

Medical Fitness to Drive and a Voluntary State Reporting Law

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Seniors face serious driving safety and mobility issues.

About the Researchers

Principal Investigators Thomas M. Meuser, PhD Associate Professor of Social Work & Psychology Director, Gerontology Graduate Program University of Missouri - St. Louis 1 University Blvd., 406 Tower St. Louis, MO 63121-4400 Office: (314) 516-5421 Fax: (314) 516-5210 E-mail: meusert@umsl.edu

David B. Carr, MD Associate Professor of Medicine & Neurology Division of Geriatrics & Nutritional Science Washington University School of Medicine 4488 Forest Park St. Louis, MO 63108 Office: (314) 286-2700 Fax: (314) 286-2701 E-mail: dcarr@im.wustl.edu

<u>Co-Investigators</u>* Gudmundur F. Ulfarsson, PhD, University of Iceland Marla Berg-Weger, PhD, Saint Louis University Patricia Niewoehner, OTR/L, CDRS, St. Louis VA Medical Center, Jefferson Barracks Joon-Ki Kim, DSc, Korea Research Institute for Human Settlements Thomas J. Epplin-Zapf, Washington University, St. Louis (student) Peggy Barco, MS, OTR/L, Washington University, St. Louis Katherine MacLean, MSW, Alzheimer's Association, St. Louis Chapter Scott Osberg, PhD, AAA Foundation for Traffic Safety

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Important Abbreviations

| DOR | Department of Revenue |
|-----------|-------------------------------------------------------|
| DSK | Driving Skills Test (on-road evaluation through MSHP) |
| Form 153 | Reporting Form for License Office Staff |
| Form 1528 | Physician Statement |
| Form 4319 | Driver Condition Report (general reporting form) |
| MAB | Medical Advisory Board |
| MDR | Missouri Driver Record |
| MFD | Medical Fitness to Drive |
| MSHP | Missouri State Highway Patrol |

Medical Fitness to Drive & A Voluntary Reporting Law: Characteristics of Reported Older Drivers & Safety Outcomes

SECTION 0

Executive Summary

0.1 Background

This project evaluated the functional impact and efficacy of Missouri's Voluntary Reporting Law (House Bill HB-1536) for drivers considered as potentially unfit due to real or suspected medical-functional deficit or compromise. Passed in 1998, HB-1536 provides a voluntary, legal process whereby concerned family members, police officers, physicians, license office staff, and others can report a driver for re-evaluation and possible license revocation. The reporter's identity is maintained as confidential, and HB-1536 provides civil immunity protection from prosecution for breach of patient confidentiality (if applicable). HB-1536 is non-specific with respect to age, such that a 20-year-old with psychosis can be reported as readily as an 80-year-old with dementia. However, historically, most of those reported were 50 years of age or older (93%).

HB-1536 is administered through the driver licensing authority in Missouri, the Department of Revenue (DOR), in cooperation with the Missouri State Highway Patrol (MSHP) which provides on-road testing services utilizing a standardized operational test applied to all prospective drivers regardless of age or functional condition. To retain a valid license, reported drivers must submit a Physician's Statement (Form 1528) within 30 days and, depending on health status and physician recommendations, may be subject to immediate license revocation (i.e., when health status clearly precludes safe operation of a motor vehicle) or may be required to participate in on-road testing to certify ongoing fitness to drive. DOR staff members make all such determinations based on available data, with preference given to physician opinion when congruent with other information.

The current evaluation project was undertaken pursuant to ongoing educational partnerships between the authors (St. Louis Aging & Driving Research & Education "Team") and officials from the DOR, the MSHP, and the Division of Highway Safety, Missouri Department of Transportation. Various outreach efforts targeting physicians, other health professionals, law enforcement officials, family members, and others, revealed that many of these "stakeholders" in older driver safety were unaware of the HB-1536 process. In addition to motivating additional educational outreach concerning the reporting process, this finding also prompted a number of research questions to explore with the DOR; most important being how HB-1536 functions to identify, evaluate and adjudicate potentially unfit drivers.

HB-1536 is considered by many to be a "model law" for voluntary reporting on the state level. It emphasizes medical-functional status over chronological age, provides important confidentiality and legal immunity protections, and has well-defined procedures and forms. Although most states have voluntary reporting procedures, until now little was known about the functional efficacy of such procedures. How do voluntary mechanisms actually work in practice? Are drivers with medical fitness problems identified and evaluated appropriately?

Findings from Missouri will provide a basis for understanding voluntary reporting and offer a point of comparison for other states.

Funding support was provided by the AAA Foundation for Traffic Safety (primary grant) and the Washington University Center for Aging (secondary grant to G.F. Ulfarsson), and the 2-year project was initiated in May 2006. A team of over 30 state officials, university investigators, health professionals, and students donated their time and expertise, working cooperatively, to make this project possible.

0.2 Evaluation Sample & Controls

The research team reviewed case materials for 4,100 individuals, aged 50 and older, reported to the DOR as potentially unfit during years 2001-2005. Over 15,000 document pages were extracted from microfilm, printed, reviewed, and the data hand entered to an integrative database over a 9-month period in 2007. This "reported" sample represented 87% of all drivers aged 50 and older reported during this period. Time and resource constraints precluded gathering the remaining 13%. Younger drivers (aged 16-49) were reported, but in very small numbers (just 375 individuals during this period), and consequently were not included in this evaluation project. A 2.8:1 age and gender matched control sample of non-reported drivers was created; and all reported and control cases were linked to the MSHP Statewide Traffic Accident Reporting System (STARS) crash database to document retrospective and prospective crash history for 1993 to early 2007.

0.3 Research Questions & Key Findings

What groups filed reports under HB-1536 and for what reasons?

HB-1536 was developed, in part, to encourage identification and reporting of *medically-atrisk* drivers by physicians and other health professionals. During 2001-2005, more than half of all reports were submitted by police officers (30%) and license office staff (27%). Most policeinitiated reports (87%) were made pursuant to a crash, dangerous action, and/or traffic violation involving the reported driver.

Reports from license office staff, in contrast, focused on first hand observations of cognitive and physical function, and included concerns about balance/ambulation (33%), confusion (15%), and appearance of frailty (15%).

Physicians (20%) and family members (16%) were the sources for most other reports. While concerns about driving were noted by these sources, their primary concerns were related to health and functional status (e.g., medical diagnosis, observed confusion). In most instances, when a physician was the source of report, the DOR staff utilized this information to make a license or testing determination directly (i.e., and did not require a second physician evaluation be submitted).

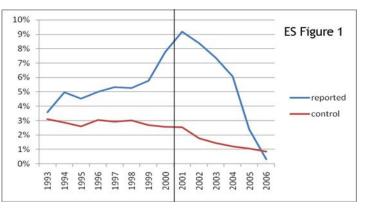
What were the demographic and health characteristics of reported drivers?

Reported drivers in this sample were quite old, with a mean age of 80 years (Range 50-105, SD = 9), and disproportionately male (55%). Race and education data were not available. Mortality was high, such that 38% of reported drivers were listed as deceased when records were gathered in December 2006, just 12 months after the end of the reporting period for this study. Mortality in the control sample was somewhat lower at 33%.

Eight health condition categories were examined: dementia/cognitive impairment (listed in 45% of all cases), vision conditions (31%), musculoskeletal/neuromuscular conditions (28%), disorders of consciousness (16%), cardiac/cardiovascular conditions (12%), brain insult/tumor/stroke (10%), psychiatric conditions (8%), and alcohol/drug abuse (3%). The mean number of health conditions for reported drivers was 1.6 (Range 0-8, SD = 1.4).

What was the annual crash involvement of reported drivers in comparison to controls?

As shown in ES Figure 1, reported drivers were more likely to be involved in a crash as the driver (vertical axis) relative to controls starting in 1993 and through 2005, with involvement percentage peaking at over 9% in 2001 at the start of the reporting period (a threefold difference from controls). Annual crash involvement increased sharply in reported drivers immediately before the reporting period, and

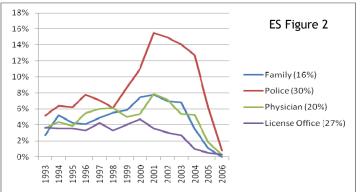


declined sharply as these individuals were reported, retired from driving, and/or died.

Over this fourteen year period, reported drivers (n = 4,100) were involved in 3,472 crashes, whereas controls (n = 11,615) were involved in 4,345 crashes. When involved in a crash, more than half in both samples were involved in just one incident (58% and 73% respectively), but reported drivers were somewhat more likely to have multiple crash histories. The vast majority (98%) of all crashes in the reported sample, however, occurred before the Department Action date (i.e., report date) when the HB-1536 process was initiated. There is little evidence that older adults pose a traffic safety problem following license revocation, at least from the perspective of crashes.

In 2006, there were ~7,800 control drivers and ~2,600 reported drivers still living. All but 75 of the reported group had been de-licensed at this point. It is not known how many control drivers had retired from or restricted their driving by 2006, but it is likely that some had given their advancing age. Substantially more individuals in the control sample were involved in crashes in 2006 relative to the reported sample (165 drivers vs. 19 drivers), suggesting that HB-1536 was effective in removing potentially unsafe drivers from the road.

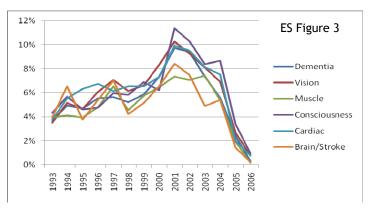
As shown in ES Figure 2, crash involvement varied by report source. Not surprisingly, those reported by police had the highest annual crash involvement, peaking at 16% in 2001. Those reported bv familv and physicians were similar. Those reported by license office staff mirrored controls in their annual crash involvement, suggesting that license office staff may identify drivers as unfit *before* any potential increase in



crash risk and related compromise in public safety.

As shown in ES Figure 3, crash involvement varied somewhat by disease category, but all followed a similar overall pattern. Annual crash involvement percentages for those with disorders of consciousness, cognition, and vision were somewhat elevated over other conditions in 2001-2003, but all declined to similar levels as these drivers retired from driving and/or died.

Data concerning on-road exposure (i.e., miles traveled) and attrition (i.e., date of death, date of driving cessation) were not available in HB-1536 case files. Hence, these graphs do not represent crash rates but merely crash involvement (i.e., percentage of individuals in а documented crash as the driver in a given year). While informative, these figures tell only part of the story and must be interpreted with caution.



What happened to reported drivers as they moved through the HB-1536 process?

ES Figure 4 summarizes what occurred at each step in the HB-1536 process for those reported in 2001-2005, starting with the sample of 4,100 reported drivers reviewed for this study and ending with the 144 individuals (3.5%) who retained a valid license in the end. In contrast, 67% of age-gender matched control drivers held valid licenses at this time.

| | Reported as Unfit to Drive | Physician Evaluation | Testing Required | Testing Performed | Retained License Pursuant to DOR Full Case Review |
|--------------------|-------------------------------|-------------------------|---------------------|----------------------|---------------------------------------------------------------|
| Reviewed Sample | N = 4,100 | 2,028 | 979 | 562 | 144 |
| % of Total | 100% | 50% | 24% | 14% | 3.5% |
| % of Preceding | | 50% | 48% | 57% | |
| % Increment Change | | - 50% | - 52% | -43% | |
| % Male Gender | 55% | 58% | 51% | 50% | 61% |

A few findings are especially notable in this figure:

Half of reported drivers, for one reason or another, did not pursue the required physician evaluation and were subject to immediate license revocation. This does not mean, however, that all of these drivers were necessarily unfit or would have necessarily failed a driving skills test. The DOR allows 30 days (with another 30 day extension by request) for reported drivers to see their physicians and have a medical evaluation submitted. Why did so many choose to drop out at this early stage? The

advanced age of these individuals, their health status and physical frailty, and their high mortality were probably all contributing factors. Many (45%) had dementia or cognitive impairment. For some, simply receiving official written notification was probably enough to give up driving, while for others notification likely initiated discussions with family members and health providers that motivated a decision to retire from driving.

- Based on this input, DOR officials revoked the licenses of 52% of the remaining individuals and required 48% to participate in on-road testing to certify ongoing fitness to drive. Even more individuals chose or were forced by circumstances of life or function to drop out at this stage. Just 14% of those originally reported presented in person for on-road testing through the MSHP. The fitness of other drivers was determined based on physician and other input represented in the figure. In the end, 144 (3.5%) of the drivers in this sample retained a valid license to drive. Eighty-two of these individuals were still living in 12/06 when mortality data were obtained. We do not know if they or other de-licensed individuals were actively driving, but the <1% crash percentage for the reported sample in 2006 suggests that few were. These data indicate that the overall HB-1536 process was effective during this period in moving reported drivers into driving retirement. We cannot conclude, however, that these drivers were necessarily medically unfit behind the wheel, as most dropped out before on-road testing. In other words, their fitness levels were never evaluated.</p>
- Given the advanced age of this sample, population demographics would have predicted that females outnumber males approximately 60% to 40%. As a general observation, males are more likely to be licensed drivers, however, and to travel more miles than females. Their higher presence in this sample is, therefore, not surprising. Tracing the proportion of males that remained active across the HB-1536 process, however, is rather interesting. Males were somewhat more likely to see their physician and have an evaluation submitted, but a similar number of both genders were required to take on-road testing. This change may be explained by the fact that males had a higher mean number of health conditions (1.7 vs. 1.4), suggesting greater physical-functional compromise. In the end, however, males were somewhat more likely to pass and retain a valid license to drive possibly because they were more persistent and otherwise less willing to relinquish the driving privilege.

0.4 Summary & Implications

This Executive Summary and the full report that follows only begin to scratch the surface on the voluminous data gathered and questions raised through this collaborative project. A number of initial conclusions and implications are suggested:

The HB-1536 process is effective in moving those reported as potentially unfit into driving retirement. While we cannot say that all of those reported were truly unfit to drive, a substantial number were likely at risk due to advanced age, frailty, medical compromise, observed problematic driving behaviors, and crash history. Many dropped out at each step in the evaluation process, and only a handful were tenacious and/or functional enough to participate in and pass on-road testing and retain a valid license to drive. Only 2% of total crashes occurred after the reporting process was initiated. Crash data indicate that, once reported, these individuals likely ceased to be active drivers, and public safety was thereby enhanced.

- The high attrition across the HB-1536 process raises questions of reasonableness. In our managed health care system, was it reasonable to require all reported drivers see a physician and submit a form in just 30 days? Arranging to see a physician involves both time and cost. Was this requirement a barrier that prevented some "fit" drivers from proceeding and having a chance to test out and retain a valid license? Similarly, was it reasonable to apply a one-size-fits-all driving skills test to this heterogeneous group of reported drivers? Might there be some justification for testing to be tailored for certain groups? Data are not available in this project to answer these questions precisely. The HB-1536 process is arguably reasonable and fair in its detailed standardization - all must traverse the same hurdles regardless of age or infirmity. That said, it may be valid to guestion the impact of HB-1536 from a perspective of mobility promotion. Driving cessation is one point along the mobility continuum. What happens to the mobility and well-being of those forced into driving retirement is beyond the scope of HB-1536, but this remains an important (even central) consideration for health care, quality of life, and reasonableness in public policy. In our view, a *complete* voluntary reporting system is one that is nested within an organized, collaborative strategy to promote older adult mobility on local, regional and state levels.
- The high rate of reporting by police officers, while helpful, indicates that there's room for safety-related improvements in the system. When police officers are filing reports based on crashes and on-road incidents, public safety is already compromised. Procedural and educational initiatives to enhance reporting by physicians, family members, and health/service professionals (groups hardly represented in the 7% of other reporters not specifically quantified in this report) could go a long way in changing the crash-safety profile of reported drivers. Early recognition of "red flags" in health and function, along with the knowledge and motivation to intervene with respect to driving, could mean that more drivers are reported when less medically compromised and, by extension, before a crash is likely to occur. Right now, police officers are the reporters of last resort, and they will always fill this role to some extent. Can the proportionate burden of reporting be shifted from police to other stakeholders? *We believe so.*
- Our data suggest that dementia is a top public health concern with respect to fitness to drive in older adults. Almost half of this sample of reported drivers had an indication of dementia and/or cognitive impairment in their records. Vision problems were a distant second in prevalence, possibly because of systems are already in place to address vision loss. Dementia and other forms of cognitive impairment, in contrast, can be difficult to identify, especially in those experiencing the early stages of decline. Other research has shown that it is *not a question of if persons with dementia should retire from driving, but merely when*. Some of those reported under Missouri's HB-1536 surely passed over this line and drove too long into the progression of their disease. Organizations, such as the Alzheimer's Association, have devoted significant resources to educating the public and family caregivers about dementia and driving. Our data suggest that such education is critical and has public safety implications.
- Finally, our data suggest that license office staff may play a more significant role in identifying at risk drivers than may be apparent on the surface. License office staff members interact with and otherwise observe individuals at the time of driver license and auto plate renewal. Their observations of problems in ambulation, confusion and

frailty were influential with respect to driving retirement; few of those they identified as potentially unfit passed through the HB-1536 process and retained valid licenses to drive. This was true, of course, for everyone in this sample. But, those reported by license office staff had much lower annual crash involvement - very similar to controls, in fact. Were these individuals destined to experience higher crash involvement over time, and was this eventuality prevented by the intervention of license office staff? While not a form of testing, per se, the observations of license office staff still constituted direct, official interactions concerning the licensing process. With more training, could license office staff provide an even higher and more useful level of feedback in the voluntary reporting process? This is an important consideration. The proactive role of license office staff in identifying potentially unfit drivers should not be underestimated, in our view.

- Voluntary reporting is one of number of tools employed in most states to ensure driver fitness. The accessibility and acceptability of the voluntary reporting law, along with its known outcomes, are important considerations. Missouri's HB-1536 is well-defined and applied with consistent standardization. It's non-specificity with respect to age and its provisions regarding confidentiality elevate it to "model law" status in the minds of many. That said, our data suggest that HB-1536 is potentially under-utilized in a state with over 600,000 drivers aged 65 years and older. While we cannot say for sure, prevalence data for conditions, such as dementia, suggest that many more individuals could be reported than the ~1,000 annual reports over the past few years. Limited knowledge of HB-1536 may be part of this. From our own educational efforts, we know that most potential reporters from these groups do not know that HB-1536 even exists. Most "decisions" concerning driving retirement happen on the level of the individual and their immediate circle of caregivers - family, medical and social. Increased knowledge of HB-1536 and its primary outcome (i.e., almost certain driving retirement) could promote greater reporting to state authorities, or it could just as well motivate further private action (i.e., so as not to put seniors through this process). These are empirical issues for future study.
- Although Missouri's voluntary reporting law only impacted a relatively small number of drivers in 2001-2005, it still served a vital and necessary role as a safety net for evaluation and de-licensing of potentially unfit drivers. When drivers lack insight and continue to drive despite clear deficits (i.e., as in dementia), or when the independent efforts of older adults, their families, health professionals, police officers, etc., fail to promote appropriate restriction or retirement from driving, there must be a mechanism in place to force the issue and enhance public safety. HB-1536 accomplishes this task in Missouri, and we believe is a model for other states to follow.

In the future, additional analyses will examine a variety of specific questions comparing individuals by diagnosis or health profile, characteristics of crashes, how observations of license office staff and MSHP driver examiners contribute, etc. For now, this first report provides a helpful summary for use in enhancing driver safety in Missouri and other states, especially in the area of medical fitness to drive. A number of recommendations flow from this first analysis and are offered below.

0.5 Recommendations

This descriptive evaluation project supports a number of policy recommendations and best practice suggestions put forward at the *2008 North American License Policies Workshop* sponsored by the AAA Foundation for Traffic Safety (Molnar & Eby, 2008), including an emphasis on function over chronological age in driver fitness determinations, an emphasis on voluntary reporting as a national standard, the provision of legal immunity from prosecution protection for those filing reports, encouragement of in-person license renewal procedures, the promotion of Medical Advisory Boards to assist (and provide helpful credibility) state officials in making licensing determinations, and a need for validated assessment approaches and tools. Additional recommendations are specific to Missouri, based in the findings of this study and in our team's very collaborative relationship with state officials over the past few years.

- Voluntary reporting in Missouri appears to identify frail older adults nearing the end of their driving life expectancies. It does so via a standardized process that moves reported individuals into driving retirement, with little evidence of post-revocation driving. We conclude that this mechanism is successful and appropriate for implementation in other states. This view is also consistent with a recent position statement by the American Academy of Neurology (Bacon, Fisher, Morris, Rizzo, & Spanaki, 2007) arguing that individual differences in disease presentation, and a relative lack of driving safety information for many health conditions, are sufficient reasons for reporting to remain voluntary physicians (and others) need to make individual decisions in this complex area.
- Although we support voluntary reporting as the national standard, we recognize that mandatory reporting has potential advantages, especially with respect to certain conditions, such as progressive dementia. More comparative research is needed between voluntary and mandatory states to clarify the benefits and downsides of each respective approach. Is it necessary, for example, to list specific diagnoses, such as Alzheimer's disease, for reporting as in California? Or, might less specificity in mandatory and/or voluntary mechanisms be more effective? More research is needed, especially in the area of disease-specific reporting.
- Voluntary reporting procedures should be embedded within a larger mobility service continuum, and not simply engines for de-licensing. As pointed out by the AAA Foundation for Traffic Safety (Molnar & Eby, 2008), additional emphasis is needed in most communities to provide information and guidance on the difficult question of when to stop driving and how to remain mobile afterwards. Most especially, newly de-licensed drivers and their families need targeted guidance and support. The degree to which such integrated support may be possible will vary by state and available resources. Simple changes to the HB-1536 process, such as provision of a handout on driving retirement and alternative mobility options at the point of initial notification and/or after license revocation could go a long way in helping to support ongoing mobility.
- Medical review and other evaluative procedures must be sufficiently comprehensive and evidence-based so as to be reasonable to all concerned. Missouri meets this standard to a reasonable extent, we believe. Although it may be that many drivers reported under such mechanisms will be subject to license revocation, all must have an adequate opportunity to work through the process. In the case of Missouri, many reported drivers appear to drop out before medical review. Little is known about why

this attrition may occur, but the short window for response may be a factor. Enhanced communication and flexible procedures may be useful to overcome potential barriers. To this end, we make the following focused recommendations:

- We recommend that a single form be adopted for the reporting by all stakeholders. This form should provide clear guidance concerning the types and level of information necessary to support licensing review, emphasizing check boxes and explicit instructions to ensure ease of use and recording of pertinent information.
- Once a driver is reported, the Missouri DOR sends a letter requiring that a Physician's Statement be returned within 30 days. For some, this time window may be insufficient to schedule a physician visit and otherwise consider the implications of moving forward with the review process. We recommend that this period be extended to 60 days so as to allow more time and flexibility.
- While drivers de-licensed under Missouri's HB-1536 may appeal this decision to the DOR Director, the specific appeal process and its evidentiary basis remains undefined. We recommend that a formal, structured appeal process be instituted whereby reported drivers may appeal revocation decisions viewed as unnecessary or unfair. This process might include automatic review by members of the Medical Advisory Board. Perhaps, too, other trained health professionals, such as occupational therapists, could provide "second opinion" evaluations in all or certain grievance cases. Occupational therapists are trained to evaluate broad aspects of human function, and their input could be especially helpful in circumstances favoring license restriction over revocation. Such an approach could counter any perceived age-related bias and provide a form of "medical" confirmation that may be more acceptable to the involved parties (although we did not see any overt bias in this project).
- For DOR officials to make reasoned decisions concerning driver licensing, they need reasonably comprehensive and comprehensible information from physicians and other report sources. The current forms utilize a combination of quantitative check boxes and space for written remarks. On many of the forms we reviewed, often only check boxes were marked and potentially helpful qualifying information was left out. For example, a checked box by *Dementia* says nothing about level of impairment and function. Whereas someone with very mild dementia may be safe behind the wheel, someone with severe dementia would not. We recommend revision of forms to allow qualifiers and to include other important medical conditions (e.g., stroke, macular degeneration) and driving history data (e.g., recent crashes) which are currently absent.
- Missouri utilizes a one-size-fits-all, pass-fail testing strategy, such that teenagers and older adults are evaluated on the same set of operational driving skills. While our data suggest that the current test is quite challenging for older adults, we nonetheless believe the basic approach to be valid. The MSHP has made a commitment to train driver examiners concerning the aging process and driver fitness, and their case documentation now includes a listing of observed strengths and weaknesses to better inform DOR licensing decisions. It is likely that some older drivers with borderline passing scores might be best served by receiving a restricted license. Yet, it is unclear to what extent DOR officials utilize MSHP data to consider individual circumstances and the option of

restricted licensure. More integration of HB-1536 process with the current restricted licensure review system appears warranted.

- A unique aspect of this project was the integration of voluntary reporting data with statewide crash data over a multi-year period. While lines of communication exist between the Missouri DOR and those that maintain the STARS database at the Highway Patrol, crash evidence was lacking in more than half of the DOR files on reported drivers. It took our study to bring these data points together. Yet, it would seem that knowledge of crash history would be valuable for DOR staff and their Medical Advisory Board members when licensing decisions are made. Such information could serve as a trigger for more detailed review, for example, or as a means of determining if on-road testing should be pursued. Would DOR require a driver involved in multiple crashes in the immediate years before the report date to engage in on-road testing? As of now, this level of review is not possible, yet this seems a relatively simple intervention to implement. We recommend that this linkage be pursued.
- Those professionals expected to participate in the identification of at-risk drivers and to utilize reporting procedures need adequate, evidence-based training, as recommended by the AAA Foundation for Traffic Safety (Molnar & Eby, 2008). Such training must be tailored to the learning needs of each group, and be readily accessible for all to participate and benefit. Materials are available for tailored outreach through many national organizations, including:
 - The National Highway Traffic Safety Administration (see http://safety.fhwa.dot.gov/older_driver/index.htm; http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.31176b9b03647 a189ca8e410dba046a0);
 - AAA (http://www.aaapublicaffairs.com/Main/);
 - AAA Foundation for Traffic Safety (http://www.seniordrivers.org/home/);
 - American Medical Association (http://www.amaassn.org/ama/pub/category/8925.html).

Our team has worked closely with state officials in Missouri to educate health professionals, driver examiners, and police officers. We are now targeting license office staff. In each case, our approach has been tailored to the group, recommending specific behaviors and outcomes. A significant barrier to such education, however, is its expense. Internet-based resources and training systems may provide the most cost-effective avenue for such efforts.

We further recommend that educational initiatives target reporting groups so as to boost the activity level of physicians, other health and service professionals and family members. Proportionately more reporting from these groups could enhance public safety by identifying at-risk drivers before crashes occur. While some may disagree with this interpretation and approach, we believe this is an empirical issue worthy of implementation and evaluation.

SECTION 1

Introduction

1.1 Overview

Collaborative research, linking public records with broader scientific findings, can have a positive impact on how public policies are formulated and implemented. The identification and evaluation of medically impaired older drivers is an important public health and safety issue today, requiring action from stakeholders in government, academic, healthcare, social service, and lay constituencies (Wang & Carr, 2004). This paper details a 2-year collaborative project to describe and otherwise evaluate the functional impact of a state voluntary reporting law for unfit drivers, with a specific emphasis on those aged 50 and older at the time of report.

This effort to evaluate the efficacy of HB-1536 is an outgrowth of an educational initiative to train physicians and other healthcare professionals about MFD assessment and state reporting procedures (see description in Meuser et al, 2006). An important goal of this initiative was (and is) to change behavior, such that health care professionals will incorporate evaluation of MFD into regular patient care activities. Post-test evaluation over a one year period showed significant and lasting changes, especially with regard to incorporation of driving-related questions into clinical care and documentation of findings.

Another important issue was the way in which trainees utilized HB-1536 to report unfit drivers who refused to stop driving voluntarily. Increases in reporting where older driver assessment workshops were offered would further validate this educational intervention. We approached DOR officials in an effort to obtain data on HB-1536 reporting trends by zip code and date. While negotiating this request, the research team and DOR officials agreed that a more comprehensive evaluation of HB-1536 was warranted, and so, with funding support from the AAA Foundation for Traffic Safety, this project was initiated in June 2006.

While the concept of *medical fitness to drive* (MFD) is applicable to all age groups, it is particularly salient for older adults. As a group, older adults are at greater risk for health conditions that may impair driving ability and increase crash risk, especially after age 70 (Li, Braver, & Chen, 2003; Foley, Heimovitz, Guralnik, & Brock, 2002; Carr, 2000). The "medically fit" driver is one with sufficient vision, alertness, cognition, joint range of motion, and motor skills, to manage the operational, tactical and strategic demands of driving (Anstey, Wood, Lord, & Walker, 2005; Wang & Carr, 2004; Wang, Kosinski, Schwartzberg, & Shanklin, 2003). Health conditions that detract meaningfully from these key abilities may increase crash risk, and thus require focused evaluation and intervention by health professionals (Odenheimer, 2006; Dobbs & Carr, 2005).

A range of health conditions have been linked with crashes, licensing, and performance-based outcomes, and these are summarized in Table 1 (Dobbs, 2005; Charlton, Koppel, O'Hare, Andrea, Smith, Khodr, Langford, Odell, & Fildes, 2004; Vernon, Diller, Cook, Reading, & Dean, 2001). Certain age-associated conditions, such as progressive dementia (e.g., Alzheimer's disease), are of particular concern due to high prevalence in later life (~40% of adults aged 85+) and strong evidence for unsafe driving when the disease progresses beyond the mild stage (Duchek, Carr, Hunt, Roe, Xiong, Shah, & Morris, 2003; Dubinsky, Stein, & Lyons, 2000).

Most states utilize voluntary procedures to address MFD concerns, whereby professionals of various types and/or family members may report concerns to the State Department of Motor Vehicles (DMV; Morrisey & Grabowski, 2005). Licensed drivers are also encouraged to take personal responsibility for MFD by self-reporting any concerns to the DMV and/or self-limiting their on-road exposure. In Illinois, for example, drivers must report "any medical or mental condition which could result in a loss of consciousness or any loss of ability to safely drive a vehicle" (CyberDriveIllinois, n.d.). When a report is made, the DMV may require medical evaluation and/or driving-related testing (written, vision, and/or on-road) to determine ongoing license eligibility. If a physician identifies a MFD-related concern, for example, he or she can report the affected driver to the DMV for evaluation and possible license revocation (Meuser, Carr, Berg-Weger, Niewohner, & Morris, 2006). A few states, such as Maryland, utilize detailed, age-specific evaluation protocols under such circumstances (see Staplin, Gish, & Wagner, 2003a; Staplin, Lococo, Gish & Decina, 2003b), whereas others, such as Missouri, evaluate older drivers using standard driving tests applied at any age.

A handful of states, including California, Delaware, New Jersey, Oregon, and Pennsylvania, mandate that certain MFD-related health conditions (e.g., Alzheimer's disease, epilepsy) *must be* reported to the DMV at the time of diagnosis so that driving-related decisions can be addressed (Wang, Kosinski, Schwartzberg, & Shanklin, 2003). The identification of individuals as medically unfit to drive, therefore, is a collaborative effort between the public, professionals and government officials. However, the final decision to revoke any individual's license to drive resides only with the state government.

Although states, such as Maryland, have long recognized the importance of addressing MFD concerns (Baldwin, 1980), the most common means for states to learn of medically impaired drivers is by voluntary report. Most states (45 of 50 as of this writing) utilize voluntary reporting mechanisms (see reviews in Meuser, 2008; Wang et al, 2003); yet these have never been subject to comprehensive characterization or efficacy evaluation. This assertion is based on extensive searches of the published literature and on-line sources, and queries to various researchers and government officials. Little systemic information is known about how drivers are reported, their characteristics and health status, and, most importantly, what happens in terms of driver licensing decisions and protection of public safety. Are those "at risk" for

crashes effectively removed from the road by these voluntary mechanisms? This is an important question underlying the current investigation.

The Missouri House Bill 1536 (HB-1536), governing MFD, and implemented in 1999, allows health professionals, law enforcement officers, family members, and others, to report potentially unsafe drivers for medical evaluation, retesting, and possible license revocation. The law maintains the confidentiality of the reporter and provides civil immunity protection from prosecution for breach of confidentiality, is nonspecific with regard to age, and includes a Medical Advisory Board (MAB) for review of complex cases. The law is administered through the Driver License Bureau of the Missouri Department of Revenue (DOR). On-road testing of reported drivers is conducted through the Driver Examination Program of the Missouri State Highway Patrol (MSHP).

The HB-1536 process is depicted in Figure 1, with specific definitions of each component provided in the Results Section below. As in most states, HB-1536 requires that a report be made in writing, that medical input be obtained, that on-road testing be considered if driver fitness is in question, and that the reported driver be informed of applicable rights and duties at each step. Specific administrative procedures vary between voluntary reporting states, and not all states protect the confidentiality of the reporter or provide legal immunity protection. HB-1536 is similar enough to laws in other states, however, to serve as a reasonable proxy for understanding how such laws may operate in general.

1.2 Older Drivers, Health Status & Crash Risk

There are over 35 million people over age 65 years in the United States with almost 5 million people over age 85 years (US Census Bureau, 2005). Twenty-one percent of our population will be over age 65 by the year 2050, representing over 86 million older adults (US Census Bureau, 2005). Currently, there are almost 30 million licensed drivers age 65 years and older in the U.S. representing 15 percent of the driving population. A major increase in the number of older drivers is expected based on current demographics (Retchin & Appanolle, 1993), and these drivers will retain their licenses longer than in past generations (Hakamies-Blomqvist, 1994). There is an expected increase to 25 percent by the year 2030 (Insurance Information Institute, 2007). Older drivers will also travel greater distances and take more trips than the current cohort (Rosenblum, 2000). Although older female drivers have historically driven less and retired from driving earlier than men, there is some data to suggest these gender gaps are already narrowing (Bauer, Adler, Kuskowski & Rottunda, 2003). The bottom line is that many more drivers will be over the age of 65 in the years in the future.

The incidence and prevalence of chronic diseases increases with advancing age. Chronic disabling conditions affect about 25 million people (Centers for Disease Control, 2005). In 2002, over half of older adults surveyed stated they had some type of chronic disabling illness, with almost 40% percent of these illnesses reported to be severe and 16% requiring outside assistance for basic living tasks (Administration on Aging, 2006). These numbers rise dramatically with advanced age, with 30 percent of adults over age 80 reporting the need for some type of assistance. Many adults remain reasonably healthy and able to engage in complex tasks, such as driving, well into advanced old age. This is not true for a substantial and growing minority with certain chronic and/or progressive conditions. If these chronic illnesses are undetected, under-treated, or not assessed appropriately, then this group of older drivers may be at-risk for a motor vehicle crash.

Public safety concerns exist regarding older adult crash rates. A consistent finding across many states and developed countries is an increased crash rate per miles driven for older drivers in comparison to middle-aged counterparts (National Highway Traffic Safety Administration, 2000). This finding has been attributed to age-related changes in physiological functioning, in addition to the presence of medical illnesses. Frail elders are also more vulnerable for injury or death when involved in an accident. Motor vehicle fatality rates among older drivers continue to exceed that of middle-aged drivers (Cerrelli, 1998), in large part due to the effects of frailty. Currently, driver deaths over age 65 years account for 14% of all traffic fatalities, but this rate is anticipated to increase to 25+% by the year 2030 (Lyman, Ferguson, Braver, & Williams, 2002). Injury statistics for older adults are another matter, and these may be subject to under-reporting since the full extent of injury may not be apparent at the time of a crash (i.e., when police reports are completed).

The most appropriate definition of crash risk in older drivers is a matter for debate. Exposure (miles driven) may be less important for determining crash risk than other factors in this population (Hakamies-Blomqvist, 2004). Many older drivers operate in relatively high-risk driving environments (e.g. urban areas rather than on freeways) which would place them at a greater average risk per miles driven when compared to drivers of other ages (Frith, 2002; Hildebrand & Hutchinson, 1999). In addition, there is the issue of frailty bias, since older adults are more likely to sustain serious injury and have their crashes reported (Li, Braver, & Chen, 2003). Furthermore, researchers have pointed out that groups with small yearly driving distances can still have inflated risk when compared to groups with longer traveling distances (Janke, 1991). The relationship between exposure and accidents is not a direct linear relationship inflating the risk of younger and older drivers (Ekman, 1996). This finding is further supported in a study that did not find different crash risks when aged groups were compared by matching for similar driving distances (Hakamies-Blomqvist, Raianen, & O'Neil, 2002; Hakamies-Blomzvist, 2005).

Crash analysis has shed some light on the types of motor vehicle crashes common among older drivers. Older drivers have a higher prevalence of crashes while turning and at intersections (Ryan, Legge, & Rosman, 1998; Hakamies-Blomqvist, 1993). Failure to yield has been a consistent finding in the older driver literature (Zhang, Lindsay, Clarke, Robbins, & Mao, 2000). Older adult drivers have higher rates of multiple-vehicle crashes when compared to middle-aged drivers. In one study, the relative risk increased by a factor of ten for those 85 years and older. These findings were common at intersections with stop signs and other uncontrolled intersections (Preusser, Willliams, Ferguson, Ulmer, & Weinstein, 1998). Left-hand turns have also been cited in several studies as a difficult task for older drivers (Matthias, DeNicholas, & Thomas 1996; Finison, 2002). It is likely that some medical conditions complicate such maneuvers and, thus, may be targets for future safety-related interventions.

Not surprisingly, most crashes tend to occur at low speed during ideal road and weather conditions. Abdel-Aty and colleagues (1999) found a higher proportion of crashes with older adults under ideal conditions when compared to their younger counterparts. A slight increase was also noted by McGwin and Brown (1999) in senior Alabama drivers. Older drivers are more likely to crash in urban areas (Finison & Dubrow, 2002), but are more likely to die in rural crashes (Transport Canada, 2001). Older adults are more likely to crash at lower speed than their younger counterparts (Baker, Falb, Voas, & Lacey, 2003; Cook, Knight, Olson, Nechodom, & Dean, 2000; McGwin & Brown, 1999).

In the majority of the studies that examine "fault" across age groups, senior drivers are more likely to be charged with crash responsibility than younger adults. One measure called the relative accident involvement ratio (RAIR) represents the ratio of at-fault to non-fault crashes in a given population. If the RAIR is above 1 then the study population is deemed to be more likely responsible for causing crashes. Studies that have shown older adults with RAIR values greater than 1 are plentiful (Stamatatiadis, Taylor, & McKelvey, 1990; Rothe, 1990; McGwin & Brown, 1999; Garber & Srinivasan, 1990; Garber & Srinivasan, 1991). Some of these studies also noted that female older drivers were at higher risk than older adult male drivers. Crashes that occur at intersections with stop signs are more likely to be linked with fault from the older driver (Retting, Weinstein, & Solomon, 2002). Older adults have also been found to be over-represented in failure-to-yield crashes (Mayhew, Simpson, & Ferguson, 2006).

It is difficult to know the contribution of driving with medical impairments to a motor vehicle crash risk, since this information is usually not apparent or presented to the highway patrol officer when a report is made. In Texas, Griffin and colleagues found that medical impairments were more likely to be implicated in crashes involving older drivers, and that this likelihood increased in a stepwise fashion for each decade after age 65. The study also noted increases based on the characteristics of the crash (higher incidence of medical impairments with multiple-vehicle crashes and nighttime driving). In Alabama, McGwin and Brown (1999) found that 8.4% of the crashes of older adults had an associated medical illness as determined by the police officer on the scene, when compared to younger drivers (1.4%). In a study of fixed deficits that included vision and cognition, Hakamies-Blomqvist (1993) noted that 50% of fatal collisions involving seniors included a medical condition that possibly was a contributing factor in comparison to 10% of younger drivers.

Another well known observation is a predilection for difficulty with turning maneuvers, especially left hand turns (Aizenberg & McKenzie, 1997; Cook et al, 2000). Further risk factors for having a left turn crash in older adults include: increasing age, female gender, dark conditions, rural setting, low traffic volume, turning onto two-

way roads, and when driving alone (Chandaratna, Mitchel & Stamatiadis, 2002; Chandraranta & Stamatiadis, 2002). Trouble with gap selection is often cited as the major problem in these maneuvers and may be affected by high task complexity, high traffic volumes, high speed of approaching traffic, limited sight distance, and turning into multiple lanes (Fildes, Corben, Morris, Oxley, Pronk, Brown, & Fitzharris, 2000).

1.3 Medical Conditions

Medical conditions, in general, are less effective predictors of motor vehicle crashes in older adults than are functional impairments (Hu, Trumble, Foley, Eberhard, & Wallace, 1998). A number of studies have correlated physiologic measures, key driving abilities and crash risk. A relationship has been found between increased crash risk and age-related changes or declines in vision, hearing, and reaction time. Impairments in executive function appear to correlate strongly with a history of motor vehicle crashes in older adults (Daigneault, Joly, & Firgon, 2002). A number of studies have also examined functional visual field or "useful field of view" with age, and this measure has been correlated with increased crash risk (Owsley, McGwin & Ball, 1998). Translation of these findings to the level of the DMV remains problematic. The "added value" of adopting a functional screening approach to identify at-risk older drivers in the DMV setting or the physician's office remains to be demonstrated.

Albeit with low to moderate risk ratios, there is still reasonable evidence of relationships between medical conditions and driving performance (Fildes et al, 2000). Two recent comprehensive reviews of medical conditions and driving safety (Dobbs, 2005; Charlton, Koppel, O'Hare, Andrea, Smith, Khodr, Langford, Odell, & Fildes, 2004) link a number of specific diagnoses or diseases with increased crash risk. These include neurological disorders (e.g., Alzheimer's disease, stroke, epilepsy), vision disorders (e.g., cataracts, glaucoma, macular degeneration), and joint/movement-related disorders (e.g., rheumatoid arthritis).

Common medical illnesses or conditions in late life can be grouped into three categories based on their high prevalence and potential to impair key intrinsic factors or functional abilities necessary for driving. They include; vision (e.g. cataracts, glaucoma, macular degeneration), cognition (e.g. stroke, dementia, sleep apnea, medications), and motor skills (e.g. arthritis and muscle weakness). We will briefly review these conditions in regards to their prevalence and evidence that ties them to an increase risk of motor vehicle crash. It is estimated in 2005 that there were 36 million older adults over age 65 years and 28 million of them were licensed drivers. In Missouri, there was a total population of 800,000 older adults in 2005 with an estimated 600,000 licensed drivers. There is little or no data on the percentages of adults with specific medical conditions that are licensed to drive and are actively driving. A first effort to understand the prevalence of medical conditions by age and thus the potential pool of licensed drivers is summarized in Table 2.

An estimated 20% of Americans aged 65 and older have a cataract in one eye, and 6% have had a lens implant or lens extraction (pseudophakia/aphakia). The total

number of adults with cataracts over the age of 65 is projected to rise to 3 million by 2020 (The Eye Diseases Prevalence Research Group, 2004). Cataracts have the highest rate of self-reported visual impairment and account for over 8 million physician office visits every year (Koch, 1985). Cataracts have been associated with increased motor vehicle crash risk (Owsley, Stalvey, Wells, & Sloane, 1999) and an intervention such as cataract surgery has been associated with a decrease in risk (Owsley, McGwin, Sloane, Wells, Stalvey, & Gauthreau, 2002).

An estimated 90,000 Americans over the age of 65 years have advanced macular degeneration (MD), and MD affects the majority (~15%) of women over age 80 (The Eye Diseases Prevalence Research Group, 2004). Two studies found that patients with MD had an increased crash risk while driving at night (Szlyk, Fishman, Severing, Alexander, & Viana, 1993; Syzlik, Pizzimenti, Fishman, Kelsch, Wetzel, Kagan, & Ho, 1995). In a larger and more recent study, macular degeneration was found to be associated with increased at-fault crash risk (Owsley, McGwin, & Ball, 1998).

An estimated 199,000 Americans over the age of 65 years (1% of the population) have glaucoma. The total number of adults with glaucoma is expected to rise to over 3 million by 2020 (The Eye Diseases Prevalence Research Group, 2004). In 2005, the American Academy of Ophthalmology stated that glaucoma is one of the leading causes of visual blindness, yet almost 50 percent are unaware of their diagnosis. A recent study indicated that patients referred to a glaucoma clinic in comparison to controls had an increased risk for motor vehicle crashes, including atfault crashes (Haymes, LeBlance, Nicolela, Chiasson, & Chauhan, 2007). Some additional studies have noted an increase in crash risk in patients with glaucoma (Szlyk, Mahler, Seiple, Deepak, & Wilensky, 2005; Hu, Trumble, Foley, & Eberhard, 1998; Owsley, McGwin, & Ball, 1998), but these findings have not been consistent (McGwin, Mays, Joiner, DeCarlo, McNeal & Owsley, 2004; McCloskey, Keopsell, Wolf, & Buchner, 1994). A more recent study noted increased crash risk (Szlyk et al, 2005).

Stroke is the third leading cause of death accounting for up to 10 percent of all deaths (Leske, Hejl, Hussein, Bengtsson, Hyman, & Komaroff, 2003). Five hundred thousand people in the U.S. have one stroke, and two hundred thousand will have a recurrent attack. Stroke is the leading cause of serious disability in the U.S., with more than 1.1 million American adults reporting functional limitations resulting from stroke. From 50-70 percent of stroke survivors regain functional independence, but 15-30 percent fail to regain independence. Legh-Smith, Wade, and Hewer (1986) noted many community dwelling stroke patients continue driving (~42 percent). One study suggests that the majority of stroke patients (87 percent) do not receive any type of formal driving evaluation, but simply resume the operation of a motor vehicle (Fisk, Owsley, C, Vonne, & Pulley, 1997). One study revealed an increase in crash risk in stroke patients when compared to controls (Koepsell, Wolf, & McCloskey, 1994). In contrast, Salzberg and Moffat did not find an increase in risk, but their study had a very small sample size.

Polypharmacy is defined as taking multiple medications, usually with the implication that too many are taken. It has been estimated that one third of adults over age 65 take five or more prescription medications (Mitchell, Kauffman, Kelly, & Rosenberg, 2005). Older adults represent 12 percent of the population in the U.S., yet consume 30 percent of prescription drugs (Rathmore, Mehta, Boyko, & Schulman, 1998). As a group, older adults are at higher risk for adverse drug events due to age-related changes in drug metabolism, taking more routine medications increasing the changes for drug-drug or drug-disease interactions, and the presence of co-morbidities.

Wang (2003) noted that any drug that can impair the central nervous system may be associated with risk in operating a motor vehicle. A way to classify medications has been developed as to whether or not they are Potentially Driver Impairing (PDI) Medications. As more PDI medications are prescribed and used, risk increases (Leroy & Morse, 2005). There are many common medication classes that have been studied and are associated with increased crash risk and include, but are limited to, narcotics and barbituates, benzodiazepines, not antihistamines. antidepressants, antipsychotics, hypnotics, alcohol, antiepileptic agents, anti-emetic agents, and muscle relaxants. One study that focused on older adults noted that long-acting benzodiazepines have been associated with markedly increased crash rates (Hemmelgarn, Suissa, Huang, Boivin, & Pinard, 1997). Additional reports suggest that there may be a significant number of older adults driving under the influence of medications (Higgins, Wright, & Wrenn, 1996; Johansson, Bryding, Dahl, Holmgren, & Viitanen, 1997).

Sleep apnea is common, often undiagnosed, and it has been suggested that the prevalence rate may be as high as diabetes, with 4 percent of men and 2 percent of women affected (Young, Palta, Dempsey, Skatrud, Weber, & Badr, 1993). Estimates of the prevalence in older adults have not been well established, but recent evidence suggests it is about 1.7% over age 65 years, which is slightly lower than the general population (Bixler VGontzas, Ten Have, & Tyson, 1998). Sleep apnea patients have been noted to have increased crash risk (Teran-Santos, Jimenez-Gomez, & Cordero-Guevara, 1999), and these drivers are also at risk for more serious injuries (Medical News Today, 2007). George (2001) found that treatment reduces crash risk back to base-line levels.

It is estimated that over 40 million individuals in the U.S. have some form of arthritis and over 7 million suffer limited activity (Arthritis Foundation, 2007). Osteoarthritis, is the most common form of arthritis in older adults, and affects over 20 million people (Springhouse, 2007). Older adults with frailty may be at increased risk for a motor vehicle crash (Sims, McGwin, Allman, Ball, & Owlsey, 2000; Marottoli, Wagner, Cooney, & Tinetti, 1994) and perhaps more vulnerable to injury (Kent, Funk, & Crandall, 2003). One study noted that crash involved subjects were more likely than controls to have difficulty walking one quarter of a mile (Sims, McGwin, Pulley, & Roseman, 2001). Decreased cervical range of motion and delayed rapid pace walk

have been correlated with increased crash risk (Ball, Roenker, Wadley, Edwards, Roth, McGwin, Raleigh, Joyce, Cissell, & Dube, 2006).

Dementia of the Alzheimer's Type (DAT), the most common dementing illness, currently afflicts over 4.5 million individuals, or approximately 15% of adults over age 75, in the United States. Research on driving and dementia indicates that many drivers with a dementing illness continue to drive (Odenheimer, 1993), even well into the disease process. It has been estimated that 4% of current drivers aged 75+ have cognitive deficits consistent with dementia (Foley, Masaki, Ross, & White, 2000). Results from one study that examined the mental status of older adults during driver license renewal using a brief cognitive screen found that as many as 6% of persons 65 to 69 year old and almost 20% of those 80 years and older were impaired (Stutts, Stewart, & Martell, 1998). Taken together, these studies may underestimate the actual number of demented drivers on the road since some older drivers with memory loss may choose not to renew their license or may forget to do so and still continue to drive.

The evidence suggests that drivers with dementia have an increased risk of crashes compared to those that are not demented (Carr, 1997), but this increased risk is not found in all studies (Carr, Murphy, Buckles, Duchek, & Morris, 2000). The variability in findings can be explained by the varied definitions of crashes (self-report vs. state recorded) and settings (referral centers vs. community settings). In addition, the risk of a crash for DAT appears to increase with the duration of driving after disease onset (Dubinsky, Williamson, Gray, & Glatt, 1992).

Additional diseases in older drivers that may affect driving ability include diabetes mellitus (Koepsell et al, 1994), seizure disorders (Hansotia & Broste, 1991), depression (Doege, 1986), and cardiovascular disease (Gallo, Rebok, & Lesikar, 1999). These areas have been extensively reviewed on several occasions (Eby & Kostyniuk, 1998; Janke, 1994). Unfortunately, not all medically impaired older adults will restrict their driving (Stutts, Stewart, & Martell, 1998). Others have raised similar concerns regarding continued driving despite the presence of significant cognitive-functional impairment (Cox, 1988; Marotolli & Richardson, 1998).

A study of older driver crashes from Texas recorded physical defects and/or medical impairments noticed by highway patrol officers at the scene. Although the majority of drivers did not have any impairments recorded in the crash database (98.3%), it is interesting the study still found that older adults were more likely to be rated as having medical conditions when compared to controls (Griffin, 2004).

In a recent review, retrospective case control studies of medical conditions were summarized as to overall risk of crash involvement (Charlton et al, 2004). Eight conditions were found to have at least a moderately elevated risk of crash involvement compared with a relevant control group: alcohol abuse, dementia, epilepsy, multiple sclerosis, psychiatric disorders, schizophrenia, sleep apnea, and cataracts. This is consistent with a recent NHTSA-sponsored review of the literature between 1960-2000 on medical conditions and driving (Dobbs, 2005). Drugs that were found to be problematic included alcohol, anticonvulsants, narcotics, antidepressants, antiemetics, antihistamines, sedatives, hypnotics (sleeping pills such as zolipedem or Ambien®), anxiolytics (medications for anxiety e.g. diazepam or Valium®). Additional red flags include other eye disorders, stroke, chronic obstructive pulmonary disease, and cardiovascular disease. Table 1 summarizes medical conditions and functional limitations that have been found to be associated with increased crash risk.

1.4 State Reporting of Medical Fitness Concerns

Most states in the US require physician input during the re-evaluation process for persons reported as unfit to drive, so physicians have a tangible need for knowledge and training in this area (Kakalya, Tisovec, & Fulkerson, 2000; O'Neill, Crosby, Shaw, Haigh, & Hendra, 1994; Giddins & Hammerton, 1996). Yet, many physicians have no training in driver fitness evaluation in older adults, have little knowledge of what medical conditions may impact on driving safety, and often little incentive to report the potentially unfit driver. In fact, in states without confidentiality or civil immunity protection, physicians may have compelling reasons to avoid making a report. Both physicians and their patients could suffer negative consequences. Although there have been efforts by national organizations in Canada and the United States to inform physicians about driver fitness assessment, most of the available tools have yet to be validated in clinical settings.

Most states also require that licensed drivers and their families take individual responsibility for monitoring health conditions that may impair driving ability. In Illinois, for example, drivers must report to the DMV "any medical or mental condition which could result in a loss of consciousness or any loss of ability to safely drive a vehicle." This information is then used to determine continued eligibility for a driver license and may require retesting and/or restricted driving status.

Many states allow physicians and other health professionals to voluntarily report individuals for license review when a medical concern exists, but few have clear reporting mechanisms or protections for physicians that alleviate concerns about breaching patient confidentiality. Only a handful of states (e.g., California) actually require physicians to report patients with specific conditions. Our experience in offering driving-related training in Missouri (see Meuser et al, 2006) tells us that very few physicians (<10%) know about applicable laws and procedures. With regard to medical fitness to drive, a "disconnect" appears to exists between legal requirements and healthcare practice today. State referral systems will benefit from improved communication between DMV officials and health professionals, along with formal training and more published studies in the medical literature.

Driver license bureaus need reliable and valid processes for evaluating older adults driving competency (Christie, 2000). A recent report from the Organization for Economic Cooperation and Development (OECD, 2004) expressed support for a more focused, consistent approach to older driver evaluation and licensing. The OECD report argued that crash risk is largely a function of medical illnesses and associated functional deficits, many of which are more prevalent with aging. The OECD report recommended that future efforts for evaluating older driver safety should target medically impaired older drivers and not older adults in general (OECD, 2001).

In order to appropriately target drivers with medical and/or functional impairments there must be a mechanism, policy, or law in each state or province that allows health professionals and law enforcement personnel to file reports. Concerns regarding breach of confidentiality and lawsuits have been cited as barriers to physician reporting. Six states currently have mandatory reporting requirements for specific diseases or conditions: California, Delaware, New Jersey, Nevada, Oregon, and Pennsylvania.

In California, for example, physicians are required to report any patient with a disorder characterized by lapse of consciousness. This includes seizure disorders and Alzheimer's disease, among other conditions. Minimal data has been collected on the effectiveness of mandatory physician reporting. Pennsylvania requires health professionals to report any medical condition that may impair the ability to control or safely operate a motor vehicle. Wording in the Pennsylvania law suggests that physicians who do not report "could be held responsible as a proximate cause of an accident resulting in death, injury or property loss caused by your patient. Also, providers who do not comply with their legal requirement to report may be convicted of a summary criminal offense" (Pennsylvania Department of Transportation, 2008). According to Loccoco & Staplin (2003), Pennsylvania receives over 15,000 reports a year, and 72% of these individuals have impairments serious enough to warrant temporary or permanent license revocation. About 50% of these revocations were attributed to seizure disorders, while 16% were related to other neurological disease (Older Californian Traffic Safety Task Force, 2004).

Data from Oregon in 1993 suggested that close to 5,300 reports are submitted each year (NHTSA, 2006). About 55% of reports are for persons over age 65 years. One third (33%) of reports in Oregon were self-referrals. Health providers were the source for about 37% of all reports. The two leading reasons for reporting were epilepsy (19%) and stroke (15%). It also appears that a small proportion of reports resulted in license suspension. In 1995, Florida reported that 11.7% of reported drivers had their licenses revoked, compared to only 7% in the Province of Ontario (NHTSA, 2006).

There is some data to indicate that patients may not inform their doctor of medical concerns related to driving safety (Taylor, Chadwick, & Johnson, 1995). Drivers may have a poor understanding of the rules and laws in their state and lack insight into their own driving abilities (Kelly, Warke, & Steele, 1999) and, consequently some experts argue in favor of mandatory reporting. On the other hand, physicians may be reluctant to report unless they are required by law to do so. At least one study has found that physicians practicing in mandatory reporting law states are more likely to report impaired drivers to the licensing agency (Cable, Reisner, Gerges, & Thirumavalavan, 2000). Another study looked at the attitudes of 523 Saskatchewan physicians found that most said they would report patients medically unfit to drive, but a majority also believed the patient-physician relationship could be

adversely impacted (Shawn, Mitchell, & Gilbert, 1999). Clearly, damaging the patientphysician relationship could lead to negative, and possibly expensive, health consequences in other areas.

Reporting of unsafe drivers was studied in the state of Victoria, Australia (Di Stefano, 2003). In this study, the medical reports filled out by doctors were found to be of variable guality, which limited the findings of the study. Hypertension, diabetes, musculoskeletal, visual, arthritis, and mental or behavioral difficulties were the most frequently identified conditions of concern. No relationship was found between medical diagnosis and performance in on-road testing, however. Individuals with more severe functional impairments were excluded from standard DMV testing and sent instead for specialist testing by an Occupational Therapist. This differential approach may have prevented the researchers from finding an association between health status and driving skills. Law enforcement was the main source of reports in this study (63%). Other sources included physicians (23%), family members or friends (8%), and other health professionals (3%). In 54% of the law enforcement reports, mention was made of a crash or observed driving behavior suggestive of impaired driving skills. The pass rate on testing was higher for drivers reported by health professionals compared to law enforcement officials. Overall, approximately 50% of all reported drivers failed the road test.

Utah has a specific driver assessment program for persons with certain medical conditions, but entry is based on self-reporting. Drivers are categorized by medical condition or functional ability. In a recent study, drivers were further stratified based on whether they had license restrictions. Medical conditions were then linked with the Utah Crash Outcome Data Evaluation System (CODES). Crash rates were significantly higher for patients with diabetes, cardiovascular disease, neurological disease, epilepsy, psychiatric illness, and visual acuity. The magnitude of the increase was judged as moderate with odds ratios in the 1.5-2.5 range. Some drivers with combinations of diabetes or musculoskeletal diseases with other illnesses were found to have increased crash risk or at-fault crash risk (DOT, 1999).

Some physicians have raised concerns about mandatory reporting, suggesting that it violates privacy, compromises their ability to counsel patients without immediate punitive action, and is detrimental to the doctor-patient relationship. Mandatory reporting has the potential to discourage patients from visiting a physician or disclosing their illness. This could result in under-diagnosis and/or under-treatment of some medical conditions. Although reasonable, this concern appears to be anecdotal and evidence is not available at this time.

Some states, such as Missouri, provide legal protection (i.e., civil immunity from prosecution) to health professionals who breech confidentiality to report a patient to the DMV. However, many do not. Of the 43 states with voluntary reporting laws, 18 currently do not protect reporting health professionals in this way. In a survey sponsored by NHTSA, state licensing representatives identified the granting of immunity from civil liability as a top issue for enhancing medical oversight of driving

fitness (Lococo & Staplin, 2004). In some countries (e.g., Australia), all reporters to the DMV acting in good faith are protected from civil prosecution (Odell, 2005).

Studies have shown that physicians have poor knowledge of fitness to drive requirements or are aware of what constitutes an adequate medical report to the state. Despite structured forms, many physicians are unaware of what tests they should perform to determine license eligibility (Kelly et al, 1999; Marshall & Gilbert, 1999). Another study documented that inter-rater reliability was low when different doctors filled out medical reports on the same patient (Steir, Kitai, Wiener, & Kahan, 2003).

Family members are an important source of information for identifying at-risk older drivers (Lloyd, Cormack, Blais, Messeri, McCallum, Spicer, & Morgan, 2001; Messinger, Rapport & Rader, 2000). Unfortunately, the civil immunity protections offered to health professions in many states do not extend to other groups, such as family members (Federal Highway Administration, 1997). Some countries require a medical report from a physician for both new licensees and renewals (over age 70 years in Finland and some states in Australia). These reports require that physicians describe medical conditions and any functional impairment that could adversely affect driving ability (King, Bendow, & Barret, 1992).

In addition, some studies have indicated that older drivers reported for driving re-evaluations by law enforcement are more likely to fail tests or lose their license in comparison to those reported by health professionals. The higher pass rates of drivers reported by physicians may reflect limitations/barriers that physicians face when trying to assess driving abilities during routine office evaluations (Fitten, Perryman, Wikinson, Little, Burns, Pachana, Mervis, Malmgren, Siembieda, & Ganzell, 1995; Johansson et al, 1996), or they may highlight the challenges inherent in linking medical status with actual driving performance. Insufficient time and information may lead to sub-optimal reporting on medical fitness to drive forms. Administration of specific screening measures known to correlate with crash risk may ultimately be a better way to identify the unsafe driver (Ball et al, 2006; Staplin, 2005).

Currently, cognitive test batteries have not been developed to the point where they can replace performance-based, on-road tests for determining driving competence (British Psychological Society, 2001; Withaar, Brouwer, & Van Zomeren, 2000). Road tests have high face validity and so are more acceptable to the person being assessed (Korteling & Kaptein, 1996). Performance-based testing will continue to be a major component of driving competency assessment well into the future (Withaar et al, 2000). However, there is continued hope of developing a battery of tests that can predict road test failure and research efforts are on-going in this area (Charlton, 2002). The AAA Foundation for Traffic Safety emphasizes the importance of such work in a recent proceedings paper on driver licensing and medical review (Molnar & Eby, 2008).

1.5 License Renewal

Most states have the same license and renewal processes for all age groups (see Appendix A). Most states require that drivers renew their licenses every 4-5 years. However, seven states have a six-year renewal, four states an 8-year renewal, two states a 10-year renewal, and one state has no renewal requirement until age 65. Fourteen states require accelerated renewal for older drivers, beginning from age 61 years to 81 years, with the length of the accelerated renewal cycle ranging from 1 year to five years. One state actually has decelerated renewal for older drivers with no renewal required after age 65.

There has been a trend towards lengthening the renewal period (Molnar & Eby, 2005). Seventeen states have other special renewal provisions for older drivers, including requirements for in-person renewal, vision tests, or other certification (e.g. written and road tests, medical certification of fitness). Thus, a minority of states have requirements for more frequent vision and/or road tests for older adult drivers who desire a renewal of their license (Morrisey & Grabowski, 2005). There are a variety of options that can occur due to the special renewal provisions of older drivers. These include: license renewal, revocation or suspension, restriction, or shortening the renewal cycle.

There is some evidence to support vision testing during license renewal for older adults. Shipp compared occupant motor vehicle fatalities for those over age 60 years in states with and without vision-related re-licensing laws. He concluded there would be a 12.2% reduction in fatalities if the majority of states were to adopt such laws (Shipp, 1998). However, the issue of simply examining the effect of in-person renewal was not explored independently of vision testing, as was done in the Grabowski study (Grabowski, Campbell & Morrisey, 2004). This study concluded that in-person license renewal over the age of 80 was the only intervention associated with a safety benefit.

Lange and McKnight investigated the effect of renewal testing by comparing the accident rates of older drivers in Indiana and Illinois (which require vision, knowledge, and road testing at age 75) with similar controls in states that do not have age-based testing (e.g., Ohio and Michigan). In states that had age-based testing, there was a 7% reduction in crash-related injuries, but an increase in at-fault singlevehicle accident rates (Lange & McKnight, 1996).

Another study examined the effects of license renewal timing, visual acuity, knowledge, and on-road test results relative to older driver fatalities. The researchers concluded that tests of visual acuity were associated with lower fatal crash risk for older drivers (Levy, Werrick & Howard, 1995). Routine road testing for the general older adult population was not found to be useful. Utilizing data on drivers up to age 75 in Illinois, researchers examined the effects of a reduction in the license renewal period and a related reduction in road test requirements for renewing drivers. Comparison of data from before to after the new policies were enacted, revealed no effects on frequency of crashes, fatal crashes, crash rates, or licensure rates of older

drivers. Although there is little data to support road testing for the general older adult population during license renewal, these types of requirements along with vision testing have been noted to decrease license renewal rates (Levy, 1995).

More recent studies have also raised skepticism concerning the efficacy of routine screening during the license renewal process (Grabowski & Morrisey, 2001). State-required vision tests, road tests, shorter intervals for license renewal with age, and in—person renewal were not associated with reductions in crash risk for adults age 84 and younger in a large scale national study (Grabowski, Campbell, & Morrisey, 2004). Only for those in the oldest-old group (85+ years) was there a reduction in crash risk, but only with regards to in-person renewal. Requiring the oldest-old to renew their licenses at the counter might cause some to think twice about doing so, especially those with medical-functional problems related to driving. For others that do arrive at the counter, the interaction with license office staff could trigger a referral for medical review pursuant to observations of deficit (e.g., serious vision loss, inability to stand or balance).

In Australia, the different states have varying requirements for older adults, ranging from no license renewal requirements, all the way to mandatory vision, on-road testing, and/or physician evaluation (Fildes et al, 2000). One study in Australia found similar crash rates between states with very different requirements, indicating no demonstrable safety benefits for mandatory assessment programs for the general older adult population (Langford, Fitzharris, Newstead, & Koppel, 2004). Consistent with the above findings was a comparison study between Finnish and Swedish licensing practices. Finland requires regular medical evaluations starting at age 70 for license renewals, whereas Sweden has no age-related requirements. The Finnish program was not associated with a reduction in crash rates, and Finland actually had higher pedestrian fatality rates (Hakamies-Blomqvist, 1996).

In-person renewal and more frequent testing impose significant financial costs on states and even on individual drivers. If licenses are revoked, older adults may face restricted mobility which can lead to isolation, depressed mood, and even physical deterioration. It is estimated that each roadway death or serious injury costs upwards of \$1,000,000 (Blincoe, Seay, Zaloshnja, Miller, Ro mano, Lucther, & Spicer, 2000). This financial burden and the social costs to individuals will need to be carefully weighed against the actual *added value* or benefits of improved public safety (Miller & Levey, 2000).

1.6 Evaluation Questions

This evaluation project addressed a number of questions concerning reported individuals, those initiating reports, the health status of reported drivers, their problematic driving behaviors, the testing procedures employed to determine continued license eligibility, licensing outcomes, and roadway safety as measured by crash history. Key questions for this descriptive study are summarized as follows:

- What groups utilized the provisions of HB-1536 to report medically unfit drivers in Missouri during 2001-2005?
- What were the characteristics of these reported older drivers?
 - **Demographics**
 - Medical Status & Behavioral Presentation
 - Unsafe or Problematic Driving Behaviors
- What diagnoses and conditions were of greatest concern? Were some conditions under/over-reported?
- What were the outcomes for reported drivers at each step in the evaluation process towards a final licensing decision?
- What were the retrospective and prospective crash histories of those reported in 2001-2005?

Section 2.

Method

2.1 Data Collection & Processing

This two-year project was undertaken in two phases: (I) six-month "feasibility" phase whereby data acquisition and analysis procedures were tested on a pilot sample; and (II) eighteen-month data acquisition and analysis phase. All key data definitions, coding and acquisition methods were developed during Phase I with cooperation and input from DOR officials.

Figure 1 depicts the HB-1536 reporting process and the primary data sources available for this project: report of a fitness concern, physician evaluation findings, on-road testing information and observations, licensing outcome, and crash history (see Section 2.3). HB-1536 was implemented in 1999, but did not become well established in terms of procedures and regular reporting until 2001. The years 2001-2005 were the focus period for data collection. Most forms utilized in the HB-1536 process included both quantitative entries (primarily check boxes for important driving behavior and medical issues) and space for qualitative comments and notes.

From January 2001 through December 2005, 5,362 drivers were reported to DOR as potentially unfit to drive. The majority of these, 4,987 (93%), were age 50 and older at the time of report, and 4,134 (83%) were age 70 and older. Data collection focused on just those 50 and older, and material from 4,100 cases (87% of the total) were reviewed and entered. The research team was unable to review the other 13% due to time and resource constraints. The characteristics of the reported sample and a matched control sample are described in Section 3 below.

Forms available for this project are listed and summarized in Table 3; and samples are reprinted in Appendix B. Most reports under HB-1536 were submitted via one of two written forms: the Driver Condition Report (Form 4319) and the Possible Driver Impairment Notification (Form 153). Form 4319 may be submitted by anyone, but primarily is used by law enforcement officers, family members, and non-physician health and service professionals. Form 153 is completed by license office staff for HB-1536 purposes or to suggest that a license restriction be considered. Data were not available for this latter purpose. As noted in Table 3, 52% of cases had Form 4319 on file and 26% had Form 153. Less than 2% of the total case sample had both of these forms submitted.

A total of 1,881 cases had a Physician Statement (form 1528) on file. If a physician submitted a report using Form 4319, the DOR often accepted this form in lieu of the Physician Statement (Form 1528), but in some cases Form 1528 was requested if important information was lacking on Form 4319. Of the 203 cases with physician-initiated 4319 forms in our sample, DOR officials accepted this form for decision-making purposes in 147 (72%) instances. Conversely, if a physician reported a driver using Form 1528 initially, the DOR most always accepted this for decisional purposes. This was the case in 516 (27%) of the 1,881 cases with Form 1528 on file.

Documentation for those reported under HB-1536 are maintained and stored at the DOR offices in Jefferson City, the capitol of Missouri. While certain limited information was available via the computerized Missouri Driver Record (i.e., a basic system to track all current and former licensed drivers), most data for this project had to be retrieved by hand from one of two archival sources based on receipt date: images on microfilm (received 2004 & earlier) and scanned images (2005+). Documents for a single case were often distributed across 3-5 separate rolls of microfilm. Case files were "built" by:

- a) Identifying document tracking numbers from a master catalog provided by DOR officials;
- b) Viewing source documents of various types on computer or projection screen;
- c) Sending pertinent documents or pages to a network printer;
- d) And, finally, stapling all pages into case-specific packets for later review and hand entry.

Approximately 15,000 document pages were reviewed and printed for packet inclusion and data entry. Code numbers were assigned to each packet for confidential tracking and data analysis purposes. Only coded, de-identified data were taken off-site for analysis.

An integrative data entry system was programmed in Microsoft Access during Phase I, with screens designed to mirror the appearance and content of key forms. Quantitative and qualitative data were collected by trained raters (i.e., members of the research team, including graduate students) guided by a detailed *Data Acquisition Manual*. Screen shots showing the database entry pages are provided in Appendix C. The team gathered as much data as possible, entering over 500 separate variables. This report focuses on just a portion of these variables. Three Tablet PCs were employed in the hand entry process, and data tables were later merged and transferred to SPSS for final coding and analysis. The average time to build a case packet and hand enter the data was ~20 minutes from start to finish; thus, the 4,100 case sample required ~1,350 person hours to generate.

2.2 Qualitative Coding & Inter-Rater Reliability

During Phase I, a pilot set of 389 case packets were gathered for individuals reported during the month of July in years 1999-2005. This pilot sample provided a helpful time distribution across the life of the reporting law, while keeping the number of cases manageable. A subset of 150 cases (i.e., those randomly numbered 1-150) formed the content base for qualitative code development. Figure 2 summarizes the code development process. A grounded theory approach to coding was employed (per Strauss & Corbin, 1998), using real case material as a base, while building in clinical and literature-derived codes for consistency with pre-existing standards. Most qualitative information in these pilot cases fell into three categories:

- a) Medical conditions (i.e., as reported by physicians, family members, others)
- b) Problematic driving behaviors (i.e., as observed by driver examiners, police, others)
- c) Behavioral observations (i.e., how a driver looked and acted)

Sample codes are shown in Table 4. Screen shots of the full qualitative entry pages are reprinted in Appendix C.

Other data from pilot cases (i.e., those numbered 151+) were utilized during Phase I to test the data entry process, determine inter-rater agreement, and make database modifications to enhance standardization. This process is also summarized in Figure 2. Additional efforts towards standardization were conducted on-site at the DOR Offices during the 9-month data collection period. These efforts included formal and informal training of raters and over-the-shoulder supervision from the two Principal Investigators (Meuser, Carr).

During Phase II, a second double entry process was undertaken to determine inter-rater reliability. Three hundred cases were selected to proportionately represent the contributions of members of the hand entry team. We focused on cases containing the Driver Condition Report (Form 4319; see sample in Appendix B), as this form included both qualitative and quantitative data of all types. Forms were assigned to other members of the team, and these were entered as "new" cases in a clean copy of the database. The two samples (original vs. second entry) were then compared. Qualitative comparisons focused on primary, summary categories only. For example, if Rater 1 listed "Dementia, NOS" and Rater 2 listed "Alzheimer's Disease", these were considered as falling under the same Cognitive/Dementia umbrella. Percent agreement was strong for both quantitative (94%) and qualitative (96%) entries. Cohen's Kappa was calculated, and acceptable levels were achieved in each case: 0.72 and 0.87 respectively.

In preparing for this summary report, the data coding structure was reduced to a core set of observations in the areas of medical status, problematic driving behaviors, and behavioral observations (listed in Table 5). Related quantitative and qualitative variables were merged, when possible, to create this menu of 22 summary variables.

2.3 Statewide Accident Reporting System

A particular strength of this project was the ability to link the identities of reported drivers with a state-of-the-art crash database maintained by the Missouri State Highway Patrol: the Statewide Traffic Accident Reporting System (STARS). As in other states, police and highway patrol officers in Missouri complete detailed reports concerning crashes involving death, injury, or property damage in excess of \$500. Over 200 separate crash variables may be entered or generated, including specific details of the crash itself, injuries and deaths, and road and environmental condition information. STARS data in which the reported individual was the driver were obtained for both reported and matched control samples, and included crashes from January, 1993, through the first quarter of 2007. Full crash data were available through 2006, and some figures end with this year. Crash involvement, timing, and severity are the focus areas for this report. The full range of crash data will be examined, in time, through a series of journal article submissions.

The STARS data made available for this project did not include a clear determination of driver fault status, hence crash involvement and related findings are presented without this characteristic (i.e., at-fault and not-at-fault crashes are together). Whether at-fault or not, however, it is reasonable to consider that drivers can (and surely do) avoid or become involved in crashes as a result of their overall driving fitness. Although a driver may not have caused a crash, could that driver have avoided it if more fit behind the wheel? Our data cannot address this issue, per se, but it is nonetheless an important consideration.

In many instances, reported drivers with a crash history identified in STARS also had a Form 4319 on file from a law enforcement source. Form 4319 includes a check box labeled "Caused Traffic Accident/Incident" so some discussion of fault status is possible in this sample. Of the 1,997 individuals with a STARS crash record in our sample, 769 (39%) had a police-initiated Form 4319. The "caused" box was checked on 497 (65%) of these forms. Of the 2,103 individuals without a STARS crash history, 325 (15%) had a police-initiated Form 4319 in their files. The "caused" box was checked on just 120 (37%). Due to variations in form dates and other factors, it was not possible to link STARS and 4319 data to create a unified and accurate "fault"

variable for analysis in this report. Rather, we report on fault status in a limited way and just using entries from Form 4319.

2.4 Statistics & Presentation

The purpose of this project was to describe and otherwise characterize the functioning of Missouri's voluntary reporting law for medically unfit drivers. Descriptive statistics and plots comprise the majority of analyses and findings presented in this first report. Mean differences were evaluated by use of T-tests and General Linear Model (GLM) equations with post hoc comparisons. Frequency differences were evaluated by use of nonparametric tests (e.g., Chi Square, Kolmogorov-Smirnoz Z). In response to the large sample size and the many comparisons involved, findings were considered as statistically significant only at the $p < .001^{***}$ level.

Quantitative data are presented in summary form and based on individual case characteristics. For example, in some instances it was possible to compare how different report sources responded to specific quantitative items on the same form. Qualitative data overlapped in many instances with quantitative data, and so qualitative responses were merged into summary variables as described in Section 2.2. As composites, these summary variables cannot be readily tied back to their specific sources. For example, in a specific case, the dementia composite would be positive if any quantitative or qualitative entry across all available data for that case indicated dementia.

2.5 Data "Keyed" to the Department Action Date

When a driver is reported under the provisions of HB-1536, the DOR initiates what is called a "Department Action" (DA) against the driver's license within weeks of receiving the report. A notification letter is mailed, and DA date is assigned and stored in the MDR database.

While, in theory, case files for all reported drivers should have included a document showing the report and when it was submitted (i.e., a report signed and dated by a police officer, physician, etc.), this was not true in practice. A few reporters did not date their forms. More often, a document page was missed or rendered illegible in the original microfilming or scanning process, making it difficult or impossible to determine an exact report date. Approximately 5% of all documents reviewed had such problems and about 10% of cases lacked a clear report date. To simplify and standardize our analyses for this presentation, the most recent Department Action date (DA-1) served as the de *facto* report date.

The majority of reported drivers (3,769; 92%) had just one Department Action against their license during 2001-2005. A handful (205; 5%) had two actions, and a smaller number (126; 3%) had three or more actions listed. We gathered information from the Missouri Driver Record on just DA-1 and DA-2 for this project, but did tally total actions. Of all drivers with multiple license actions, 110 (33%) were reported

twice in the same year during the study period (2001-2005). Another 67 (20%) were reported twice in different years during the study period. Of the remainder, 154 (47%) drivers were reported once during the study period and at another time before (i.e., in 2000 or earlier). The characteristics of multiply reported drivers will be described and examined in future publications from this dataset.

2.5.1 Data Collapsed Across Sources

When DOR officials make fitness determinations on reported drivers, all documents and sources of information are used. One case file might contain just a physician report, whereas another might include information from police, family and physician sources. As shown in Table 3, more than half of all reviewed cases lacked a Physician Statement (Form 1528), but that does not mean that medical data were not available. On the contrary, most case files contained some relevant medical information provided by family members, police officers, and other sources. Form 4319 was a significant source of medical information.

Unless otherwise specified, the medical, driving-related, and behavioral observation summary variables presented below were based on all sources (see Table 5). This is how DOR officials receive and treat the data (i.e., as a package), and this report follows the same approach.

In coding these variables, however, we gave preference to those groups with the most "expertise" for each specific area (i.e., from the perspective of DOR reviewers). Preference was given to physicians for medical data, to police officers and highway patrol examiners for problematic driving behaviors, and to license office staff for behavioral observations. All three of these preferences make sense, but the latter requires additional explanation. License office staff report drivers as unfit primarily after seeing them during license renewal. These interactions can last 5-15 minutes, and the reporting form they use (Form 153) is designed to capture their observations (and not medical or driving data as in other forms). License office staff received regular training concerning potential indicators of a driver fitness concern (at least until 2003 when License Offices were privatized statewide) and were guided by specific observational criteria (see criteria booklet in Appendix D).

SECTION 3

Results

3.1 Relative Contribution of Data Sources

Figures 3-5 show the relative contribution of each source in providing data in these three categories: medical, problematic driving behaviors, behavioral observations. When coding medical information, physician source material was

reviewed first. If a physician listed a diagnosis of dementia, for example, and this was also listed by a family member, the physician was credited as the originating source. Likewise, with driving information, if a police officer listed a problem with operational control of the vehicle and a family member did, also, the police officer was credited as the source. Credit was given to the other source groups in a similar fashion, with family members reviewed second for each of the three data types.

Data points were aggregated across the sample, subdivided by source, and subtracted in an iterative fashion to generate these overall percentages. Individual cases varied widely in source composition, however, based on what forms were submitted and how they were filled out. The dataset is not coded to show relative percentages for individual cases at this time. Hence, the percentages in Figures 3-5 show merely overall composition for the sample.

As shown in Figure 3, just over half (53%) of the aggregated medical data available for DOR review came from physicians. Family members and police provided 19% and 12%, respectively. To focus only on medical data provided by physicians would be to miss nearly half the story.

In the case of problematic driving behaviors (Figure 4), most information came from police and driver examiners (72%). Only a handful of physicians provided any driving-related information, and so their data were collapsed into the *other* category for this presentation. Behavioral observations (Figure 5) were distributed more evenly across sources, as one might expect. License office staff provided the most observational data (36%), followed by police and driver examiners (29%) and family members (16%).

In summary, Missouri's voluntary reporting mechanism relies on many data sources. Some sources are dominant based on their position and/or expertise (i.e., physicians for medical, police for crash data), but lesser sources still provide tangible data in certain areas.

3.2 Samples

The sample frame for this project was all drivers, aged 50 and older, when first reported as potentially medically unfit to drive during years 2001-2005 (n = 4,987). Birth years ranged from 1896-1955 in this group. Just one reported individual was born before 1900, however. As noted above, 87% of these cases were subject to full records review and this sample is described further in Section 3.2.1 below.

Officials from the DOR and Missouri State Highway Patrol (MSHP) cooperated in linking basic MDR information (name, social security number, birth date, gender, living status, license type) with STARS crash data, resulting in the development of a control sample pool of 64,663 unreported drivers born 1900-1955.

This nonrandom control pool was generated based on birth date ranges - the only procedure that was workable for DOR system analysts without extensive reprogramming - and was completed in three steps by DOR officials:

- a) All licensed drivers born July 1-5, 1900-1955, were extracted from the MDR. This yielded a large sample of drivers born after 1925 (n = 24,736), but relatively few from 1925 and before (n = 3,926). At this point, even a 1:1 match on gender and birth year was not possible for those born pre-1926.
- b) A second set of unreported drivers born on various dates from January through May, 1900-1925, was then extracted from the MDR. A total of 36,001 additional cases were identified.
- c) Identifiers from both control sets were forwarded to the MSHP and a coded spreadsheet of STARS crash variables was generated and returned to the research team.

3.2.1 Reported Sample

As noted above, due to time and resource constraints, the research team was unable to review documents for all reported cases, aged 50+ years, from 2001-2005. Instead, we sought to develop a representative group of cases following a quasirandom master code list provided by DOR officials. We set 4,000 cases as a target for review and finished with 4,100 cases. From a statistical standpoint, fewer cases could have been reviewed and the sample would have been representative. Since our Team had access to DOR files, however, we chose to gather as much data as our resources and time would allow (i.e., in case another opportunity would not occur). Figure 6 shows the number of reports per year under HB-1536, as well as the relative proportion of cases reviewed for this sample in each year. Proportionately more cases were reviewed for recent years: 2003-2005 (90%) vs. 2001-2002 (76%).

3.2.2 Control Sample

The control pool of unreported cases (n = 64,663) was sufficiently diverse to allow for a 2.8:1 match on gender and birth year with the 4,100 reported case sample. A 3:1 match was not possible because a few gender/birth year blocks required all available control cases to be used. Random numbers were generated and applied to cases in the control pool, and then these cases were ordered by year of birth, gender and random number. Gender blocks for each birth year were extracted up to the pre-determined match number. Demographic and crash data from the matched control sample (n = 11,615) were then merged with the reported driver data for the development of this report.

3.2.3 Comparing Samples - Reviewed, Not Reviewed & Control

Basic demographic, driver licensing and crash data available across samples are summarized in Table 6. Reported drivers were 55% male, with a median birth year of

1922, and a mean age at first report of 80 years. The majority (95%) possessed standard Class F, non-commercial driver licenses. Few (8.7%) had prior convictions for traffic violations. Two thirds (62%) were listed as alive when this information was obtained in 12/06; in other words, total mortality was 38% through 2006. Two thirds (68%) lived in urban areas when last licensed to drive. Almost half (49%) had a positive crash history (i.e., at least one crash as a driver in 1993-2007) – one fifth with multiple crashes – and a full third (33.5%) had at least one crash proximate to the reporting period. One third (31%) had a recent crash within 0-6 months of the Department Action 1 (i.e., report) date. Just one quarter (26%) of these drivers were directed to participate in on-road testing through the MSHP, and a smaller portion of these actually participated. In the end, only 3.5% of reported drivers retained a valid license subsequent to the HB-1536 process, and just 2.4% of drivers listed as living in 12/06 held a valid license. In contrast, 67% of living controls held valid licenses. The vast majority of drivers reported under HB-1536 from 2001-2005 were de-licensed.

Drivers reported in 2001-2005, but not reviewed for this study, differed from those reviewed in a few areas. They were born earlier, but were of similar age when reported. There were somewhat fewer males in this group (53% vs. 55%), and mortality was higher, such that only half (49.5%) were alive in 12/06. Of those living, however, a higher percentage (3.5%) held a valid license to drive. Also, fewer of these drivers (5.7%) had a history of convictions. This group was equivalent to the reviewed sample in terms of crash history, however, suggesting that they weren't necessarily safer or more capable drivers. Although significant in a statistical sense, these differences are modest in magnitude; and exclusion of un-reviewed cases should not impact meaningfully on the overall findings.

As shown in Figure 7, reported cases did not differ meaningfully by age group based on whether or not they were reviewed for this study. The proportions by age were essentially the same. An age comparison is not possible for the control sample, as there was not a date upon which to fix age. Matching on birth year solves this problem.

As might be expected, mortality was lowest in the control sample, with 67% listed as still living in 8/07 when final control data were obtained. Crash indicators were roughly half or less in the controls when compared to either reported sample. Only 12.4% of control drivers were involved in a crash during the reporting period in comparison to 33.5% of the reported drivers in the reviewed sample.

Table 7 shows gender differences across the three samples. Mortality was greater in males across samples. Less than four in ten (39%) of reported males not reviewed for this study were alive, suggesting that this subgroup had poorer overall health. Across samples, males also had more convictions than females and were more likely to have been involved in a crash when driving. Living males were more likely to retain a valid license to drive, however, with the highest proportion (4.5%) in reported cases not reviewed for this study. Although it is not shown in the table, there were no differences in requirement for participation in on-road testing between

genders. Males and females were referred and presented for testing in similar proportions.

All findings reported from this point on are based on the reviewed case sample (n = 4,100) and/or comparisons with matched controls. In the instances where frequency counts are presented, it is important to recognize that a smaller proportion of available cases were collected from years 2001-2002 (76%) vs. 2003-2005 (90%).

3.3 Source of Report

What groups utilized the provisions of HB-1536 and filed reports in 2001-2005? Figure 8 shows the breakdown of reports by source. The largest number of reports were submitted by police and highway patrol officers (30%), followed by license office staff (27%), physicians (20%), and family members (16%).

In cases with multiple report histories, the role of first reporter was assigned based on a review of form dates. Some multiply-reported cases had just one report form scanned to microfilm. The individual completing this form (if identifiable) was coded as the report source. Otherwise, when two or more reports were available, the individual completing the report dated first after the start of the review period (i.e., 1/1/2001) was defined as the initial source. The authors recognize that this classification is not perfect, but this method seemed reasonable given the quality of available data and objectives of this report.

As noted earlier, 2,028 reported drivers underwent medical evaluation, most of these by choice after receiving a notification letter from the DOR. A substantial minority did not choose and pursue medical evaluation, however. One third (663 of 2,028, 33%) were actually reported by their physicians, and in most of these cases no additional medical evaluation was required by the DOR. In other words, the first two steps in the HB-1536 process (reporting, medical review) occurred at the same time. These reported drivers did not have to arrange separate evaluations with their physicians as those reported by other stakeholders might. The physician report allowed an immediate determination to test or revoke.

Figure 9 shows the frequency of these reports by year. All sources show an upward or at least stable trend over time, with the exception of reports from license office staff. After reaching a peak of 264 reports in 2003, by 2005 just 165 reports were submitted - a decline of 38%.

Examination of the relative proportion of reports by source and year adds to this picture. As shown in Figure 10, physician reports were similar to or below the other groups through 2003, but later made up the largest proportion in years 2004-2005. The proportion of reports from family and police largely stabilized in these final two years, with the exception of those coming from license office staff, as noted above. This increase in physician reporting correlated in time with a significant educational outreach effort in Missouri (Meuser et al, 2006).

3.3.1 Concerns Motivating Reports

What issues or concerns motivated people to submit reports in 2001-2005? The Driver Condition Report (Form 4319, see sample in Appendix B) is the recommended reporting form for all sources, with the exception of license office staff. The latter utilize an open-ended, observation-based form (Form 153, see Appendix B). Form 4319 includes check boxes for a variety of driving-related and medical concerns. Table 8 shows the relative frequency of these concerns as a function of report source: family member, police, and physician. Motivating concerns differed meaningfully between these groups.

With respect to driving, as Table 8 shows, police were especially concerned with those causing crashes (56%), committing traffic violations (50%), and otherwise exhibiting poor/dangerous driving (50%). When family members did express a similar concern, it was more likely to focus on poor/dangerous driving (39%) and/or lack of attention (38%). Few physicians reported concerns in any of these areas.

Those completing Form 4319 may make a causal attribution concerning a crash or on-road incident. This incident could be recent or long past. As noted above, this attribution is separate from crash data available through the Missouri STARS database, and sometimes inconsistent. Table 8 includes two relevant percentages from STARS focusing on these sub-samples: overall and recent crash involvement. In general, police complete Form 4319 in response to recent events. The 21% difference between the 4319 and STARS data (56% minus 35%) is curious, and may reflect that not all police reports were for recent crashes of sufficient magnitude for inclusion in STARS. Although physicians reported relatively few causal attributions, their attributions line up favorably with recent crashes from STARS. It is likely that attributions from family members involved a mix of recent and past events.

A different pattern was seen with medical conditions. When physicians initiated a report using Form 4319, they expressed concern about cognitive impairment and dementia in fully 65% of cases (Table 8). Family members were similarly concerned about dementia (57%), but also provided information about other conditions, including limited mobility (36%). Police reported relatively few concerns in any of these areas.

Table 9 summarizes the main categories of concern expressed by license office staff in their written observations. An observed problem with balance/ambulation was a significant motivating concern in one third of cases (33%), followed by an appearance of confusion (15%) and appearance of frailty (15%). These observations closely mirror the guidelines for identifying potentially unfit drivers provided to license office staff by the DOR prior to 2003 (see Appendix D and Discussion).

3.4 Medical Status of Reported Drivers

What diagnostic categories and medical conditions were represented in the reviewed case sample? As shown in Table 3, just under half of drivers in this sample (46%) had a Physician Statement (Form 1528) in their case file. Whether reported by a

physician or someone else, failure to complete this required step in the HB-1536 review process is sufficient grounds for license revocation. Once notified, reported drivers had 30 days within which to see their physicians and submit Form 1528. A 30-day extension is granted to anyone requesting it, but most probably do not know to do this.

Whether by choice, circumstance and/or mortality, females were more likely to drop out at medical review than males (57% vs. 52%), and thus move into driving retirement. Conversely, males were somewhat more likely than females to have completed the medical evaluation step (48% vs. 43%).

Other source documents (notably Form 4319) provided medical data, also, thus allowing for some cross-group comparisons. The number of primary health conditions ranged from 0-8, with a mean of 1.6 and a standard deviation (SD) of 1.3. Figure 11 shows number of health conditions by gender. Females had fewer primarily health conditions overall (mean = 1.4 vs. 1.7), although some of this difference may be explained by their lower physician evaluation rate. Surprisingly, no difference was found between number of health conditions and age.

Table 10 shows the frequency of primary medical conditions in this sample of reported drivers. *All source* and *physician only* data are shown in separate columns. Conditions ranked similarly from most frequent to least based on source, led by dementia in each case.

Table 11 shows the eight primary medical condition categories, rank ordered by frequency. Listed under each category are the specific health conditions hand written in by physicians, family members, and others. As shown under Dementia & Cognitive Impairment, Alzheimer's disease was the most frequently recorded diagnosis, accounting for 23% of such cases. More often than not, however, respondents merely checked this category on Forms 1528 or 4319, and did not provide a specific diagnosis. Except for the Cardiac and Brain categories which lacked their own check boxes, the majority of endorsements were non-specific as to diagnosis.

3.5 Crash History in Reported vs. Control Samples

How did reviewed cases compare with matched controls in terms of crash history and indicators? Just under half of the reported sample had a positive crash history (i.e., at least one crash as driver) from 1993-2006. Fault status was not available, so these data include both at-fault and not-at-fault driver events. Table 12 shows the frequency counts. Most reported drivers (79%) had one or no crashes during this period. One in five (19%) had 2-4 crashes, and a handful (2%) had an amazing 5-11 crashes. The majority of these crashes (98% of the total number of crashes) occurred before the driver was reported under HB-1536, suggesting little driving post license revocation.

Crashes did not differ in severity between reported and control drivers. We compared crashes closest in time to the DA1 date in reported drivers to most recent

crashes in controls. High severity crashes were those involving a fatality or a major disabling injury per police designation. All others were considered of low severity. Six percent of reported driver crashes were of high severity vs. 5% in control drivers. This difference was not statistically significant. Two-vehicle incidents were prominent and statistically similar in both groups: 78% reported vs. 82% controls. For both groups, the same proportion of these crashes (32%) occurred at intersections.

As noted in Section 3.2.2 above, men were more likely to have had a crash as a driver than women. Among those with a positive crash history, men had a higher mean number of crashes of 1.83 vs. 1.61 for women (p < .001, T-test). Figure 12 shows the percentage of each gender involved in crashes over time. A greater percentage of men were involved in crashes every year in the measurement period, and this pattern was also true for controls (not shown).

Figures 13 and 14 show involvement in at least one crash by birth year decade. Figure 13 covers the full 1993 - early 2007 period, whereas Figure 14 covers crashes proximate in time to the reporting period for this study (2000-2006/7). Crash history in reported drivers was double (or more) that of controls. A U-shaped curve is shown in Figure 13, such that there was a greater history of crashes among younger (~50-60) and older (85+) age groups, but just in the reported driver sample. History of crash tailed off amongst controls in both Figures 13 and 14 as age increased.

Figure 15 shows involvement in at least one crash by year and birth year decade for reported drivers (a) and controls (b). Significant variability is evident in the oldest driver group (i.e., those born 1896-1905) in both samples, likely due to small sample sizes and high mortality. The other birth groups (Figure 15a) increased beginning in 2000 and declined by 2004. There was more annual variability in crash involvement among control drivers, especially for the youngest age group (i.e., those born 1946-1955). With just a few exceptions, however, the overall annual crash involvement of reported drivers was approximately double that of control drivers across the birth year spectrum.

Possibly the most telling and important graphic is Figure 16. This shows the percentage of drivers involved in at least one crash for years 1993 - early 2007. The crash involvement percentage for reported drivers started at 4% in 1993, jumped to over 9% in 2001 when reporting began, and dropped steadily due to mortality and driving retirement to under 1% in 2006. Control drivers started at a 3% annual rate and gradually declined.

Table 13 shows total and mortality-adjusted crash involvement percentages for both samples. In 2002, 9.3% of living reported drivers were involved in crashes vs. just 2.2% of living control drivers; a fourfold difference in crash involvement between groups. Even in 2005, the adjusted crash involvement for reported drivers was still more than twice that of control drivers (3.8% vs. 1.7%). It was not until 2006 (i.e., after the reporting period) that the lines crossed, such that more control drivers were involved in crashes. Characteristics of the one crash most proximate to the Department Action 1 (DA1) date (i.e., when a driver was reported) were isolated for focused analysis. Figure 17 shows the relative proportion of crashes before and after DA1 date. One third of these crashes occurred within 0-6 months before DA1, and just 5% of proximate crashes occurred after. The majority of crashes occurred 7+ months before the Department Action.

Table 14 summarizes the key characteristics of proximate/recent (0-6 months) vs. older/remote (7+ months) crash events. Proximate crashes involved drivers that were older, with more listed health conditions, and fewer diagnoses of dementia. Drivers in proximate crashes were more likely to have been viewed as causing the crash (66% vs. 19%; derived Form 4319 responses), and these recent crashes involved a disproportionate number of fatal and disabling injuries. Proximate crashes were somewhat more likely to be single-car events, and involve hitting a fixed object or parked vehicle. Lane usage (e.g., improper passing, driving on wrong side of road) and improper turns were more frequent in proximate crashes, also. Drivers involved in proximate crashes were also more likely to have a passenger with them, which may partly explain the disparity in injury severity (Table 1; see mean number of additional occupants).

3.5.1 Crash History by Medical Condition

Did crash history vary by diagnostic category? Yes, but the available data cannot determine if the diagnostic category differences were causal factors in a crash, or merely a reflection of report status (i.e., the presence of the disease motivating a report). With this caveat, the data are provided for review purposes and in support of future research in this area.

Figure 18 shows driver crash history for the most frequent disease categories reported in this sample. The relative proportions in each disease category are surprisingly similar between groups: no documented crashes vs. 1+ crashes. Dementia status was the same in both groups. The only significant difference was in those with a musculoskeletal/neuromuscular condition, such that 31% were represented in the no crash group vs. 25% with a positive crash history.

Figure 19 and Table 15 show annual crash involvement by disease category. Persons with a Disorder of Consciousness or Cardiac Condition had the highest average crash involvement of 6.2%, whereas those with a Musculoskeletal Condition or Brain Injury/Stroke had the lowest at ~5%. Annual crash involvement increased over time for each condition, peaking for all at the start of the reporting period in 2001, and declining afterwards as individuals were reported, retired from driving, and/or died.

Figure 20 compares reported drivers based on dementia status (listed diagnosis vs. no diagnosis) to controls. The crash involvement for reported drivers were essentially the same regardless of dementia status, except for slight elevations for demented drivers in 2001-2002. Regardless of dementia status, reported drivers began in 1993 with a higher annual crash involvement percentage; the gap widened

substantially to midway through the reporting period; and the lines crossed finally after most had retired from driving or died in 2006.

3.6 Differences in Driver Characteristics Based on Report Source

How did reported drivers differ based on report source? Table 16 shows differences in location, crash history, and observed behavioral characteristics of reported drivers as a function of report source. Drivers reported by family members tended to be slightly older, to show behavioral signs of confusion, forgetfulness and frailty, and to have a relatively low recent/proximate (19%) crash history. In contrast, drivers reported by police had the highest total (72%) and proximate (47%) crash histories, but the fewest listed behavioral indicators. Drivers reported by physicians also had relatively low proximate (19%) crash histories, and they tended to be slightly younger. Physician reported cases had few listed behavioral indicators, also.

Drivers reported by license office staff were quite different in a number of respects. They were more frequently from urban locations and to show signs of balance/ambulation problems (33%), confusion and physical frailty. What stands out most, however, was their low total and proximate crash histories. Just 10% of those reported by license office staff had a crash within 6 months of the DA1 date.

Table 17 shows differences in disease categories as a function of report source. Drivers reported by family members had the highest mean number of health conditions (2.3) and were somewhat more likely to have dementia (74%), vision loss (43%), alcohol abuse (5%), and cardiac diagnoses (18%). Drivers reported by police officers had the lowest levels of alcohol or drug abuse (<1%). Like those reported by family members, drivers reported by physicians had a high rate of dementia (75%). Those reported by license office staff had the lowest mean number of health conditions (1.1) and only one third (38%) had a physician evaluation in their case file. Only 11% were listed as having dementia in what records were available, but a much larger proportion had a listing of a musculoskeletal or neuromuscular condition (34%). This latter observation corresponds with the observation of balance/ambulation difficulties noted above.

Finally, Table 18 summarizes differences in driving behaviors and attribution characteristics as a function of report source. Depending on report source, one fifth to one third of drivers were required to participate in on-road testing. Those reported by police were most likely (35%) to be required to undergo testing, whereas just 20% of those reported by License Office staff had this requirement. Drivers reported by police officers overwhelmingly showed poor operational control of their vehicles (70%) and a propensity for dangerous, crash-causing behaviors (58%), and these individuals had the highest rate of on-road testing participation (67%). Few problematic driving behaviors were listed for those reported by license office staff, likely due to their lack of opportunity to observe such behaviors.

3.7 Problematic Driving Behaviors by Medical Condition

Do reported problematic driving behaviors vary across disease categories? Table 19 shows percentages of problematic driving behaviors based on disease category. These categories are not mutually exclusive, as many reported drivers had more than one listed condition. Those with cardiac and consciousness conditions tended to have more medical co-morbidities, while those with dementia had the least on average.

Most did not participate in on-road testing, but those with cardiac and vision conditions were somewhat more likely to have done so. Only 13% of those with dementia and 15% of those with brain injury/stroke participated in on-road testing. The overlap between groups and varying rates of on-road testing make intergroup comparisons difficult. Poor operational control and dangerous/aggressive actions were the first and second most frequently mentioned observations, probably reflecting the preponderance of police reports.

Table 20 examines problematic driving behaviors in "pure" cases where the driver was reported to have just one medical condition. A full third of those with vision as their sole problem participated in on-road testing. Just a handful of those with brain injury / stroke (4%), disorders of consciousness (7%), and dementia (7%) did so. Again, poor operational control and dangerous/aggressive actions stand out as prominent observations within and across groups. For those with vision problems, committed traffic violations (27%), impaired attention (28%) and having caused a crash (32%) were also prominent. Having caused a crash was common in persons with disorders of consciousness (30%).

3.8 Other Physician Input & Recommendations

Once an individual is reported under HB-1536, he or she must arrange to undergo a medical evaluation and have a Physician's Statement (Form 1528) submitted to the DOR. Failure to do so leads to license revocation in <u>all</u> cases. In addition to reviewing and documenting health status (cognitive, psychiatric, consciousness, musculoskeletal, etc.), the physician must state if the primary health concern is *permanent*, if the *ability to operate a motor vehicle* safely is compromised, and whether *a written and/or on-road test should be conducted* to determine ongoing license eligibility.

Form 1528 asks physicians to define their care relationship with the reported driver: regular doctor or first-time evaluator. *Do reported drivers in Missouri "doctor shop" for a more favorable opinion?* Our data would suggest not. Most physicians that responded to this item identified themselves as the driver's regular doctor (87%). Those seeing their own doctor were more likely to receive a favorable opinion on safety (45% rated as capable of safe driving) in comparison to those seeing a physician for the first time (21% rated safe), which argues against doctor shopping for a favorable outcome.

Most physicians (95%) submitting Form 1528 either gave an opinion on safety and/or recommended certain testing. Table 21 shows these physician judgments

relative to license status and safety factors, as well as the most common health condition in this sample, dementia. Regardless of their judgment of safety, physicians rarely recommended that just a written driving test be administered. They showed a clear preference for on-road testing or a combination of both written and on-road testing. When unsure on safety (i.e., as indicated by no endorsement), physicians generally checked that a driving skills test should be administered (35%) or that both tests should be administered (40%).

Only one third of drivers that physicians rated as *capable* had dementia or cognitive impairment, whereas the large majority of those rated *not capable* (80%) had dementia. DOR officials rarely (8%) required drivers rated as *not capable* to complete the driving skills test (DST), but would often require such testing for drivers viewed by their physicians as safe (64%). Similarly, if the physician did not make an endorsement on safety, DOR officials required the DST over half of the time (56%). As with the full sample data presented earlier, fewer drivers participated in testing and just a tiny minority passed. For example, of those deemed *not capable* by their physicians, just 5 individuals (<1%) retained a valid license. Of those rated as *capable*, just 44 (7%) retained a valid license. Finally, it is interesting to note that crash history was similar across all three physician-rated groups. Physicians rated *as many* crash-prone drivers as *capable* as they did *not capable*.

Table 22 shows the distribution of primary medical conditions across these three physician-rated groups. Percentages show the proportion of individuals rated as capable of safe driving, not capable, or no endorsement, with each primary medical condition. In addition to a tendency to rate persons with dementia as *not capable (80%)*, physicians conversely tended to rate persons with vision (72%), cardiac (30%) and musculoskeletal conditions (45%) as more likely capable of safe driving (or at least in need of further testing).

3.9 Attrition from Initial Report to Final Licensing Outcome

Ultimately, it is the final licensing disposition that matters most for public safety (see Figure 21). Once Form 1528 is submitted to the DOR, an administrative decision is made to allow a driver to remain licensed, to revoke the driver's license, or to require the driver to take an on-road test (sometimes preceded by a written test) through the Highway Patrol. This testing is conducted at one of two dozen facilities statewide, and follows the same procedures as those used for new, usually teenage drivers. A series of standard maneuvers are performed in one's own vehicle with the examiner taking notes in the passenger seat. Test results are mailed back to DOR for a final determination on license status.

Drivers reported under HB-1536 may take the DST up to three times, but as many as six testing sessions may occur if written testing is included. Physicians can recommend just road testing or a combination, and DOR officials can also order one or both for other reasons. After three failures of the testing process, the driver can petition the Director of DOR for another attempt, but this is a rare occurrence. In 562 cases, testing was ordered pursuant to the reporting process under investigation in this study and contributed to subsequent licensing decisions. The following pass-fail pattern was found for Highway Patrol testing:

- Session 1 (n = 562) 14 (2.5%) Passing
- Session 2 (n = 417) 6 (1%) Passing
- Session 3 (n = 324) 4 (<1%) Passing</p>
- Session 4 (n = 49) 0 Passing
- Session 5 (n = 21) 0 Passing

Very few passed in each case, and some drivers chose to drop out after 1-2 attempts. Others were quite tenacious, however, and chose to go the full distance, and most of these failed three times.

Figure 21 shows how the HB-1536 process unfolded for drivers reported in 2001-2005, moving from a large sample (n = 4,100) through to a very small group surmounting all the hurdles and retaining a valid license to drive (144 individuals, 3.5%). Mortality certainly played a role in this process, as 38% of reported drivers were deceased when demographic data were obtained in 12/06, just one year after the end of the reporting period. Advancing illness and death were likely factors in why so many dropped out at each step.

Another interesting finding concerns those who chose to pursue a physician evaluation vs. those originally reported by their physician. Although 2,028 were evaluated by a physician during this process, a large number (663, 33%) were reported up front by their physicians and were not required to undergo any further medical evaluation. While many of those who chose to complete a physician evaluation (1,345 of 2,208, 44%) were required to undergo on-road testing, just a fraction (18%) of the non-choice group were allowed to proceed to the next step. Surprisingly, those reported by their physicians in this context were slightly younger (79 vs. 81), less medically compromised (1.9 vs. 2.4 conditions on average), and more likely male (62% vs. 55%) than their other-reported counterparts.

Section 4.

Discussion

This report presents key findings from a two-year, collaborative project to characterize the functional efficacy of Missouri's voluntary reporting law for medically unfit drivers, known as House Bill 1536 (HB-1536). While similar reporting laws exist in most states, relatively little is known about how these voluntary

mechanisms work in practice and enhance public safety. Are drivers with medicalfunctional fitness concerns effectively identified, reported, evaluated and, if necessary, de-licensed? Data from a sample of 4,100 drivers reported in 2001-2005 were collected, analyzed and compared to age/gender matched controls for this first in a series of planned reports. The Missouri experience - a success story in many ways - can serve as a point of comparison and a model for other states in the future.

Passed in 1998, HB-1536 provides a voluntary, legal process whereby concerned family members, police officers, physicians, and others can report a driver of any age for re-evaluation and possible license revocation. The reporter's identity is maintained as confidential, and HB-1536 provides civil immunity protection from prosecution for breach of confidentiality (i.e., when reporting a patient or client). HB-1536 is administered through the Department of Revenue (DOR) - Missouri's driver licensing authority - in cooperation with the Missouri State Highway Patrol (MSHP) which provides on-road testing services.

HB-1536 has received significant attention since passage as a "model" for other states (S. Suroff, personal communication, November, 2005). It emphasizes functional level over chronological age, provides important confidentiality and immunity protections, and has well-defined procedures and forms.

Overall, our data suggest that HB-1536 is an effective mechanism for the reporting and evaluation of potentially unfit drivers in Missouri. It is used by a variety of lay and professional stakeholders, but not necessarily in the numbers or proportions intended by the framers. Reports from law enforcement officers and license office staff were most frequent in 2001-2005, with substantially fewer coming from health professionals and family members (i.e., those more likely to recognize early fitness concerns). Nearly 1,000 reports were submitted annually during this period, a rather low number given Missouri's population and comparison reporting data from other states.

Although not specific to age, HB-1536 effectively functioned as an *older driver reporting law* in 2001-2005, and likely still does today. The majority of those sampled for this evaluation project (78%) were age 75 years or older at the time of report, and 15% of these were 90+ years. Many were frail or otherwise medically compromised (76% had at least one listed condition related to driving fitness), and more than a third (38%) were listed as deceased just one year after the reporting period. It is reasonable to conclude that many of those reported in 2001-2005 were nearing the end of *both* their driving *and* physical life expectancies. When required to submit medical reports and/or undergo testing, a substantial number of these individuals were found to have medical-functional impairments that called into question their fitness to drive. For these drivers, the reporting process served its intended purpose.

Another tangible finding is how crash history distinguished reported drivers from controls. Whereas both groups started with similar annual crash involvement in 1993, their curves diverged significantly thereafter, such that by 2001-2002 reported drivers had a four times (4x) greater crash involvement percentage vs. controls (9%

vs. 2%; see Figure 16). A full third of the reported driver sample had one or more crashes while driving within 6 months of the report date. Crashes and other on-road incidents (e.g., dangerous actions, moving violations) were investigated by police and highway patrol officers, and served as important motivators for reporting. Although a clear designation of fault could not be determined from our STARS crash data, the sheer magnitude of this difference suggests a compromised safety profile for many of these reported drivers.

Arguably the most important finding is how few individuals retained a valid license to drive at the end of the HB-1536 process. The vast majority (96.5%) of those reported as unfit were de-licensed and retired from driving - willingly or not - within weeks to a few months. Figure 21 summarizes attrition at each step. Of the 4,100 individuals sampled from reporting years 2001-2005, just 144 were licensed to drive following the HB-1536 process. Half failed to traverse the first hurdle of the HB-1536 process and submit a required medical evaluation form. Based on physician input, DOR officials revoked the licenses of 52% of the remaining individuals and required the others to participate in on-road testing. Even more chose or were forced by circumstances of life and/or function to drop out at this final stage. Just 14% (562) of those originally reported actually presented for on-road testing through the MSHP, and most (86% of these) failed in up to three attempts. In other words, the pass rate for Missouri's driving skills test - a test of operational skills primarily - was just 11% for those taking it.

Why did so few make it to the end and retain a valid license? This is a central question for discussion. The advanced age of some of these drivers, their health and functional status, and high mortality were likely all contributing factors. Many (45%) had progressive dementia or cognitive impairment - conditions that necessitate eventual driving cessation in just about all cases (see Carr, Duchek, Meuser & Morris, 2006). For some, simply receiving official written notification was probably enough to give up driving, while for others this notification may have initiated discussions with family members and/or health providers that motivated a decision to retire from driving. Only the most determined made it to the Highway Patrol Office for on-road testing.

Of course, the act of driving and a license to drive are two different things. We cannot say for sure that all of those de-licensed under this process stopped driving immediately, but the finding of mortality-adjusted crash involvement <1% for the year immediately after the sample period (2006) suggests that few were. The high mortality rate of this group suggests that some may also have had additional morbidity (e.g., stroke) and/or a change in level of care (e.g., nursing home placement) that may have also ended their autonomy and ability to drive. Unfortunately, our data cannot say what impact driving retirement had on these individuals and the quality of their subsequent mobility.

What do these findings say about HB-1536? In sum, they indicate that HB-1536 works as a package, as a combination of steps or hurdles: drivers viewed as unfit, many with potentially significant medical-functional compromise and history of

crashes, are reported and effectively de-licensed. With so few retaining a valid license in the end, it is difficult to parse out the exact contribution of each step or factor to this final outcome. Would more drivers have passed on-road testing if they had taken the test? While we can characterize many in this sample as medically compromised, we cannot say with surety that these individuals were unfit behind the wheel. They dropped out *too soon* to know.

Our data indicate that the first components of the HB-1536 process - written notification and requirement for medical evaluation - have the greatest impact towards encouraging driving retirement. The high attrition upon notification raises questions of reasonableness. Is it reasonable to require all reported drivers to see a physician and submit a form within just 30 days? Arranging an appointment and otherwise considering one's transportation options can take time, possibly longer than 30 days. The Missouri DOR will readily grant a 30-day extension, but this information is not conveyed to reported drivers - they must request it. Does this requirement constitute a barrier preventing some "fit" drivers from proceeding and having a chance to test out and retain a valid license?

One recommendation is to extend the initial review period to 60 days, thus giving reported drivers greater *breathing room* to schedule a doctor's appointment and otherwise review their options with family members. Many may still choose driving retirement, but at least they would have a more time to consider their options and act accordingly.

Similarly, is it appropriate to apply a one-size-fits-all driving skills test to this heterogeneous group of reported drivers? Might there be some justification for testing to be tailored for to address specific functional changes associated with advancing age? A growing body of literature (as reviewed in the Introduction to this report) suggests that older adults present with unique and specific driver fitness concerns, and that targeted screening and assessment techniques are warranted. This is a central recommendation in a new set of guidelines issued by the AAA Foundation for Traffic Safety (see Molnar & Eby, 2008).

The HB-1536 process is arguably reasonable and fair in its detailed standardization - all must traverse the same hurdles regardless of age or infirmity. That said, it may be valid to question the impact of HB-1536 from a perspective of mobility promotion. Driving cessation is one point along the mobility continuum. What happens to the mobility and well-being of those forced into driving retirement is beyond the scope of HB-1536, but this remains an important (even central) consideration for health care, quality of life, and reasonableness in public policy. In our view, a "complete" voluntary reporting system is one that is nested within an organized, collaborative strategy to promote older adult mobility on local, regional and state levels.

These major findings and issues are accompanied by a series of finer, equally meaningful and compelling results. The remainder of this section is organized around the following topical headings: Utilization, Reporting, Characteristics of Reported

Drivers, Medical-Functional Status & Physician Input, On-Road Safety, and Summary & Implications.

It is important to note that this project was not without some limitations. First, not all reported cases in 2001-2005 were reviewed. Those not reviewed differed significantly in a number of areas. On balance, we believe that the inclusion of these cases, when averaged across this large sample, would not change the overall findings presented here. Also, while our data collection strategy was quite rigorous, we lacked the resources to do extensive double entry. It is likely that some variations in entry and coding occurred across team members and as a function of time and experience with the data. The large sample size should minimize the impact of such errors in terms of overall results. Finally, we chose to examine just reported drivers from the age of 50 and up. Few were reported under this age, but it is important to recognize that our results only reflect this restricted range.

4.1 Utilization

HB-1536 resulted in 900-1,000 reports annually in 2001-2005. This was in a state with 4.4 million persons of driving age according to the 2000 US Census, for an annual reporting percentage of .023% of the adult population. Reports under similar voluntary mechanisms in two other Midwestern States - Wisconsin and Michigan - were twice as high, .059% and .064% respectively (NHTSA, 2006). Approximately 700,000 of Missouri residents were over the age of 65 during this period, and most of these (87%) were licensed drivers (Missouri Department of Health & Senior Services, 2007). As shown in Table 1, many thousands of older Missourians are impacted by chronic and often debilitating diseases that can impair driving ability. For example, dementia afflicts ~104,000 Missourians today, and this was a diagnosis for almost half of reported drivers in this sample. Based on the prevalence of chronic disease in this aging cohort (>10% for many chronic conditions), along with the information that is available to us from other states, we conclude that HB-1536 is currently under-utilized.

In other words, the potential pool of medically and functionally compromised drivers in Missouri would seem much greater than the one thousand or so reported annually during this period. On the whole, our data suggest that only the oldest, most obviously compromised and/or dangerous (per crash history and/or causal attribution) were reported. What about other older drivers who may be less impaired or dangerous, but that still represent a safety concern? How might education enhance recognition and encourage voluntary reporting? We will consider these questions further below.

4.2 Reporting

Medical fitness to drive (MFD) can be thought of as a continuum, ranging from early or mild impairment to late or severe impairment. Those most severely impaired may be considered particularly at risk for on-road incidents and crashes; a wellestablished finding regarding those with advanced dementia (see Dubinsky et al, 2000). It is generally accepted that adults in their 70's and 80's will eventually outlive their driving life expectancy (Foley et al, 2002). Age alone, however, is not an adequate measure of MFD. Some drivers in their 60's may be unfit due to medical and functional conditions, whereas some in their 80's may retain full capability. Therefore, how is it possible to know if or when a person has moved *too far* along the continuum and may need a driving evaluation?

One answer is to rely on the observations and initiative of those in closest contact with the potentially unfit driver. An important objective of HB-1536 was to encourage reporting by physicians, other health and service professionals, and family members (C. Rodriguez, personal communication, February, 2006). These groups may be in the best position to notice the early manifestations of a driver fitness concern and to take corrective action before public safety is threatened. This is a core principle underlying most voluntary mechanisms; namely, to facilitate timely reporting by those most qualified to do so.

Our data paint a mixed picture in terms of report source and timeliness. The proportion of reports from various stakeholder groups was not necessarily as the framers of HB-1536 intended. Just one third of reports in 2001-2005 came from physicians (20%) and family members (16%). In contrast, many more came from police and highway patrol officers (30%) and license office staff (27%). Most reports made by police were pursuant to crashes. A crash involving an impaired older driver motivated the passage of HB-1536 and, as the data suggest, crashes continue to be a primary impetus for filing reports. Not surprisingly, annual crash involvement was highest among those reported by police, but crash involvement levels among those reported by physicians and family members were also higher than for controls.

Were reports by family members and physicians timely (i.e., as in early on the fitness continuum)? The relatively levels of high crash involvement would suggest not. It could be that some of these reporters waited too long before taking action. Targeted education in how and when to use HB-1536 has the potential, we believe, to encourage timely reporting and thereby enhance public safety.

Drivers reported by license office staff were least likely to have had crashes compared to drivers reported by other sources. License office staff members interact with individuals at the time of driver license and auto plate renewal. They are unlikely to have any knowledge of a driver's on-road performance. Much to our surprise, drivers reported by license office staff in 2001-2005 had annual crash involvement percentages very similar to controls. These were somewhat safer drivers from the perspective of crash history, at least. Less than one third (31%) had a positive crash history; and only 10% were involved in a crash proximate to (i.e., 0-6 months before) Department Action date. Why were they reported? Our data show that they were reported due to observations of impaired ambulation and balance, physical frailty, and mental confusion. License office staff are encouraged to make such observations by their own training materials (see manual "Evaluating Driving Impairments: A Guide for Field and Central Office Staff" in Appendix D). Like other reported drivers, few of those reported by license office staff retained a valid license to drive. Might these drivers have been destined to become crash-prone in the future had they not been identified in the license office? If so, then license office staff may play a particularly valuable role in the timely management of driver fitness concerns. We cannot say this for sure, but this conclusion is consistent with a recent paper showing a safety benefit for in-person license renewal by the oldest-old (see Morrisey & Grabowski, 2005). As emphasized by Molnar & Eby (2008), functional performance should be the central focus of driver fitness screening and evaluation. One could consider the actions of license office workers as a type of functional screening, and their training manual states as much:

"Certain abilities are needed to safely operate a motor vehicle... Your observations of an applicant's behavior and physical condition help to determine the existence of those abilities... you may inquire about observable behaviors or conditions that would appear to impact upon the applicant's ability to safely operate a vehicle... Write facts, not just opinions or conclusions. The applicant's ability to safely drive, with our without restrictions, should be based on observed and reported facts..."

This study demonstrates that trained license office staff can play an important role in bringing driver fitness concerns to the attention of other state officials.

The guidelines provided to license office staff also mention options for restricted licensure (e.g., daytime driving only, restricted to 45 mph or less). Their objective may be to maintain on-road mobility rather than end it. As noted elsewhere in the manual, "People with varying types of physical limitation can safely operate motor vehicles but they may require special equipment to assist with vehicle control." In fact, both interpretations have some truth. For this project, our team was just given access to cases referred under HB-1536. The larger portion (~50-75%) of Form 153 submissions were directed by DOR staff to a separate driver restriction process (N. Hensiek, personal communication, July, 2008). Of the 4,100 reported drivers reviewed for this project, 7.5% had license restrictions in their driver record. In contrast, of the 144 individuals that retained a valid license, just 7 (<5%) had a listed restriction. Restricted licensure was not an emphasis of the HB-1536 process in 2001-2005, but could be in the future. In fact, the Missouri DOR is preparing to issue a new, simplified set of license restrictions and procedures for implementation in 2009 (N. Hensiek, personal communication, July, 2008).

Whether for restriction or fitness determination, behavioral observations can be helpful for identifying potentially at-risk drivers. Problems with ambulation have been associated with increased crash risk in older individuals (see Staplin et al, 2003). Other observations of license office staff showing confusion, for example, can be informative to the medical review process, especially given the high prevalence of dementia in this sample of reported drivers.

Although their contribution may be open to interpretation, license office staffers are still a part of the process and their potential contributions cannot be

overlooked or discounted. While not a form of screening, per se, their observations still constitute direct, "official" interactions concerning the licensing process. License office staff members represent our state government. With detailed, evidence-based training, could license office staff provide valid and even more useful feedback in the voluntary reporting process? We believe so, and with funding from the Missouri Department of Transportation, our team is now initiating a new project with the Missouri DOR to provide such training statewide in 2009.

As shown in Figure 10, the balance of HB-1536 reporting shifted over time, such that more reports were submitted by physicians in years 2004-5 and less from license office staff. The former finding is consistent with increased professional education on older drivers starting in 2003 (see Meuser et al, 2006; Wang & Carr, 2004), whereas the latter finding may be due to changes in staff training related to a privatization of license offices that occurred in 2002-2003. Our new training project with the Missouri DOR will address this.

Police and license office personnel are the final safety net, and it is fortunate that they were using this mechanism (although there may be room to increase referrals by these groups as well). One problem is that many on-road incidents and crashes are occurring, possibly needlessly, because MFD is not being addressed up stream, in the context of ongoing medical care (see discussion in Meuser et al, 2006). Possible reasons for this are a *lack of knowledge* (i.e., of how health conditions may impact on driving ability, of appropriate assessment methods, of helpful referral sources, of how to use state reporting procedures), *unwillingness to participate* in the process, or *concern for damaging the doctor-patient relationship* (see Meuser et al, 2006). Most physicians and other health professionals have little or no training in this area of practice, and some fear that acting to restrict driving may harm the patient (e.g., by causing isolation, reducing visits for medical care), bring undue legal liability on themselves (Aschenasy et al, 2006; Perkinson et al, 2005; Cable et al, 2000; King et al, 1992), or alienate the patient altogether. These factors must be taken into consideration.

4.3 Characteristics of Reported Drivers

The advanced age, gender composition, and medical fragility of the reported driver sample is notable. The mean sample age was 80 years, and males comprised the majority (55%) across the 50-105 age range. Although reported just since 2001, more than a third of these individuals (38%) were already deceased when demographic data were obtained in December, 2006. Mortality was significantly higher in the reported sample in comparison with matched control drivers. This latter finding makes intuitive sense given the health status of reported drivers (see 4.4 below).

Based on census figures and driver licensing statistics by age for Missouri, females were expected to make up the majority. This was not the case; with males

making up 55% of the sample. According to the 2000 Missouri Census, only 41% of persons over the age of 65 were male (US Census Bureau, 2007). More driver licenses in Missouri are held by women over age 65 than men (Highway Statistics, 2005).

Why were males over-represented in this sample? One explanation is that older women self-regulate or retire from driving at a higher rate than older men (Molnar & Eby, 2008b; Ragland, Satariano, & MacLeod, 2004; Oxley, Charlton, Fildes, Koppel, & Scully, 2004). Another is based on vehicle miles traveled (VMT). As a group, males drive more miles on average than do females, and this holds true across 65+ and 75+ age groups (National Household Travel Survey, 2001). This difference in VMT means that males have higher on-road exposure, thus increasing their risk of crash. Older men also make more trips, on average, than do older women, possibly due to being primary drivers in their family units. In this role, their on-road exposure may also be greater, making them somewhat more likely to be observed with respect to driving safety.

According to one study, older women who continue to drive into late life may have driving histories and exposure characteristics similar to men (Hakamies-Blomqvist & Siren, 2004). There appears to be support for this in the current sample. Gender-based comparisons indicated no statistically significant differences in mean age or in any specific problematic driving behavior. Males did outnumber females in terms of overall crashes, but interestingly not in crashes within 6 months of the report date. Police reports were also evenly distributed by gender, indicating that men were not specifically targeted.

4.4 Medical-Functional Status & Physician Input

Physicians play important evaluative and advising roles in the HB-1536 process. Reported drivers must obtain a physician evaluation and submit the necessary form (Form 1528) to even have a chance of retaining a valid license to drive. DOR officials look to physicians to provide detailed diagnostic information, to rate driver fitness (likely safe vs. unsafe), and to recommend a course of action (de-license immediately or test). DOR officials take physician opinions and recommendations seriously and largely follow them, unless other case information is conflicting. DOR officials revoked the licenses of most drivers rated as unsafe by their physicians, and erred on the side of caution by requiring testing for the majority of drivers labeled as safe. This conservative approach corresponds with something discussed earlier - most physicians are not trained in the evaluation of MFD. While physician input is clearly important in the HB-1536 process, on-road testing remains the final arbiter.

In most instances, the drivers in this sample who sought medical evaluation did so through their regular primary care physicians. While some reported drivers probably did "doctor shop" for a more favorable opinion, our data indicate that most did not. Ironically, those seeing a physician for the first time were more likely to receive an unfavorable opinion on driving fitness! This finding is not as surprising as it sounds, however. Physicians seeing a patient for the first time do not have an established doctor-patient relationship, and so may feel less constrained about issuing a negative opinion.

An original goal of this evaluation project was to quantify specific medical conditions and diagnoses of reported drivers. Specifically, we were interested in whether certain conditions were over or under-represented. As we began to review the hundreds of Physician Statements submitted to DOR, however, we realized that these goals were unrealistic. Despite instruction to contrary, physician respondents tended to provide an absolute minimum of qualitative diagnostic information. Instead, they checked off categories listed on the form (see Form 1528 in Appendix B). For every case with a specific, handwritten diagnosis, there were ten cases or more with checked categories only. The most frequent hand written diagnoses were Alzheimer's disease (429; 10% of cases), stroke (369; 9%), arthritis (277; 7%), diabetes (197; 5%), Parkinson's disease (132; 3%), and cataracts (111; 3%). Other common conditions, such as Macular Degeneration or Sleep Apnea, were hardly mentioned at all. Given the sample size and known prevalence of these and other conditions in older adults, our disease-specific frequencies are likely unreliable.

In reviewing medical data, in fact, we found almost as much medical information provided by family members and other sources as physicians (47% vs. 53% respectively)! In practice, the medical input of family members and others is very important to DOR decision-makers. This may explain why most drivers rated by physicians as safe to drive were still subject to on-road testing. The determination of driving fitness is ultimately a performance-based enterprise, and rightly so.

Our strategy in compiling medical information focused on the general categories for which reasonable data were available, and emphasized a holistic approach. If a diagnosis was listed in a case file, it was counted, regardless of source. As shown in Table 10, dementia was the most frequent condition in just under half (45%) of all reviewed cases, followed by vision conditions (31%), musculoskeletal and neuromuscular conditions (28%), and disorders of consciousness (16%). These frequencies correspond reasonably well with population prevalence rates as summarized in Table 2. Approximately 14% of persons over the age of 70 have dementia (Alzheimer's Association, 2007).

As a whole, our findings are consistent with the literature on disorders known to impair driving ability (as summarized in Dobbs, 2005). The fact that dementia was a top concern did not come as a surprise to our research team, as this condition is well-studied with respect to MFD. Although arguably most common, vision conditions have a certain "face validity" with respect to driving safety, and so may be more easily recognized with respect to MFD. Also, like other states, Missouri has clear regulations on vision function (at least with respect to acuity and monocular vision) and procedures for evaluation. It is notable how frequently stroke was written in as a diagnosis, even though this category is not listed on either the general reporting form (Form 4319) or the Physician Statement (Form 1528). Clearly, many physicians and other reporters were aware that stroke is a potential factor in MFD, and made a special effort to record this. The impact of stroke on driving ability has received increased attention in the literature in recent years (see Poole, Chaudry & Jay 2008; Ponsford, Viitanen, Lundberg, & Johansson, 2008), and our data support this increased scrutiny.

A number of gender differences in health status merit discussion. Of the eight general medical categories reviewed for this report, males significantly outnumbered females in the three most closely related to brain function: dementia (49% male vs. 41% female), disorders of consciousness (21% vs. 15%), and stroke/brain insult (12% vs. 8%). As noted earlier, males were somewhat more likely to see a physician and submit the necessary paperwork, and this may explain some of these differences. Also, males had more co-morbid conditions, on average, than females.

4.5 On-Road Safety

Most of those reported under the provisions of HB-1536 in 2001-2005 were not habitual offenders in terms of convictions for unsafe driving and moving violations. For most, in fact, the report under HB-1536 was the first blemish on their official driver record. Half of the reported sample had no history of crash dating back to 1993, suggesting that these were reasonably safe drivers when younger. It was a different story, of course, for the other half of the sample. Although most of these individuals had just one crash back to 1993, a substantial minority had two or more. One individual had eleven before finally being reported!

Many, but not all, individuals with a positive crash history were reported by law enforcement. Almost half (43%) were reported by police, followed by physicians (18%), license office staff (16%), family members (14%), and others (9%). Those with a positive crash history were just as likely to complete medical review, and they were similar to those without a crash history in seven of eight medical categories. The one exception was musculoskeletal and neuromuscular conditions: there were fewer in the crash group (25% vs. 31%). The reason for this finding is unclear, but it could indicate lower exposure and hence lower crash risk. Crash history did differ somewhat in the reported sample based on medical condition, such that those with disorders of consciousness, vision conditions, and dementia showed elevated rates over other conditions in 2001-2005.

Surprisingly, those with a positive crash history were more likely than their non-crash counterparts to be required to take on-road testing (29% vs. 23%). Those with a positive crash history had greater reported problematic driving behaviors across the board, but this finding may be unreliable due to an imbalance of police reports between the two groups. In the end, however, a similar number from both groups passed and retained a valid license to drive.

A third (32%) of drivers with a positive crash history were involved in one or more incidents within 0-6 months of being reported. These recent/proximate crashes were qualitatively different than events that occurred earlier in time. Drivers in

recent crashes were older, more medically compromised, more likely to be labeled by police as having caused the crash, and more likely to have had a passenger in the vehicle. Surprisingly, fewer of those in recent crashes carried a dementia diagnosis (40% vs. 49% for older events). Recent crashes involved disproportionate numbers of fatalities and disabling injuries, fixed object collisions, and single vehicle incidents. Recent crashes involved more problems in passing, lane usage (including wrong way driving), and improper turns. It is no wonder that these events caught the attention of law enforcement and were submitted under HB-1536. These drivers did not differ, however, in completing medical review or being required to take on-road testing.

As shown in Table 13, the regular and mortality-adjusted crash involvement percentages for reported drivers and controls show years of difference between these groups. Our crash data is such that attributions of cause exist for some, but not all drivers in each group, so these events include a mix of at-fault and not-at-fault events. Still, the 2-4 fold difference depending upon which year is examined is startling.

Crash history was somewhat age dependent in the reported vs. control samples. Whereas crash involvement declined consistently with advancing age in controls, a U-shaped distribution emerged for reported drivers. Reported drivers in their 50's-60's and also those in their 90's showed higher annual crash involvement since 1993. Annual crash involvement based on birth year varied widely for both reported drivers and controls, however, making these data rather difficult to interpret.

The bottom line is that crash played a significant role in the reporting process in 2001-2005. When crash is a major reason for reporting, public safety has already been compromised. HB-1536 can only work to enhance public safety when at-risk drivers are reported, ideally before crashes and not after.

4.6 Practical Aspects of Reporting, Reporters & Licensing Decision-Making

The driver fitness decisions of state licensing officials depend on information supplied by many sources, and these decisions have broad implications for individual and societal safety and well-being. The notion that driving is a privilege and not a right is easy to say, but probably doesn't reflect the true reality for many drivers in the US. We value our freedom to go from place to place, most often in our cars. While we have some alternative transportation systems in place, their reach and convenience vary widely. De-licensing decisions, while sometimes necessary to protect public safety, have real implications for those thrust into driving retirement. How can and do these individuals remain mobile and otherwise engaged in our society? Do state officials have some responsibility beyond licensing and de-licensing?

First and foremost, it is important that licensing decisions be based on reasonable procedures and adequate information. In Missouri, reports may be filed via a number of different written forms and means. The two most common, Forms 4319 and 153, are very different in format and content. The former specifies the driving-

related and medical-functional data to be addressed, whereas the latter leaves this open and undefined. Form 153 is formatted this way, in part, because it has different purposes; it is not specific to just HB-1536. When completed by different stakeholders, the various forms produce variable data from driver to driver. A Form 4319 submitted by a diligent family member might include detailed crash and health histories, whereas a Form 153 completed by a busy license office clerk might be purely observational and simply say "confused at counter, poor ambulation."

Although it stands to reason, the systematic differences in what gets reported by different sources is an important finding from this study (see Tables 16-19). As discussed before, those reported by police were involved in proportionately more crashes overall and proximate to the reporting period. License office staff emphasized what they could see, as they often had just one exposure to the reported driver. Physicians focused on health almost exclusively, saying little about driving and behavioral concerns. Family members emphasized a broad range of health, driving, and behavioral data. Those reported by family members were especially likely to have problems with cognition, vision loss, and musculoskeletal health. Like those reported by police, those reported by family were quite likely to show impaired attention and poor operational control of their vehicles. In fact, the information provided by family members was probably most complete and useful for understanding reported drivers as people.

All reported drivers, regardless of what information is provided up front, must see a physician and have Form 1528 submitted. This step provides an important opportunity for DOR officials to gather needed medical and functional data. With this information, licensing decisions can be made and cases otherwise adjudicated. Half of reported drivers never submitted Form 1528 in our sample, and thus moved into driving retirement. For some of these drop outs, DOR officials knew a lot about their driver fitness status, whereas for others very little information existed. Nonetheless, the outcome was the same. As discussed elsewhere in this report, we can surmise that these individuals dropped out for reasons of poor health, frailty, mortality, etc., but the information isn't there to say for sure. Just what constitutes an adequate informational basis for licensing decisions is an important issue for Missouri and other states.

State officials have a responsibility to be clear and open in their communications. Reported drivers in Missouri receive a standard form letter notifying them of their status and need to receive a medical evaluation (see copy in Appendix B). They may know nothing about why they were reported or by whom. While this confidentiality is intentional, it can leave the reported driver and his/her family in the dark and guessing. Also, the form letter is focused solely on licensing and medical review, and not mobility in a larger sense. While state licensing officials cannot be social workers and counsel reported drivers about transportation alternatives, they can provide some guidance - if only written - to steer folks in a helpful direction. Simply rewording the form letter to make is more "personal" and mobility- oriented might be a good step. Following is some possible text:

The prospect of losing one's license to drive can be worrisome and fearful. Many adults must give up the driving privilege at some point due to changes in health or function. It is important to recognize that you are not alone, and that you have options and choices. Your first choice is whether you wish to try and retain your license to drive. Do you believe yourself still capable of safe driving? If so, you will need to make an appointment with your doctor and submit Form 1528 within ____ days. Doing so will assure you an opportunity for full review and the possibility of participating in on-road testing through the Missouri State Highway Patrol.

You may be unsure of what to do. If so, we encourage you to speak with your family, physician, minister, or others close to you, and determine what may be best. You may choose to surrender your license voluntarily and move into driving retirement. This choice poses the challenge of securing alternative transportation for health-related appointments, shopping, recreation, etc. These options exist through your family, local governments, churches, and social service organizations. Your local Area Agency on Aging can help you determine the resources and options available to you. In Missouri, we are fortunate to have a free statewide resource and referral hotline available to residents 24 hours per day: just dial 2-1-1 or visit them on-line at http://www.211missouri.org/.

Voluntary reporting mechanisms provide an important safety net for responding to driver fitness concerns. People restrict their on-road exposure and retire from driving for many reasons, and it is likely that most of these decisions occur without any formal intervention. For some individuals, however, official intervention from the state is necessary. Reporting mechanisms may be especially appropriate for those lacking in judgment or openness in the face of strong evidence of compromised safety. Given this, the fact that dementia was the most common health concern in our sample is not surprising. By definition, persons with progressive dementia lose personal insight and may be at the highest risk for driving too long. Missouri's HB-1536 provides important legal protections, too, which can be helpful to both the reported driver and the reporter. When a physician is aware that a compromised patient continues to drive despite efforts to implement a retirement plan, we would argue that submitting a report to the state is a prudent step.

4.7 Summary & Implications

This project demonstrates what can be accomplished when academic researchers and state officials work together to reach a common objective. All of those involved had to "park their egos at the door" so to speak and work together, sharing resources and knowledge, to make this project possible. Over 30 separate individuals contributed - many of them students - committing over 1,300 person hours, traveling over 10,000 round trip miles between St. Louis and Jefferson City, Missouri, and reviewing over 15,000 document pages from microfilm during a 9-month data collection period. Officials from the Missouri Department of Revenue were there

with our team at every step, sharing their time, knowledge and equipment to ensure ultimate success. Officials from the Missouri State Highway Patrol were similarly committed.

Our findings indicate that the components of Missouri's HB-1536 work as a package to encourage driving retirement among those reported due to MFD concerns. Many of those reported in 2001-2005 were quite old, frail and likely near the end of their driving and physical life expectancies. Dementia was the most prevalent health condition, and clearly is a major public health issue with respect to MFD in our aging society. The number of persons with Alzheimer's disease alone could triple by mid century, and most of these will be licensed drivers. Half of the sample had positive crash histories, and recent crashes were especially problematic in terms of danger to the driving public. Apart from crash involvement, however, we cannot say with certainty that the majority of those reported were truly unfit or unsafe behind the wheel, as a large proportion dropped out prior to seeing a physician or taking the onroad test.

The provisions of HB-1536 ensuring reporter confidentiality and legal protection for breach of confidentiality are important safeguards, and worthy of replication elsewhere (see Meuser, 2008). The availability of forms on-line with detailed instructions for their completion is also positive. Missouri DOR officials act on reports, in both a timely and professional manner. All reported drivers are treated equally by this mechanism.

Still, there is room for improvement. This voluntary mechanism appears to be under-utilized overall, and especially by stakeholders most capable of recognizing early signs of MFD-related problems, namely physicians, family members, and other health/service professionals. Although many people retire from driving of their own accord and hence never need to be reported, the number reported in Missouri each year and the potential pool of persons with medical-functional compromise do not jibe. Our data suggest that, on balance, only the most obviously compromised and unsafe were reported. It is likely that hundreds (if not thousands) more could be reported each year, but that many stakeholders may be uninformed and/or unwilling to take such drastic action.

Further, our data suggest voluntary reporting may be most appropriate for intractable drivers (i.e., those absolutely unwilling to stop regardless of the evidence) and those with dementia who often lack insight concerning their driving ability, believing themselves to be more capable than they are (Freund, Cosgrove, Burke, & McLeod, 2005; Wang et al, 2003). Missouri's voluntary law protects physicians and other reporters from legal sanction if a report is submitted in good faith. Given that the State is the only entity that can license or de-license a driver, having some form of reporting mechanism is essential. When unsure if an unfit patient has stopped driving, we recommend that physicians (and others) err on the side of caution and report to the state. The action of reporting to the state initiates a formal process with the potential to enhance the safety and well-being of all involved.

When police are the primary report source, public safety has already been compromised, and so reducing police-initiated reports while enhancing others is a worthwhile goal. License office staffers were regular reporters in 2001-2005, and our data suggest that this group is especially adept at recognizing early warning signs and reporting drivers before crashes. Physicians play important evaluative and advisory roles in HB-1536, yet their input often lacks specificity. The forms used in the HB-1536 process do not necessarily encourage a sufficient flow of information, especially with respect to medical diagnoses. Communication among state officials, family members and community professionals could also be enhanced. There is still work to be done in educating the various stakeholders to recognize MFD concerns, take responsibility for dealing with them, communicate with each other, and otherwise execute coordinated efforts to promote older driver safety.

Removing unfit drivers from the road is just one piece of a much larger puzzle. Most communities lack accessible, affordable alternative transportation systems. When older adults are forced to retire from driving, they are at risk for negative health and emotional outcomes (Marottoli et al, 2000). Working with older adults and their families to identify alternate transportation options and implement a sustainable mobility plan is a huge challenge, and one that will also involve coordinated efforts on many levels (Beverly Foundation, 2004). A linkage between voluntary reporting mechanisms, such as Missouri's HB-1536, and alternative transportation resources makes good sense.

All stakeholders can and must play roles in and across the full driving retirement and mobility continuum. Thanks to leadership from the National Highway Traffic Safety Administration and the American Medical Association's Older Drivers Project (ODP; see Wang & Carr, 2004; Wang et al, 2003), more physicians and other stakeholders are now receiving needed education in how to recognize and address MFD concerns. To date, the ODP has trained over a dozen education teams (consisting of a physician, an occupational therapist, and others) to educate physicians and other health professionals on evidence-based assessment and driver retirement strategies. Our research team has participated in these efforts, conducting over 60 professional workshops in the Midwest since 2003, and we know from studying our efforts to disseminate the ODP message that health professionals are interested in this information and willing to adopt it (Meuser et al, 2006). Other similar education efforts have found much the same (see Byszewski, Graham, Amos, Man-Son-Hing, Dalziel, Marshall, Hunt, Bush, & Guzman, 2003).

As of this writing, a new law enforcement curriculum on older driver safety is being rolled out nationwide (E. Wagner, personal communication, June, 2008). Thanks to the efforts of the Missouri Department of Transportation and Missouri State Highway Patrol, and our research and education team, all 220 driver examiners in Missouri received similar training earlier this year, and there is a move to incorporate an older driver module into future patrol officer training sessions as well.

Another area ripe for research is the decision-making process through which

many older adults, family members, and health professionals, leading up to selfinitiated driving retirement. State laws to identify at-risk drivers are really a last line of defense, so to speak, as many older adults retire from driving without ever coming to the attention of legal authorities. Little is known, however, about the characteristics of older drivers that choose driving retirement and why they do so, and how others may influence this process. Studies applying health behavior models are needed to highlight this other important side of the driving retirement equation.

Moving forward, our team plans to continue collaborating with the Missouri State Highway Patrol, Missouri Department of Transportation (MODOT), and Missouri Department of Revenue to enhance knowledge and practice with respect to older driver safety. Our next effort, just funded for MODOT's 2008-2009 grant cycle, will utilize data described in this report to suggest ways to improve Forms 1528 and 153, and will deliver evidence-based training to license office staff.

Future reports from this dataset will "drill down" and address a variety of specific questions comparing individuals by diagnosis or health profile, characteristics of crashes, how observations of license office staff and MSHP driver examiners contribute, etc. For now, this first report provides a helpful summary for use in enhancing driver safety in Missouri and other states, especially in the area of medical fitness to drive.

4.7 Recommendations

This descriptive evaluation project supports a number of policy recommendations and best practice suggestions put forward at the 2008 North American License Policies Workshop sponsored by the AAA Foundation for Traffic Safety (Molnar & Eby, 2008). These recommendations include: an emphasis on function over chronological age in driver fitness determinations, an emphasis on voluntary reporting as a national standard, the provision of legal immunity from prosecution protection for those filing reports, encouragement of in-person license renewal procedures, the promotion of Medical Advisory Boards to assist (and provide helpful credibility) state officials in making licensing determinations, and a need for validated assessment approaches and tools. Additional recommendations are specific to Missouri, based in the findings of this study and in our team's very collaborative relationship with state officials over the past few years.

Voluntary reporting in Missouri appears to identify frail older adults nearing the end of their driving life expectancies. It does so via a standardized process that moves reported individuals into driving retirement, with little evidence of postrevocation driving. We conclude that this mechanism is successful and appropriate for implementation in other states. This view is also consistent with a recent position statement by the American Academy of Neurology (Bacon, Fisher, Morris, Rizzo, & Spanaki, 2007) arguing that individual differences in disease presentation, and a relative lack of driving safety information for many health conditions, are sufficient reasons for reporting to remain voluntary - physicians (and others) need to make individual decisions in this complex area.

- Although we support voluntary reporting as the national standard, we recognize that mandatory reporting has potential advantages, especially with respect to certain conditions, such as progressive dementia. More comparative research is needed between voluntary and mandatory states to clarify the benefits and downsides of each respective approach. Is it necessary, for example, to list specific diagnoses, such as Alzheimer's disease, for reporting as in California? Or, might less specificity in mandatory and/or voluntary mechanisms be more effective? More research is needed, especially in the area of disease-specific reporting.
- Voluntary reporting procedures should be embedded within a larger mobility service continuum, and not simply engines for de-licensing. As pointed out by the AAA Foundation for Traffic Safety (Molnar & Eby, 2008), additional emphasis is needed in most communities to provide information and guidance on the difficult question of when to stop driving and how to remain mobile afterwards. Most especially, newly de-licensed drivers and their families need targeted guidance and support. The degree to which such integrated support may be possible will vary by state and available resources. Simple changes to the HB-1536 process, such as provision of a handout on driving retirement and alternative mobility options at the point of initial notification and/or after license revocation could go a long way in helping to support ongoing mobility.
- Medical review and other evaluative procedures must be sufficiently comprehensive and evidence-based so as to be reasonable for all concerned. Missouri meets this standard to a reasonable extent, we believe. Although it may be that many drivers reported under such mechanisms will be subject to license revocation, all must have an adequate opportunity to work through the process. In the case of Missouri, many reported drivers appear to drop out before medical review. Little is known about why this attrition may occur, but the short window for response may be a factor. Enhanced communication and flexible procedures may be useful to overcome potential barriers. To this end, we make the following focused recommendations:
 - We recommend that a single form be adopted for the reporting by all stakeholders. This form should provide clear guidance concerning the types and level of information necessary to support licensing review, emphasizing check boxes and explicit instructions to ensure ease of use and recording of pertinent information.
 - Once a driver is reported, the Missouri DOR sends a letter requiring that a Physician's Statement be returned within 30 days. For some, this time window may be insufficient to schedule a physician visit and otherwise consider the implications of moving forward with the review process. We recommend that this period be extended to 60 days so as to allow more time and flexibility.

- While drivers de-licensed under Missouri's HB-1536 may appeal this decision to the DOR Director, the specific appeal process and its evidentiary basis are undefined. We recommend that a formal, structured appeal process be instituted whereby reported drivers may appeal revocation decisions viewed as unnecessary or unfair. This process might include automatic review by members of the Medical Advisory Board. Perhaps, too, other trained health professionals, such as occupational therapists, could provide "second opinion" evaluations in all or certain grievance cases. Occupational therapists are trained to evaluate broad aspects of human function, and their input could be especially helpful in circumstances favoring license restriction over revocation. Such an approach could counter any perceived age-related bias and provide a form of "medical" confirmation that may be more acceptable to the involved parties (although we did not see any overt bias in this project).
- For DOR officials to make reasoned decisions concerning driver licensing, they need reasonably comprehensive and comprehensible information from physicians and other report sources. The current forms utilize a combination of quantitative check boxes and space for written remarks. On many of the forms we reviewed, often only check boxes were marked and potentially helpful qualifying information was left out. For example, a checked box by *Dementia* says nothing about level of impairment and function. Whereas someone with very mild dementia may be safe behind the wheel, someone with severe dementia would not. We recommend revision of forms to allow qualifiers and to include other important medical conditions (e.g., stroke, macular degeneration) and driving history data (e.g., recent crashes) which are currently absent.
- Missouri utilizes a one-size-fits-all, pass-fail testing strategy, such that teenagers and older adults are evaluated on the same set of operational driving skills. While our data suggest that the current test is quite challenging for older adults, we nonetheless believe the basic approach to be valid. The MSHP has made a commitment to train driver examiners concerning the aging process and driver fitness, and their case documentation now includes a listing of observed behaviors to better inform DOR licensing decisions. It is likely that some older drivers with borderline passing scores might be best served by receiving a restricted license. Yet, it is unclear to what extent DOR officials utilize MSHP data to consider individual circumstances and the option of HB-1536 process with the current restricted licensure system appears warranted.
- A unique aspect of this project was the integration of voluntary reporting data with statewide crash data over a multi-year period. While lines of communication exist between the Missouri DOR and those that maintain the STARS database at the Highway Patrol, crash evidence was lacking in more than half of the DOR files on reported drivers. It took our study to bring these data

points together. Yet, it would seem that knowledge of crash history would be valuable for DOR staff and their Medical Advisory Board members when licensing decisions are made. Such information could serve as a trigger for more detailed review, for example, or as a means of determining if on-road testing should be pursued. Would DOR require a driver involved in multiple crashes in the immediate years before the report date to engage in on-road testing? As of now, this level of review is not possible, yet this seems a relatively simple intervention to implement. We recommend that this linkage be pursued.

- Those professionals expected to participate in the identification of at-risk drivers and to utilize reporting procedures need adequate, evidence-based training, as recommended by the AAA Foundation for Traffic Safety (Molnar & Eby, 2008). Such training must be tailored to the learning needs of each group, and be readily accessible for all to participate and benefit. Materials are available for tailored outreach through many national organizations, including:
 - The National Highway Traffic Safety Administration (see http://safety.fhwa.dot.gov/older_driver/index.htm; http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.31176b9 b03647a189ca8e410dba046a0);
 - AAA (http://www.aaapublicaffairs.com/Main/);
 - AAA Foundation for Traffic Safety (http://www.seniordrivers.org/home/);
 - American Medical Association (http://www.amaassn.org/ama/pub/category/8925.html).

Our team has worked closely with state officials in Missouri to educate health professionals, driver examiners, and police officers. We are now targeting license office staff. A significant barrier to such education, however, is its expense. Internet-based resources and training systems may provide the most cost-effective avenue for such efforts.

• We further recommend that more educational initiatives reach out to potential reporting groups, thereby increasing referrals and improving information on the forms completed by physicians, other health and service professionals and family members. Proportionately more reporting from these groups could enhance public safety by identifying at-risk drivers before crashes occur. While some may disagree with this interpretation and approach, we believe this is an empirical issue worthy of implementation and evaluation.

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| Category ² | Conditions with Reasonable Evidence for Increased Crash Risk | Conditions that May Contribute to Increased Crash Risk (More & better studies are needed) |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vision | CataractsGlaucoma | Age Related Macular Degeneration Diabetic Retinopathy Visual Field Loss Monocular Vision Loss of Contrast Sensitivity Uncorrected refractive eye disorders |
| Cognitive Impairment | Neurodegenerative dementia (e.g., Alzheimer's disease) Multiple Sclerosis Cardiovascular disease | Parkinson's disease Chronic Obstructive Pulmonary Disease Cerebrovascular disease (e.g., stroke, TIA, aneurysm) Traumatic Brain Injury Hypothyroidism Chronic Renal Failure |
| Psychiatric Disorder | Schizophrenia Use of certain psychoactive medications (e.g., tricyclic antidepressants, benzodiazapines) Psychiatric Disorders (as a general category) | Attention Deficit Hyperactivity Disorder Mood Disorder (especially when suicidal thoughts are present) |
| Disorders that Impair Consciousness | Epilepsy (especially when seizures are frequent) Sleep Apnea Severe & Sudden Hypoglycemia | SyncopeDelirium |
| Musculoskeletal Conditions | | OsteoarthritisRheumatoid ArthritisSpinal Cord Injury |
| Alcohol or Drug Abuse | Alcohol or Drug Dependence | |
| Other Conditions | Respiratory Disorders | Diabetes MellitusVestibular disorders |

Table 1: Medical Conditions & Crash Risk ¹

¹ Table based on comprehensive reviews by Charlton et al (2004) and Dobbs (2005).

 $^{^2}$ The table is organized around categories of medical disorders identified in Missouri Department of Revenue Forms 4319 (Driver Condition Report) and 1528 (Physician Statement).

| Medical Conditions | Prevalence Estimate in Age 65+ Adults | Estimated Number in Age 65+ Adults - US | Estimated Number in Age 65+ Adults - Missouri |
|------------------------------------|------------------------------------------------|--------------------------------------------------|--------------------------------------------------------|
| Chronic Disease ³ | 84% | 30 million | 670,000 |
| Heart Disease ⁴ | 30% | 10.8 million | 240,000 |
| Arthritis ⁵ | 30% | 10.8 million | 240,000 |
| Medications ⁶ | 20% | 7.2 million | 160,000 |
| Diabetes ⁷ | 18% | 6.5 million | 144,000 |
| Psychiatric ⁸ | 16% | 5.7 million | 128,000 |
| Cataracts ⁹ | 15% | 5.4 million | 120,000 |
| Dementia ¹⁰ | 13% | 4.7 million | 104,000 |
| Stroke ¹¹ | 8% | 2.8 million | 64, 800 |
| Macular Degeneration ¹² | 5% | 1.7 million | 37,600 |
| Glaucoma ¹³ | 3% | 3.7 million | 96,000 |
| Syncope ¹⁴ | 3% | 1.1 million | 24,000 |

Table 2: Disease Prevalence Estimates for Older Adults (US & Missouri)

³ Anderson & Horvath, 2004

- ⁴ Canadian Community Health Survey, 2001
- ⁵ Canadian Community Health Survey, 2001
- ⁶ Web MD, 2004
- ⁷ Centers for Disease Control, 2008
- ⁸ Bartels, 2004; National Institute on Alcohol Abuse and Alcoholism, 2006
- ⁹ CCSD, 2004
- ¹⁰ Alzheimer's Association, 2007
- ¹¹ CDC National Health Interview Survey, 2004
- ¹² The Eye Diseases Prevalence Research Group, 2004
- ¹³ Weston, Albadi, & White, 2000
- ¹⁴ Faculty of Medicine Sirraj Hospital, 2007

| Alcoholism ¹⁵ | 3% | 180,000 | 4,000 |
|---------------------------|------|---------|--------|
| Sleep Apnea ¹⁶ | 1.7% | 540,000 | 12,000 |
| Seizure ¹⁷ | 1.5% | 540,000 | 12,000 |

¹⁵ Adams & Cox, 1995

¹⁶ Bixler, Vgontzas, Ten Have T, et al., 1998

¹⁷ Sutton, 2007; Leppik, 2001

| Data Type | Data Source ¹⁸ | Number of Cases | Percentage of Sample (N = 4,100) |
|--------------|---------------------------------------------------------------------------|--------------------|----------------------------------------|
| Quantitative | Missouri Driver Record (MDR) | 4,100 | 100% |
| | State Traffic Accident Report System (STARS) Crashes 1993 - early 2007 | 4,100 | 100% |
| | Physician Statement (Form 1528) | 1,881 | 46% |
| | Driver Condition Report (Form 4319) ¹⁹ | 2,126 | 52% |
| | Physician Evaluation (Form 1528 or 4319) ²⁰ | 2,028 | 50% |
| | Possible Driver Impairment Notification (Form 153) | 1,080 | 26% |
| | Vision Examination (Form 999) | 292 | 7% |
| | Driver Examination Form (Form 232) ²¹ | 1,064 | 26% |
| | Driving Skills Summary (Form 100) ²² | 41 | <1% |
| | Letter / Informal Document | 616 | 15% |
| Qualitative | Medical Conditions ²³ | 2,585 | 63% |
| | Problematic Driving Behaviors ²⁴ | 1,951 | 48% |
| | Problematic Behavioral Observations ²⁵ | 953 | 23% |

Table 3: Data Sources for Reported Sample

¹⁸ Due to resource and time constraints, the data collection team was able to review microfilmed and scanned documents from 4,100 cases (87% of all reported cases aged 50+ during 2001-2005). In addition to the MDR and STARS which were available for all cases, the median number of documents of per case was two, with a range of one to six.

¹⁹ The Driver Condition Report (Form 4319) may be submitted by any concerned party. Form 153 is exclusive to License Office Staff. Reports may also be filed using Form 1528 or by letter. Most case files (95%) contained just one report. When two or more reports were present (i.e., two different individuals expressed concern about the driver), the report closest in time to the first Department Action 1 date was retained for analysis. Qualitative data was collected and summarized from all available forms, however.

²⁰ In 147 instances, physicians submitted their evaluations on Form 4319 and the DOR did not require that a separate 1528 be submitted also. In other words, the Missouri DOR accepted the Form 4319 in lieu of the 1528 for decisional purposes in these instances. Half of those in the reported sample were subject to medical review in one form or another.

²¹ Form 232 submitted by the Driver Examination Division, Missouri State Highway Patrol (MSHP), to the Missouri DOR summarizing written and on-road test findings for cited drivers required to participate in testing. Copies of this form are submitted even if the cited driver fails to keep a testing appointment (i.e., documenting "no shows").

²² Form 100 used by MSHP Driver Examiners to record specific on-road test behaviors and scores. Data from Form 100 are summarized on Form 232; and Form 100 itself is only rarely included in case material submitted to the DOR.

²³ Recorded from any source form. Sources include physicians (53%), family (19%), law enforcement and driver examiners (12%), license office staff (11%), and others (5%).

²⁴ Recorded from any source form. Sources include law enforcement and driver examiners (72%), family (15%), license office staff (2%), and others (11%).

²⁵ Recorded from any source form. Sources include license office staff (36%), law enforcement and driver examiners (29%), family (16%), physicians (14%), and others (5%).

Table 4: Qualitative Coding Samples²⁶

| COGNITIVE IMPAIRMENT / DEMENTIA |
|-----------------------------------------------------|
| Alzheimer's disease |
| Cognitive Impairment, Not Otherwise Specified (NOS) |
| Dementia with Lewy Bodies |
| Dementia, NOS |
| Frontotemporal Dementia |
| Mild Cognitive Impairment |
| Organic Brain Syndrome |
| Vascular / Multi-Infarct Dementia |
| Other Dementia or Cognitive Disorder |
| |
| TRAFFIC SIGNS |
| Failure to obey traffic signs |
| Failure to stop at stop sign or light |
| Inconsistent / slow response to road signs |
| Misunderstanding of road signs |
| Unaware / oblivious to road signs |
| |
| |
| Appears confused / disoriented |
| Behaves as if intoxicated |
| Difficulty comprehending questions / instructions |
| Driver is unaware of on-road incident |
| Easily distracted / in attentive |
| Forgetful in conversation |
| Memory loss / forgetfulness |
| Difficulty in communication |
| Needs prompting / verbal cues to stay on task |
| Problem finding correct words |
| Repeats statements / questions |
| □ Slow, halting speech |
| □ Tangential / Inappropriate comments |
| Used hostile / angry language |
| |

²⁶ When a specific diagnosis or observation was recorded in the database, the summary category was also checked and entered automatically. For example, if an Alzheimer's disease diagnosis appeared in a case file and was checked in data entry, the Cognitive Impairment/Dementia summary category was also checked by default. In cases lacking a specific diagnosis or observation, just the summary category may have been checked and entered.

| Category | Coding Basis ²⁷ | Content Label |
|----------------------------------|-------------------------------|--------------------------------------------------|
| Medical Conditions | Quantitative + Qualitative | Cognitive Impairment / Dementia |
| | | Vision Condition ²⁸ |
| | | Disorder of Consciousness ²⁹ |
| | | Musculoskeletal & Neuromuscular Condition |
| | | Psychiatric Condition |
| | | Alcohol &/or Drug Abuse Condition |
| | Qualitative Only | Brain Insult, Tumor or Cerebrovascular Injury |
| | | Cardiac / Cardiovascular Condition |
| | | |
| Behavioral Observations | Qualitative Only | Confused, Disoriented |
| | | Forgetful, Memory Loss |
| | | Ambulation / Balance Problem |
| | | Appears Physically Impaired / Frail |
| | | |
| Problematic Driving Behaviors | Quantitative + Qualitative | Impaired Attention, Alertness (while driving) |
| | | Poor Operational Control of Vehicle |
| | | Dangerous, Aggressive Actions |
| | | Committed Traffic Violation |
| | | Caused Crash |
| | | Slow, Obstructs Traffic |
| | Qualitative Only | Difficulty Judging Distances & Vehicle Position |
| | | Incorrect Lane Usage |
| | | Difficulty Managing Turns |
| | | Deficient Response to Signs & Traffic Conditions |

Table 5:Collapsed, Simplified Summary Codes for Presentation in this Report

²⁷ Summary codes used in this report are based on both quantitative (check box) and qualitative entries. Some pertinent conditions and observations were based on qualitative responses only, as the forms in use in 2001-2005 did not prompt for specific responses.

²⁸ Includes all reported vision problems, from impaired acuity or other perceptual disturbance, to various diseases of the eye, to monocular vision.

²⁹ Includes most reported conditions that may impact on mental alertness and/or consciousness, including seizure, syncope, blackout, metabolic disorder, medication effect/interaction, respiratory disorder, and sleep disorder.

Table 6:Characteristics of Reported & Control Samples

| Category | Reported Cases (A) | Reported Cases (B) | Control Sample (C) |
|----------------------------------------------------|--------------------------------|---------------------|----------------------|
| | 2001-2005 | 2001-2005 | 2.8:1 Match to |
| | | | Reviewed Cases on |
| | Reviewed for Project | <u>Not</u> Reviewed | Age & Birth Year |
| | (n = 4,100 / 2,553 Living) | (n = 887 / 429) | (n = 11,615 / 7,770) |
| Median Birth Year (Mean Age at DA 1) | 1922 | 1920 | 1922 |
| Birth Year A=C>B*** Age Difference NS | 80 (9.3) | 80 (9.0) | 1722 |
| Male Gender | 55.1% | 53.1% | 55.1% |
| Living Driver | | | |
| (as of ~12/06 - ~3/07) | 62.4% | 49.5% | 66.9% |
| A=C>B*** | | | |
| Urban Location | 68% | 68 % | Unavailable |
| Last License Class = F (non-commercial) | 95.6% | 95.6% | 93.3% |
| Any (1+) Listed | | | |
| Convictions in MDR | 8.7% | 5.7% | Unavailable |
| NS Required to Take | | | |
| Driving Skills Test | 26% | Unavailable | NA |
| Participated in Driving | 14% | Unavailable | NA |
| Skills Test | (562 or 57% of those required) | Ullavallable | INA |
| Retained Valid License | | 2 (0) | |
| Subsequent to HB-1536 | 3.5% | 3.6% | NA |
| Evaluation (2001-2005) Valid Driver License | | | |
| (of living drivers in 12/06 | | | |
| only) | 2.4% | 3.5% | 67% |
| B > A*** | | | |
| Any Crash as Driver | | | |
| (1993-2007) | 48.7% | 47.8% | 27% |
| A=B>C*** | | | |
| Multiple (2+) Crashes as | | | |
| Driver (1993-2007) | 20.7% | 21.9 % | 7.3% |
| A=B>C*** | | | |
| Crash as Driver - Before | | | |
| Reporting Period | 27.3% | 30.9% | 18.2% |
| (1993-1999) | 27:370 | 30.770 | 10.2/0 |
| A=B>C*** Crash as Driver - | | | |
| Proximate to Reporting | | | |
| Period | 33.5% | 28.4% | 12.4% |
| (2000-2007) | / - / - | | |
| A=B>C*** | | | |
| Crash as Driver - | | | |
| Recent Before Report | 31% | 39% | NA |
| <i>(0-6 months before Department Action 1)</i> | 51/0 | 37/0 | /VA |
| NS | | | |
| 110 | L | L | 4 |

Table 7: Gender Differences in Reported & Control Samples

| Category | Reported Cases (A) 2001-2005 Reviewed for Project | | Reported Cases (B) 2001-2005 <u>Not</u> Reviewed | | Control Sample (C) 2.8:1 Match to Reviewed Cases on Age & Birth Year | |
|-----------------------------------------------------------------------------------------|---------------------------------------------------------|------------------------|--------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------|------------|
| | (n = 4,100 / 2 | ,553 Living) | (n = 882 | 7 / 429) | (n = 11,61 | 5 / 7,770) |
| Gender | Male | Female | Male | Female | Male | Female |
| Median Birth Year (Mean Age at DA 1) Age Difference NS | 1922 <i>80 (SD = 9.5)</i> | 1 922 80 (9) | 1 920 <i>80 (8.8)</i> | 1 921 <i>80 (9.2)</i> | 1922 | 1922 |
| Living Driver (as of ~12/06 - ~3/07) A,B,C - F>M*** | 55% | 71.5% | 39.2 % | 60.8% | 61.7% | 73% |
| Urban Location A,B - F>M*** | 66.7% | 69.5 % | 65.2% | 71.2% | Unavail. | Unavail. |
| Any (1+) Listed Convictions in MDR <i>A, B - M>F***</i> | 11.5% | 5.3% | 8.5% | 3.5% | Unavail. | Unavail. |
| Retained Valid License Subsequent to HB-1536 Evaluation (2001-2005) | 3.9% | 3% | 3.5% | 4% | NA | NA |
| Valid Driver License (of living drivers in 12/06 only) | 3% | 1.8% | 4.5% | 2.8% | 69% | 66% |
| <u>Any</u> Crash as Driver (1993-2007) <i>A,B,C - M>F***</i> | 52.8% | 43.6% | 53.3% | 41.6% | 30% | 23.4% |
| Multiple (2+) Crashes as Driver (1993-2007) <i>A,B,C - M>F***</i> | 23.7% | 16.9% | 26.3% | 16.8% | 8.9% | 5.5% |
| Crash as Driver - Before Reporting Period Driver (1993-1999) A,C - M>F*** | 30.1% | 23.8% | 35% | 26% | 20.6% | 15.2% |
| Crash as Driver - Proximate to Reporting Period (2000-2007) A,C - M>F*** | 36.3% | 30.1% | 29.7% | 27% | 13.8% | 10.8% |
| Crash as Driver - Recent Before Report (0-6 months before Department Action 1) | 32% | 30% | 38% | 39% | NA | NA |

| Driving Concern | Family (n = 468) | Police (n = 1,094) | Physician (n = 203) |
|-------------------------------------------------------------------------------------|---------------------|-----------------------|------------------------|
| Caused Traffic Accident/Incident ³¹ | 20% | 56% | 5% |
| Positive Crash History (from STARS) | 42% | 65% | 44% |
| <i>Proximate Crash (from STARS)</i> (0-6 months prior to Department Action Date) | 8% | 35% | 6% |
| Committed Traffic Violation | 11% | 50% | 2% |
| Lack of/Poor Driving Skills | 43% | 50% | 9% |
| Dangerous Action | 39% | 45% | 7% |
| Lack of Attention | 38% | 39% | 11% |
| Obstructs Traffic | 8% | 9% | 1% |
| Lacks Knowledge of Traffic Laws | 8% | 6% | 2% |
| Medical Concern | Family | Police | Physician |
| Cognitive/Psychiatric Impairment | 57% | 17% | 65% |
| Limited Mobility | 36% | 11% | 19% |
| Visual Impairment | 32% | 11% | 10% |
| Disorder of Consciousness | 12% | 4% | 11% |
| Alcohol/Drug Abuse | 6% | 1% | 4% |

Table 8: Concerns Checked on Driver Condition Report (Form 4319) by Source³⁰

³⁰ The Driver Condition Report (Form 4319) is used primarily by family members and police officers to report individuals under HB-1536. Physicians may use the form, too, but they are more likely to submit a Physician Statement (Form 1528) instead. License office staffers rarely complete Form 4319, as they have a designated form to use (Form 153). The listed driving and medical concerns are represented by check boxes on the form, and the percentages are source specific.

³¹ Causal attribution as listed by report source on Form 4319. Overall and recent/proximate crash history from STARS database listed below for comparison.

Table 9: Concerns of License Office Staff

| Observation | % Positive |
|-----------------------------------|------------|
| Impaired Balance/Ambulation | 33% |
| Appears Confused/Disoriented | 15% |
| Appears Physically Frail/Impaired | 15% |
| Forgetful/Impaired Memory | 4% |

| Condition Summary Category (n = 4,100) | Frequency Count (AII Sources) | Percent of Sample (AII Sources) | Frequency Count (Physicians only) | Percent of Sample (Physicians only) |
|--------------------------------------------------|----------------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------|
| Dementia / Cognitive Impairment | 1,863 | 45% | 1,236 | 30% |
| Vision Condition ³³ | 1,285 | 31% | 968 | 24% |
| Musculoskeletal & Neuromuscular Conditions | 1,145 | 28% | 646 | 16% |
| Disorder of Consciousness ³⁴ | 740 | 16% | 480 | 10% |
| Cardiac / Cardiovascular Condition | 505 | 12% | 203 | 5% |
| Brain Insult, Tumor or Cerebrovascular Injury | 428 | 10% | 177 | 4% |
| Psychiatric Condition | 322 | 8 % | 191 | 5% |
| Alcohol &/or Drug Abuse Condition | 102 | 3% | 52 | 1% |

Table 10: Primary Medical Conditions of Reported Drivers, 2001-2005³²

³² Table based on 4,100 cases for which microfilmed and scanned records were reviewed. Hearing conditions are not included because Missouri law does not apply hearing standards to non-commercial driver licensing.

³³ Includes all reported vision problems, from impaired acuity or other perceptual disturbance, to various diseases of the eye, to monocular vision.

³⁴ Includes most reported conditions that may impact on mental alertness and/or consciousness, including seizure, syncope, blackout, metabolic disorder, medication effect/interaction, respiratory disorder, and sleep disorder.

| CONDITION / Disease or Disorder | Frequency | Percentage of Cases within Category | Percentage of all Reviewed Cases (n = 4,100) |
|---------------------------------------------|----------------|-------------------------------------------|----------------------------------------------------|
| COGNITIVE IMPAIRMENT / DEMENTIA (n = 1,863) | | | |
| Alzheimer's Disease | 429 | 23% | 11% |
| Vascular (Multi-Infarct) Dementia | 43 | 2% | 1% |
| Mild Cognitive Impairment | 33 | 2% | <1% |
| Dementia with Lewy Bodies | 6 | <1% | <1% |
| Other/Nonspecific (check box) | 1,352 | 73% | 33% |
| VISION (n = 1,285) | | | |
| Cataracts | 111 | 9% | 3% |
| Macular Degeneration | 66 | 5% | 2% |
| Field Deficit &/or Monocular | 59 | 5% | 1% |
| Glaucoma | 33 | 3% | <1% |
| MUSCLOSKELETAL, MOVEMENT & NEUROMUSCUL | AR (n = 1,145) | | |
| Arthritis | 277 | 24% | 7% |
| Parkinson's Disease | 132 | 12% | 3% |
| Frailty / Muscle Wasting | 102 | 9 % | 3% |
| Neuropathy | 55 | 5% | 1% |
| CONSCIOUSNESS & ALERTNESS (n = 740) | 1 | | |
| Diabetes | 197 | 27% | 4% |
| Medication Interaction/Effect | 114 | 15% | 2% |
| Seizure Disorder | 91 | 12% | 2% |
| Syncope | 77 | 10% | 2% |
| CARDIAC & CARDIOVASCULAR (n = 505) | | | |
| Hypertension | 214 | 42% | 5% |
| Coronary Artery Disease | 90 | 18% | 2% |
| Congestive Heart Failure | 78 | 15% | 2% |
| Cardiac Arrhythmia | 59 | 12% | 1% |
| BRAIN INSULT & CEREBROVASCULAR (n = 428) | | | |
| Stroke (Infarction) | 369 | 86% | 9% |
| Transient Ischemic Attack | 36 | 8% | <1% |
| Cerebral Hemorrhage | 18 | 4% | <1% |
| Tumor | 12 | 3% | <1% |
| PSYCHIATRIC (n = 322) | | | |
| Alcohol Abuse | 91 | 28% | 2% |
| Depression | 83 | 26% | 2% |
| Psychosis/Psychotic Features | 99 | 31% | 2% |
| Anxiety Disorder | 36 | 11% | <1% |

Table 11: Most Frequently Identified Medical Disorders & Diagnoses³⁵

³⁵ With the exception of the last two categories, much of these data were derived from quantitative check boxes. For example, on the Physician Statement, there is a check box for Cognitive Impairment. For there to be a specific diagnosis, such as Alzheimer's disease, the physician (or another source) would have needed to write this in. The top four diagnoses or disorders are listed per general category. Two or more of the diagnoses may apply in a single case, hence the total number of individuals in the category may be lower than the sum of conditions.

| Frequency | Percentage |
|-----------|-----------------------------------------------------------------------|
| 2103 | 51.3 |
| 1150 | 28.0 |
| 495 | 12.1 |
| 206 | 5.0 |
| 81 | 2.0 |
| 34 | .8 |
| 15 | .4 |
| 9 | .2 |
| 2 | .0 |
| 4 | .1 |
| 1 | .0 |
| | 2103 1150 495 206 81 34 15 9 2 2 2 4 |

Table 12: Frequency of Crashes for Reported Sample (1993-2006)

| Year | Crash Involve | ement - Total | | olvement - or Mortality |
|------|---------------|---------------|----------|----------------------------|
| | Reported | Control | Reported | Control |
| 1999 | 6.3% | 3.0% | | |
| 2000 | 7.7% | 3% | | |
| 2001 | 9.3% | 2.6% | | |
| 2002 | 8.6% | 2% | 9.3% | 2.2% |
| 2003 | 7.1% | 2.2% | 8.4% | 2.5% |
| 2004 | 5.7% | 1.6% | 7.4% | 2% |
| 2005 | 2.6% | 1.3% | 3.8% | 1.7% |
| 2006 | 0.7% | 1.4% | 0.6% | 2% |

Table 13: Crash Involvement of Reported vs. Control Drivers³⁶

 $^{^{36}}$ Adjusted crash rate calculations assumed that all drivers (reported and control) were living in 2001, and that death occurred at a steady annual rate.

| Crash Characteristic | Recent Crash Finding | Comparison of Recent vs. Older Crashes ³⁷ |
|------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Driver Age | Mean = 77 years (SD = 10) | Recent crashes involved older drivers (Mean ages 79 vs. 75) *** |
| Driver Gender | 60% Male | NS |
| Driver Health Status | Mean = 1.6 (SD = 1.4) | Recent crashes involved drivers with a slightly higher number of primary health conditions (1.7 vs. 1.4) *** |
| Driver Cognitive Status | 46% of Drivers with Dementia or Cognitive Impairment | Recent crashes involved somewhat fewer drivers with dementia (40% vs. 49%) *** |
| Causal Attribution (per police report) | 66% with a positive attribution of cause | Only 19% of those in remote crashes carried a positive attribution of cause *** |
| Driver Injury | 96% Non-Disabling Injury | Recent crashes involved a disproportionate number of driver fatalities (5 vs. 0) and disabling injuries (35 vs. 42) *** |
| Accident Type | 80% Involving Other Vehicle in Transit | Recent crashes involved a disproportionate number of Fixed Object (117 vs. 98) and Parked Vehicle (71 vs. 74) occurrences *** |
| Weather Conditions | 91% Clear or Dry Cloudy | NS |
| Number of Vehicles | 79% Two-Vehicle | Recent crashes involved a disproportionate number of single-vehicle incidents (120 vs. 128) *** |
| Number of Occupants | 56% No Additional Occupants | Mean number of additional occupants was greater in recent (0.85) vs. older (0.3) crashes *** |
| Electronic Signal | 77% Not Involving Signal | NS |
| Stop Sign | 82% Not Involving Stop Signs | NS |
| Yield Sign | 97% Not Involving Yield Signs | NS |
| Vehicle Action | 57% Going Straight, 18% Making Left Turn | NS |
| Police Attribution of Driver Behavior | 22% Failure to Yield 18% Driver Inattention | Recent crashes involved disproportionate occurrences of Improper Passing (12 vs. 9), Driving on Wrong Side of Road (27 vs. 24), Improper Turns (43 vs. 43), Improper Lane Usage (55 vs. 58), and Wrong Way Driving (14 vs. 4) *** |
| Posted Speed Limit | 56% @ 35 MPH or Less | NS |
| Road Type (Direction) | 84% on Straight Roadways | NS |
| Road Type (Grade) | 73% on Level Roadways | NS |
| *** n < 001. T tosts and | · · · · | • |

Table 14: Characteristics of Crashes Recent/Proximate to HB-1536 Report Date

*** p < .001; T-tests and nonparametric comparisons

³⁷ Comparison of crashes occurring 0-6 months before Department Action 1 date (n = 739) and those occurring 7+ months before (n = 1,448). Crashes occurring after the Action 1 date were excluded. Recent crashes were a frequent motivator for reporting under HB-1536.

| | Dementia | Vision | Muscle | Consciousness | Cardiac | Brain/Stroke |
|-------------------------------|------------|------------|------------|---------------|------------|--------------|
| 1993 | 4% | 4% | 4% | 4% | 4% | 4% |
| 1994 | 5% | 5% | 4% | 6% | 6 % | 7% |
| 1995 | 5% | 5% | 4% | 5% | 6 % | 4% |
| 1996 | 6 % | 6 % | 5% | 5% | 7% | 5% |
| 1997 | 6% | 7% | 7% | 6% | 6 % | 7% |
| 1998 | 5% | 6 % | 5% | 6% | 7% | 4% |
| 1999 | 6% | 7% | 6 % | 7% | 7% | 5% |
| 2000 | 7% | 8% | 6 % | 6% | 7% | 7% |
| 2001 | 10% | 10% | 7% | 11% | 10% | 8% |
| 2002 | 9 % | 9 % | 7% | 10% | 10% | 7% |
| 2003 | 7% | 8% | 7% | 8% | 8 % | 5% |
| 2004 | 6% | 7% | 5% | 9 % | 8 % | 5% |
| 2005 | 2% | 3% | 2% | 3% | 2% | 1% |
| 2006 | 0% | 1% | 0% | 1% | 1% | 0% |
| Overall Mean Percentage | 5.6% | 6.1% | 4.9% | 6.2% | 6.2% | 5% |

Table 15: Annual Crash Involvement by Most Frequent Disease Categories³⁸

³⁸ These rates are not mutually exclusive, such that many individuals carried more than one diagnosis. All drivers were included so more recent years were more impacted by mortality and driving retirement.

| Report Source | Gender | Mean Age | Urban Residence | Positive Crash History ⁴⁰ | Crash 0-6 months ⁴¹ | Confused, Disoriented | Forgetful, Memory Loss | Ambulation, Balance Problem | Appears Physically Impaired/Frail |
|-----------------------------------|----------------------------|------------------------|---------------------------|--------------------------------------------|-----------------------------------|--------------------------|------------------------------|-----------------------------------|-----------------------------------------|
| Family Member (FM; n = 633) | 56% Male | 81 | 69 % | 43% | 19% | 28% | 26% | 18% | 18% |
| Police Officer (PO; n = 1,161) | 56% Male | 81 | 66 % | 72% | 47% | 2% | 1% | <1% | <1% |
| Physician (P; n = 798) | 63% Male | 79 | 68% | 43% | 19% | 2% | 3% | 2% | 3% |
| License Office (LO; n = 1,041) | 49% Male | 79 | 78 % | 31% | 10% | 15% | 4% | 33% | 15% |
| Other Reporter (OR; n = 290) | 53% Male | 80 | 79 % | 58% | 40% | 4% | 3% | 2% | 2% |
| Total, All Reporters | 55% Male | 80 | 68 % | 49 % | 34% | 9 % | 12% | 6% | 7% |
| Differences | *** P > FM=PO=LO =OR | *** FM=PO > P=LO | *** FM=PO=P < LO=OR | *** PO > OR > FM=P > LO | *** PO=OR > FM=P > LO | *** FM > LO > OR=PO=P | *** FM > LO=P=OR=P O | *** LO > FM > OR=P=PO | *** FM=LO > P=OR=PO |

Table 16: Location, Crash Outcome, & Combined Behavioral Characteristics of Reported Drivers by Report Source³⁹

**** p < .001; Nonparametric comparisons or GLM with Post-Hoc Bonferroni

³⁹ Table based on driver record data and all behavioral observations from narrative responses only (i.e., source must have written phrases or sentences); counted separately from similar quantitative and qualitative entries utilized to generate medical summary variables. Most (65%) of behavioral observation data derived from License Office Staff, Police, and Driver Examiner reports. *These frequencies reflect the full driver-related data available to DOR staff when reviewing cases for possible license revocation.*

⁴⁰ Positive if any crash listed in the STARS Crash Database for the reported driver from 1993-2007.

⁴¹ Limited to crashes by case most proximate (i.e., closest in time) to the Department Action 1 date. Percentage of crashes that occurred 0-6 months before (i.e., as a proximate motivator for HB-1536 report).

| Report Source | Physician Form 1528 in Record | Mean # Primary Medical Conditions | Vision Condition | Cognitive, Dementia | Conscious- ness, Alertness | Muscle, Mobility | Psychiatric Condition | ETOH, Drug Abuse | CNS Insult, Tumor, or Stroke | Cardiac Condition |
|-----------------------------------|-------------------------------------|----------------------------------------------|----------------------------|-----------------------------|----------------------------------|------------------------|----------------------------------------------------|---------------------------|------------------------------------|----------------------------|
| Family Member (FM; n = 633) | 42% | 2.3 | 43% | 74% | 24% | 37% | 13% | 5% | 14% | 18% |
| Police Officer (PO; n = 1,161) | 41% | 1.5 | 36% | 43% | 17% | 23% | 9 % | <1% | 5% | 11% |
| Physician (P; n = 798) | 79 % ⁴³ | 1.9 | 27% | 75% | 26% | 26% | 11% | 5% | 12% | 12% |
| License Office (LO; n = 1,041) | 38% | 1.1 | 24% | 11% | 12% | 34% | 2% | <1% | 15% | 11% |
| Other Reporter (OR; n = 290) | 35% | 1.4 | 33% | 43% | 15% | 23% | 7% | 2% | 7% | 11% |
| Total, All Reporters | 40% | 1.6 | 31% | 55% | 18% | 28% | 8% | 3% | 10% | 12% |
| Differences | *** P > All Others | *** FM > All Others, PO=OR ≠ Others | ** FM > PO=OR > P=LO | *** P=FM > PO=OR > LO | *** P=FM > PO > OR=LO | *** FM=L0 > P=P0=0R | *** FM > PO, P=PO, P > OR, PO=OR, > LO | *** FM=P=OR > PO=LO | *** LO=FM > PO, P=OR=PO | *** FM > P=PO=LO= OR |

Table 17: Combined Medical Characteristics of Reported Drivers by Report Source⁴²

*** p < .001; Nonparametric comparisons or GLM with Post-Hoc Bonferroni

⁴² A combination of all reported medical data (i.e., from all sources) was used to generate this table. Most medical data derived from physician (53%) and family (19%) reports. *These frequencies reflect the full driver-related data available to DOR staff when reviewing cases for possible license revocation.*

⁴³ Not all of those reported by a physician had a Physician Statement (Form 1528) in their record. Some were reported via Form 4319 and only this form appeared. This is explained in detail in Section 2.1.

| Report Source | Required to take Driving Skills Test | Impaired Attention, Alertness | Poor Operational Control of Vehicle | Difficulty Judging Distances & Vehicle Position | Improper Lane Usage | Difficulty Managing Turns | Slow, Obstructs Traffic | Deficient Response to Signs & Traffic Conditions | Dangerous, Aggressive Actions | Committed Traffic Violation ⁴⁵ | Caused Crash ⁴⁶ |
|-----------------------------------|-----------------------------------------------|-------------------------------------|----------------------------------------------|-------------------------------------------------------------|----------------------------------|--------------------------------------------|-------------------------------|-----------------------------------------------------------|-------------------------------------|-------------------------------------------------|-------------------------------|
| Total, All Reporters | 25% | 23% | 35% | 2% | 14% | 9 % | 9 % | 21% | 26% | 18% | 22% |
| Family Member (FM; n = 633) | 21% | 33% | 47% | 4% | 14% | 8% | 11% | 32% | 35% | 11% | 19% |
| Police Officer (PO; n = 1,161) | 35% | 44% | 70% | 3% | 29% | 16% | 17% | 36% | 58% | 53% | 58% |
| Physician (P; n = 798) | 21% | 10% | 11% | <1% | 5% | 5% | 3% | 8% | 7% | 2% | 4% |
| License Office (LO; n = 1,041) | 20% | 3% | 5% | <1% | 2% | 3% | 1% | 5% | 3% | <1% | 1% |
| Other Reporter (OR; n = 290) | 28% | 19% | 43% | 2% | 24% | 10% | 10% | 27% | 22% | 12% | 21% |
| Differences | *** PO = OR > FM = P = LO | *** PO > FM > OR > P > LO | *** PO > FM=OR > P > LO | *** FM=PO=OR > P=LO | *** PO=OR > FM > P > LO | ** PO > OR=FM, FM=P, OR > P, P=LO | *** PO > FM=OR > P=LO | ** PO=FM, PO > OR, FM=OR, > P, P=LO | ** PO > FM > OR > P > LO | *** PO > OR=FM > P=LO | *** PO > OR=FM > P > LO |

Table 18: Combined Driving Behavior & Attribution Characteristics of Reported Drivers by Report Source⁴⁴

*** p < .001; Nonparametric comparisons

⁴⁴ A combination of all reported driving behavior and attribution data (i.e., from all sources) was used to inform this presentation. Most driving behavior and attribution data were derived from police and driver examiner reports (72%). These frequencies reflect the full driver-related data available to DOR staff when reviewing cases for possible license revocation.

⁴⁵ Separate from formal convictions listed in the Missouri Driver Record. Documentation from police and other sources make specific mention of violations, the majority of which are not listed as formal convictions.

⁴⁶ Derived separately from STARS Crash Database via check box and/or written attributions of causal action primarily from Form 4319.

| Medical Condition Category ⁴⁸ | Mean # Co-Morbid Conditions | Participated in On-Road Testing | Impaired Attention, Alertness | Poor Operation al Control of Vehicle | Improper Lane Usage | Difficulty Managing Turns | Slow, Obstructs Traffic | Deficient Response to Signs & Traffic Conditions | Dangerous, Aggressive Actions | Committed Traffic Violation ⁴⁹ | Caused Crash ⁵⁰ |
|------------------------------------------------|-----------------------------------|---------------------------------------|-------------------------------------|-----------------------------------------------|---------------------------|---------------------------------|-------------------------------|--------------------------------------------------------------|-------------------------------------|-------------------------------------------------|-------------------------------|
| Dementia (n = 1,863) | 1.3 | 13% | 27% | 39% | 15% | 9 % | 11% | 27% | 29 % | 19% | 22% |
| Vision (n = 1,285) | 1.7 | 26% | 33% | 43% | 21% | 14% | 12% | 28% | 35% | 25% | 27% |
| Muscle (n = 1,145) | 1.7 | 19 % | 25% | 39 % | 15% | 10% | 10% | 21% | 29 % | 15% | 21% |
| Consciousness (n = 739) | 2.2 | 19 % | 25% | 39% | 17% | 10% | 10% | 21% | 31% | 18% | 24% |
| Cardiac (n = 505) | 2.4 | 26% | 24% | 41% | 17% | 11% | 9 % | 22% | 29% | 20% | 24% |
| Brain/Stroke (n = 428) | 1.8 | 15% | 17% | 27% | 9 % | 6% | 6% | 14% | 19 % | 10% | 14% |

Combined Driving Behavior & Attribution Characteristics of Reported Drivers by Diagnostic Category⁴⁷ Table 19:

 ⁴⁷ Percentage of cases with each condition reported to have the driving behavior.
 ⁴⁸ Medical diagnostic categories are not mutually exclusive. Many reported drivers had 2 or more conditions.
 ⁴⁹ Separate from formal convictions listed in the Missouri Driver Record. Documentation from police and other sources make specific mention of violations, the majority of which are not listed as formal convictions.

⁵⁰ Separate from STARS Crash Database. Based on check box and/or written attributions of causal action by police and other report sources.

| Medical Condition Category | Participated in On-Road Testing | Impaired Attention, Alertness | Poor Operation al Control of Vehicle | Improper Lane Usage | Difficulty Managing Turns | Slow, Obstructs Traffic | Deficient Response to Signs & Traffic Conditions | Dangerous, Aggressive Actions | Committed Traffic Violation | Caused Crash |
|------------------------------------------------|---------------------------------------|-------------------------------------|-----------------------------------------------|---------------------------|---------------------------------|-------------------------------|--------------------------------------------------------------|-------------------------------------|-----------------------------------|-----------------|
| Dementia/Cognition (n = 630) | 7% | 21% | 26% | 10% | 5% | 9 % | 23% | 20% | 14% | 20% |
| Vision (n = 241) | 32% | 28% | 42% | 22% | 15% | 7% | 21% | 32% | 27% | 32% |
| Musculoskeletal/ Neuromuscular (n = 244) | 11% | 8% | 20% | 6% | 2% | 5% | 7% | 15% | 7% | 14% |
| Consciousness (n = 67) | 7% | 9 % | 33% | 1 9 % | 7% | 6% | 9% | 28% | 19 % | 30% |
| Cardiac (n = 28) | 11% | 4% | 11% | 4% | 4% | 0 | 7% | 7% | 0 | 7% |
| Brain/Stroke (n = 99) | 4% | 4% | 6% | 3% | 2% | 3% | 2% | 4% | 6% | 6% |

<u>Table 20</u>: Combined Driving Behavior & Attribution Characteristics of Reported Drivers by Pure Diagnostic Category⁵¹

⁵¹ This table compares individuals with a pure (single) diagnosis. Disease categories are mutually exclusive. Persons with no or multiple conditions excluded.

| | | | Testing Recommendation | | | | Testing & Licensing Outcome | | | Positive Crash History | |
|----------------------------------------------------|----------------------------------------------------|---------------------------|-------------------------|--------------------------------|-------------------|---------------------------------|-----------------------------|---------------------|----------------------|----------------------------------------------|--|
| Physician Opinion | Driver is Demented / Cognitively Impaired | Driving Skills Test | Written Test Only | Driving Skills + Written | No Endorsement | <mark>Required</mark> by DOR | Driver Participated | Passed Test | Anytime 1993-2006 | Recent (0-6 months) before DA1 Date | |
| Capable of Safe Driving (n = 620) | 34% | 26% | 1% | 12% | 61% | <mark>64%</mark> | <mark>43%</mark> | <mark>4%</mark> | 51% | 15% | |
| <u>Not</u> Capable of Safe Driving (n = 853) | 80% | 14% | <1% | 30% | 55% | <mark>8%</mark> | <mark>5%</mark> | <mark><1%</mark> | 45% | 13% | |
| No Endorsement (n = 408) | 54% | 35% | <1% | 40% | 25% | <mark>56%</mark> | <mark>35%</mark> | <mark>4%</mark> | 50% | 16% | |

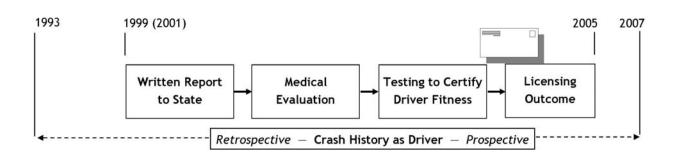
<u>Table 21</u>: Physician Judgment of Driver Safety & Related Outcomes⁵²

⁵² Limited to cases in which a Physician Statement (Form 1528) was submitted (n = 1,881). Percentages are based on the sub-sample sizes listed under Physician Opinion column.

| Physician Opinion | Dementia / Cognitive Impairment | Vision | Muscle | Consciousness | Cardiac | Brain Injury / Stroke | Psychiatric | Alcohol / Drug |
|---------------------------------------------|---------------------------------------|--------|--------|---------------|---------|-----------------------------|-------------|-------------------|
| Capable of Safe Driving (n = 620) | 34% | 72% | 45% | 27% | 30% | 11% | 6% | 2% |
| Not Capable of Safe Driving (n = 853) | 80% | 37% | 32% | 29 % | 13% | 13% | 13% | 4% |
| No Endorsement (n = 408) | 54% | 52% | 44% | 32% | 20% | 13% | 12% | 6% |

Table 22: Physician Judgment of Driver Safety & Diagnostic Category

Figure 1: Steps in the HB-1536 Review Process & Data Types⁵³



⁵³ Initiated in 1999, the HB-1536 process became well established by 2001, and this project focused specifically on those reported in 2001-2005. Crash data from 1993 to early 2007 supplement the HB-1536 findings, allowing broader public safety implications to be addressed.

Figure 2: Steps in Data Identification & Coding

Review of HB-1536 Procedures & Forms

- On-site training from Missouri DOR & SHP officials involved in HB-1536 process from initial report to final licensing outcome.
- Detailed review of procedures, forms, data flow, and decision-making processes.
- Key forms and data (qualitative, quantitative) identified to allow characterization of HB-1536 process (Figure 1), with an emphasis on MFD.

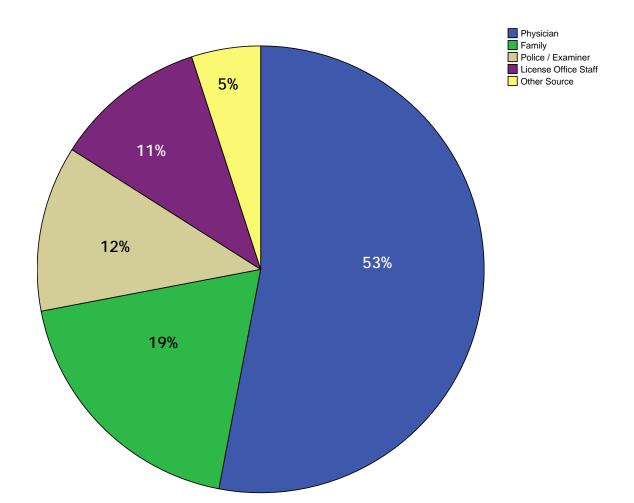
Collection of Pilot Case Files

- Missouri DOR officials collected case material from microfilm and computer-based sources, creating de-identified paper packets.
- These packets were reviewed by the research team for database development and data coding purposes.
- Data entry forms were created in Microsoft Access to mirror those used by the DOR for efficient hand entry on a Tablet PC.

Qualitative Coding Procedures

- 150 case files were reviewed for content and a spreadsheet of all key words/phrases was generated as an initial *coding library* for the project.
- An interdisciplinary Review Committee (RC) added other medical and drivingrelated codes based on clinical experience and published findings.
- The RC revised and narrowed the coding library, creating a structure of summary and specific subordinate codes in three categories: medical conditions, driving behaviors, & general behavioral observations (see examples in Table 2).
- A Qualitative Coding Manual (QCM) was drafted, outlining this structure and providing specific definitions to guide the data entry process.
- The RC reviewed the draft QCM and provided suggestions for revision.
- The QCM was pilot tested on 100 new case files by 2 trained student raters, entering data separately. Both qualitative and quantitative fields were entered.
- The raters reviewed qualitative entry decisions together, identifying discrepancies and differences of interpretation, and provided feedback to the team for further revision of the QCM.
- The QCM was tested again on 150 additional case files by 3 trained student raters, entering data separately in blocks of 50 cases at a time.
- Inter-rater reliability was reviewed for each block and across raters. This resulted in additional QCM revisions.
- Inter-rater agreement of 80% was achieved at the final iteration for combined summary and subordinate qualitative categories. Agreement was 90% for summary categories alone.
- Inter-rater agreement of 96% was achieved for quantitative data during a parallel review process.





⁵⁴ This figure is intended to give an overall summary of data sources. When data came from both a physician and one or more other sources, only the physician was given sole credit for this breakdown. Just over half (53%) of all medical data came from physicians alone. Data points were aggregated across the sample, subdivided by source, and subtracted to generate these overall percentages. Individual cases varied widely in source composition based on what forms were submitted and how they were filled out.

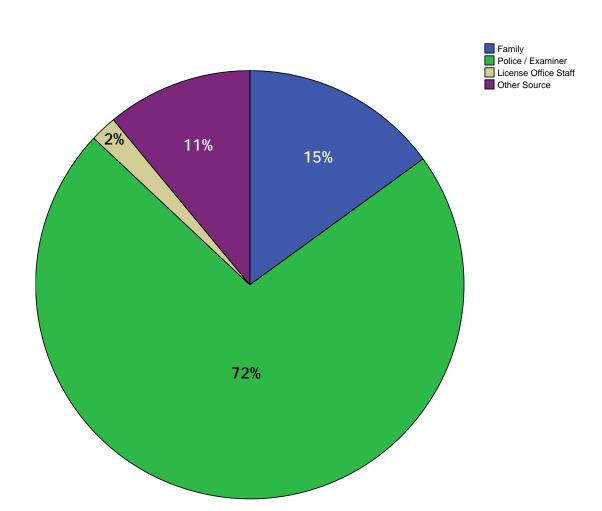


Figure 4: Sources of Qualitative Driving Behavior Data⁵⁵

⁵⁵ This figure is intended to give an overall summary of data sources. When data came from both a law enforcement source (police, driver examiner) and another, only the law enforcement source was given sole credit for this breakdown. Almost three quarters (72%) of all driving behavior data came from police investigating an on-road incident or driver examiners pursuant to driver testing. Data points were aggregated across the sample, subdivided by source, and subtracted to generate these overall percentages. Individual cases varied widely in source composition based on what forms were submitted and how they were filled out.

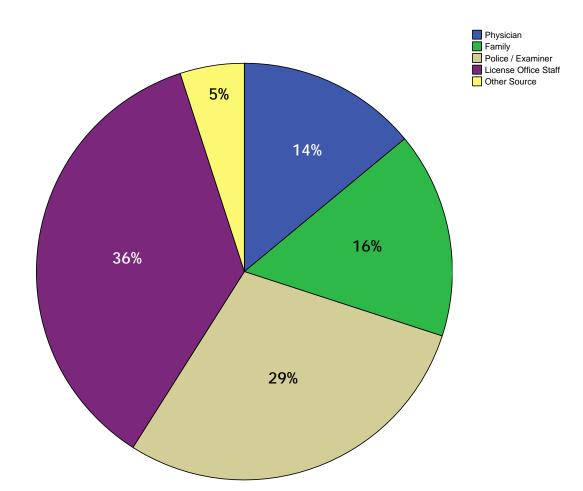


Figure 5: Sources of Qualitative Behavioral Observations⁵⁶

⁵⁶ This figure is intended to give an overall summary of data sources. The form used by license office staff to report an unfit driver (Form 153) is narrative-based (i.e., the clerk writes down his/her observations in prose). When data came from a license office clerk and from another source, the license office clerk was given sole credit for this breakdown. Just over one third (36%) of this data type came from license office staff members. Data points were aggregated across the sample, subdivided by source, and subtracted to generate these overall percentages. Individual cases varied widely in source composition based on what forms were submitted and how they were filled out.

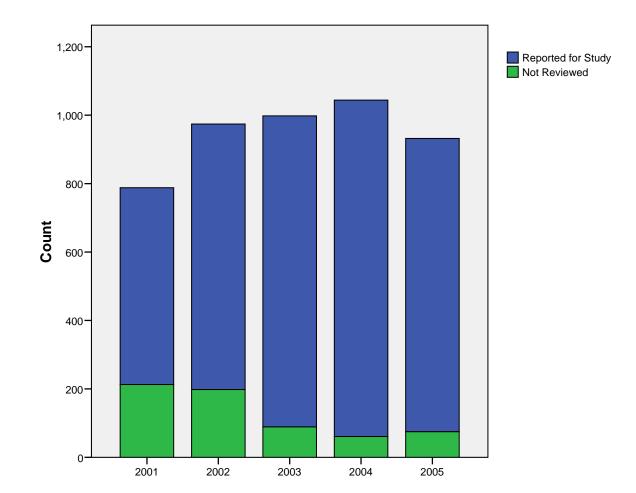


Figure 6: Distribution of Reviewed vs. Total Reported Drivers by Year

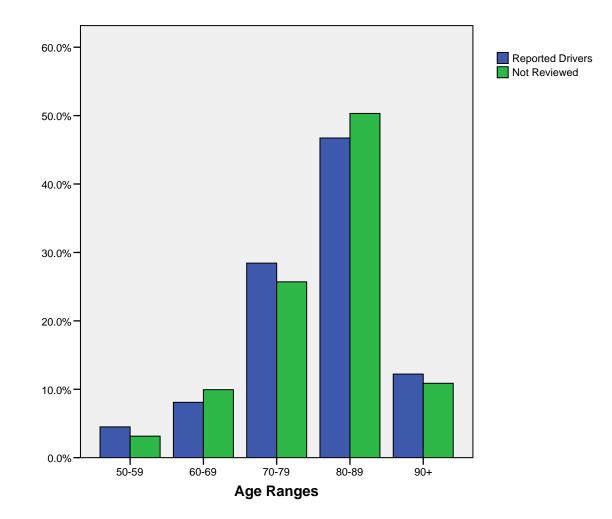
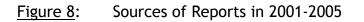
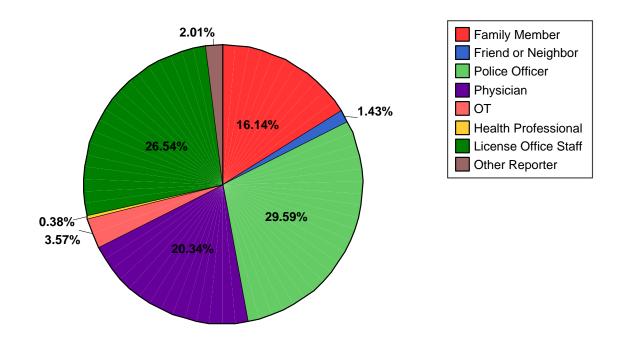


Figure 7: Proportion of Age Groups by Case Review Status





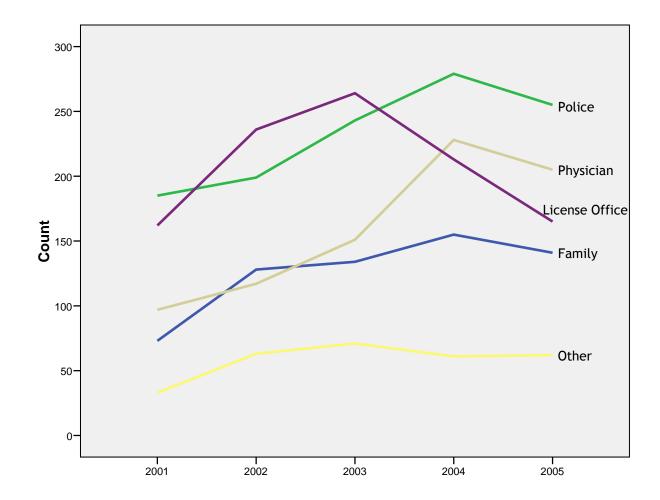


Figure 9: Frequency of Reports by Source for Years 2001-2005

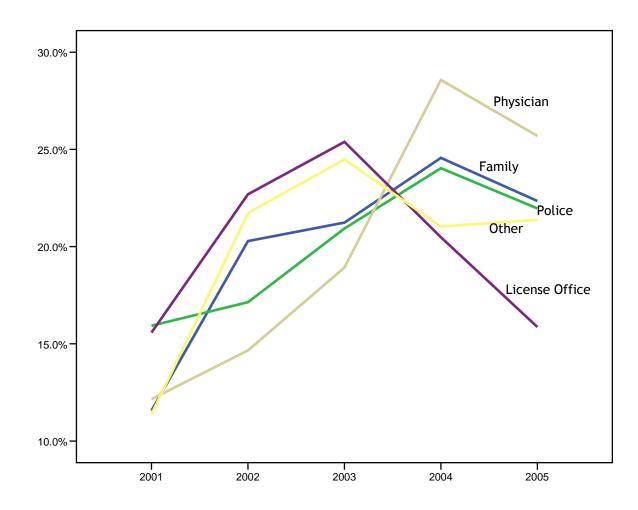
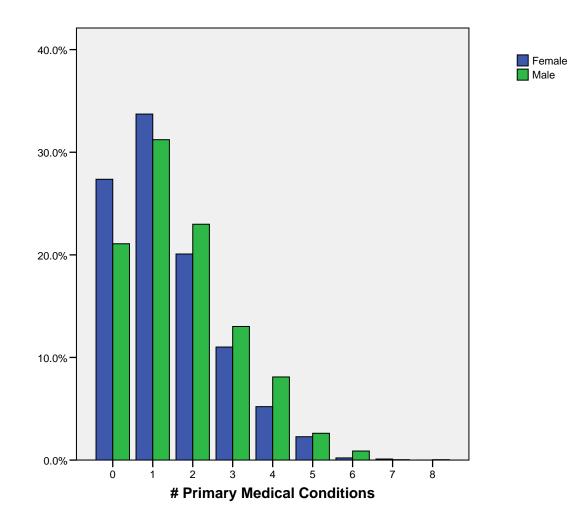


Figure 10: Percentage of Reports by Source for Years 2001-2005

Figure 11: Number of Primary Medical Conditions & Gender



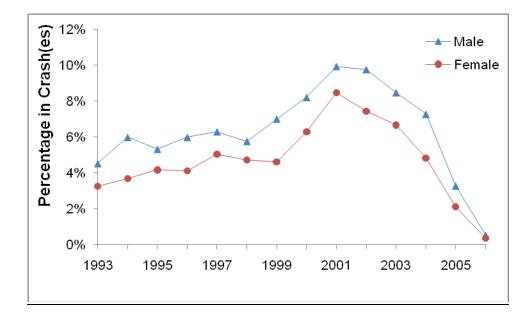


Figure 12: Percentage Crash Involvement as Driver by Gender & Year

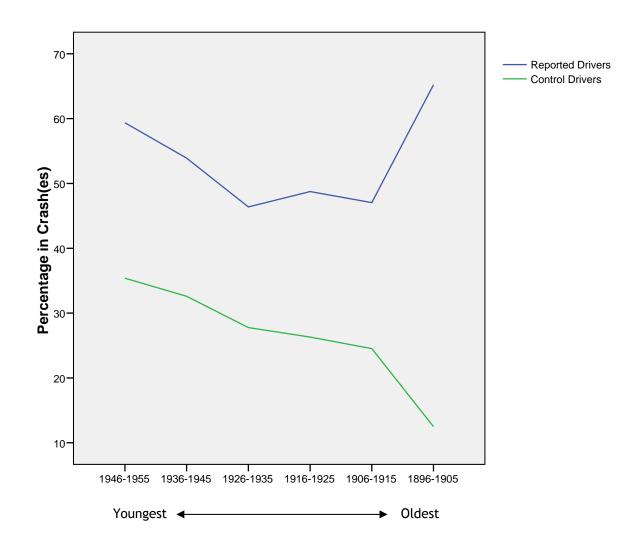


Figure 13: Percentage Crash Involvement by Birth Year Range (1993-2007)

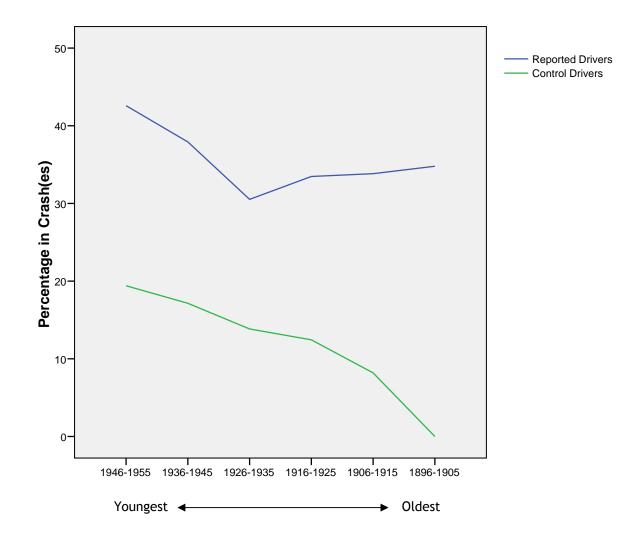
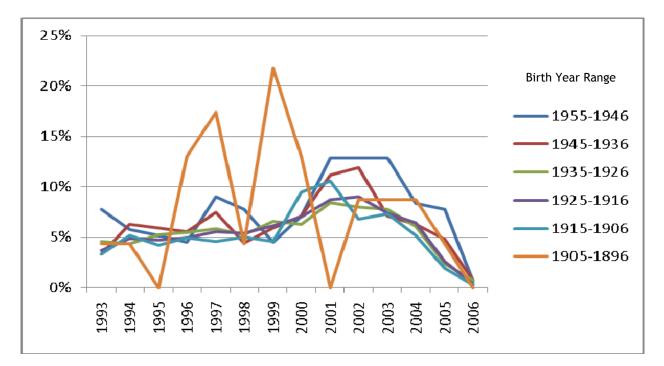


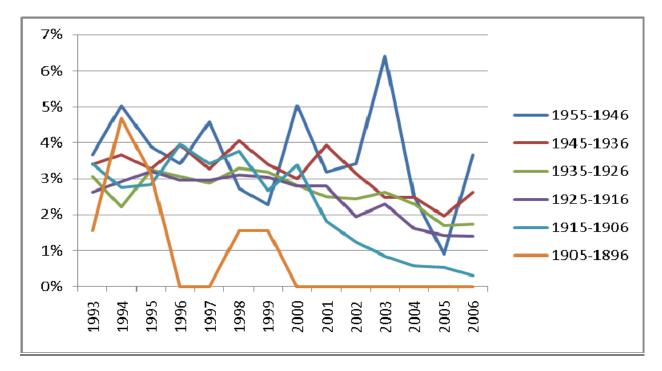
Figure 14: Percentage Crash Involvement by Birth Year Range (2000-2007)

Figure 15: Crash Involvement by Year & Birth Year Range



(a) Reported Drivers (n = 4,100)

(b) Control Drivers (n = 11,615)



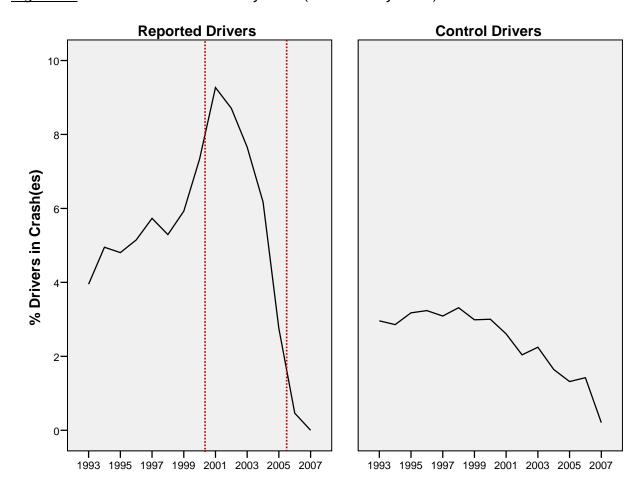
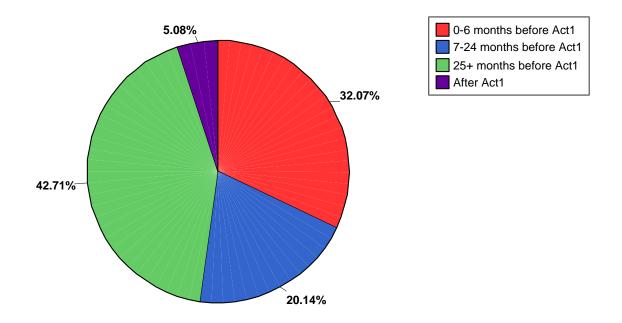


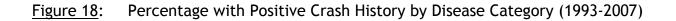
Figure 16: Crash Involvement by Year (1993 - early 2007)⁵⁷

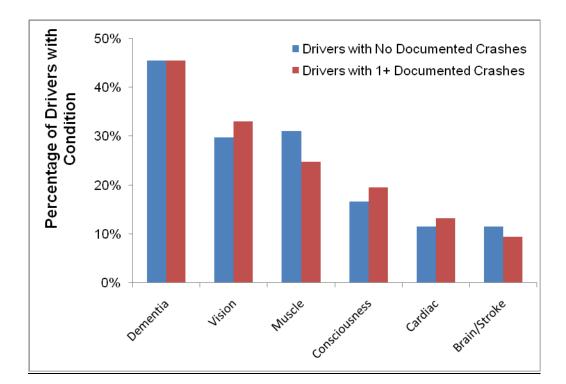
⁵⁷ The dotted line shows the reporting period. Only limited 2007 data were available, so the graphs may under estimate the true rate. In a handful of instances, a reported driver had more than one crash in a single year.

Figure 17: Proximity of Crashes to Department Action 1 Date⁵⁸



⁵⁸ Based on crashes per reported driver closest in date to Department Action 1. For example, if a driver had two crashes in 1994 and 2001, respectively, just the latter is counted here.





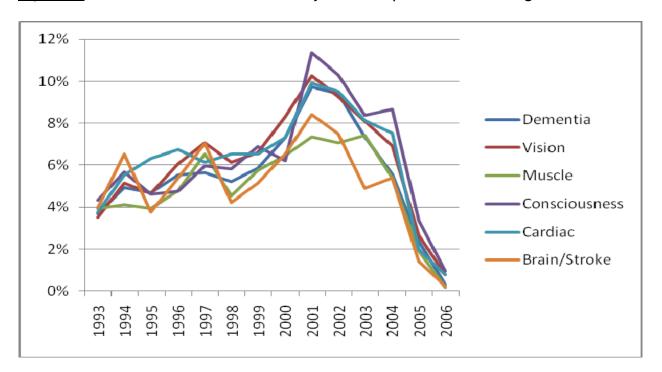


Figure 19: Annual Crash Involvement by Most Frequent Disease Categories⁵⁹

⁵⁹ Disease categories not mutually exclusive, as some individuals had more than one condition.

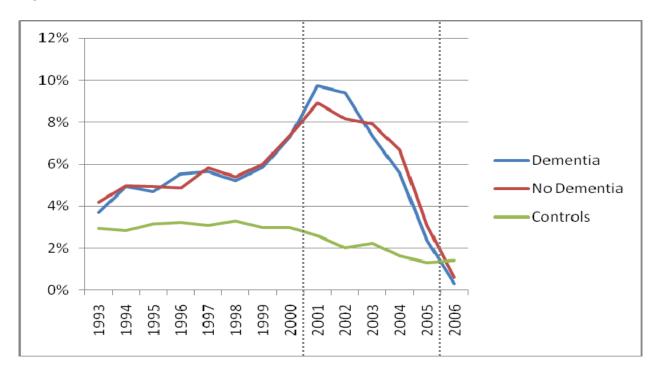


Figure 20: Annual Crash Involvement - Dementia vs. No Dementia⁶⁰

⁶⁰ The dotted lines demark the reporting period for this sample.

Figure 21: Summary of Attrition & Outcomes from Initial Report to Final Status⁶¹

| | Reported as Unfit to Drive | Physician Evaluation | Testing Required | Testing Performed | Retained License Pursuant to DOR Full Case Review |
|--------------------|-------------------------------|-------------------------|---------------------|----------------------|---------------------------------------------------------------|
| Reviewed Sample | N = 4,100 | 2,028 | 979 | 562 | 144 |
| % of Total | 100% | 50% | 24% | 14% | 3.5% |
| % of Preceding | | 50% | 48% | 57% | |
| % Increment Change | | - 50% | - 52% | -43% | |
| % Male Gender | 55% | 58% | 51% | 50% | 61% |

⁶¹ The combined table and graphic above shows attrition from initial report to final licensing outcome. It also shows the types of information considered and reviewed by DOR staff and the Medical Review Board (when called upon for input) to determine a final licensing outcome. On-road testing through the Highway Patrol (HP) is one element, but not always a determining factor. Additional HP testing was not required for 101 of 144 (70%). Seven of these individuals had a history of prior on-road testing. Of those referred for HP testing that retained a valid license, 2 (5%) passed, 14 (32%) failed to show up when scheduled, and 27 (63%) failed. Others listed as having passed on-road testing (26 individuals; see Section 3.9) were de-licensed apparently for other reasons. The precise factors behind all DOR licensing decisions cannot be determined from our data. For example, information on appeals was not available in the Missouri Driver Record (i.e., the computerized record showing license status) or in microfilmed documents. Did some individuals appeal a licensing decision and provide information in support of on-going fitness? Did strongly worded concerns from family members contribute to specific de-licensing decisions? Were some de-licensed before Highway Patrol test data were received and processed at the DOR? Our data cannot answer these questions, but we are currently following up with DOR officials to address these few inconsistencies.

| | | ICEIISIIIg RE | quirements in 05 states | |
|---------|--------------------|------------------------------------------------|-----------------------------------------------|------------------------------------------------------------|
| State | Renewal (Years) | Accelerated Renewal For Older Drivers | Other Renewal Provisions | Reporting of Medical Conditions by Health Provide |
| Alabama | 4 | No | None | Voluntary |
| | | | No mail renowel for any 60 and older: no more | |

Appendix A: Driver Licensing Requirements in US Statesⁱ

| State | (Years) | For Older Drivers | Other Renewal Provisions | Conditions by the Health Provider ⁱⁱ |
|-------------------------|--------------------|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| Alabama | 4 | No | None | Voluntary |
| Alaska | 5 | No | No mail renewal for age 69 and older; no more than one mail renewal in a row for all ages; vision test required at renewal for all ages | NA |
| Arizona | Until age 65 | 5 yr. for age 65 and older | No mail renewal for age 70 and older; vision test verification required for age 65 and older mail renewal; vision test required every 12 yr. for all ages | Voluntary ⁱⁱⁱ |
| Arkansas | 4 | No | Vision test required at renewal for all ages | Voluntary |
| California | 5 | No | No mail renewal for age 70 and older; no more than two successive mail renewals for all ages | Mandatory ^{iv} |
| Colorado | 10 | 5 yr. for age 61 and older | No mail renewal for age 66 and older or electronic renewal for age 60 and older; no more than one mail/electronic renewal in a row for all ages | Voluntary |
| Connecticut | 4 or 6 | Age 65 and older may choose 2 or 6 yr. | Mail renewal for age 65 and older only if show hardship; vision test required at first renewal and then every other renewal for all ages | Voluntary |
| Delaware | 5 | No | None | Mandatory [∨] |
| District of Columbia | 5 | No | Physician certification of physical/mental driving competency, vision test, and possible reaction test required at renewal for age 70 and older; written and road tests may be required at renewal for age 75 and older | Voluntary |
| Florida | 6, 4-bad record | No | Vision test required at renewal for age 80 and older; no more than two successive mail/electronic renewals for all ages | Voluntary |
| Georgia | 4 | No | Vision test required at renewal for all ages; mail/electronic renewal every other renewal for all ages | Voluntary |
| Hawaii | 6 | 2 yr. for age 72 and older | Vision test required at renewal for all ages | Voluntary |
| Idaho | 4 | 4- or 8-yr. for age 21- 62; 4-yr. for 63 and older | Vision test required at renewal for all ages | Voluntary |
| Illinois | 4 | 2 yr. for age 81-86; 1 yr. for age 87 and older | Road test required at renewal for age 75 and older; vision test required for in-person renewal | Voluntary ^{vi} |
| Indiana | 4 | 3 yr. for age 75 and older | Vision test required at renewal for all ages; electronic renewal every other renewal if meet eligibility criteria | Voluntary |

| Iowa | 5 | 2 yr. for age | Vision test required at renewal for all ages | Voluntary |
|-------------------|------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| | 0 | 70 and older | | |
| Kansas | 6 | 4 yr. for age 65 and older | Vision test required at renewal for all ages | Voluntary |
| Kentucky | 4 | No | None | Voluntary |
| Louisiana | 4 | No | No mail renewal for age 70 and older; no more than one mail renewal in a row for all ages | Voluntary |
| Maine | 6 | 4 yr. for age 65 and older | Vision test required at every other renewal for age 40-61 and at every renewal for age 62 and older | Voluntary |
| Maryland | 5 | No | Vision test required at every renewal for age 40 and older; age 70 and older new licensees must show proof of prior safe car operation or physician's certification of fitness; age alone not grounds for re-examination | Voluntary |
| Massachuset ts | 5 | No | Age discrimination w/ regard to licensing prohibited | Voluntary |
| Michigan | 4 | No | Vision test required at in-person renewal for all ages; no more than one mail renewal in a row for all ages | Voluntary |
| Minnesota | 4 | No | Vision test required at renewal for all ages; age alone not grounds for re-examination | Voluntary |
| Mississippi | 4 | No | None | Voluntary |
| Missouri | 6 | 3 yr. for age 70 and older | Vision test required at renewal for all ages | Voluntary |
| Montana | 8 (4 by mail) | 4 yr. for age 75 and older | Vision test required at renewal for all ages; Mail renewal for all ages only in areas with no driver license services - no more than one in a row | Voluntary |
| Nebraska | 5 | No | Vision test required at renewal for all ages | Voluntary |
| Nevada | 4 | No | Medical report required at mail renewal for age 70 and older; no more than two successive mail/electronic renewals for all ages; age alone not grounds for re-examination | Voluntary |
| New Hampshire | 5 | No | Road test required at renewal for age 75and older | Voluntary |
| New Jersey | 4 | No | Vision test may be required at renewal for all ages | Mandatory ^{vii} |
| New Mexico | 4 or 8 | 4 yr. if turn 75 in 2nd half of 8-yr. renewal cycle | Vision test may be required at renewal for all ages | Voluntary |
| New York | 5 | No | Vision test required at renewal for all ages | Voluntary |
| North Carolina | 5 | No | Parallel parking not required in road test for age 60 and older; vision test required at renewal for all ages | Voluntary |
| North Dakota | 4 | No | Certification of vision required at renewal for all ages | Voluntary |

| Ohio | 4 | No | Vision test required at renewal for all ages | Voluntary |
|-------------------|----|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Oklahoma | 4 | No | License fees reduced for age 62-64, waived for age 65 and older | Voluntary |
| Oregon | 8 | No | Vision screening required every 8 years forage 50 and older | Mandatory ^{viii} |
| Pennsylvani a | 4 | Age 65 and older may choose 4 or 2 yr. | Vision test may be required at renewal for all ages | Mandatory ^{ix} |
| Rhode Island | 5 | 2 yr. for age 70 and older | None | Voluntary |
| South Carolina | 10 | 5 yr. for age 65 and older | Vision test required at renewal for age 65and older; beginning Oct. 1, 2008, vision test required every 5 years for all ages | Voluntary |
| South Dakota | 5 | No | Vision test required at renewal for all ages | Voluntary |
| Tennessee | 5 | No | No expiration for licenses issued to age 65and older; no more than one mail/electronic renewal in a row at all ages; fees reduced age 60 and older | Voluntary |
| Texas | 6 | No | Vision test required at renewal for all ages | Voluntary |
| Utah | 5 | No | Vision test required for age 65 and older; vision test required every 10 years for all ages; no more than one electronic renewal in a row for all ages | Voluntary |
| Vermont | 4 | No | None | Voluntary |
| Virginia | 5 | No | Vision test required at renewal for age 80and older; no more than one mail/electronic renewal in a row for all ages | Voluntary |
| Washington | 5 | No | Vision test required at renewal for all ages; no more than one mail/electronic renewal in a row for all ages | Voluntary |
| West Virginia | 5 | No | None | Voluntary |
| Wisconsin | 8 | No | Vision test required at renewal for all ages | Voluntary |
| Wyoming | 4 | No | Vision test required at renewal for all ages ;no more than one mail renewal in a row for all ages | Voluntary |

Appendix B: HB-1536 Legal Text & Key Forms

SECOND REGULAR SESSION (TRULY AGREED TO AND FINALLY PASSES) SENATE COMMITTEE SUBSITITUTE FOR HOUSE COMMITTEE SUBSTITUTE FOR HOUSE BILL NO. 1536 89TH GENERAL ASSEMBLY 1998 AN ACT

To repeal sections 302.291 and 302.292, RSMo 1994, and to enact in lieu thereof two new sections relating to the reporting and examination of impaired drivers, with penalty provisions and an effective date.

Be it enacted by the General Assembly of the state of Missouri, as follows: Section A. Sections 302.291 and 302.292, RSMo 1994, are repealed and two new sections enacted in lieu thereof to be known as sections 302.291 and 302.292, to read as follows:

302.291.

1. The director, having good cause to believe that an operator is incompetent or unqualified to retain his license, after giving ten days' notice to such person in writing by [registered] certified mail directed to his present known address. may require him to submit to an examination as prescribed by the director. Upon conclusion of the examination, the director may allow the licensee to retain his license. may suspend, deny or revoke the license of the licensee, or may issue to the examinee a license subject to restrictions as provided in section 302.30 I. If an examination indicates a condition that potentially impairs safe driving, the director, in addition to action with respect to the license, may require the licensee to submit to further periodic examinations. The refusal or neglect of the [operator] licensee to submit to [such] an examination within thirty days after the date of such notice shall be [ground] grounds for suspension, denial or revocation of his license by the director, an associate circuit or circuit court. Notice of any suspension, denial, revocation or other restriction shall be provided by certified mail. As used in this section, the term "denial" means the act of not licensing a person who is currently suspended, revoked or otherwise not licensed to operate a motor vehicle. Denial may also include the act of withdrawing a previously issued license.

2. The examination provided for in subsection I of this section may include, but is not limited to, a written test and tests of driving skills, vision, highway sign recognition and, if appropriate, a physical and/or mental examination as provided in section 302.173.

3. The director shall have good cause to believe that an operator is incompetent or unqualified to retain his license on the basis of, but not limited to, a report by:

(1) Any certified peace officer;

(2) Any physician, physical therapist or occupational therapist licensed under chapter 334, RSMo; any chiropractic physician licensed under chapter 331, RSMo; any registered nurse licensed under chapter 335, RSMo; any psychologist or soc~1 worker licensed under chapter 337, RSMo; or

(3) Any member of the operator's family within three degrees of consanguinity, or the operator's spouse, who has reached the age of eighteen, except that no person may report the same family member pursuant to this section more than one time during a twelve month period. The report must state that the person reasonably and in good faith believes the driver cannot safely operate a motor vehicle and must be based upon personal observation or physical evidence which shall be described in the report, or the report shall be based upon an investigation by a law enforcement officer. The report shall be a written declaration in the form prescribed by the department of revenue and shall contain the name, address, telephone number, and signature of the person making the report.

4. Any physician, physical therapist or occupational therapist licensed under chapter 334, RSMo, any chiropractor licensed under chapter 331, RSMo, any registered nurse licensed under chapter 335, RSMo, or any psychologist or social worker licensed under chapter 337, RSMo, may report to the department any patient diagnosed or assessed as having a disorder or condition that may prevent such person from safely operating a motor vehicle. Such report shall state the diagnosis or assessment and whether the condition is permanent or temporary. The existence of a physician-patient relationship shall not prevent the making of a report by such medical professionals.

5. Any person who makes a report in good faith pursuant to this section shall be immune from any civil liability that otherwise might result from making the re- port. Notwithstanding the provisions of chapter 610, RSMo, to the contrary, all reports made and all medical records reviewed and maintained by the department of revenue under this section shall be kept confidential except upon order of a court of competent jurisdiction or in a review of the director's action pursuant to section 302.311.

6. The department of revenue shall keep records and statistics of reports made and actions taken against driver's licenses under this section.

7. The department of revenue shall, in consultation with the medical advisory board established under section 302.292, develop a standardized form and provide guidelines for the reporting of cases and for the examination of drivers under this section. The guidelines shall be published and adopted as required for rules and regulations under chapter 536, RSMo. The department of revenue shall also adopt rules and regulations as necessary to carry out the other provisions of this section. The director of revenue shall provide health care professionals and law enforcement officers with information about the procedures authorized in this section. The guidelines and regulations implementing this section shall be in compliance with the federal Americans with Disabilities Act of 1990.

8. Any person who knowingly violates a confidentiality provision of this section or who knowingly permits or encourages the unauthorized use of a report or reporting person's name in violation of this section shall be guilty of a class A misdemeanor and shall be liable for damages which proximately result.

9. Any person who intentionally files a false report under this section shall be guilty of a class A misdemeanor and shall be liable for damages which proximately result.

10. All appeals of license revocations, suspensions, denials and restrictions shall be made as required under section 302.311 within thirty days after the receipt of the notice of revocation, suspension, denial or restriction.

11. Any individual whose condition is temporary in nature as reported pursuant to the provisions of subsection 4 of this section shall have the right to petition the director of the department of revenue for total or partial reinstatement of his or her license. Such request shall be made on a form prescribed by the department of revenue and accompanied by a statement from a health care provider with the same or similar license as the health care provider who made the initial report resulting in the limitation or loss of the driver's license. Such petition shall be decided by the director of the department of revenue within thirty days of receipt of the petition. Such decision by the director is appealable pursuant to subsection 10 of this section.

302.292.

1. In order to advise the director of revenue on medical criteria for the reporting and examination of drivers with medical impairments, a medical/vision advisory board is hereby established within the department of revenue. The board shall be composed of three members appointed by the director of the department of revenue. The members of the board shall be licensed physicians and residents of this state. Of the original appointees, one shall serve for a term of two years and two shall serve for terms of four years. Subsequent appointees shall each serve for a term of four years or until their successors are appointed and approved. Any vacancy shall be filled in the same manner as the original appointment for the remainder of the term. The members of the board shall be reimbursed for their actual and necessary expenses incurred in the performance of their official duties. After the first full year of operation of the advisory board, the board shall meet no more than four times per year .

2. No civil or criminal action shall lie against any member of the medical/vision advisory board of the department of revenue who acts in good faith in advising the department under the provisions of this chapter. Good faith shall be presumed on the part of members of the medical/vision advisory board in the absence of a showing of fraud or malice.

Section: B. The provisions of this act shall become effective on January 1, 1999.



MISSOURI DEPARTMENT OF REVENUE CUSTOMER ASSISTANCE BUREAU P.O. BOX 200 JEFFERSON CITY, MO 65105-0200 DRIVER CONDITION REPORT

| Res | et | Print | FORM |
|-----|----|----------------------------------|------------|
| TEL | | (573) 751-2730 | 4319 |
| v | | (573) 522-8174 www.dor.mo.gov | (REV 9-03) |

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.

| PERSONAL INFORMATION ON | NAME (LAST, FIRST, MIDDLE) | s | SOCIAL SECURITY NUMBER OR DRIVER LICENSE NUMBER | | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------|--------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------|--|
| PERSON BEING REPORTED: | LICENSE PLATE NUMBER STATE OF ISSUANCE | | DATE OF BIRTH | | TELEPHONE NUMBER | | |
| Please complete all available information. | ADDRESS | | CITY | STA | re | ZIP CODE | |
| Describe in detail incide specific information such other available informatio You should report only i knowledge or physical evi told or heard. | as dates, places, acciden n to support the need for nformation of which you | t reports and all re-examination. have personal | | ersonal kr pplicable. | nowled Pleas f incid | priate boxes based on dge of incident if e give a detailed ent. Age alone is not a r retesting. | |
| | | | Traffic Violations Dangerous Actio Poor Driving Sk | ons 🗌 Ca | | ttention raffic Accident/Incident | |
| | | | Lack of Knowled | dge of Traffic I | Laws | | |
| | | | Obstructing Traf | | | | |
| | | | | | | | |

MO 860-2507 (9-03)



MEDICAL CONDITIONS

Please check ✓ appropriate boxes if the driver being reported has any of the following conditions that would impair his or her ability to safely operate a motor vehicle:

| COGNITIVE IMPAIRMENTS/PSYCHIATRIC DISORDER (i.e., sees or hears things that are not there, gets lost easily, has problems remembering words for common things, confusion in thought process or judgment) Please explain: | DISORDERS THAT IMPAIR CONSCIOUSNESS (i.e., seizures, blackouts, sleep disorders) When was the last loss of consciousness?/// Please explain: |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| VISUAL IMPAIRMENT (frequently runs into objects, cannot see road signs, cannot see objects on the side without turning head) Please explain: | LIMITED MOBILITY (i.e., paralysis, problems moving freely) Please explain: |
| ALCOHOL/DRUG ABUSE Please explain: | OTHER CONDITIONS Please explain: |
| ADDITIONAL COMMENTS | |
| Please attach additional comments if necessary. | |

| PERSON | ANY PERSON WHO INTENTIONALLY FILES A FALSE REPORT SHALL BE GUILTY OF A CLASS A MISDEMEANOR, AND SHALL BE LIABLE FOR THE DAMAGES WHICH RESULT. | | | | | | |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------|-------------|-----------------|--|--|
| COMPLETING FORM: | PRINT FULL NAME (LAST, FIRST, MIDDLE) | RELATIONSHIP TO DRIVER | | TELEPHONE (| NUMBER | | |
| | STREET ADDRESS | CITY | STATE | ZIP CODE | | | |
| | SIGNATURE | | | | | | |
| MO 860-2507 (9.03) | | | | | DOD-4319 /9-031 | | |



MISSOURI DEPARTMENT OF REVENUE DRIVER LICENSE BUREAU POSSIBLE DRIVER IMPAIRMENT(S) NOTIFICATION



This document should be completed when license office personnel observe an obvious physical impairment of an applicant, and when appropriate restrictions are not noted on the driver license as provided in Sections 302.173, 302.291, and 302.301, RSMo. Information submitted on this form may result in a mandatory physical examination and/or a driver examination to determine the driving ability of the applicant.

| APPLICANT'S NAME: | | |
|-------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| LICENSE NUMBER: | | |
| 1. Describe the impairment _ | | |
| | | |
| | | |
| | | |
| 2. How long has the applicant be | en impaired? Years Mor | nths Days. |
| 3. Is the impairment permanent? | 🗌 Yes 🗌 No 🗌 Unknown | |
| reasonably and in good faith, belie | eve that he/she cannot safely operate a | ormation relayed to me by this individual, I a motor vehicle and should be required to take t driver license restrictions, if any, are needed. |
| OFFICE LOCATION | ADDRESS | DATE |
| EMPLOYEE SIGNATURE | PHONE NUMBER | TITLE |
| NO 860-0011 (7-2008) | | DOR-153 (7-200 |

Standard text used in DOR notification letter sent to drivers immediately after they are reported:

The Driver and Vehicle Services Bureau has received information that you may have a medical/physical condition that could interfere with your ability to operate a motor vehicle in a safe and responsible manner.

For this reason, please complete the following:

____ Physical Examination: Please have the enclosed medical form completed by your regular attending physician. Your doctor must state whether he or she believes you can drive safely.

If you successfully complete the physical examination, restrictions may have to be added to your license. You may also have to take the complete driving skills (road) test.

If you are unable to complete the physical/vision examination by _____ (date), you may voluntarily surrender your driver license to the Driver and Vehicle Services Bureau. You must then contact this office for approval when you are ready to take the test.

An extension to take the test may only be granted in an emergency situation. If an emergency extension is required, your request must be in writing and supported with documentation about the emergency. Documentation could be a statement from your physician, etc. We will review your request and notify you in writing whether the extension is granted.

If you do not take the physical examination by _____ (date), or if you are unable to successfully pass the examination, your driver license will be revoked...

| | | | Print | | Reset | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-------------------|--------------------------|--|
| Solution () | JRI DEPARTMENT OF REVENUE | | | | | |
| 2. Altain | I LICENSE BUREAU ST HIGH STREET — ROOM 225 | TELEPHONE (572) 751 14 | | 400 | FORM | |
| 3.1 1.1.1992 1.8 | SON CITY, MO 65105-0200 | TELEPHONE: (573) 751-1489 FAX: (573) 522-8174 | | 469 | 1528 | |
| Thomas and the second sec | CIAN'S STATEMENT | WEB SITE: www.dor.mo.gov | | | (REV. 10-2005) | |
| | | WEB SITE. WWW.doi.mo.gov | | | | |
| PLEASE REA | D THE FOLLOWING INFORMA | TION CAREFULLY BE | FORE CO | MPLE | TING THIS | |
| FORM! | | | | | | |
| N | | | | | | |
| | eting this report does not violate phy | | | | | |
| physic | ian shall be immune from any civil liat | pility that might otherwise r | result from m | naking | this report. | |
| You s | hould complete and sign the Phys | sician's Statement based | on vour e | xamin | ation of the | |
| patier | it, and indicate if he or she is capab | le of operating a motor v | ehicle safely | y and I | responsibly. | |
| | | | | | | |
| | | | | | | |
| | PATIENT NAME (LAST, FIRST, MIDDLE) | SOCIAL SECURITY NUMBER | 3 | DATE OF | BIRTH | |
| PATIENT | | | | | | |
| INFORMATION | PATIENT'S MAILING ADDRESS | CITY | | STATE | ZIP CODE | |
| | | | | | | |
| | | | | | | |
| MEDICAL CONDITIONS | ANY OF THE FOLLOW | PPROPRIATE BOXES IF THE NG CONDITIONS THAT WO A MOTOR VEHICLE. | | | | |
| | - 4 | | | | | |
| | | | VISION | | | |
| CONDITIONS ANY OF THE FOLLOW TO SAFELY OPERATE VISUAL IMPAIRMENT Yes No Should patient be required to wear glasses/lenses | | VISION | | | | |
| Should patient be | Yes No | DISTANT VISION ONLY | RIGHT | LEFT | | |
| Should patient be while driving? | required to wear glasses/lenses | WITH PRESENT CORRECTION | RIGHT 20/ | 20/ | 20/ | |
| Should patient be while driving? Should patient be | Yes No | WITH PRESENT CORRECTION | RIGHT 20/ 20/ | 20/ 20/ | 20/ | |
| Should patient be while driving? Should patient be Does patient have driving unsafe? | required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION | RIGHT 20/ 20/ 20/ | 20/ 20/ 20/ | 20/ 20/ 20/ | |
| Should patient be while driving? Should patient be Does patient have | required to wear glasses/lenses | WITH PRESENT CORRECTION | RIGHT 20/ 20/ | 20/ 20/ | 20/ 20/ 20/ | |
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| Should patient be while driving? Should patient be Does patient hav driving unsafe? Additional comments: | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EYE DOCTOR SIGNATURE EKING A COMMERCIAL DRIVE | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |
| Should patient be while driving? Should patient be Does patient hav driving unsafe? Additional comments: | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EYE DOCTOR SIGNATURE | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |
| Should patient be while driving? Should patient be Does patient hav driving unsafe? Additional comments: | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EYE DOCTOR SIGNATURE EKING A COMMERCIAL DRIVE | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |
| Should patient be while driving? Should patient be Does patient hav driving unsafe? Additional comments: | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EVE DOCTOR SIGNATURE EKING A COMMERCIAL DRIVE PSYCHIATRIC Hallucinations or Del | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |
| Should patient be while driving? Should patient be Does patient have driving unsafe? Additional comments: | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EVE DOCTOR SIGNATURE EKING A COMMERCIAL DRIVE PSYCHIATRIC Hallucinations or Del | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |
| Should patient be while driving? Should patient be Does patient hav driving unsafe? Additional comments: HEARING — DO Normal COGNITIVE IMP/ Impaired Prote | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EVE DOCTOR SIGNATURE EKING A COMMERCIAL DRIVE PSYCHIATRIC Hallucinations or Del | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |
| Should patient be while driving? Should patient be Does patient have driving unsafe? Additional comments: | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EVE DOCTOR SIGNATURE EKING A COMMERCIAL DRIVE PSYCHIATRIC Hallucinations or Del | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |
| Should patient be while driving? Should patient be Does patient hav driving unsafe? Additional comments: HEARING — DO Normal COGNITIVE IMP/ Impaired Prote | Yes No required to wear glasses/lenses | WITH PRESENT CORRECTION WITHOUT CORRECTION BEST POSSIBLE CORRECTION FIELD EVE DOCTOR SIGNATURE EKING A COMMERCIAL DRIVE PSYCHIATRIC Hallucinations or Del | RIGHT 20/ 20/ RIGHT | 20/ 20/ 20/ | 20/ 20/ 20/ EFT | |

| DISORDERS THAT IMPAIR CONSCIOUSNESS | | DITIONS | |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------|----------------------|
| Medication Effect Disorders, such as Sleep Apnea, Narcolepsy, Other | Paralysis | Loss of Lim | ıb |
| Epilepsy, Seizure Disorder, Other | Restricted Range of Motio | on | |
| Blackouts Date of Event with Impaired Consciousness | Other (Please explain) | | |
| Other (Please explain) | | | |
| | | | |
| ALCOHOL OR DRUG ABUSE | | | |
| (Please explain) | (Please explain) | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| PLEASE ATTACH ADDITIONA | L COMMENTS IF NECESSARY. | | |
| STATEMENT OF PHYSICIAN | | | |
| CONDITION IS: Permanent Temporary (please explain): | | | |
| Are you the patient's regular physician? | | | |
| If yes, how many times have you seen patient in the past year? | | | |
| If no, have you reviewed the patient's medical records? | | | |
| I have examined | on | | and in my |
| opinion he/she: \square is capable of operating a motor vehicle safely a | nd responsibly without further evalu | ation at this time | |
| ☐ is NOT capable of operating a motor vehicle satisfies | ely and responsibly. | | |
| must take the following test(s) in order to determ and responsibly: written test and/or determ | ine whether or not he/she is capable Iriving skills test | e of operating a n | notor vehicle safely |
| I RECOMMEND THE FOLLOWING SPECIAL RESTRICTIONS AND/OR DEVICES WHILE DRIVING: | | | |
| PHYSICIAN'S SIGNATURE | | DATE | |
| PHYSICIAN'S NAME (PRINT OR TYPE) | MEDICAL LICENSE NUMBER | TELEPHONE NUMBER | 3 |
| PHYSICIAN'S ADDRESS | CITY | () STATE | ZIP CODE |
| | | | |

MO 860-0448 (10-2005)

DOR-1528 (10-2005)

| D | IISSOURI DEPARTMEN RIVER LICENSE BURE ISION EXAMINATI | AU | | Print | | Reset | 9 | ORM 999 (10-2005) |
|----------------------------------|------------------------------------------------------------------------------------------------|---------------|----------------------|--------------------------------|----------------|--------------|---------------|--------------------------|
| VOID IF ERASE | ED/ALTERED OR NAM | E/DATE OF | BIRTH NOT INCLUDE | D | ACUITY | LEFT | BOTH | RIGHT |
| DATE | NAME | | | | NO AID | 20/ | 20/ | 20/ |
| STREET ADDRESS | 1 | | _ | | COR- RECTED | 20/ | 20/ | 20/ |
| CITY | | | COUNTY | | FIELD | 0 | 0 | 0 |
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| Driving Project Document Entry |
| Missouri Driver Records |
| 1528 - Physicians' Statements |
| 4319 - Driver Condition Reports |
| 232 - Driver Information Reports |
| 153 - Possible Driver Impairment Forms |
| 999 - Vision Exam Records |
| Driving Skills Tests/100 - Driver Examinations · · · 5 |
| General Letters |
| License Verification Statement |
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| Qualitative Data Entry |
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Appendix C: Screen Shots from Access Database

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| Epilepsy, Seizure, Convulsions, Other Restricted Range of Motion |
| Blackouts Date of Event Other Illegible Information |
| Dizzy Spells |
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| Alcohol/Drug Abuse |
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| Have you reviewed the patient's medical records? Yes No 1 Exam Date: |
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EVALUATING DRIVING IMPAIRMENTS



A GUIDE FOR FIELD AND CENTRAL OFFICE STAFF

Safety is a primary concern when licensing any driver.

Field and Central Office staff play an essential role in determining whether an applicant applying for a Missouri driver license or permit has the ability to safely operate a motor vehicle. The responsibility to evaluate a driver's ability is the same for all classes of licenses and endorsements⁹.

CHART FOR EVALUATING DRIVING IMPAIRMENTS

| ABILITY (what the applicant is able to do) | STANDARD (what the applicant should be able t o do) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lower body strength, range of motion, mobility and coordina- tion to use foot-operated vehicle controls. | Person is able to walk to a license office counte unaided physically by another person or significant support device (i.e., walker, wheel chair, breathing apparatus or artificial limb). There is no loss (full or partial) of a leg or foot. No excessive shaking, tremor, weakness, rigidity or paralysis. |
| Upper body strength, range of motion, mobility and coordina- tion to use hand-operated vehicle controls and to turn the head and body to the left, right and rear to observe for other traffic and pedestrians. | Person is able to turn head and upper body to the left and right, and has full use of the arms and hands. There is no loss (full or partial) of an arm. There is no loss of a hand or finger that interferes with proper grasping. No excessive shaking, tremor, weakness, rigidity or paralysis. |
| To see other traffic, road conditions, pedestrians, traffic signs and signals. | Person is able to meet applicable vision require ments by passing a Department of Revenue vision screening or presenting evidence of similar testing by a vision specialist. |
| Cognitive skills (i.e., to think, understand, perceive and remember). | Person exhibits cognitive skills. Responds to questions and instructions (i.e., is able to complete an application, knowledge test or vision screening). No obvious disorientation. |
| To maintain normal conscious- ness and bodily control. | Person exhibits normal consciousness and bodily control (i.e., no self-disclosed or obvious incident or segment of time involving altered consciousness. No loss of body control involv- ing involuntary movements of the body charac- terized by muscle spasms or muscle rigidity, or loss of muscle tone or muscle movement). No obvious disorientation (i.e., responds to questions and instructions. Is able to complete an application, knowledge test or vision screening). |
| To maintain a normal social, mental or emotional state of mind. | Person does not exhibit an extremely hostile and/or disruptive, aggressive behavior, or being out of control. No obvious disorientation. |



ABILITIES NEEDED TO DRIVE SAFELY

Certain abilities are needed to safely operate a motor vehicle, i.e., the ability to see, to operate hand and/or foot controls and adequate cognitive skills. Your observations of an applicant's for help to determine the minterence of

rour observations or an applicant s behavior and physical condition help to determine the existence of those abilities. Check the chart on the back of this guide for more details regarding observable abilities and behavior you should observe. For example:

- Is the applicant unable to walk to the counter unaided by another person or without support device(s)? Does the applicant not have full use of hands, arms or legs? Does the applicant exhibit excessive rigidity, paralysis, shaking or tremor? People with varying types of physical limitation can safely operate motor vehicles but they may require special equipment to assist with vehicle control.
- Is the applicant unable to respond either orally or in writing to questions or instructions? Does the applicant exhibit obvious disorientation? If so, then the applicant's ability to perceive and judge driving conditions and situations may not be adequate.

MEDICAL CONDITION INQUIRIES

When inquiring of medical conditions, be mindful of an applicant's possible confidentiality concerns. Ask questions in as private a manner as reasonably possible. Speak quietly and respectfully.

- Ask each question on the OTC medical screen.
 In addition to the standard OTC medical question
- In addition to the standard OTC medical questions, if necessary, you may inquire about observable behaviors or conditions that would appear to impact upon the applicant's ability to safely operate a motor vehicle. However, you should **check the applicant's record first** to determine whether the license is already appropriately restricted (e.g., the applicant exhibits a limited use of legs and the license already has a hand control restriction). If the applicant's observable condition is not addressed by an existing license restriction(s), then further inquiry is appropriate. For example:

"Has there been any change in your condition since your last driver license application that would affect your ability to drive a motor vehicle? If so, what change(s)?"

"Is your motor vehicle equipped with any special equipment to help you operate the vehicle? If so, what equipment?"

 Record the answers to all questions as well as your observations of the applicant. You should record your answers on form DOR-153 or the Driver Condition Report (form DOR-4319).

PUT IT IN WRITING

You should document the medical information you receive from an applicant, and your observations of an applicant, in an accurate and professional manner.



Write facts, not just opinions or conclusions. The applicant's ability to safely drive, with or without restrictions, should be based on observed and reported facts. For example, the following statement is insufficient:

"Applicant cannot operate vehicle."

Instead, you should report:

"I observed that the applicant could not walk without the aid of a walker. No restrictions on the license. When asked, applicant stated that he or she had a stroke since the last renewal and has a weakness in legs. Applicant may need to be retested or may need a doctor's statement to ensure he or she is capable of operating a vehicle safely and determine what equipment may be needed."

Be thorough. Record all relevant facts. Use the following chart to assist you in making your evaluation. If you have any questions regarding driving impairments or driver safety, please contact your supervisor.

ⁱ Modified from Molnar, L.J., & Eby, D.W. A brief look at driver license renewal policies in the United States. Public Policy & Aging Report, 15(2), p. 1, 13-17. Reprinted here with permission of the authors.

ⁱⁱ Column added for this report. Content derived from the Older Drivers Project of the American Medical Association (Physicians Guide to Assessing & Counseling Older Drivers (See http://www.amaassn.org/ama/pub/ category/10791.html), a fact sheet on Mandatory Physician Reporting produced ElderSafetv.org (See bv http://www.eldersafety.org/pdfs/MandatoryPhysicianReportingFactSheet-final.pdf), and individual State DMV websites.

ⁱⁱⁱ Arizona and most other voluntary reporting states require that license holder be responsible for reporting medical conditions (or changes in pre-existing conditions) that may impair driving safety. A fact sheet from Arizona states "Assisted by the Medical Advisory Board, the Motor Vehicle Department (MVD) has established medical standards for driver licensing. Several questions regarding your medical condition are included on the driver license application. You must report to MVD any medical conditions that develop or worsen that may affect your ability to safely operate a motor vehicle" (http://www.azdot.gov/mvd/driver/mcmanual/documents/99-0129part1.pdf).

^{iv} California Health & Safety Code 103900: "Every physician and surgeon shall report immediately to the local health officer in writing, the name, date of birth, and address of every patient at least 14 years of age or older whom the physician and surgeon has diagnosed as having a case of a disorder characterized by lapses of consciousness. However, if a physician and surgeon reasonably and in good faith believes that the reporting of a patient will serve the public interest, he or she may report a patient's condition even if it may not be required under the department's definition of disorders characterized by lapses of consciousness pursuant to subdivision." According to California Code of Regulations (Division 1, Chapter 4, Subchapter 2.5, Section 2802), "Examples of medical conditions that do not always, but may progress to the level of functional severity described in the above subsection of this section include Alzheimer's disease and related disorders, seizure disorders, brain tumors, narcolepsy, sleep apnea, and abnormal metabolic states, including hypo- and hyperglycemia diabetes.' associated with (See

http://www.dmv.ca.gov/pubs/vctop/appndxa/hlthsaf/hs103900.htm).

^v "Any person who is subject to loss of consciousness due to disease of the central nervous system will not be issued a Delaware driver's license unless the Division receives a report from the person's treating physician stating that the driver's infirmity is under sufficient control to permit them to safely operate a motor vehicle. The certifying physician must have been treating the person for a minimum of 3 months for loss of consciousness. Any person licensed to operate a motor vehicle on the basis of this certificate/report will be required to furnish the Division with a new certificate every year no later than the last day of the person's birthday month. Failure to provide a favorable doctor's report will license." suspension person's driver's result in the of а (See Drivers Manual; http://www.dmv.de.gov/forms/ driver_serv_forms/ pdfs/dr_frm_manual.pdf)

^{vi} In Illinois, drivers with "any medical or mental condition which could result in a loss of consciousness or any loss of ability to safely drive a vehicle" and/or drivers that take "any medications that may impair ability to drive" are required to submit a report from their physician. The onus is on the driver to make the report, and not mandatory on the physician or other health provider. (See http://www.cyberdriveillinois.com/departments/drivers/ drivers_license/medical_vision.html).

^{vii} "New Jersey law requires physicians to report to Motor Vehicle Commission (MVC) information about recurrent seizures or recurrent periods of unconsciousness or impairment or loss of motor coordination their patients may have, such as those associated with various forms of epilepsy." (See Medical Conditions & Driving: When should MVC know?; http://www.state.nj.us/mvc/medical_conditions.pdf).

^{viii} As required by OAR 735-074-0090, a physician or health care provider must submit a report, as described in OAR 735-074-0120, to DMV when providing health care services to a person, over 14 years of age, and who has one or more of the following cognitive or functional impairments which is severe and uncontrollable:

(1) Functional impairments include sensory impairments affecting peripheral sensation of extremities, including but not limited to: tingling and numbness and loss of position sense in extremities affecting the ability to feel, grasp, manipulate or release objects or use foot controls effectively.

(2) Functional impairments include motor impairments affecting the following areas:

- (a) Strength, including but not limited to:
 - (A) The inability to consistently maintain a firm grip on objects;
 - (B) The inability to apply consistent pressure to objects with legs and feet;
 - (C) Weakness or paralysis of muscles affecting the ability to maintain sitting balance;

or

(D) Weakness or paralysis in extremities affecting the ability to feel, grasp, manipulate or release objects or use foot controls effectively.

(b) Flexibility, including but not limited to: rigidity and/or limited range of mobility in neck, torso, arms, legs or joints.

(c) Motor planning and coordination, including but not limited to:

- (A) Difficulty and slowness in initiating movement;
- (B) Vertigo, dizziness, loss of balance or other motor planning conditions;

(C) Involuntary muscle movements; or

(D) Loss of muscle control.

(3) Cognitive impairments affecting the following areas:

(a) Attention, including but not limited to:

(A) Decreased awareness;

(B) Reduction in the ability to efficiently switch attention between multiple objects; or

- (C) Reduced processing speed.
- (b) Judgment and problem solving, including but not limited to:

(A) Reduced processing speed;

(B) An inability to understand a cause and effect relationship; or

(C) A deficit in decision making ability.

(c) Reaction time, including but not limited to a delayed reaction time.

- (d) Planning and sequencing, including but not limited to:
 - (A) A deficit in the ability to anticipate and/or react to changes in the environment; or
 - (B) Problems with sequencing activities.
- (e) Impulsivity, including but not limited to:
 - (A) Lack of emotional control; or
 - (B) Lack of decision making skills.
- (f) Visuospatial, including but not limited to problems determining spatial relationships.
- (g) Memory, including but not limited to:
 - (A) Problems with confusion and/or memory loss; or
 - (B) A decreased working memory capacity.
- (h) Loss of consciousness or control.

See OREGON ADMINISTRATIVE RULES, CHAPTER 735, DIVISION 74, MEDICAL CERTIFICATION PROGRAM (http://www.oregon.gov/ODOT/DMV/ATRISK/docs/Severe_Uncontrollable.pdf).

^{ix} "Historically, physician reporting has provided a highly effective mechanism for removing impaired drivers from our roads. In accordance with Section 1518(b) of the Pennsylvania Vehicle Code, all physicians and other persons authorized to diagnose or treat disorders and disabilities *must report to PennDOT* any patient 15 years of age or older, who has been diagnosed as having a condition that could impair his ability to safely operate a motor vehicle." PENNSYLVANIA DEPARTMENT OF TRANSPORTATION - PHYSICIAN REPORTING FACT SHEET (October 2005; See http://www.dot10.state.pa.us/pdotforms/fact_sheets/fs-pub7212.pdf).

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