Dementia and Driving: Do We Know When to Say When?

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Medical Director, The Rehabilitation Institute of St. Louis
DISCLOSURES (2012-Present)

- Funding Support (last two years)
  - National Institute on Aging (NIA)
  - Missouri Department of Transportation
- Consulting Relationships
  - American Medical Association (AMA)
  - ADEPT
  - TIRF
  - Medscape
- Speakers Bureau
  - St. Louis Alzheimer’s Association
- Medical Director
  - Parc Provence
  - The Rehabilitation Institute of St. Louis
- Drug Industry Sponsored Trials
  - Janssen/Pfizer
- Investment/Stock/Equity
  - None
PRESENTATION OBJECTIVES

Review the safety and crash statistics around older drivers and drivers with dementia

Review current approaches and tools that are available to assist decisions in drivers with dementia

Review current research efforts in the field and areas of future collaboration
STATISTICS ON OLDER DRIVERS

• Aging Demographics
  • 2007
    • 36 Million Older Adults
    • 28 Million Licensed Drivers
  • 2050
    • 86 Million Older Adults
    • 66 Million Licensed Drivers

• Chronic Disease
  • General Population
    • 25 million people or about 1/10 citizens
    • 1.7 million die each year
  • Older adults
    • 50% affected over age 65
    • 37% report disease is severe
    • 16% require assistance
Affects > 5 million people in the U.S. (20 million world-wide)
Results in > 100,000 deaths per year/Costs > $100 billion annually
MOTOR VEHICLE CRASH RISK BY AGE

http://search.cga.state.ct.us/dtSearch_lpa.html
MOTOR VEHICLE CRASH VULNERABILITY BY AGE

Figure 4: Fatal Accident Rate Age Group Comparison by Licensed Drivers and Vehicle Miles Traveled

http://search.cga.state.ct.us/dtSearch_lpa.html
DEMENTIA AND DRIVING CESSATION

- **DESIGN:** Retrospective cohort data from a community-based study of incident dementia. The Honolulu Heart Program and the Honolulu-Asia Aging Study.

- **PARTICIPANTS:** A total of 643 men who were evaluated for the incidence of Alzheimer's disease or other dementia between the fourth and the fifth examination of the Honolulu Heart Program.

- **CONCLUSIONS:** Dementia is a major cause of driving cessation.

SUMMARY OF DRIVING STATISTICS in DEMENTIA and OLDER ADULTS

- Increasing Numbers of Older Drivers and Drivers with CVA/AD
- Increasing Prevalence of Chronic Disease and Older Drivers
- More Potential Drivers with Multiple Medical Diseases/Meds
- Increased Morbidity and Mortality Rates in MVC’s
- Increasing Exposure or Miles per Year for Aging Cohort
- The Most Vulnerable are Likely Low Mileage Drivers
- Low Mileage Drivers include those with physical/cognitive frailty
- Many older adults retire from driving
- Growing transportation burden for families, caregivers, and society to provide trips

list.nsc.org/defensivedriving/images/uploads/811161.pdf
The Changing Definitions of Cognitive Impairment and Dementia

- Normal Cognition
- Prodromal Dementia
- Dementia
  - Other dementias
  - Alzheimer’s disease
  - Vascular Dementia

From Golomb, Kluger, Ferris NeuroScience News, 2000
ANATOMY OF CRITICAL COGNITIVE DOMAINS

Ott B and Daiello L. How does dementia affect driving in demented patients? Aging Health 2010; 6: 77-85
FITNES-TO-DRIVE STAKEHOLDERS

- Patient
- Family and Friends
- Health Professionals
- Organizations
- Patrol Officers
- State DMV
- Insurance
- Community
- Federal/NHTSA
Driving Outcomes

- Cessation/Retirement
- Crashes
- Road Tests
- Simulators
- Others
Fitness to Drive Steps

• Step 1: Driving History and Med Reviews
• Step 2: Examine Co-Morbidities
• Step 3: Physical Examination/Psychometric Tests
• Step 4: Rate Disease Severity/Functional impairment
• Step 5: Referral, Rehab, and/or Retirement
Step 1: Driving History/Med Review

- Driving Behaviors
- Informant Rating
- Exposure
- Personality
- Violations
- Crashes
- Cognitive Impairment
- Functional Impairment
- Others?
Signs of Unsafe Driving: Alz Association

• Hitting curbs
• Using poor lane control
• Failing to observe traffic signs
• Making slow or poor decisions in traffic
• Driving at an inappropriate speed
• Becoming angry or confused while driving
• Making errors at intersections
• Confusing the brake and gas pedals
• Returning from a routine drive later than usual
• Forgetting the destination during the trip

### Signs of Unsafe Driving: At the Crossroads

(*stop driving immediately*)

#### Driving Behavior Warning Signs - When Noticed, How Often

| 1. Decrease in confidence while driving          | 16. Uses a “copilot”               |
| 2. Difficulty turning to see when backing up   | 17. Bad judgment on making left hand turns |
| 3. Riding the brake                              | 18. Near misses                   |
| 4. Easily distracted while driving              | 19. Delayed response to unexpected situations |
| 5. Other drivers often honk horns               | 20. Moving into wrong lane         |
| 7. Difficulty parking within a defined space    | 22. Confusion at exits            |
| 8. Hitting curbs                                | 23. Ticketed moving violations or warnings |
| 9. Scrapes or dents on the car, mailbox or garage | 24. Getting lost in familiar places |
| 10. Increased agitation or irritation when driving | 25. Car accident                  |
| 11. Failure to notice important activity on the side of the road | 26. Failure to stop at stop sign or red light |
| 12. Failure to notice traffic signs             | 27. Confusing the gas and brake pedals* |
| 13. Trouble navigating turns                    | 28. Stopping in traffic for no apparent reason* |
| 14. Driving at inappropriate speeds             |                                           |
| 15. Not anticipating potential dangerous situations |                                   |

[http://www.thehartford.com/advance50/publications-on-aging](http://www.thehartford.com/advance50/publications-on-aging)
Driving Safety Errors in Dementia


<table>
<thead>
<tr>
<th>Safety errors</th>
<th>AD (n = 40)</th>
<th>Controls (n = 115)</th>
<th>p Values for difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude</td>
<td>Age- and gender-adjusted</td>
<td></td>
</tr>
<tr>
<td>Starting and pulling away from curve</td>
<td>1.08 (0.97)</td>
<td>1.09 (0.81)</td>
<td>0.7097</td>
</tr>
<tr>
<td>Traffic signals</td>
<td>2.35 (1.56)</td>
<td>2.18 (1.56)</td>
<td>0.5101</td>
</tr>
<tr>
<td>Stop signs</td>
<td>3.80 (1.98)</td>
<td>3.61 (1.89)</td>
<td>0.7610</td>
</tr>
<tr>
<td>Other signs</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>—</td>
</tr>
<tr>
<td>Turns</td>
<td>6.50 (3.09)</td>
<td>5.44 (2.79)</td>
<td>0.0838</td>
</tr>
<tr>
<td>Lane observance</td>
<td>17.03 (11.00)</td>
<td>10.84 (7.77)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Lane change</td>
<td>5.75 (2.86)</td>
<td>5.00 (2.75)</td>
<td>0.1253</td>
</tr>
<tr>
<td>Overtaking</td>
<td>0.10 (0.38)</td>
<td>0.15 (0.46)</td>
<td>0.5075</td>
</tr>
<tr>
<td>Control of speed</td>
<td>4.03 (2.71)</td>
<td>3.56 (2.79)</td>
<td>0.2634</td>
</tr>
<tr>
<td>Backing up</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>—</td>
</tr>
<tr>
<td>Parallel parking</td>
<td>0.38 (0.49)</td>
<td>0.37 (0.52)</td>
<td>0.8172</td>
</tr>
<tr>
<td>Head-in parking</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>—</td>
</tr>
<tr>
<td>Curves</td>
<td>0.00 (0.00)</td>
<td>0.01 (0.09)</td>
<td>0.5653</td>
</tr>
<tr>
<td>Railroad crossing</td>
<td>0.03 (0.16)</td>
<td>0.19 (0.58)</td>
<td>0.1115</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0.98 (1.03)</td>
<td>0.73 (1.05)</td>
<td>0.0859</td>
</tr>
<tr>
<td>Total safety errors</td>
<td>42.00 (12.84)</td>
<td>33.18 (12.22)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total more serious errors</td>
<td>4.35 (2.97)</td>
<td>1.90 (1.59)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total less serious errors</td>
<td>37.65 (11.66)</td>
<td>31.26 (11.49)</td>
<td>0.0009</td>
</tr>
</tbody>
</table>

Groups were compared using Wilcoxon rank sum for crude p values and multiple linear regression for adjusted p values.
Driving Behaviors in Dementia

Table 2
The number of participants (N), mean score, confidence interval (±), and probability level of the Wilcoxon Signed Rank Sum test (*p*-value).

<table>
<thead>
<tr>
<th>Metric</th>
<th>Early stage dementia</th>
<th>Comparison Mean (N = 26; <em>N</em> = 17)</th>
<th><em>p</em>-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trips per day</td>
<td>3.7 ± 1.0</td>
<td>4.3 ± 0.7</td>
<td>0.08</td>
</tr>
<tr>
<td>Miles per day</td>
<td>14.9 ± 5.2</td>
<td>35.7 ± 6.1</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Number of unique destinations per week</td>
<td>6.1 ± 1.8</td>
<td>12.8 ± 2.2</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Freeway miles (%)</td>
<td>15.0 ± 9.2</td>
<td>32.9 ± 6.8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Miles driven within 5 miles of home (%)</td>
<td>70.2 ± 10.4</td>
<td>43.0 ± 6.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Miles driven within 10 miles of home (%)</td>
<td>84.2 ± 9.5</td>
<td>60.3 ± 8.3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Miles driven during daylight hours (%)</td>
<td>93.2 ± 5.1</td>
<td>86.2 ± 6.1</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Miles driven during rush hour (%)</td>
<td>15.2 ± 4.6</td>
<td>16.6 ± 4.7</td>
<td>0.30</td>
</tr>
<tr>
<td>Miles driven alone (%)</td>
<td>53.3 ± 17.1</td>
<td>Unavailable</td>
<td>N/A</td>
</tr>
<tr>
<td>Miles driven with a navigation device (%)</td>
<td>0.0 ± 0.0</td>
<td>Unavailable</td>
<td>N/A</td>
</tr>
<tr>
<td>Number of wayfinding trips of interest</td>
<td>1.9 ± 1.2</td>
<td>2.4 ± 0.9</td>
<td>0.16</td>
</tr>
<tr>
<td>Navigation trips of interest (%)</td>
<td>2.1 ± 1.6</td>
<td>2.8 ± 1.5</td>
<td>0.13</td>
</tr>
<tr>
<td>Number of likely lost trips</td>
<td>0.4 ± 0.4</td>
<td>0.0 ± 0.0*</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Miles belted (%)</td>
<td>88.3 ± 11.6</td>
<td>98.8 ± 2.3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Miles driven with short headway (%)</td>
<td>2.9 ± 1.6</td>
<td>6.1 ± 3.4</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Miles driven 10 mph or more slower traffic (%)</td>
<td>3.9 ± 12.2</td>
<td>1.8 ± 0.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Inappropriate midblock stops (%)</td>
<td>0.0 ± 0.0</td>
<td>0.1 ± 0.0</td>
<td>0.51</td>
</tr>
<tr>
<td>Running stop signs (%)</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
<td>N/A</td>
</tr>
<tr>
<td>Turn signal use for turns (%)</td>
<td>77.2 ± 10.4</td>
<td>79.4 ± 8.0</td>
<td>0.26</td>
</tr>
<tr>
<td>Left turns causing traffic conflict (%)</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
<td>N/A</td>
</tr>
<tr>
<td>Red-light running (%)</td>
<td>0.4 ± 0.0</td>
<td>Unavailable</td>
<td>N/A</td>
</tr>
<tr>
<td>Number of gear error events per week</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
<td>0.28</td>
</tr>
<tr>
<td>Number of pedal error events</td>
<td>0.0 ± 0.0</td>
<td>Unavailable</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Bolded *p*-values are significant at the .05 probability level.

* Indicate where the sample size was on 17 participants (rather than 26) for the comparison group.

MEDICATIONS

- Narcotics
- Barbituates
- Benzo’s
- Antihistamines
- Antidepressants
- Antipsychotics
- Hypnotics
- Alcohol
- Muscle Relaxants
- Antiemetics
- Antiepileptic

Hetland A, Carr DB. Annals of Pharmacology (in press)
Meuser TM, et al. The Instructional Impact of the AMA’s Older Drivers Project On-Line Curriculum. Gerontology & Geriatrics Education (In press)
Clinician Medical Guidelines

Mechanism to Update, Evidenced-Based, **Refer to Your Own State Guidelines

http://www.cma.ca/driver EGLineguide


Our Case: Diabetes is under control with no end organ disease. However, the patient screens positive for dementia. She is referred to a subspecialty clinic.
Step 3a: Physical Examination

• Visual Acuity
• Visual Fields
• Contrast Sensitivity
• Cognitive Testing
  • Clock Drawing Task
  • Trail Making Tests A/B
  • Mazes
• Motor Examination
  • Muscle Strength
  • Range of Motion

Our Case: The patient has an abnormal clock Score of 2. The patient takes 70 seconds to complete Trail Making Test A. She is unable to complete Trail Making Test B.


• Interaction of basic and higher-order abilities in driving performance

Akinwuntan et al., *J Stroke Cerebrovasc Dis* 2012

Slides courtesy of Dr. Abiodun Akinwuntan with permission
Maze Task
1) Not language based
2) Not covered by Psychological Practice Acts
3) Supported by additional studies

For information about the Snellgrove Maze Task® please contact Dr Carol Snellgrove at; carol.snellgrove@police.sa.gov.au
### Computerized Tests of Driving Performance
The DrivingHealth Inventory with UFOV/DriveABLE

<table>
<thead>
<tr>
<th>Test</th>
<th>Peak Validity OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visualization of missing information</td>
<td>4.96</td>
</tr>
<tr>
<td><em>(MFVPT; Visual Closure)</em></td>
<td></td>
</tr>
<tr>
<td>Directed visual search</td>
<td>3.50</td>
</tr>
<tr>
<td><em>(Trail-Making B)</em></td>
<td></td>
</tr>
<tr>
<td>Working memory</td>
<td>2.92</td>
</tr>
<tr>
<td><em>(Delayed Recall)</em></td>
<td></td>
</tr>
<tr>
<td>Information processing speed</td>
<td>2.48</td>
</tr>
<tr>
<td><em>(Useful Field of View, subtest 2)</em></td>
<td></td>
</tr>
<tr>
<td>Lower limb strength</td>
<td>2.64</td>
</tr>
<tr>
<td><em>(Rapid Pace Walk)</em></td>
<td></td>
</tr>
<tr>
<td>Head/neck flexibility</td>
<td>2.56</td>
</tr>
<tr>
<td><em>(Recognizing Clock Time)</em></td>
<td></td>
</tr>
</tbody>
</table>

Staplin L, et al. MaryPODS revisited.  
Dobbs AR. Accuracy of DriveABLE.  
Canadian Family Practice 2013: 59: e158-161.
Trail Making Test, Part B

- Tests attention, working memory, visual processing, visuospatial skills, and psychomotor coordination
- Patient connects numbers and letters in alternating pattern
- Test is scored by time (sec) to complete and number of errors requiring correction
- Greater than 180 sec signals a need for intervention

## Step 4: Rating Disease Severity/Function

<table>
<thead>
<tr>
<th>Clinical Measure of Dementia Severity</th>
<th>No Dementia (CDR=0)</th>
<th>Questionable or Very Mild Dementia (CDR=0.5)</th>
<th>Mild Dementia (CDR=1.0)</th>
<th>Moderate to Severe Dementia (CDR=2.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For the Dementia Specialist:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Dementia Rating</td>
<td>No memory loss or inconsistent memory loss</td>
<td>Consistent slight forgetfulness</td>
<td>Memory loss interferes with everyday activities</td>
<td>Severe memory loss</td>
</tr>
<tr>
<td></td>
<td>Fully oriented</td>
<td>Slight difficulty with orientation or judgment</td>
<td>Geographic disorientation</td>
<td>Severe difficulty with time relationships and judgment</td>
</tr>
<tr>
<td></td>
<td>Judgment intact</td>
<td>Slight impairment in community activities or home activities</td>
<td>Moderate impairment in judgment</td>
<td>No longer independent in activities</td>
</tr>
<tr>
<td></td>
<td>Function intact</td>
<td>Personal care intact</td>
<td>Mild but definite impairment of community or home activities</td>
<td>Only simple chores preserved</td>
</tr>
<tr>
<td></td>
<td>Personal care intact</td>
<td></td>
<td>Needs prompting for personal care</td>
<td>Needs assistance in personal effects</td>
</tr>
<tr>
<td><strong>For the Clinician:</strong></td>
<td><strong>N (SD)</strong></td>
<td><strong>N (SD)</strong></td>
<td><strong>N (SD)</strong></td>
<td><strong>N (SD)</strong></td>
</tr>
<tr>
<td>Short Blessed Test</td>
<td>1.2 (1.9)</td>
<td>4.8 (5.9)</td>
<td>15.4 (5.2)</td>
<td>18.5 (5.5)</td>
</tr>
<tr>
<td>Mini-Mental Status Exam</td>
<td>28.9 (1.3)</td>
<td>23.1 (2.5)</td>
<td>20 (3.9)</td>
<td>16.1 (4.7)</td>
</tr>
<tr>
<td><strong>For the Psychologist:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logical Memory</td>
<td>8.8 (2.9)</td>
<td>4.3 (2.7)</td>
<td>1.9 (1.7)</td>
<td>1.5 (2.3)</td>
</tr>
<tr>
<td>Block Design</td>
<td>30.1 (8.6)</td>
<td>22.2 (9.8)</td>
<td>12.0 (9.6)</td>
<td>3.2 (6.6)</td>
</tr>
<tr>
<td>Digit Symbol</td>
<td>45.6 (11.5)</td>
<td>31.7 (13.6)</td>
<td>17.0 (13.3)</td>
<td>8.3 (8.7)</td>
</tr>
<tr>
<td>Trailmaking A</td>
<td>40.9 (20.0)</td>
<td>70.2 (39.2)</td>
<td>108.3 (50.5)</td>
<td>???</td>
</tr>
<tr>
<td>Benton Copy</td>
<td>9.6 (.88)</td>
<td>9.1 (1.6)</td>
<td>7.3 (2.7)</td>
<td>???</td>
</tr>
</tbody>
</table>

Mobility and Safety Issues in Demented Drivers Carr DB and O’Neill D
Assessment of Dementia: AD8

- Detect change compared to previous level
  - No need for baseline assessment
  - Patients serve as their own control
  - Not biased by education, race, gender
- Brief (< 2 min), Yes/No format
  - 2 or more “Yes” answers highly correlated with presence of dementia

The Eight-item Informant Interview to Differentiate Aging and Dementia (AD-8) is a copyrighted instrument of the Alzheimer’s Disease Research Center, Washington University, St. Louis, Mo. The AD8 is not a substitute for clinical judgment.

Alzheimer’s Detection: AD8

<table>
<thead>
<tr>
<th>Problem</th>
<th>YES, A change</th>
<th>NO, No change</th>
<th>N/A, Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems with judgment (e.g. falls for scams, bad financial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decisions, buys gifts inappropriate for recipients)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced interest in hobbies/activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeats questions, stories or statements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trouble learning how to use a tool, appliance or gadget (e.g.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCR, computer, microwave, remote control)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forgets correct month or year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty handling complicated financial affairs (e.g. balancing checkbook, income taxes, paying bills)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty remembering appointments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistent problems with thinking and/or memory</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL AD8 SCORE**
NACC Uniform Data Set (UDS) – Initial Visit Packet
Form B7: Functional Assessment – Functional Assessment Questionnaire (FAQ)

Center: __________________________ ADC Subject ID: __ __ __ __ __ __ __ __ __ __ __ __ Form Date: __/__/________ ADC Visit #: __________

NOTE: This form is to be completed by the clinician or other trained health professional, based on information provided by informant. For additional clarification and examples, see UDS Coding Guidebook for Initial Visit Packet, Form B7. Indicate the level of performance for each activity by circling the one appropriate response. Examiner’s initials: __________

<table>
<thead>
<tr>
<th>Activity</th>
<th>Not applicable (e.g., never did)</th>
<th>Normal</th>
<th>Has difficulty, but does by self</th>
<th>Requires assistance</th>
<th>Dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Writing checks, paying bills, or balancing a checkbook.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Assembling tax records, business affairs, or other papers.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Shopping alone for clothes, household necessities, or groceries.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Playing a game of skill such as bridge or chess, working on a hobby.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Heating water, making a cup of coffee, turning off the stove.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Preparing a balanced meal.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Keeping track of current events.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Paying attention to and understanding a TV program, book, or magazine.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Remembering appointments, family occasions, holidays, medications.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Traveling out of the neighborhood, driving, or arranging to take public transportation.</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>


(version 2.0, February 2008)
# The 4 C’s: Screening Tool for At-Risk Drivers

## N=161, hospital based driving evaluation program, outcome marginal and fail on road test

O’Connor MG, et al. JAGS 2010; 58: 1104-8

<table>
<thead>
<tr>
<th>CRASH/CITATION (past two years)</th>
<th>CONCERN (Family Report)</th>
<th>CLINICAL STATUS (Medical History)</th>
<th>COGNITION (Family Report and Clinical Impressions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No crashes/citation</td>
<td>1. No driving concerns</td>
<td>1. Overall good health</td>
<td>1. Intact cognition</td>
</tr>
<tr>
<td>2. One or more fender bender</td>
<td>2. Mild concerns: family has talked with patient about driving safety</td>
<td>2. Medical condition/mild impact on vision, attention, motor (e.g., frailty, arthritis, neuropathy)</td>
<td>2. Mild cognitive decline/Intact daily functions</td>
</tr>
<tr>
<td>3. Citation for dangerous violation</td>
<td>3. Moderate concerns: family restricts patient from driving with passengers</td>
<td>3. Medical issues/moderate impact on vision, attention, motor (e.g., stroke, early stage Alzheimer’s disease, Parkinson’s disease, multiple sclerosis)</td>
<td>3. Moderate cognitive decline/decline in daily functions</td>
</tr>
<tr>
<td>4. Crash or crashes</td>
<td>4. Extreme concerns: family wants patient to stop driving immediately</td>
<td>4. Medical issues/severe impact on vision, attention, motor (e.g., advanced Alzheimer’s disease, Parkinson’s disease, multiple sclerosis)</td>
<td>4. Severe cognitive decline/dependence on others for daily functions</td>
</tr>
</tbody>
</table>
**Results**

Scores of 9 or greater on the 4Cs identified 84% of participants who were at risk for poor performance.

AUC=0.81 for pass vs. marginal and fail, 0.70 comparing pass and marginal to fail.

*Figure 2. Receiver operating characteristic curve for total 4Cs score. The outcome is a final clinical rating of fail or marginal versus pass. The predictor is the total 4Cs score. Selected cut points are noted.*
**Likelihood Ratios**

- LR+ is simply the % of “sick” people with a given test result divided by the % of “well” people with same result
- Ex: LR+ = Sens/(1-Spec): LR+ 2-5 small, 5-10 moderate, >10 large ↑
  Ex LR- = (1-Sens)/Spec: LR- .2-.5 small, .1-.2 moderate, < .1 large ↓
- Predictive values of tests are driven by the prevalence of dx
- Best when prior probability 30-70%
- Uses all four cells of the 2x2 table, can apply to a specific patient
- 95% confidence intervals can calculate the precision of the estimate.

Dementia Model 1: HIGH Probability of Failure >82%  
Based on Trails A, CDT-F, and AD-8 scores  
“You can’t drive, no road test needed”

<table>
<thead>
<tr>
<th></th>
<th>Unfit to Drive (Fails Road Test)</th>
<th>Fit to Drive (Passes Road Test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Combo &gt; .82</td>
<td>a (37)</td>
<td>b (1)</td>
</tr>
<tr>
<td>Test Combo &lt; .82</td>
<td>c (26)</td>
<td>d (33)</td>
</tr>
<tr>
<td></td>
<td>a + c (63)</td>
<td>b + d (34)</td>
</tr>
</tbody>
</table>

a = true+, b = false +, c = false-, d = true-

Sensitivity (TPF)=a/(a+c) = 59%  
Specificity=d/(b+d) = 97%  
LR +: 19.7

NOTE: 38% of sample characterized (high specificity/low false +)  
37 patients correctly ID as unfit, 1 incorrectly classified
Dementia Model 1: LOW Probability of Failure <30% Based on Trails A, CDT-F, and AD-8 scores “You can drive: No road test needed”

<table>
<thead>
<tr>
<th>Test Combo &gt; .3</th>
<th>Unfit to Drive (Fails Road Test)</th>
<th>Fit to Drive (Passes Road Test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a (62)</td>
<td>b (23)</td>
</tr>
<tr>
<td>Test Combo &lt; .3</td>
<td>c (1)</td>
<td>d (11)</td>
</tr>
<tr>
<td></td>
<td>a + c (63)</td>
<td>b + d (34)</td>
</tr>
<tr>
<td>a + b (85)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Combo &gt; .3</th>
<th>Unfit to Drive (Fails Road Test)</th>
<th>Fit to Drive (Passes Road Test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a = true+, b = false +, c = false-, d = true-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sensitivity (TPF) = \( \frac{a}{a+c} = 98\% \)
Specificity = \( \frac{d}{b+d} = 32\% \)
LR- = .06

NOTE: 12% of sample characterized (high sensitivity, low false -)
11 patients correctly ID as fit, 1 incorrectly classified
### Probability of Failing Driver Test

<table>
<thead>
<tr>
<th>Probability of Failing Road Test Calculator</th>
</tr>
</thead>
</table>

**Coefficient**

<table>
<thead>
<tr>
<th>Intercept</th>
<th>trlA</th>
<th>AD8TOT</th>
<th>CDTf</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.7594</td>
<td>0.0283</td>
<td>0.5516</td>
<td>-0.3643</td>
</tr>
</tbody>
</table>

**Observed Value**

<table>
<thead>
<tr>
<th>score</th>
<th>exp(score)</th>
<th>probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Change values in box above.

\[
\text{score} = 2.251 \\
\text{exp(score)} = 9.497228318 \\
\text{probability} = 0.904736758
\]

**How much uncertainty are you willing to accept?**

**How good do our tests need to be?**

\[
Prob(\text{Fail}) = \frac{e^{x_\beta}}{1 + e^{x_\beta}}
\]

where

\[
x_\beta = -1.7594 + (0.0283 \times \text{trlA}) + (-0.3643 \times \text{CDTf}) + (0.5516 \times \text{AD8TOT})
\]

\[
e = 2.718282.
\]
Algorithm: Evaluating Driving Risk

**Risk factors: None**
- CDR 0.5
- CDR 1.0

**Risk factors: Few**
- CDR 0.5
- CDR 1.0

**Risk factors: Several**
- CDR 0.5
- CDR 1.0

**Risk factors: Multiple**
- CDR 0.5

**Relatively low risk**

**Relatively high risk**

**Risk Management**
- Encourage family support for alternate transportation.
- Strongly consider voluntary surrender of driving privileges.
- Consider DMV referral or professional driving evaluation, based on state guidelines.

**Intervention pursuant to state guidelines**
Algorithm

CLINICIAN’S CARE OF THE AGING PATIENT: FROM EVIDENCE TO ACTION

THE OLDER ADULT DRIVER WITH COGNITIVE IMPAIRMENT:

“It’s a Very Frustrating Life”
David B. Carr, MD
Brian R. Ott, MD

B. Carr, MD. Brian R. Ott, MD. JAMA 2010; 303: 1632-1641
Step 5: Referral and Counseling

• **Green Light**
  - No red flags
  - Monitor at intervals
  - Full speed ahead!

• **Yellow Light**
  - Red flags/co-morbid illnesses
  - Decline in traffic skills
  - Deficits on office screening
  - Consider referral and caution!
  - Driving Rehab Specialist

• **Red Light**
  - Driving Retirement/Counseling
  - Stop! Case Manager, MSW!
Referral

- Primary Care
- Subspecialist
- Neuropsychologist
- Occupational Therapists
- Driving Specialist

### Prediction of On-Road Performance in Patients with Early Alzheimer’s Disease
A Driver Rehabilitation Specialist

• One who plans develops, coordinates and implements driving services for individuals with disabilities

• These individuals are often Occupational Therapists with specialized training in driver assessment and rehabilitation
Disabilities and Driving Aids

Lack of range of motion--neck
  • Wide angle mirrors or additional rear and side mirrors

Nonfunctional lower extremity
  • restraint for disabled leg, hand-operated parking brake, automatic transmission

All or partial loss strength on 1 side of body
  • spinner knob, left foot accelerator, right-side turn signal

Photograph courtesy of Rod Schmall
WHICH TYPE OF OLDER ADULT IS AT RISK?

Langford J, et al. 2006 Accident Analysis and Prevention, 28(3), pp. 574-578
Restrictions based on speed, radius, time of day, time per trip, in-vehicle technologies...
Most older adults would accept restriction. Very few (<5%) have restricted licenses.

Not clear whether license restriction or the natural reduction in exposure with aging is cause for crash reduction. It is also not clear how to enforce restriction with dementia.

Nasvadi GC and Wister A. Do Restricted Driver’s License Lower Crash Risk Among Older Drivers. The Gerontologist 2008 49; 474-484.
REMOVING THE RESISTANT DRIVER

• Ask physician to “prescribe” driving retirement orally/writing
• Focus on other medical conditions as the reason to stop driving
  • (e.g. vision too impaired, reaction time too slow)
• Use a contract (see THE HARTFORD At the Crossroads guide)
• Vehicle-Related Tactics
  • Hiding/filing down keys
  • Replacing keys
  • Do not repair the car/ send car for “repairs” but do not return
  • Remove the car by loaning, giving or selling
  • Disable the car
• Discuss financial implications of crash or injury
• Revoke license
When Should You Refer to the State?

Please complete the Driver Condition Report if you have personal knowledge about a driver you believe is no longer able to safely operate a motor vehicle.

- You should report only your firsthand knowledge of the driver.
- You should complete the entire form and sign your name on the reverse side.
- After reviewing this report, the Director of Revenue may require the driver to take certain tests such as a medical, vision or driving test.
- All information contained in this report shall be kept confidential, unless released by a court order.

<table>
<thead>
<tr>
<th>PERSONAL INFORMATION ON PERSON BEING REPORTED:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please complete all available information.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NAME (LAST, FIRST, MIDDLE)</th>
<th>SOCIAL SECURITY NUMBER OR DRIVER LICENSE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LICENSE PLATE NUMBER</th>
<th>STATE OF ISSUANCE</th>
<th>DATE OF BIRTH</th>
<th>TELEPHONE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADDRESS</th>
<th>CITY</th>
<th>STATE</th>
<th>ZIP CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Describe in detail incidents or conditions about this driver. Give specific information such as dates, places, accident reports and all other available information to support the need for re-examination. You should report only information of which you have personal knowledge or physical evidence. Do not report what you have been told or heard.

Please check appropriate boxes based on personal knowledge of incident if applicable. Please give a detailed description of incident. Age alone is not a sufficient reason for retesting.
SUMMARY OF LICENSING OUTCOMES

Meuser T, Carr DB, Ulfarsson GF. Motor-Vehicle Crash History and Licensing Outcomes for Older Drivers Reported as Medically Impaired in Missouri Accident Analysis & Prevention. Accident Analysis & Prevention 2009; 41: 246-52
Crash Involvement by Report Source

- Family (16%)
- Police (30%)
- Physician (20%)
- License Office (27%)

Years: 1993 to 2006
The Importance of the Automobile

- The Transportation Method of Choice
- Autonomy
- Identity
- Social Connectedness
- Psychological and Physical Health Correlates
- Private cars account for over 90% of trips made by seniors
Mobility Counseling
Transportation Alternatives

- St. Louis Options
- Social Work Referral
- CORP
- Call-A-Ride
- Good Shepherd
- Metro
- Bus
- Taxi
- ITNAmerica
- Other
SUMMARY: STEPS TO CONSIDER

- Consider driving in the context of the disease
- Consider involving your physician or specialist
- Consider referral to a driving clinic
- Consider referral to the state DMV’s
- Consider list of resources/handouts
- Consider self-help courses (AARP, AAA, etc)
- Consider transportation alternatives
CLUES TO SPECIFIC NEURODEGENERATIVE DISEASES

Alzheimer’s Disease

Rapidly evolving dementias

Temporal profile + laboratory results

Stroke, Focal Signs

EPS, Visual Hallucinations

Behavior, Language

Vascular dementia

Frontotemporal dementias

Lewy body dementia

In vivo Amyloid Imaging
Pittsburgh Compound B (PIB)
(Klunk et al, Ann Neurol 2004)
Fitness-to-Drive in Older Adults

Funded by the Division of Highway Safety/MoDOT 2007-2014

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