Will a Driverless Ms. Daisy Make Medical Fitness to Drive Obsolete?

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DISCLOSURES (2015-Present)

• Funding Support
  • National Institute on Aging (NIA)
  • Missouri Department of Transportation
  • State Farm

• Consulting Relationships
  • TIRF
  • Medscape
  • AAAFTS
  • American Geriatric Society
  • University of Toronto

• Medical Director
  • Parc Provence/TRISL

• Drug Industry Sponsored Trials/Investment-Stock-Equity
  • None
PRESENTATION OBJECTIVES

Review the safety and crash statistics around older and demented drivers

Review current approaches and tools that assist fitness to drive decisions in older drivers (FIVE STEPS TO FITNESS TO DRIVE)

Meeting new challenges of technologies: Vehicle interventions to improve safety
Question #1: True or False?

The majority of older adults no longer have an active driver’s license in the US after age 85 years due to medical impairments (e.g. stroke, dementia)....
**FALSE: But Barely…**

- **Aging Demographics**
  - 2015
    - 46 Million Older Adults (5.5 >85)
    - 40 Million Licensed Drivers (3>85)
  - 2050
    - 86 Million Older Adults
    - 66 Million Licensed Drivers

- **Motor Vehicle Crashes**
  - 2014
    - 5,700 older adults were killed 236,000 were injured
    - 15 older adults killed and 500 injured in crashes on average every day

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http://www.iihs.org/iihs/topics/t/older-drivers/fatalityfacts/older-people

https://www.cdc.gov/motorvehiclesafety/older_adult_drivers/index.html
Question #2: True or False?

The average demented driver has an increased motor vehicle crash risk when compared to other age groups...
FALSE: DEPENDING ON YOUR PERSPECTIVE

Figure 3: Accident Involvement Rate Age Group Comparison by Licensed Drivers and Vehicle Miles Traveled

http://search.cga.state.ct.us/dtSearch_lpa.html
Question #3: True or False?

The risk of a medically impaired driver over 70 years of being injured in a crash has decreased over the past decade, likely due to better cars and roadways...
TRUE...
MOTOR VEHICLE CRASH VULNERABILITY BY AGE

http://search.cga.state.ct.us/dtSearch_lpa.htm
http://www.iihs.org/iihs/topics/t/older-drivers/fatalityfacts/older-people/2010
Question #4: True or False?

Demented drivers that put the most miles per year on the road are at the highest risk for a crash due to increased exposure...
FALSE, although the risk remains low…

Langford J, et al. 2006 Accident Analysis and Prevention, 28(3), pp. 574-578
Nasvadi GC and Wister A. Do Restricted Driver’s License Lower Crash Risk Among Older Drivers. The Gerontologist 2008 49; 474-484.
Question #5: True or False?

The majority of older women remain active behind the wheel with very little time at the end of life without the ability to drive a car...
FALSE…there is quite a time without wheels

Men over age 70 have about 6 yrs without driving, women 10 yrs


Older women at increased risk of serious injury in MVC, tend to lack confidence, higher risk for premature driving cessation

Oxley et al, Monsash University, Older Women and Driving, 2004
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
OLDER ADULTS

- Increasing Numbers of Older Drivers
- Increasing Prevalence of Chronic Disease and Demented 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

http://www.iihs.org/iihs/topics/t/older-drivers/fatalityfacts/older-people/2010
Which Lobes are Key For Driving?

CLUES TO SPECIFIC NEURODEGENERATIVE DISEASES

- Alzheimer’s Disease
  - Temporal profile + laboratory results
  - Stroke, Focal Signs
  - Behavior, Language
- Rapidly evolving dementias
- Vascular dementia
- Frontotemporal dementias
- Lewy body dementia
- Vascular dementia
- Lewy body dementia
Case-Based Approach

- An 83 year old female presents with early AD
- Daughter raises concerns about driving given mother’s slowed reaction time, medications, and other medical conditions
- PMH: HTN, Type II DM, Anxiety Disorder (GAD)
- Medications:
  - Atenolol 50mg BID,
  - Metformin 500g BID
  - Alprazolam .25 TID
  - Sertraline 25mg QD
Algorithm: Evaluating Driving Risk

<table>
<thead>
<tr>
<th>CDR 0.5-1.0</th>
<th>CDR 2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate for risk factors</td>
<td></td>
</tr>
<tr>
<td><strong>Risk factors</strong></td>
<td></td>
</tr>
<tr>
<td>Level B evidence</td>
<td></td>
</tr>
<tr>
<td>Caregiver report of marginal or unsafe skills</td>
<td></td>
</tr>
<tr>
<td>History of citations</td>
<td></td>
</tr>
<tr>
<td>History of crashes</td>
<td></td>
</tr>
<tr>
<td>Level C evidence</td>
<td></td>
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<tr>
<td>Driving &lt; 60 miles/week</td>
<td></td>
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<tr>
<td>Situational avoidance</td>
<td></td>
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<tr>
<td>Aggression, impulsivity</td>
<td></td>
</tr>
<tr>
<td>MMSE &lt; 24</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Alcohol, medications, sleep disorders, visual impairment, motor impairment</td>
<td></td>
</tr>
</tbody>
</table>

**Risk factors:**
- None
  - CDR 0.5
  - CDR 1.0
- Few
  - CDR 0.5
  - CDR 1.0
- Several
  - CDR 0.5
  - CDR 1.0
- Multiple
  - CDR 0.5

**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**

Fitness to Drive Steps

• Step 1: Driving History and Med Review
• Step 2: Examine Co-Morbidities
• Step 3: Physical Examination
• Step 4: Rate Primary Disease Severity
• Step 5: Referral, Rehab, and/or Counseling
# Signs of Unsafe Driving: At the Crossroads (*stop driving immediately)

http://www.thehartford.com/advance50/publications-on-aging

<table>
<thead>
<tr>
<th>Driving Behavior Warning Signs - When Noticed, How Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Decrease in confidence while driving</td>
</tr>
<tr>
<td>2. Difficulty turning to see when backing up</td>
</tr>
<tr>
<td>3. Riding the brake</td>
</tr>
<tr>
<td>4. Easily distracted while driving</td>
</tr>
<tr>
<td>5. Other drivers often honk horns</td>
</tr>
<tr>
<td>6. Incorrect signaling</td>
</tr>
<tr>
<td>7. Difficulty parking within a defined space</td>
</tr>
<tr>
<td>8. Hitting curbs</td>
</tr>
<tr>
<td>9. Scratches or dents on the car, mailbox or garage</td>
</tr>
<tr>
<td>10. Increased agitation or irritation when driving</td>
</tr>
<tr>
<td>11. Failure to notice important activity on the side of the road</td>
</tr>
<tr>
<td>12. Failure to notice traffic signs</td>
</tr>
<tr>
<td>13. Trouble navigating turns</td>
</tr>
<tr>
<td>14. Driving at inappropriate speeds</td>
</tr>
<tr>
<td>15. Not anticipating potential dangerous situations</td>
</tr>
<tr>
<td>16. Uses a “copilot”</td>
</tr>
<tr>
<td>17. Bad judgment on making left hand turns</td>
</tr>
<tr>
<td>18. Near misses</td>
</tr>
<tr>
<td>19. Delayed response to unexpected situations</td>
</tr>
<tr>
<td>20. Moving into wrong lane</td>
</tr>
<tr>
<td>21. Difficulty maintaining lane position</td>
</tr>
<tr>
<td>22. Confusion at exits</td>
</tr>
<tr>
<td>23. Ticketed moving violations or warnings</td>
</tr>
<tr>
<td>24. Getting lost in familiar places</td>
</tr>
<tr>
<td>25. Car accident</td>
</tr>
<tr>
<td>26. Failure to stop at stop sign or red light</td>
</tr>
<tr>
<td>27. Confusing the gas and brake pedals*</td>
</tr>
<tr>
<td>28. Stopping in traffic for no apparent reason*</td>
</tr>
<tr>
<td>29. Other signs:</td>
</tr>
</tbody>
</table>

Department of Medicine and Neurology
Division of Geriatrics and Nutritional Science/Knight ADRC

Washington University in St. Louis • School of Medicine
Step 1a: Driving History

- Driving Behaviors (lost x 1)
- Informant Rating (fair)
- Exposure (low)
- Personality (no change)
- Violations (none)
- Crashes (none)
- Cognitive Impairment
- Functional Impairment
- Others?
Step 1b: MEDICATION REVIEW

- Narcotics
- Barbituates
- Benzo’s (present)*
- Antihistamines
- Antidepressants
- Antipsychotics
- Hypnotics
- Alcohol
- Muscle Relaxants
- Antiemetics
- Antiepileptic

Step 2: Co-Morbid Conditions
Clinician Medical Guidelines

Updated, Evidenced-Based
Also Refer to Your Own State Laws/Statutes

http://www.cma.ca/driversguide

http://geriatricscareonline.org

http://www.austrroads.com.au

Hypersomnolence/Epworth Sleepiness Scale >10,
Depression/PHQ >10, Visual Acuity OU 20/40, HHIE>26
OUR CASE: ESS 8, PHQ 12, VA 20/40 corr, HHIE 10, HgbA1C 6.5
Step 3a: Physical Examination

- Visual Acuity
- Visual Fields
- Motor Examination
  - Muscle Strength
  - Range of Motion
- Cognitive/Functional Testing
  - Clock Drawing Task
  - Trail Making Tests A
- Functional Exam
  - AD-8
Step 3b: Cognitive/Functional Screens

- Trails A
- AD-8
- Clock Drawing

**Alzheimer’s Detection: AD8**

<table>
<thead>
<tr>
<th>remembering “Yes, a change” indicates that you think there has been a change in the last several years caused by cognitive (thinking and memory) problems</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 scows, bad financial decisions, buys gifts inappropriate for recipients)</td>
<td></td>
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<tr>
<td>Reduced interest in hobbies/activities</td>
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<tr>
<td>Repeats questions, stories or statements</td>
<td></td>
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</tr>
<tr>
<td>Trouble learning how to use a tool, appliance or gadget (e.g. VCR, computer, microwave, remote control)</td>
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</tr>
<tr>
<td>Forgets correct month or year</td>
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<td></td>
</tr>
<tr>
<td>Difficulty handling complicated financial affairs (e.g. balancing checkbook, income taxes, paying bills)</td>
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<td></td>
<td></td>
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<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**
Probability Calculator of Failing Road Test: Dementia

Our Case:
Trail Making Test A (TrlA) of 57 secs
AD-8 Total (AD8TOT) score of 3
Clock Drawing Task-Freund (CDTf) of 4

Probability of Road Test Failure: 51%

Carr DB, et al. JAGS, 2011
### STEP 4: Rating Dementia Severity

<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> Clinical Dementia Rating</td>
<td>No memory loss or inconsistent memory loss Fully oriented Judgment intact Function intact Personal care intact</td>
<td>Consistent slight forgetfulness Slight difficulty with orientation or judgment Slight impairment in community activities or home activities Personal care intact</td>
<td>Memory loss interferes with everyday activities Geographic disorientation Moderate impairment in judgment Mild but definite impairment of community or home activities Needs prompting for personal care</td>
<td>Severe memory loss Severe difficulty with time relationships and judgment No longer independent in activities Only simple chores preserved Needs assistance in personal care</td>
</tr>
<tr>
<td><strong>For the Clinician:</strong> Short Blessed Test Mini-Mental Status Exam</td>
<td>1.2 (1.9)* 28.9 (1.3)#</td>
<td>4.8 (5.9)## 23.1 (2.5)@</td>
<td>15.4 (5.2)# 20 (3.9)#</td>
<td>18.5 (5.5)# 16.1 (4.7)#</td>
</tr>
<tr>
<td><strong>For the Neuropsychologist:</strong> 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>XXX</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>XXX</td>
</tr>
</tbody>
</table>

**Our Case:** MMSE 24, Short Blessed Test 6, CDR=0.5

**Very Mild Dementia**
What Are The Next Steps?

- **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!

- **Red Light**
  - Driving Retirement/Counseling
  - Stop!
Step 5: REFERRAL SOURCES

- Primary Care Physician
- Subspecialist
- Neuropsychologist
- Occupational Therapists
- Physical Therapists
- Speech Therapists
- Case Managers
- Others

Driving ability after a stroke: evaluation and recovery. [Review]
Murie-Fernandez M; Iturralde S; Cenoz M; Casado M; Teasell R.
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
Case cont.

- No history of prior poor driving performance
- She has a very mild dementia, CDR=0.5
- It is expected to progress
- Alprazolam was tapered off and sertraline
- Visual acuity was 20/40 corrected/no field cuts
- She passed her initial OT/CDRS road test
- She was scheduled for a f/u at 6 months with nurse practitioner, one year with physician
- At six months there was no change in status
Probability Calculator of Failing Road Test: Dementia
One year follow up

<table>
<thead>
<tr>
<th>Probability of Failing Driver Test</th>
<th>Intercept</th>
<th>trlA</th>
<th>AD8TOT</th>
<th>CDTf</th>
</tr>
</thead>
<tbody>
<tr>
<td>coefficient</td>
<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>2.3076</td>
<td>10.050275</td>
<td>0.9095045</td>
</tr>
</tbody>
</table>

Our Case:
Trail Making Test A (TrlA) of 72 secs
AD-8 Total (AD8TOT) score of 5
Clock Drawing Task-Freund (CDTf) of 2
Probability of Road Test Failure: 91%

Carr DB, et al. JAGS, 2011
Case cont. f/u one year

- She had one minor crash when backing into a car in a parking lot
- The daughter noted more cognitive and functional decline (higher order IADL’s)
- The probability calculator for predicting road test failure was performed
- Based on the history of progression, calculator score and history of at-fault crash, driving retirement was suggested
- Patient resistant to driving cessation
- Consider referral to social services/DMV
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 Licensing Authorities?

Missouri has voluntary reporting law, anonymity, confidentiality
Know your own state law and statutes
Consider your own policy with legal advice
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

Figure 1: Purpose of Private Vehicle Trips by Persons Age 65 and Older, 2001

- Shopping, 44%
- Social, Recreation, Meals, 27%
- School, Church, Family, 13%
- Medical or Dental, 5%
- Passenger, 7%
- Work Related, 4%

Source: National Household Travel Survey, 2001. Passenger trips are those made for the purpose of transporting another individual.
Mobility Counseling
Transportation Alternatives

• St. Louis Options
• Social Work Referral
• CORP
• Call-A-Ride
• Good Shepherd
• Metro
• Bus
• Taxi
• ITNAmerica
• Uber
• 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
<table>
<thead>
<tr>
<th>MyCarDoesWhat.org</th>
<th>National Safety Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back up Camera</td>
<td>Curve Speed Warning</td>
</tr>
<tr>
<td>Anti-lock brake system</td>
<td>Drowsiness Alert</td>
</tr>
<tr>
<td>Blind Spot Monitor</td>
<td>Electronic Stability Control</td>
</tr>
<tr>
<td>Automatic Braking</td>
<td>Forward Collision Warning</td>
</tr>
<tr>
<td>Lane Departure</td>
<td>High Speed Alert</td>
</tr>
<tr>
<td>Tire Pressure Monitor</td>
<td>Hill Descent Assist</td>
</tr>
<tr>
<td>Adaptive Cruise Control</td>
<td>Hill Start Assist</td>
</tr>
<tr>
<td>Auto Parallel Parking</td>
<td>Lane Keeping Assist</td>
</tr>
<tr>
<td>Back-up Warning</td>
<td>Left Turn Crash Avoidance</td>
</tr>
<tr>
<td>Bike/Ped Detection</td>
<td>Obstacle Detection</td>
</tr>
<tr>
<td>Brake Assist</td>
<td>Parking Sensors</td>
</tr>
<tr>
<td>Push Button Start</td>
<td>Sideview Camera</td>
</tr>
<tr>
<td>Rear Cross Alert</td>
<td>Traction Control</td>
</tr>
</tbody>
</table>

https://mycardoeswhat.org
Top Technologies Requested by Older Drivers

- Blind Spot Warning Systems
- Crash Warning Systems
- Emergency Response Assistance Systems
- Drowsy Driver Alerts
- Reverse Monitoring Systems

Only 1/3 in survey report they have these technologies

http://www.reuters.com/article/us-column-miller-cars-idUSBRE98G05I20130917
Understanding the Future of Mobility

Three trends shaping personal and commercial mobility
1. On-Demand Mobility 2, 3. Driverless/Electric Vehicles

On-Demand Mobility
-based on mobile app/ease of scheduling and payment
-ride sharing/car sharing global shift away from personal ownership to shared in-demand model
-cost of ownership, commute times, limits on infrastructure expansion, conserve resources, cut greenhouse gases, millennial relationship with cars
-India, only 5% own cars and roads are already jammed

https://techcrunch.com/2015/08/08/understanding-the-future-of-mobility/
https://www.zacks.com/stock/news/207881/who-are-ubers-biggest-competitors
Autonomous Driving

Smart Cars

Super Cruise-Cadillac

Traffic Jam Assist-Ford

Google Car-Lexus

Compact Electric Cars-Nissan, BMW

Urban Transport Cars-London, Dubai

Understanding the Future of Mobility

Benefits
- 80% reduction in cost of transportation
- Reduced pollution
- Reduced stress and road rage
- Dramatic decrease in accidents and traffic deaths
- Gaining back lost time to commuting
- Increase productivity
- Freeing up lanes by eliminating park cars
- Reclaiming home space allocated to home garages
- Leaders of on-demand mobility need to build trust with; consumers, regulators, insurers, investors

https://techcrunch.com/2015/08/08/understanding-the-future-of-mobility/
Different Perspectives

http://www.garageconversion.org/garage-conversion-gallery/garage-to-room/

https://mysonisdreaming.com
Why is the need for research urgent?

Baby Boomers are Coming!!!