

# **The Risky Driver**



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## **An Annotated Bibliography of Recent Research**

**Prepared by Carrol S. Perrino, Ph.D.  
and Anthony Saka, Ph.D., P.E.**

**Morgan State University  
National Transportation Center**



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## Section I

### Novice and Impaired Drivers

#### 1. Prediction Models and Potential Ameliorating Conditions

Models developed from large data bases to predict auto crash involvement focused on prior violations, points accumulated and prior at fault accidents. The probability of future accidents was predicted by both prior accidents and violations, the prior accidents a better predictor than the convictions. Specific violations, e.g. failure-to-yield and disobeying a traffic signal were, after prior accidents, the best predictors of future accidents. Some using both convictions and accidents have proven quite accurate, ignoring the at-fault or not-at-fault classification as well as type of violation. Current point systems tend to be poor predictors of future accidents. The best models use age, gender, total accidents and different conviction categories including - insecure load, truck weight offense, unsafe vehicle, failure to take a test for alcohol, no driver's license, seat belt use, careless driving, disobeying light, speeding, and failure to yield.

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## 2. Driving Patterns

The latest Facts publication from the Insurance Institute for Highway Safety using 1995 data reveal that 16-19 year olds have four times the risk of crash involvement and death per mile driven than older drivers with those 16 and 17 years of age evidencing the highest risk. Their driving behavior includes high frequency of speeding and tailgating violations with single vehicle, run-off-the-road accidents a frequent result. As the population of 16 - 19 year olds increases as has been the case since 1992, statisticians fear a new trend, an increase in motor vehicle deaths. This has occurred in the last three years when compiled for total deaths or deaths per population. Maryland motor vehicle deaths over the past three years have not decreased reversing a trend noted by the State Highway Administration beginning in 1968. A peak in deaths per population occurs at age 18 for both males and females, levels substantially higher for the males with night fatal crashes per miles driven 3 or 4 times the rate for older drivers. One study separated youthful age and novice driving experience using insurance data for complete crash identification and found that "noviceness" best predicts at-fault crashes. Driving in the second and third years is associated with an increase in at-fault accidents attributable to alcohol, bad weather and high speed. It is estimated that restricting the novice driver of any age on the basis of any traffic law violation or accident occurrence would influence the occurrence of 40% of all serious crashes. Again the risky driving behavior noted for this young age group includes speeding, tailgating and other behaviors that bring the driver into conflict with other drivers, as well as impaired driving.

Looking at the patterns of risky driving for impaired drivers of any age the first thing to note is a steady decrease over the last decade in drinking and driving crashes with fatalities whether based on population or distance traveled. This is a trend noted around the world. However, a note of caution is necessary. Certain groups are not following this trend, e.g. female drivers 21 -24 years of age, and there is some concern that the trend may be reversing. Studies that have randomly sampled drivers and tested for the presence of alcohol show a similar decrease in

drinking and driving over the period 1982 -1992, a one third reduction in drivers evidencing BAC levels .05 or higher.

The involvement of alcohol in fatal or serious crashes using the case-control method reveals the pattern of risky behavior for those identified. One particularly disturbing study evaluated drivers admitted for minor or moderate injuries to Maryland's MIEMSS in Baltimore. They were judged impaired or not by the investigating police. An alcohol conviction rate of only 10.3 % was reported for those in the impaired group, very low compared to a state-wide conviction rate of 46.8%. The drivers in the impaired group had significantly poorer pre and post accident alcohol-related convictions. It appears that for this group of drivers, injuries mask the consequences of their behavior.

Finally, while the largest category of impaired driving is alcohol-related, other instances include those drivers convicted of felony narcotic, felony marijuana, felony other drugs, and felony dangerous drugs crimes with associated poor driving records prior to and after incarceration for the noted offenses.

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### **3. Correlates of Risky Driving**

Age has been found to be a correlate of drinking and driving with drivers 20-24 reporting in a telephone survey a greater frequency of this type of behavior than any other age group. Conversely, respondents in this same age category reported having a friend or relative who had driven after drinking and who had been convicted of a drinking and driving offense during the past three years. Drivers in this age group report less probability of being impaired and of being apprehended by the police while impaired. Drivers in the age category 16 -24, report in that same

telephone survey that they engage in aggressive driving most often, e.g. losing their temper while driving, making nasty gestures at others, enjoying passing other drivers, finding it enjoyable to weave through heavy traffic, etc.. Drivers in the youngest age category, 16 -19, and the oldest, 65 and older, report driving the fewest number of miles and making the fewest number of trips. The 16 - 19 year olds achieved the highest number of violations followed closely by the 20 -24 year olds with the latter most likely of any age group to have their licenses suspended. The heaviest drinking was reported by the 20 -24 year olds, many indicating they ought to cut down, generally a symptom of problem drinking. The reported incidence of illicit drug use was very small but occurred most often in the 16 - 24 year old group. Most importantly, different types of risky behaviors, e.g. accident involvement, drinking and driving, riding with a DWI, driving aggressively, heavy drinking, etc., were significantly intercorrelated. Female drivers evidenced the same pattern as male drivers with males producing higher levels of risky behavior until age 24 when male risky behavior dropped rapidly.

Education has also been found to correlate with risky driving behavior, those with more than a high school education are more likely to both speed and be involved in a crash. Those motorists who made indecent gestures and those who argue with other motorists are most likely to commit unlawful acts. Thus, youth and hostility are important predictors of bad driving.

Personality characteristics of individuals apprehended for DUI following an accident and violation include high levels of hostility and sensation seeking and low levels of social responsibility. After drinking, these same individuals perceive their risk of being in an accident as unchanged. Alcohol consumption was highest for those in this group. Problem driving, psychosocial unconventionality, risk-taking, hostility and aggression predict almost 60% of the variance in young adult drinking and driving behavior. Finally, social deviance was found to be a good predictor of accident rates for a sample of drivers 23-70 years of age.

Looking at a sample of high school students, social influences were found to be important in predicting DUI behavior or riding with a driver producing DUI behavior. These social influences included partying and being with those who drink.

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#### **4. Risk Perceptions**

Adolescence is hypothesized to be a time of risk taking as individuals strive for autonomy and identity. Some view risk taking during this period as part of the normal developmental sequence with biology and the social environment interacting to influence this behavior. One's self esteem, cognitive function and established peer group norms also play a role.

Gender differences appear in studies comparing judgements of riskiness of various driving scenarios as well as judgments of self driving skill and of danger compared to peers and the average driver. Young males expressed more optimism especially when judging their own skill and the magnitude of the dangerous driving behavior. This is an interesting mix of estimate of high driver skill, estimate of diminished dangerous driving behavior and decreased accident prone consequences.

The potential presence of a risky behavior syndrome is supported by the research reporting high intercorrelations among a variety of self-report measures including perceptions of risk, driving practices and the influence of alcohol on lifestyles. This syndrome could be measured with an appropriate instrument with the assumption of its existence, to varying degrees, in different adolescents.

Another approach views risk as a type of decision-making process that occurs when the driver gets behind the wheel and can be distinguished from the driver's skill. This approach stresses the importance of decision frames (outlooks) for young people. The individual visualizes the act, outcome and contingencies associated with a particular choice. Then the individual appraises the threat of the situation. Threat is inferred if the situation is viewed as beyond the individual's ability to cope. An emotional reaction occurs when the individual perceives the threat and then he/she takes steps to either change the external situation or adapt to its demand.

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## 5. Interventions

Novice driver risky behavior was the subject of a workshop sponsored by the U.S. DOT-NHTSA in April, 1993. Suggestions included a complete analysis of the driving process with incorporation of the findings into a driver training program. The program would also contain a risk management component. In addition, the use of graduated licenses with full licensure obtained only after two years of experience was proposed. The aim of such a program would be to teach safe driving skills and not just pass a driving test. Components might include the use of divided attention techniques, feedback systems for line of sight problems, speed control, a standardized road test shown to be correlated with crash exposure, alcohol use reduction, altering DWI norms, risk arousal, etc.

Various interventions for risky drivers have been assessed. One program introduced exposure to a study guide and a test of safe driving practices and skills to eliminate conflict situations. All drivers in the state with a moving violation in one four month period were exposed to the new treatment and their subsequent violation-accident records were compared to drivers in the state with the same prior driving violations who had been just given a re-test behind the wheel-the control group. The treatment produced significant reductions at three and six month intervals for subsequent multiple vehicle chargeable accidents. There was also a significant decrease in all violations and particularly moving/point violations at three, six, nine, and twelve months after exposure. Cost savings of the new program were also evident.

Participants in a traffic violator school program, however, did not evidence a subsequent reduction in risky driving when compared to a similar group convicted of the same infractions. The masked conviction record of the attendees was not an incentive to eliminate future problem driving.

Interventions to reduce drinking and driving have been substantial. One study introduced feedback of a personal and general nature to tavern patrons at the beginning of the night, but it had little effect on the patrons consumption of alcohol or their subsequent driving. A publicized police surveillance reduced drinking and driving for only a short interval.

Looking at habitual offenders offers the opportunity to evaluate a variety of intervention modes. Classification and adjudication reduces traffic violations for all but extensive DUI offenders. The probability regardless of their official status to commit future DUI offenses is high. For this particular group, treatments that combine strategies such as education, therapy and continued monitoring hold the

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## **6. Licensing Issues**

Different teenage licensing practices have been compared in proximate states. Early licensing is associated with high crash involvement rates for 16 year olds. Delayed licensure until 17 ensures low crash rates for 16 year olds. Those states that allowed 16 year olds to drive but not at night, fell in between. Those states where unsupervised driving by 16 year olds is not allowed shared the lowest crash rates. These comparisons lend support to the use of graduated licensing for teenagers including delaying full-privilege licensure and forbidding night driving. Supervised practice using Oregon's provisional licensing program was evaluated

using teens who were licensed prior to the enactment of the statute and after. Although provisional licensing allowed teens to pass the driver test in larger numbers, subsequent driver records indicated no differences in traffic violations. However, young male drivers licensed under the provisional restrictions produced 16% fewer accidents in the first year of driving compared to males not licensed provisionally.

An evaluation of a current program to deal with persistent DUI offenders found a great deal of problems in implementation. For example, license suspension has been shown to be effective when utilized but difficulties in enforcement abound. Thus, the FARS report of fatal accident drivers in 1991 and 1992 indicate that 13% of these were driving on suspended or revoked licenses. Mandatory license suspension is more effective than discretionary suspension especially with respect to DUI recidivism. The effectiveness results from the role of reduced exposure with no evidence of a change in driving behavior for these individuals.

Administrative license suspension has been only recently evaluated and its role as a deterrent is not substantiated. Establishing contingencies for relicensing the DUI driver also has promise as evidenced in several European countries with reinstatement a function of successful completion of a treatment regimen. In Germany, for example, after assessment of the problem, one-third of the drivers are permanently revoked, for they are judged unable to be treated. Vehicle incapacitation might be in order. Identifying the persistent DUI offenders necessitates utilizing the BAC level, number of priors and total number of accidents and violations. Subsequent actions might include a series of steps differentiating BAC levels with different associated sanctions. Some possible license strategies might include enforcing all stated sanctions. Complete records of offenses would be a part of the driving record available at DMV for seven or ten years. Lifetime revocation would be available for chronic repeaters.

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## Section II

### Elderly Drivers

#### 1. Prediction Models and Potential Ameliorating Conditions

Older drivers, above 70 years of age, appear at greater risk for future accidents as a function of prior incident levels than drivers in general. Using fewer prior convictions, it is possible to identify potentially accident-prone older drivers. This elevated risk potential occurred only among older drivers with 3 or more points during the prior 3 year period. The intersection requiring a left turn is risky for the elderly driver. It is possible to lessen this risk factor by utilizing a protected phase for a larger percent of the turning volume and increase the amber interval, usually set between 3- 5 seconds as the speed limit increases.

Garber, N.J. and Srinivasan, R. (1991). Risk assessment of elderly drivers at intersections: Statistical modeling. In Transportation Research Record, 1325, 17-22. Washington, DC: National Research Council, Transportation Research Board.

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#### 2. Driving Patterns

A number of features characterize the behavior of elderly drivers. Patterns identified include the increased likelihood of a fatality following an accident, higher rates of citations for failure to yield the right-of-way as well as illegal turns and improper lane change. Accidents involving elderly drivers occur frequently at intersections outside of cities. Elderly drivers report driving less as they age, avoiding night driving, avoiding driving during peak hours, avoiding driving on limited access highways at slower speeds and carrying fewer passengers. The problems they perceive in highway driving include a fear of large trucks, the speeds necessary to maintain the traffic flow and the dislike of the rudeness of other drivers.

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### 3. **Sensory/Perceptual/Cognitive and Psychomotor Correlates of Risky Driving**

Various sensory, perceptual, cognitive and psychomotor measures have been administered with performance on these measures correlated with different measures of driving including accepted measures of risky driving. Significant correlations in the .20 to .38 range included depth perception, peripheral vision measures, and visual discrimination, figure/ground response time, visual memory response time and mental status using the Mini-Mental State Exam with daily diary entries of driving experiences. Specific driving problems correlated significantly both with measures of dynamic visual acuity in the .34 to .36 range, with measures of peripheral vision in the .20 to .21 range and with performance on the subtests of the Wechsler Adult Intelligence Scale, .20 to .34 Psychomotor measures including simple and choice reaction times as well as tracking correlated in the .21 to .38 range with problems of driving by the elderly. However, the nature of the test using reaction time and the measure of driving can both influence this relationship for the elderly driver. The laboratory measures of reaction time, categorization, and discrete choice showed no significant relationship to response measures while driving in a platoon-car driving task. Finally, visual field defects were found to be correlated with driving simulator performance as well as accident occurrence and performance on a closed - circuit course. Combining different measures including visual acuity, horizontal visual field and contrast sensitivity produced a significant correlation with accidents. A model has been created and is currently being tested combining the perceptual measures of useful field of vision and the cognitive measures of mental status, the Mattis Organic Mental Status Syndrome Examination. Together, these measures predict 20% of the variation in state reported accidents attributable to elderly drivers.

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Ball, K., Owsley, C., Sloan, M.E., Roenker, D.L. and Bruni, J.R. (1993). Visual attention problems as a predictor of vehicle crashes in older drivers: Investigative Ophthalmology and Visual Science, 34, 3110 - 3123.

Brouwer, W.H., Waterink, W., Van Wolffelaar, P.C. and Rothengatter, T. (1991). Divided attention in experienced young and older drivers: Lane tracking and visual analysis in a dynamic driving simulator. Human Factors, 33, 573-582.

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Decina, L. and Staplin, L. (1993). Retrospective evaluation of alternative vision screening criteria for older and younger drivers. Accident Analysis and Prevention, 25, 267-275.

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Korteling, J.E. (1990). Perception response speed and driving capabilities of brain-damaged and older drivers. Human Factors, 32, 95-108.

Laux, L.F. and Brelsford, J.J. (1990). Age related changes in sensory, cognitive, psychomotor and physical functioning and driving performance in drivers aged 40 to 92. Washington, DC: AAA Foundation for Traffic Safety.

Lovsund, P., Hedin, A. and Tornros, J. (1991). Effects on driving performance of visual field defects: A driving simulator study. Accident Analysis and Prevention, 23, 331-342.

Owsley, C., Ball, K., Sloane, M.E., Roenker, D.L. and Bruni, J. R. (1991). Visual/cognitive correlates of vehicle accidents in older drivers. Psychology and Aging, 6, 403-415.

Ranney, T.A. and Pulling, N.H. (1990). Performance differences on driving and laboratory tasks between drivers of different ages. In Transportation Research Record, 1281, 3-10. Washington, DC: National Research Council, Transportation Research Board.

Staplin, L. (1995). Simulator and field measures of driver age differences in left-turn gap judgements. In Transportation Research Record, 1485, 49-55. Washington DC: National Research Council, Transportation Research Board.

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Tarawneh, M.S., McCoy, P.T., Bishu, R.R. and Ballard, J.L. (1993). Factors associated with driving performance of older drivers. In Transportation Research Record, 1405, 64-71. Washington, DC: National Research Council, Transportation Research Board.

Teed, N.J. (1996). Visual Field Deficits and Motor Vehicle Crashes. Arlington, VA: Insurance Institute for Highway Safety.

Wood, J.M. and Troutbeck, R.J. (1994). Effect of age and visual impairment on driving and vision performance. In Transportation Research Record, 1438, 84-90. Washington, DC: National Research Council, Transportation Research Board.

#### **4. Predicting Accidents and Insurance Claims Using a Battery of Tests and Measures**

Demographic characteristics, driving history, visual measures, perceptual measures, cognitive measures, personality measures, interests and insurance rating/underwriting variables were used as predictors of at-fault accidents. Correlations of significant magnitudes varied from .05 to .18. Combining test measures including contrast sensitivity, visual detection, performance on a simulator, and internal - external locus of control with annual mileage, insurance-rated territory, age, prior at fault accidents and prior violations, marital status, gender, prior non-fault accidents and prior non-accident insurance claims resulted in a

16.4% prediction of subsequent at-fault accidents.

Brown, J., Greaney, K., Mitchel, J. and Lee, W.S. (1993). Predicting accidents and insurance claims among older drivers (ITT Hartford Insurance Group and AARP). Southington, CT.

Carr, D., Jackson, T.W., Madden, D.J., Cohen, H.J. (1992). The effect of age on driving skills. Journal of American Geriatrics Society, 40, 567-573.

## 5. **Physical Fitness and the Relationship to Normal Driving**

Analysis of the relationship of cardiorespiratory fitness, reaction time and movement time, and joint flexibility measured via a battery of tests to a field-based assessment of driver performance, the Automobile Driving On - Road Performance Test (ADOPT) was determined for a group of young, 20 - 25 year of age and old, 60 - 75 years of age adult drivers. For the older driver, the higher the proficiency scores on different aspects of fitness, joint flexibility and reaction time, not cardiovascular fitness, were found to be the best predictors of good driving ability. Simple reaction time was related to safe practices, maintaining speed and observing aspects of driving ability, not the more complex driver-processing requirements.

McPherson, K., Ostrow, A., Shaffron, P. and Yeater, R. (1988). Physical fitness and the aging driver (AAA Foundation of Traffic Safety). Washington, DC.

## 6. **Attitudes Toward Driving**

The function of a self-bias in evaluating one's own driving performance compared to one's peers as well as other aged driving groups was investigated for drivers 50 to 79. The amount of positive self-bias decreased with age but increased with amount of current driving exposure as well as with amount of perceived control measured on the locus of control scale. In studies of specific accident situations known to be associated with large percentages of at-fault elderly drivers, e.g. turning left at uncontrolled intersections, elderly drivers recognized difficulties but didn't perceive their driving as contributing to this type of accident - failure to yield the right-of-way. Accident data indicated that the elderly participant in an accident was more probably judged at-fault than the middle-aged driver. Finally, almost all of the elderly drivers perceived themselves to be of average or better-than-average

driving ability with no decrease with age. An investigation of driving style and decision-making style revealed that for elderly drivers, lower thoroughness scores - not planning before acting - and higher hesitancy scores - changing one's mind before acting - and faster driving predicted higher accident rates. All other variables including sex, age, and annual mileage were not involved.

Cooper, P.J., (1990). Elderly drivers views of self and driving in relation to the evidence of accident data. Journal of Safety Research, 21, 103-113.

French, D.J., West, R.J., Elander, J. and Wilding, J.M. (1993). Decision-making style, driving style, and self-reported involvement in road traffic accidents. Ergonomics, 36, 627-644.

Holland, C.A. (1993). Self-bias in older drivers' judgements of accident likelihood. Accident Analysis and Prevention, 25, 431-441.

## 7. Interventions

A review of the research of a variety of visual measures documents the deterioration of these functions with age, particularly dynamic visual acuity, effect visual field size and contrast sensitivity. Assuming this deterioration may be undetected in many elderly drivers, the establishment of adequate screening tests to detect initial deterioration with potential training to improve those skills, e.g. search and localization within a cluttered visual field. Possible automobile design changes to reduce glare, change headlight configurations or introduce near-obstacle detection systems were discussed. Possible roadway changes to increase sign size, redundant signs, enhance sign brightness, etc. were proposed. Finally, potential licensing changes such as a 2-tiered system of initial then more sensitive screening or state-specified screening by a vision specialist as part of an annual or biannual vision exam were presented. The latter, introduced in Israel for all drivers older than 65 resulted in identification of 18% of the population with vision problems with 39% of those previously unaware of their problem. Specific attempts to improve actual driving through physical therapy, perceptual therapy, driver education and design changes resulted in a cost-effective 7.9% improvement in driving after the interventions for a group of elderly drivers 65 and older. The role of state driver licensing agencies in detecting and correcting problems evidenced by the elderly driver was examined including suggestions for screening and improving driving

performance, drivers' functional capabilities, vision capabilities, and physical capabilities.

Coleman, S. (1994). Rehabilitation of elderly drivers. In Transportation Research Circular, 429, 7-19. Washington, DC: National Research Council, Transportation Research Board.

Fonseca, A.M. (1994). Training elderly drivers. In Transportation Research Circular, 429, 21-23. Washington, DC: National Research Council, Transportation Research Board.

Hunt, L.A. (1993). Evaluation and retraining programs for older drivers. Clinics in Geriatric Medicine, 9, 439-448.

Janke, M.K. (1994) Mature driver improvement program in California. In Transportation Research Record, 1438, 77-83. Washington, DC: National Research Council, Transportation Research Board.

McCoy, P.T., Tarawneh M.S., Bishu, R.R., Ashman, R.D. and Foster, B.G. (1993). Evaluation of counter measures for improving driving performance of older drives. In Transportation Research Record, 1405, 72-80. Washington, DC: National Research Council, Transportation Research Board.

Maryott, D.W. (1994). Education, counseling, and forms of support. In Transportation Research Circular, 429, 19-21. Washington, DC: National Research Council, Transportation Research Board.

Miller, T.L. (1994). Licensing restrictions. In Transportation Research Circular, 429, 15-17. Washington, DC: National Research Council, Transportation Research Board.

Shinar, D. and Schieber, F. (1991). Visual requirements for safety and mobility of older drivers. Human Factors, 33, 507-519.

## 8. The Relationship of Symptoms, Diseases and Medications to Accidents and Driving Cessation

Studies conducted on specific geriatric populations revealed a variety of relationships between physical conditions and accident occurrence. The presence of bursitis, cold sensation in the extremities when exposed, protein in the urine and irregular heartbeat predicted accidents in elderly Florida drivers. Women from this population were more likely to willingly stop driving than men. Drivers who reported an awareness of macular degeneration, stroke, recent hospitalization, eye problems and parkinsonism were also more likely to stop driving. Conversely, the use of alcohol and magnesium hydroxide were predictors of continued driving. In a population of rural drivers, the presence of arthritis, rheumatism, cataracts and macular degeneration were reported to interfere the most with driving. Back pain, use of nonsteroidal anti-inflammatory drugs and poor free recall were predictors of accidents for the senior citizens in the rural community. Finally, in a study of the elderly in an urban setting, accidents were more common for those who were poorer copying designs on the Mini-Mental State Exam, walked fewer blocks and had more foot abnormalities. The risk of an accident increased with the presence of each predictor.

Foley, D.J., Wallace, R.B. and Eberhard, J. (1995). Risk factors for motor vehicle crashes among older drivers in a rural community. Journal of the American Geriatrics Society, 43, 776-781.

Klein, R. (1991). Age related eye license, visual impairment, and driving on the elderly. Human Factors, 33, 521-525.

Marottoli, R.A., Cooney, L.M. Wagner, D.R. Doucette, J. and Tinetti, M.E. (1994). Predictors of automobile crashes and moving violations among elderly drivers. Annals of Internal Medicine, 121, 842-846.

Persson, D. (1993). The elderly driver: Deciding when to stop. The Gerontologist, 33, 88-91.

Stewart, R.B., Moore, M.T., Marks, R.G., May, F.E. and Hale, W.E. (1993). Driving cessation and accidents in the elderly: An analysis of symptoms, diseases, cognitive dysfunction and medications (AAA Foundation for Traffic Safety).

Washington, DC.

## 9. **Diagnosis of Dementia**

A review of the dimensions for initial screening for the dementias including Alzheimer's disease, the most common accounting for about 70% of dementia cases, was presented. Using the recommendations developed by the American Academy of Neurology proves quite costly. Current diagnostic practices distinguishes between early Alzheimer's disease and normal aging using the impairment of verbal memory and category naming functions.

Geldmacher, D.S. and Whitehouse, P.J. (1996). Evaluation of dementia. New England Journal of Medicine, 335, 330-336.

## 10. **Driving with Dementia**

Elderly drivers referred from Virginia and other assessment clinics were evaluated on a variety of dimensions. In one study, comparisons were made among these cognitively impaired patients, diabetics of the same age, a healthy geriatric group from the community and a healthy younger group from the community on a variety of dimensions including road test scores, measures of attention, perceptual measures and memory measures. The dementia group received the lowest road test scores, significantly different from all of the other groups. The control groups did not differ significantly, regardless of age. Short-term memory, visual tracking and Mini-Mental State Examinations correlated significantly with driving scores. In addition, driving scores correlated significantly with number of collisions and moving violations per 1000 miles driven. Of those elderly persons referred to an out-patient geriatric assessment center, 23% were current drivers and they evidenced below normal performance on the Mini-Mental State Examination. Looking just at those still driving, 40% were diagnosed as having Alzheimer's with 26% of the drivers needing assistance in daily living activities, e.g. dressing or bathing. However, retrospective analysis of driving records or report of crashes by caregivers of diagnosed Alzheimer's patients for the 5 years prior to the study versus age-matched controls and young controls did not reveal a significantly higher risk ratio for the Alzheimer's patients. On average, patients diagnosed with this disorder drive more than 2 years after diagnosis, with driving cessation occurring gradually.

Carr, D., Jackson, T. and Alquire, P. (1990). Characteristics of an elderly driving population referred to a geriatric assessment center. Journal of the American Geriatrics Society, 38, 1145-1150.

Carr, D., Schmader, K., Bergman, C., Simon, T.C., Jackson, T.W., Haviland, S. and O'Brien, J. (1991). Journal of American Geriatrics Society, 39, 1132-1136.

Drachman, D.A. and Swearer, J.M. (1993). Driving and Alzheimer's disease: The risk of crashes. Neurology, 43, 2448-2456.

Dubinsky, R.M., Williamson, A., Gray, C.S. and Glatt, S.L. (1992). Driving in Alzheimer's disease. Journal of the American Geriatrics Society, 40, 1112-1116.

Fitten, L.J., Perryman, K.M., Wilkinson, C.J., Little, R.S., Burns, M.M., Pachana, N., Mervis, J.R., Maimgren, R., Siembieda, D.W. and Ganzell, S. (1995). Alzheimer and vascular dementias and driving: A prospective road and laboratory study. Jornal American Medical Association, 273, 1360-1365.

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Gilley, D.W., Wilson, R.S, Bennett, D.A., Stebbins, G.T., Bernard, B.A., Whalen, M.E. and Fox, J.H. (1991). Cessation of driving and unsafe motor vehicle operation by dementia patients. Archives of Internal Medicine, 151, 941-946.

Kaszniak, A.W., Keyl, P.M. and Albert, M.S. (1991). Dementia and the older driver. Human Factors, 33, 527-537.

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Parasuraman, R. and Nestor, P.G., (1991). Attention and driving skills in aging and Alzheimer's disease. Human Factors, 33, 539-557.

Rebok, G.W., Bylsma, F.W. and Keyl, P. (1990). The effects of Alzheimer's disease on elderly drivers. Paper presented at the annual meeting of the

Gerontological Society of America, Boston, MA.

## 11. Licensing Issues

The licensing issues for the older driver emerged after conferences and reports sponsored by different organizations including the AAA and the Transportation Research Board. Based on crash statistics, older drivers were judged to be more likely to be involved in fatal accidents based on miles of exposure, but have the same crash rates per licensed driver as those in middle age. Older people are more likely to die than even the very young drivers, more than 3 times greater for those 80 and older, because of physical frailty. Can older drivers regulate themselves removing themselves from behind the wheel? If aware of their limitations, many elderly drivers do so. The critical word appears to be "aware". Whether the options are graduated licenses or engineering changes in the automobile or environment, the development of tests and procedures - systems - to identify problems is essential. Coordination of evaluation criteria for safe driving as well as selection and training of licensing personnel, educating law enforcement personnel, physicians, and medical advisory boards will all be necessary support services to identify risky elderly driving to the individual and to the state.

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Levy, D.T., Vernick, J.S. and Howard, K.A., (1995). Relationship between driver's license renewal policies and fatal crashes involving drivers 70 years or older. Journal American Medical Association, 274, 1026-1030.

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Popkin, C.L., (1994). Use of traffic records to identify high risk drivers. In Transportation Research Circular, 429, 12-14. Washington, DC: National

Research Council, Transportation Research Board.

Reuben, D.B., (1991). Dementia and driving. Journal of American Geriatrics Society, 39, 1137-1138.

Shinar, D. (1994). Vision screening. In Transportation Research Circular, 429, 11-12 Washington DC: National Research Council, Transportation Research Board.

Strano, C.M. (1994). Screening for driving performance. In Transportation Research Circular, 429, 6-7. Washington, DC: National Research Council, Transportation Research Board.

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Visant, M.L. (1994). Medical evaluation. In Transportation Research Circular, 429, 8-11. Washington, DC: National Research Council, Transportation Research Board.

Waller, P.F., (1991). The older driver. Human Factors, 33, 499-505.

Walser, N., (1991). When to hang up the keys. Harvard Health Letter, 17, 1-4.

Wiseman, E.J. and Souder, E. (1996). The older driver: A handy tool to assess competence behind the wheel. Geriatrics, 51, 36-45.

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