAL / EXECUTIVE

Copy cube Draw CHECK (from past onward) (3 points)

End (E) A 2
Begin (B) 1 4 3
D C

NAMING

MEMORY Read list of words, subject must repeat them, 3x 2 trials, even if fail 1st/2nd trials. Do a recall after 5 minutes.

FACE	VELVET	CHURCH	DAISY	RED	No points
1st trial					
2nd trial					

ATTENTION Read list of digits (4 digits) and: Subject has to repeat them in the forward order: [] 2 1 8 5 4
Subject has to repeat them in the backward order: [] 7 4 2

Read list of letters. The subject must copy on this hand at one letter A. Repeat 2 x 3 times
[] FBACMNAAJKLBAFAKDEAAAJAMOFAA3

Write 7 instruction pointing at 100 [] 93 [] 86 [] 79 [] 72 [] 65

LANGUAGE Repeat I only know that I am in the one to help today. I
The cat always sit under the couch when dogs were in the room. I

Fluency / Name maximum number of words in one minute that begin with the letter P [] (N > 11 words)

ABSTRACTION Similarity between e.g. orange - orange - blue [] (blue - orange) [] match - apple

DELAYED RECALL Use the next words: FACIL VELVET CHURCH DANDY RED

Optional: Write the words with NO CHAIR [] Category Code: [] Words for WHOULD: [] Write any words for WHOULD: []

ORIENTATION [] Date [] Months [] Year [] Day [] Place [] City

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Administered by: _____ Add'l 20 W.F. & 12 Y. pts. /30

Montreal Cognitive Assessment (MoCA)

- Strengths
 - Brief (10 -12 min)
 - Easy to administer/score
 - Captures executive functioning
 - More accurate than MMSE for MCI
 - No cost
 - Available in many languages
- Weaknesses
 - Probably best for individuals with MMSE > 26
 - May misclassify cognitively normal
 - Less useful for overt dementia

MOCA cont.

- Dementia Sen = 100% Spec = 87%
- MCI Sen = 90% Spec = 87%

Minnesota Cognitive Acuity Screen (MCAS; Knopman et al., 2000)

- Strengths
 - Brief measure (15 min)
 - In-person or by telephone
 - 9 domains assessed: orientation, attention, delayed recall, comprehension, repetition, naming, computation, judgment, verbal fluency
 - Detailed instructions/scoring
 - No significant impact of age and education
 - Data to support relationship with functioning

MCAS cont.

- Weaknesses
 - Longer than MMSE and MOCA
- Dementia Sen = 98% Spec = 99%
- MCI Sen = 86% Spec = 78%

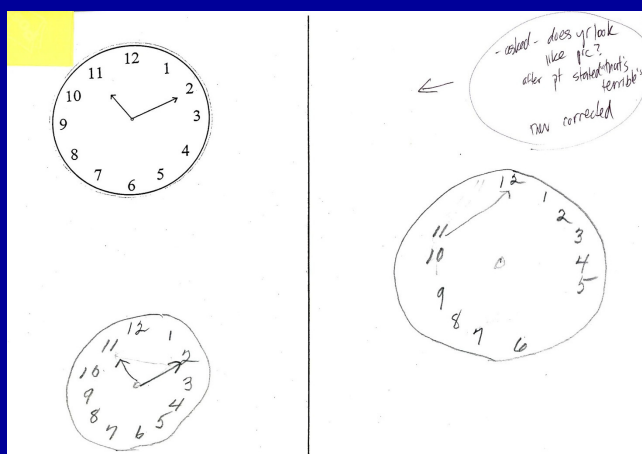
Clock Drawing Test (CDT)

- Strengths
 - Very brief
 - Measures constructional, visuospatial, & executive skills
 - Part of other screens (7-min screen)
 - May be most sensitive to vascular dementia
 - Less affected by education and culture/background

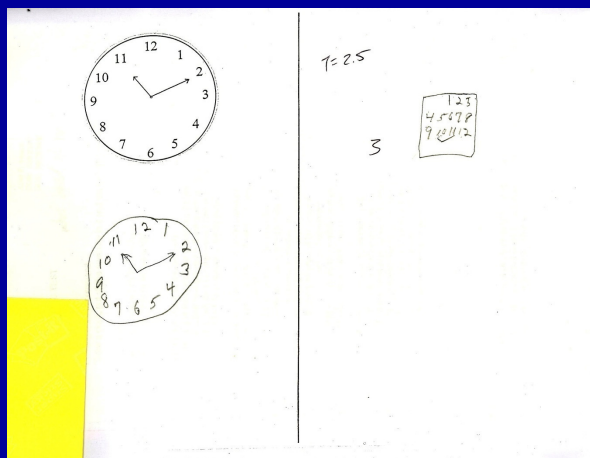
CDT cont

- Weaknesses
 - Multiple administration/scoring versions
 - Generally poor specificity
 - Very poor for detecting MCI
- Dementia Sen = 39-94% Spec = 26-96%
- MCI Sen = 48-76% Spec = 58-79%

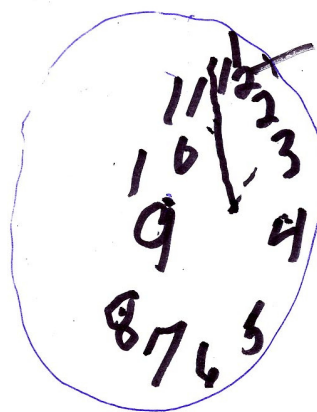
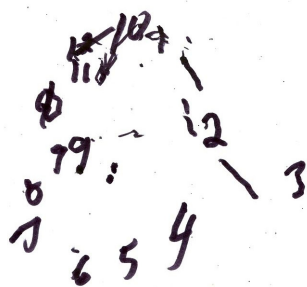
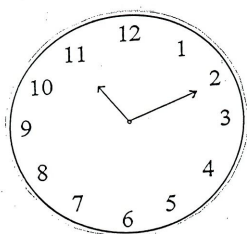
Mild Cognitive Impairment



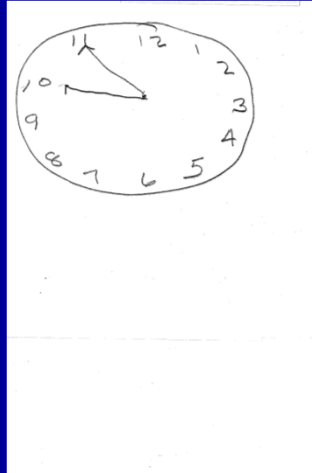
Alzheimer's Disease



Lewy Body Dementia



Frontotemporal Dementia



MCI Screen (Shankle et al., 2005)

- CERAD 10-word list w/weighted scoring
- Strengths
 - Brief & easy to administer
- Weaknesses
 - Focuses entirely on memory (Alzheimer's disease)
 - Complex scoring process
 - Costs
- Dementia Sen = 96% Spec = 99%
- MCI Sen = 95% Spec = 98%

7-Minute Screen

- Enhanced cued recall, temporal orientation, verbal fluency, clock drawing
- Strengths
 - Brief (6-10 min)
 - Easy to administer and score
- Weaknesses
 - Not helpful for MCI
- Dementia Sen = 91-93% Spec = 94-96%
- MCI Sen = 28% Spec = ?

Mini-Cog

- 3 word recall and Clock Drawing Test
- Strengths
 - Very brief (3 min)
 - Easy to administer
- Weaknesses
 - Miss milder impairments
- Dementia Sen = 76-99% Spec = 89-93%
- MCI Sen = 55% Spec = 77%

Informant-based Measures

- AD8
- Functional Activities Questionnaire (FAQ)
- Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE)
- Better for dementia than MCI
- Sen & Spec ~ 90% for dementia
- Enhanced sensitivity and specificity when combined with cognitive screens

Conclusions

- Screens can be useful for identifying individuals at risk for cognitive decline
- Consider base rates impact on PPV
- Not a substitute for thorough eval or work-up
- Very brief screens may miss milder impairment (especially in highly educated individuals)
- Brief screens may not capture all important cognitive domains

Questions?

