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Outline

• Cognitive function overview
• Alternatives for assessment of cognitive function
• Evaluation of tests for use in life insurance underwriting
• Gen Re Elderly Underwriting Practice Survey
### Cognitive Function Classification

<table>
<thead>
<tr>
<th>Anatomic Site</th>
<th>Functional Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal</td>
<td>executive, attention, working memory</td>
</tr>
<tr>
<td>Left temporo-parietal</td>
<td>dysphasia, apraxia</td>
</tr>
<tr>
<td>Right (non-dominant) hemisphere</td>
<td>visuospatial, perceptual, attention, concentration</td>
</tr>
<tr>
<td>Lateral temporal</td>
<td>naming and fluency, semantic memory</td>
</tr>
<tr>
<td>Medial temporal, hippocampus</td>
<td>episodic memory</td>
</tr>
</tbody>
</table>

Cognitive function is multidimensional

Each domain resides in a specific part of the brain

Different functional tests define and measure each domain

Cognitive function has no comprehensive meaning, and no comprehensive test
Etiology of Dementia

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer’s (AD, DAT)</td>
<td>55-70</td>
</tr>
<tr>
<td>Vascular (VaD, VCI, VCD)</td>
<td>15-20</td>
</tr>
<tr>
<td>Parkinson’s disease, Lewy body</td>
<td>10-15</td>
</tr>
<tr>
<td>Frontal lobe</td>
<td>5-10</td>
</tr>
<tr>
<td>Trauma</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>

Dementia is not a single disease
Each disease has unique causes and affects different parts of the brain
Consequently, each disease creates a different pattern of cognitive function deficits
Continuum of Cognitive Function

- Normal cognitive function
- Age-associated memory impairment (AAMI)
- Mild cognitive impairment (MCI)
- Dementia
MCI

• Intermediate between normal aging and dementia
• No consensus definition
  – Single domain
  – Preservation of IADL
• Mayo criteria
  – Memory complaint, preferably corroborated by an informant
  – Objective memory impairment (for age and education)
  – Preserved general cognitive function
  – Intact activities of daily living
  – Not demented

Dementia

• DSM IV-R criteria
  – Major impairment in learning and memory as well as at least one of the following:
    • Impairment in handling complex tasks
    • Impairment in reasoning ability
    • Impaired spatial ability and orientation
    • Impaired language
  – Cognitive symptoms must significantly interfere with work performance, usual social activities, or relationships
  • “loss of intellectual abilities of sufficient severity to interfere with social or occupational functioning, always accompanied by memory impairment and at least one of the following: impairment of abstract thinking, judgment or other disturbance of higher cortical function in the absence of delirium”
Cognitive function in the community

Prevalence (non-institutionalized population)

- **Dementia**
- **Mild Cognitive Impairment**

Annual rate of progression from MCI to dementia = 7-15%
Mortality and Cognitive Function

- Cardiovascular Health Study powerful predictor of elderly mortality was cognitive impairment
- Regardless of definition or measurement, consistent result in numerous studies
- Any illness may erode cognitive function
- Detection of cognitive impairment sometimes reveals unknown disease outside the brain
Review of Test Instruments

- Ideal test

<table>
<thead>
<tr>
<th>Cost</th>
<th>Clarity</th>
<th>Scoring</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick</td>
<td>Protocol</td>
<td>Quantitative</td>
<td>Evidence for relationship to outcome</td>
</tr>
<tr>
<td>No fee for use, score</td>
<td>Scoring Familiarity</td>
<td>Objective</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Review of Test Instruments

- Mini-Mental State Examination
- Clock Drawing Test
- Minnesota Cognitive Acuity Screen
- Delayed Word Recall
Mini-Mental State Examination

- Widest use, often benchmark for performance of other tests
- Simple, quantitative, transparent
- Multiple cognitive domains
- Score range cumulative 0-30
  - age 80, > 12 yr education median 28
  - < 24 impaired
- Extensive mortality evidence
# Mini-Mental State Examination

<table>
<thead>
<tr>
<th>Category</th>
<th>Possible points</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation to time</td>
<td>5</td>
<td>Year, Season, Month, Date, Hour,</td>
</tr>
<tr>
<td>Orientation to place</td>
<td>5</td>
<td>Country, State, City, Hotel, Room</td>
</tr>
<tr>
<td>Registration</td>
<td>3</td>
<td>Immediate word recall (3 words)</td>
</tr>
<tr>
<td>Attention &amp; calculation</td>
<td>5</td>
<td>Serial 7’s, spelling a word (“World”) backwards</td>
</tr>
<tr>
<td>Recall</td>
<td>3</td>
<td>Delayed word recall (above 3 words)</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>Show a object (pen, watch) and ask the name</td>
</tr>
<tr>
<td>Repetition</td>
<td>1</td>
<td>Repeat the phrase, “No if’s, and’s or but’s”</td>
</tr>
<tr>
<td>Complex commands</td>
<td>6</td>
<td>Varies. Can involve drawing a figure, following a written instruction, etc.</td>
</tr>
</tbody>
</table>
MMSE Drawbacks

• Numerous points for extremely low-level function
• Knock-out answers?
• Ceiling effect by IQ, education limits sensitivity
• Copyright
Clock Drawing Test

- Executive involved in working memory and planning tasks: problem solving, complex attention, strategy formation, interference control, adaptation to changing environment
- Requires visuospatial, construction and executive
- Simple, transparent, quantitative (?)
- Mortality evidence

Clock Drawing Test

• CLOX protocol CLOX2-CLOX1 scoring for executive function

• Executive impairment one of the earliest changes, regardless of etiology. May precede memory in AD.

• “Executive function is also adversely affected by poor health, such as falls, pain, certain medications, and hypoxemia. This may explain our finding of an association of the CLOX1 score with mortality.”

## Clock Drawing Test Scoring (15 points)

<table>
<thead>
<tr>
<th>Figure resembles a clock</th>
<th>Only numbers 1-12 among the Arabic numerals present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer circle present</td>
<td>Sequence 1-12 intact, no omissions or intrusions</td>
</tr>
<tr>
<td>Diameter &gt; 1 inch</td>
<td>Exactly 2 hands present</td>
</tr>
<tr>
<td>All numbers inside circle</td>
<td>All hands represented as arrows</td>
</tr>
<tr>
<td>Hour hand in the correct position</td>
<td>Proper spacing of numbers (symmetry along 12-6 axis)</td>
</tr>
<tr>
<td></td>
<td>2 points!</td>
</tr>
<tr>
<td>Minute hand in the correct position</td>
<td>Minute hand longer than hour</td>
</tr>
<tr>
<td>Only Arabic numerals</td>
<td>None of the following: “1:45” present Intrusions from “hand” or “face” present (literal depiction) Any letters, words, or pictures</td>
</tr>
</tbody>
</table>
Clock Drawing Test Scoring (10 points)

- Correctly placed numerals: 1, 2, 4, 5, 7, 8, 10 & 11
  1 point each for +8

- Correctly placed hands of the clock
  1 point each for +2
Minnesota Cognitive Acuity Screen

- Includes DWR
- Adds assessment of judgment, reasoning, orientation, comprehension, attention, repetition, naming, fluency, computation
- Telephone capacity
- Nation’s CareLink
- Proprietary scoring
- Quantitative
Delayed Word Recall

- Widely used in LTC for years
- Registration, memory domains
- Earliest deficit in DAT
- Simple, quantitative, transparent
- Language limitations

Knopman DS "A verbal memory test with high p..."
Delayed Word Recall

Necessary to follow validated script:

• Step 1
  – “Now I am going to give you a list of 10 words which I will ask you to recall later in the interview. I would like you to repeat each word and use that word in a complete sentence. Again, this needs to be done in your head and you can’t use paper and pencil to write anything down, OK?”

  • Chimney
  • Salt
  • Harp
  • Button
  • Meadow
  • Train
  • Flower
  • Finger
  • Rug
  • Book
Delayed Word Recall

• Step 2
  – Repeat step 1 instructions

• Step 3
  – After step 2, tester sets a timer for 5 minutes, and continues other elements of the examination

• Step 4
  – When the timer rings, tester asks subject to recall all 10 words, and encourages the subject “until it is clear that subject is unable to continue.”

• Score = number of words recalled
DWR Scoring

![DWR Scoring Graph]

- **DWR Score**
  - Normal
  - Probable / Possible AD

- **# of Subjects**
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10

- **DWR Score Values**
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10
Delayed Word Recall Validation

- Gen Re DWR Mortality Study
  - Laura Vecchione, MD
  - Eric Golus, FSA
DWR Mortality Study

• Surrogate for elderly life insurance in force, conventional underwriting

• Population of LTCI applicants
  – Age 70 - 99, average 78.5
  – Up to 11.2 years of follow up, average 6.9 yr
  – 14,631 lives, 4,388 deaths

• LTCI underwriting action:
  – Issued (12,928)
  – Declined solely due to cognitive impairment (1,703)

• Mortality determination
  – Social Security Death Master File: Public record of all deaths
  – Match of applicant to SSDMF determines vital status and date of death
  – Observation period 1995-2006
Gen Re DWR Mortality Study 2006

MR (% of 2001 VBT)

- 0 - 5: 194
- 6-10: 114
- Combined: 141

DWR Score
Gen Re DWR Mortality Study 2006

![Bar chart showing mortality rate (MR) as a percentage of 2001 VBT for different DWR scores.

- DWR Score 2: MR = 266
- DWR Score 8: MR = 109

The chart illustrates the mortality study from 1995 to 2006.]
## Review of Test Instruments

- **Delayed Word Recall**

<table>
<thead>
<tr>
<th>Test</th>
<th>Cost</th>
<th>Clarity</th>
<th>Scoring</th>
<th>Mortality</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMSE</td>
<td>✓</td>
<td>✓</td>
<td>❓</td>
<td>✓</td>
<td>Weak on mild disease; image</td>
</tr>
<tr>
<td>CDT</td>
<td>✓</td>
<td>✓</td>
<td>❓</td>
<td>✓</td>
<td>Image</td>
</tr>
<tr>
<td>MCAS</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>Black box</td>
</tr>
<tr>
<td>DWR</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Gen Re Survey

- Data collection January 2008 & 2011
- Participating companies: 41 in 2008; 61 in 2011
- Mixture of large/small, stock/mutual, Gen Re clients/non-clients
- Selected results
Who is old?

At what age do you classify an applicant as “elderly”?

<table>
<thead>
<tr>
<th>Age of Applicant</th>
<th># of Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>2%</td>
</tr>
<tr>
<td>65</td>
<td>15%</td>
</tr>
<tr>
<td>66</td>
<td>2%</td>
</tr>
<tr>
<td>70</td>
<td>46%</td>
</tr>
<tr>
<td>71</td>
<td>20%</td>
</tr>
<tr>
<td>75</td>
<td>7%</td>
</tr>
<tr>
<td>76</td>
<td>5%</td>
</tr>
<tr>
<td>81</td>
<td>2%</td>
</tr>
</tbody>
</table>
2008: Prevalence of testing and test instrument

Is it your standard practice to test cognitive function in your elderly applicants? If yes, which of the following tests do or will you use?

<table>
<thead>
<tr>
<th>Type of Tests</th>
<th>Of Companies Who Currently Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed Word Recall 10-Word (DWR)</td>
<td>55%</td>
</tr>
<tr>
<td>Clock Drawing Test (CDT)</td>
<td>55%</td>
</tr>
<tr>
<td>Mini Mental State Exam (MMSE)</td>
<td>18%</td>
</tr>
<tr>
<td>Other</td>
<td>18%</td>
</tr>
<tr>
<td>Enhanced Mental Skills Test (EMST)</td>
<td>9%</td>
</tr>
<tr>
<td>Minnesota Cognitive Acuity Screen (MCAS)</td>
<td>0</td>
</tr>
</tbody>
</table>

No 52%
Yes, 27%
Planned for 2008 20%
### 2011: Prevalence of testing and test instrument

#### Type of Tests

<table>
<thead>
<tr>
<th>Type of Tests</th>
<th>Of Companies Who Currently Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock Drawing Test</td>
<td>60%</td>
</tr>
<tr>
<td>Delayed Word Recall – 10 Word</td>
<td>52%</td>
</tr>
<tr>
<td>Other</td>
<td>28%</td>
</tr>
<tr>
<td>Delayed Word Recall – 3 Word</td>
<td>16%</td>
</tr>
<tr>
<td>Minnesota Cognitive Acuity Screen</td>
<td>12%</td>
</tr>
<tr>
<td>Delayed Word Recall – Other</td>
<td>8%</td>
</tr>
<tr>
<td>Mini Mental State Exam</td>
<td>8%</td>
</tr>
<tr>
<td>Enhanced Mental Skills Test</td>
<td>0%</td>
</tr>
</tbody>
</table>

- **Yes**: 45%
- **Planned**: 18%
- **No**: 38%
## Rationale

What are your reasons for testing/for not testing cognitive function?

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to garner relevant information from existing requirements (e.g., attending physician statement)</td>
<td>84%</td>
</tr>
<tr>
<td>Problems are too common to ignore</td>
<td>58%</td>
</tr>
<tr>
<td>Able to offer more competitive premium to those who pass the test</td>
<td>58%</td>
</tr>
<tr>
<td>Adverse selection, because applicant is concerned or may have failed test for another company</td>
<td>53%</td>
</tr>
<tr>
<td>Information is usually evident in other requirements</td>
<td>57%</td>
</tr>
<tr>
<td>Other</td>
<td>48%</td>
</tr>
<tr>
<td>Makes it harder to do business</td>
<td>33%</td>
</tr>
<tr>
<td>Abnormalities discovered in the tests are too rare to justify</td>
<td>14%</td>
</tr>
<tr>
<td>Tests are too expensive</td>
<td>5%</td>
</tr>
</tbody>
</table>

**2007 SOA: cost ranked second as reason not to test**
Consequences

Approximately how often does cognitive function testing result in a risk classification that differs from the assessment you would have made without the test?
Recommendations for Underwriting

• Assess cognitive function
  – 10 word delayed word recall
  – Clock drawing
• Validate
  – Instrument
  – Protocol
  – Mortality evidence
  – Appropriate population

• Make it quantitative
  – Objective
  – Underwriting performance
• Don’t innovate!
• Converge on a common standard
  – Paramed performance
  – Data analysis
• Don’t go last!!!
THE SENILITY PRAYER

Grant me the senility to forget the people I never liked, the good fortune to run into the ones I do, and the eyesight to tell the difference.