Identifying Policy Approaches to Extending the Safe Mobility of Older Adults

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AAA Foundation for Traffic Safety

Title

Identifying Policy Approaches to Extending the Safe Mobility of Older Adults

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Foreword

According to previous research by the AAA Foundation for Traffic Safety, drivers ages 60–69 have the lowest rate of crashes per mile driven, however, the rate increases with increasing age. While drivers age 80 and older have relatively low overall crash rates, they have the highest rate of driver deaths per mile driven. Older drivers may experience age-related medical conditions, functional impairments, and side effects of medications that impact their driving abilities. To address various challenges faced by older drivers, the AAA Foundation for Traffic Safety has invested resources to carry out research such as that presented in this report with the goal of reducing injuries and fatalities and improving the safety of the older driving population.

This report summarizes the methodology and results of several tasks conducted to formulate practice and policy recommendations to support the safety and mobility of older drivers. Licensing officials, policymakers, and researchers should find information presented in this report useful.

C. Y. David Yang, Ph.D.

Executive Director

AAA Foundation for Traffic Safety

About the Sponsor

AAA Foundation for Traffic Safety
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Founded in 1947, the AAA Foundation for Traffic Safety in Washington, D.C., is a nonprofit, publicly supported charitable research and educational organization dedicated to saving lives by preventing traffic crashes and reducing injuries when crashes occur. Funding for this report was provided by voluntary contributions from AAA/CAA and their affiliated motor clubs, individual members, AAA-affiliated insurance companies, and other organizations or sources.

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Abstract

Driving and driver licensing play an important role in safe mobility for older adults. However, much remains to be learned about the impact of various licensing policies on older driver crash risk and mobility. The objective of this research was to examine effective policies and practices in driver licensing of older and medically at-risk drivers and offer practical guidance to driver licensing officials and policymakers. To achieve this objective, four major tasks were undertaken. The first was to review the literature examining older driver policies internationally and their impact on crashes, traffic safety, and mobility. The second was to conduct in-depth interviews with representatives from licensing authorities to learn more about current practices, successes, challenges, needs, and recommendations. The third was to conduct multivariate analyses using data from a large-scale multi-site prospective cohort study of aging drivers, Longitudinal Research on Aging Drivers (AAA LongROAD), to examine individual and environmental factors that may mediate or moderate the effectiveness of different licensing policies. The final task was to develop recommendations to offer practical guidance to driver licensing officials and policymakers. This report discusses each of these tasks. For each of first three tasks (international literature review, in-depth interviews, and analysis of AAA LongROAD data), detailed information is provided about the background of the task, the methods or approach used to complete the task, results from the task, and overall conclusions. For the fourth task, recommendations are presented separately for licensing renewal, physician reporting and referrals by others, and the medical review process, with each section divided into policy and practice recommendations. Recommendations for partnerships to promote older driver safety and mobility are added in a fourth section, as they cut across multiple licensing policies and practices. The report also includes a conclusions and discussion section, which highlights potential avenues of research to support and enhance implementation of the recommendations.

Introduction

As the United States population ages, it will become increasingly important to understand and effectively address the mobility needs of older adults spread throughout various types of communities and travel environments, and representing a wide range of medical, functional, and personal characteristics. Driving and driver licensing play an important role in safe mobility for older adults and will continue to do so. However, states and stakeholders face complex challenges in implementing driver licensing policies and practices for older drivers that effectively balance public safety and individual mobility. States currently use a variety of licensing practices with provisions for older drivers including shorter renewal periods, more frequent vision testing, and in-person renewal requirements (IIHS, 2018). Some form of medical review process is also part of most licensing practices for older drivers. A recent evaluation found that 36 states had a medical review/advisory board that played a role in licensing decisions and most remaining states had some form of medical review process, often conducted by non-medical licensing authority staff (Lococo et al., 2017).

Much remains to be learned about the impact of these strategies on older-driver crash risk and mobility. In a review of licensing strategies, Thomas et al. (2013) noted that too few have been evaluated and findings of those evaluations are not straightforward, with studies coming to different conclusions. Evaluations of medical review processes have typically focused on feasibility and licensing outcomes but not crash or mobility outcomes.

While notable efforts have been made to assemble databases of driver licensing policies and medical review processes, examination of the impact of these policies has been limited, and no large-scale evaluation has been conducted to date to identify individual and environmental factors that may mediate or moderate the effectiveness of different licensing requirements on crashes and mobility. The AAA Foundation for Traffic Safety (AAAFTS) Longitudinal Research on Aging Drivers (AAA LongROAD) project is a multi-site prospective cohort study designed to generate data for understanding the role of medical, behavioral, environmental, and technological factors in the driving safety of aging drivers (Li et al., 2017). Targeted analysis of this database, combined with an extensive literature review to examine research conducted globally, as well as structured interviews with licensing and medical review stakeholders to update what is currently known, provides an innovative and ground breaking opportunity to comprehensively examine the effects of licensing policies on older driver safety and mobility.

Project Objective and Overview

The objective of this research was to assess what are the most effective policies and practices in driver licensing of older and medically at-risk drivers and to offer practical guidance to driver licensing officials and policymakers in the form of practice-ready recommendations. To achieve this objective, the project had four major tasks.

- The first was to review the literature examining older driver policies internationally and their impact on crashes, traffic safety, and mobility.
- The second was to conduct in-depth interviews with representatives from licensing authorities to learn more about current practices, successes, challenges, needs, and recommendations.
- The third was to conduct multivariate analyses using AAA LongROAD data to examine individual and environmental factors that may mediate or moderate the effectiveness of different licensing policies.
- The final task was to develop recommendations to offer practical guidance to driver licensing officials and policymakers.

Each of these tasks is discussed fully in the remainder of this report. For each of the first three tasks (international literature review, in-depth interviews, and analysis of AAA LongROAD data), detailed information is provided about the background of the task, the methods or approach used to complete the task, results from the task, and overall conclusions. For the fourth task, recommendations are presented separately for licensing renewal, physician reporting and referrals by others, and the medical review process, with each section divided into policy and practice recommendations. Recommendations for partnerships to promote older driver safety and mobility are added in a fourth section, as they cut across multiple licensing policies and practices. The recommendations are also consolidated in Appendix A. The report also includes a conclusions and discussion section, which considers the project recommendations within the context of the outcomes from the AAAFTS Licensing Workshop, and highlights potential avenues of research to support and enhance implementation of the recommendations.

International Literature Review

Background

The primary purpose of the literature review was to examine older driver licensing policies in the U.S. and elsewhere, and draw conclusions about their impact on crashes, traffic safety, and mobility. In addition, the review served as a source of background information for the other two components of the project. Specifically, findings from the literature review helped the project team identify jurisdictions, programs, and individuals to approach for the in-depth interviews, as well as the most salient topics for discussion during the interviews. The findings also provided the project team with a better understanding of the individual and environmental factors that play a role in the implementation and effectiveness of licensing policies, thus contributing to the development of the analysis plan for the AAA LongROAD dataset.

An important impetus for this project was a strong interest in identifying licensing policies and practices shown, in well-designed evaluations, to have an effect on crashes and mobility. While there is a large and growing literature on licensing policies and practices for older drivers, formal evaluations of these policies and practices have been quite limited. Thus, it has been difficult for researchers and others to reach firm conclusions about the effectiveness of specific licensing policies and practices.

These challenges are not new. The 2008 North American License Policies Workshop was convened by AAAFTS to inform policy-makers in the licensing community about available evidence and guide the development of its long-term research program on older adult safety and mobility (see Eby & Molnar, 2008; Molnar & Eby, 2008). The workshop brought together 35 experts from the U.S., Canada, United Kingdom, and Australia. Its overall purpose was to inform policy makers in the licensing community about the state of knowledge at that time, and to guide the development of a robust long-term research agenda in AAAFTS's research program of older adult safety and mobility. The workshop, which built on several earlier licensing policy related forums, as well as a series of "white papers" and presentations commissioned for the workshop, led to a number of consensus-based concerns and recommendations. Among the concerns were the following:

- "Data are lacking on the effectiveness of many screening methods, assessment programs, and associated licensing policies and practices, as well as interventions for at-risk drivers making it difficult to implement relevant policies and practices.
- "Randomized, controlled clinical trials and evaluations are considered the "gold standard" for research but are not always possible. Nonetheless, this is something to strive for in conducting research to evaluate best practices or interventions" (Molnar & Eby, 2008).

Among the policy recommendations were the following:

- Final licensing decisions should be based on functional and medical fitness to drive (and not chronological age).
- Empirically defensible criteria and guidelines on medical and functional fitness to drive should be developed and implemented to the extent possible, based on available scientific research.

- Standard reporting laws should be enacted that provide civil immunity for clinicians and licensing personnel who report people they think may be medically unfit to drive. Such laws will help reduce one barrier to reporting—fear of lawsuits.
- Active medical advisory boards should be established and funded that are an integral element of state licensing agencies and involved in both case review and policy development.

Among the practice recommendations were the following:

- Standardized education and training should be provided for clinicians, police officers, and licensing personnel on fitness-to-drive issues.
- Specific guidelines should be developed for licensing agencies and clinicians on how to refer drivers for specialized driving assessments.
- Education and training should be provided to clinicians so that they fully understand existing laws, regulations, and policies related to reporting individuals who they think may be medically unfit to drive.
- Incentives should be provided for physician participation in medical advisory boards.
- Education and training should be provided to members of medical advisory boards on issues related to functional limitations and medical fitness to drive.

Recommended elements of a model licensing system included the following:

- Driver assessment should not be age-determined, but triggered by decreasing functional ability, as measured objectively through screening.
- "Safety (crash prevention) should serve as the primary basis for driver screening and assessment.
- "Although it is not appropriate (or practical) to have age-triggered assessment, it is appropriate to have age-triggered driver screening, with screening only used to see if further testing should be done, not to determine licensing actions that can have much wider ramifications.
- "In-person driver license renewal should be required for drivers of all ages.
- "A medical advisory board with broad representation should be involved in both decisions on individual competency to drive and policy development relative to licensing.
- "Voluntary reporting of at-risk drivers to licensing authorities is important, as is immunity for those reporting" (Molnar & Eby, 2008).
- "It is important to have multi-tiered systems encompassing both screening and assessment," (Molnar & Eby, 2008) which are different and distinct domains of driver evaluation.
- "A model system requires valid driver screening tools.
- "High quality data systems to support licensing decisions (driver records and crash databases) should share information across states.
- "Validated road course tests for assessing driving performance are needed.
- "Education and training should be made available for licensing personnel, practitioners, and the public.
- "Agency responsibilities should be viewed along a continuum, with identification of at-risk drivers at one end and assistance in transitioning to alternative transportation options at the other end.

- "Validated driver simulation measures for assessing driving performance are needed" (Molnar & Eby, 2008).

How do these consensus-based recommendations hold up today, over a decade after the workshop was convened? What is the state of the evidence for these and other licensing policies and practices targeted to older drivers? Have the concerns identified by workshop participants been addressed, and if so, how? This literature review attempts to answer these questions by systematically examining research studies, not only since the workshop was held, but going back to 2000, several years before. In addition, as noted earlier, the main focus was not on simply identifying the specific policies and practices in place across jurisdictions, but examining their impact on safety and mobility.

Methods

Overall Search Strategy

A set of overall inclusion and exclusion criteria was used to guide the search, as well as topics and key words identified by the project team with input from AAAFTS (see below). However, the document search process was necessarily iterative in that as appropriate articles were found, relevant subject and key word terms in those articles were used to refine the search, and relevant references included in those articles were pulled. Document gathering was facilitated by the University of Michigan's MLibrary, which allows the University of Michigan Transportation Research Institute (UMTRI) faculty and staff electronic access not only to multiple databases but also has subscriptions to thousands of journals and other publications. A scan of appropriate websites, such as state licensing authorities, was also conducted to gather information that may not have appeared in other databases. All of the research sources were organized using an online tool, Zotero (https://www.zotero.org/), that allowed for the entire project team to easily access the information. Collected articles were reviewed by the Principal Investigator and Co-Investigator for appropriateness. Those deemed appropriate were included in the literature review and synthesized in this document.

Inclusion Criteria

- Journal articles, technical reports, conference papers and proceedings, books, and white papers published in English.
- Documents published in or after the year 2000.
- Documents from the U.S. and outside the U.S. (e.g., Australia, Great Britain, the Netherlands, Canada).
- Special focus on systematic reviews and meta-analyses rather than individual studies (to help keep scope manageable and leverage work already done to summarize results across studies).

Topics

The project team, with input from AAAFTS, identified a preliminary set of topics to guide the literature search. This list included the following:

- Age-based licensing restrictions and/or required retesting for driver's licenses
- In-person license renewal

- Accelerated license renewal
- Knowledge tests
- On-road tests/assessments
- Visual acuity testing at license renewal
- Bioptic telescopes
- Required vehicle equipment
- Mandatory versus voluntary physician reporting of drivers
- Physician immunity and/or confidentiality
- Family/friends reporting
- Law enforcement reporting
- Conditional or restricted licensing
- Medical review processes (including the use of medical review/advisory boards)
- Medical self-report at licensing renewal
- Required medical report at license renewal
- License examiner observation of functioning
- Examiner/staff training on older drivers
- Review of driver crash/violation record
- Post-assessment outcomes/activity

Databases and Search Terms

The following databases were searched: TRID, ScienceDirect, Web of Science, and Google Scholar. A set of search terms was derived from the topics of interest, based on the investigators' knowledge of the field and discussions with AAAFTS. These search terms were used to gather appropriate articles, reports, and other published documents. The starting set of search terms was based on the list of topics identified above, with terms combined into search strings (e.g., using AND, OR) to represent the myriad of ways the topics might be represented in the literature. The starting list of search terms was expanded as the search evolved and as additional terms were discovered in documents that emerged from the initial set of terms.

Results

Using the methods described above, the search of the relevant literature yielded a total of 992 publications (identified collectively in several databases). Based on a review of the titles and abstracts of these publications by project research assistants, 342 were found to be relevant for the review. Of the remaining publications, which included some combination of key words but were found not to be relevant, many focused on teen or young drivers, or simply reported on the general attitudes of various stakeholders outside the context of licensing policy. Once all duplicate publications were removed, 146 remained. Ninety-nine relevant publications were added after reviewing Google Scholar and as a result of an iterative process of using identified publications to search for additional publications. The final number of publications that underwent full review was 245 (see Appendix B).

Based on outcomes from the literature search, the topics of interest were consolidated into three main categories for ease of synthesizing and reporting results from the review: licensing renewal policies for older drivers; physician reporting and other referrals; and medical review/assessment processes. For each grouping, a background and overview of

policies by jurisdiction is first provided, and then implications for safety, mobility, and practice are discussed.

Licensing Renewal Policies for Older Drivers

Background and Overview of Policies by Jurisdiction

Licensing agencies play an important role in implementing policies for responsible driving and maintaining a safe environment for all road users; many of these policies come into play at the license renewal stage (Eby, Molnar & St. Louis, 2019). Many jurisdictions in the U.S. and elsewhere have one or more policies related to licensure renewal including: mandatory in-person renewal; accelerated renewal periods; knowledge, vision, and/or road tests; and conditional/restricted licensing. Restrictions on driving are often imposed by licensing authorities to enable drivers with diminished functional abilities to maintain at least limited privileges and independent mobility (Staplin & Lococo, 2003). Such restrictions vary across jurisdictions but generally include limiting exposure to certain driving situations or mandating the use of adaptive vehicle equipment. Examples of such restrictions include: driving only in daylight, with corrective lenses, and with outside rearview mirrors for individuals with vision loss; driving in limited areas, on specific roads/road types, or within certain speed limits for individuals with loss of mental function; and required use of special mirrors, mechanical direction signals, power or low-effort steering, automatic transmission, spinner knobs, and/or power brakes for individuals with disorders that limit strength and endurance (Staplin & Lococo, 2003).

It is clear that license renewal policies vary considerably across jurisdictions in the U.S. (see Appendix C for renewal policies by state), as well as the European Union member countries and Australia (e.g., see Mitchell, 2008; Siren & Haustein, 2015; Thomas, Bloomberg, Knodler & Romoser, 2013). For example, as shown in Appendix C, 12 states have a policy requiring accelerated renewal for older drivers; the age at which this requirement begins ranges from 65 to 85, and the frequency of renewal ranges from 1 to 6 years. In-person renewal is required in 10 states, with the starting age for such renewal ranging from 62 to 79. Vision tests are the most commonly required test at renewal (13 states); only two states require a knowledge test and one state requires a road test (Illinois). All states except Rhode Island have a provision in place for restricted/conditional licensing; however, the exact combination of restrictions varies considerably across states.

Among U.S. states that have such policies, there is not uniformity in the age at which these policies go into effect, how frequent the general renewal cycle is, what types of tests are required (e.g., knowledge, vision, and/or road tests) or what types of restrictions are required for conditional/restricted licenses. However, central to these renewal policies is the use of age as the trigger for policy implementation. Thus, they can all be considered age-based licensing requirements. For the purposes of this review, however, each renewal policy was examined on its own instead of focusing on the more generalized concept of age-based licensing requirements. This decision was made for several reasons. First, the effects of the renewal policies vary. It is clear from the literature that renewal policies for older drivers do not represent a unidimensional concept; instead, they often work in very different ways and can have very different outcomes in terms of safety, mobility, and practice. Therefore, when results are only presented for combinations of policies, it is not surprising that individual policy effects may be obscured. Second, many of the studies on age-based testing or age-based licensing requirements are narrowly focused on just a few policies—typically,

medical examination and on-road testing (e.g., Langford, Bohensky, Koppel & Newstead, 2008; Langford, Fitzharris, Koppel & Newstead, 2004). Therefore, it was considered more instructive to focus the review on individual and interacting effects of specific policies rather than focus on age-based requirements *per se* (with the latter generally measured by a single combined outcome for multiple policies, e.g., Ross, Browning, Luszcz, Mitchell & Anstey, 2011; Tay, 2012). To this end, studies of mandatory age-based policies were only included if they contributed to an understanding of specific licensing requirements.

Implications for Safety, Mobility, and Practice

In-person renewal: Grabowski and his colleagues conducted the first comprehensive analysis of licensure laws and fatality rates among older drivers using national data (e.g., Grabowski & Morrisey, 2001, 2002; Grabowski, Campbell & Morrisey, 2004; Morrisey & Grabowski, 2005). Of interest for this review were four policies related to license renewal for older drivers, including in-person renewal, vision tests, road tests, and the frequency of license renewal. Using data from the Fatality Analysis Reporting System (FARS) for the years 1990–2000, Grabowski et al. (2004) retrospectively examined all fatal crashes in the contiguous U.S. involving older drivers (broken out into 65–74, 75–84, and 85+ age groups) and a comparison group of drivers age 25–64. The analyses controlled for state-level factors including the number of licensed older drivers, the presence of selected laws (state speed limits, seat belt laws, blood alcohol limits, and administrative license revocation), and selected economic indicators (per capita income and unemployment).

The only renewal policy found to be associated with a lower driver fatality rate was in-person renewal. Specifically, the relative incidence rate for states with in-person renewal was close to 17% lower than states with no in-person renewal for drivers 85 and older (n=4,605). In-person renewal for drivers age 65–74 and 75–84 was not found to be independently associated with fatality rates. This was also the case for vision tests, road tests, and more frequent license renewal. The authors concluded that their study results supported the importance of in-person license renewal for older drivers as a potential approach for reducing the fatal crash rate among drivers 85 and older. However, they cautioned that their study could not identify the mechanism underlying the relationship between in-person renewal and fatality rates among drivers in the oldest-old age group. They speculated that in-person renewal might lead to greater numbers of potentially unsafe older drivers being detected and refused a license because it gives licensing personnel an opportunity to either refuse to grant licenses to obviously impaired drivers or refer them for medical evaluation. Conversely, they considered the possibility that potentially unsafe older drivers might be less likely to reapply for a license when facing in-person renewal; that is, they decide to stop driving rather than go through the renewal process.

While the lack of detailed state-by-state information on the numbers of license applicants over time made it difficult for Grabowski et al. (2004) to disentangle the effects of in-person license renewal on safety and mobility, Kulikov (2011) focused exclusively on the impact of license renewal policies on driving mobility (i.e., driving reduction and cessation). Based on examination of data on adults age 70 and older from four waves (1993, 1995, 1998, and 2000) of the Asset and Health Dynamics of the Oldest Old study (n=9,638), the author found that in-person renewal at age 70 or older was linked to driving longer trips rather than shorter trips, and continuing rather than ceasing driving. She concluded that her

results were consistent with the idea that restrictive re-licensing policies allow for older people to continue driving to meet their basic mobility needs.

Two systematic reviews of older driver licensing policies conducted since the publication of Grabowski et al. (2004) identified their studies as offering evidence supporting in-person renewal (Dugan, Barton, Coyle & Lee, 2013; Stav, 2008). Stav (2008) concluded that re-licensure policies requiring in-person renewal can reduce traffic-related fatalities, based on the findings from Grabowski et al. (2004). She cautioned, however, that it is important to consider the continued mobility needs of older adults, and noted that non-driving modes of transportation (e.g., walking and bicycling) have been associated with increased crash risk for this segment of the population. Dugan et al. (2013) also pointed to Grabowski et al. (2004) as the basis for concluding that requiring in-person license renewal was strongly supported. The authors also included the study by Kulikov (2011) in their review, highlighting her findings that in-person renewal for older drivers was associated with reduced driving but not cessation. Their review was limited to studies published in the U.S., due to their stated interest in maintaining consistency in the social context of the policies examined.

Support for the findings of Grabowski et al. (2004) came from another analysis of U.S. FARS data conducted by Tefft (2014). He used FARS data from 46 U.S. states over a 26-year period (1986–2011) to examine the effects of several driver licensing policies (length of renewal period; mandatory in-person renewal; vision, knowledge, and road tests; mandatory versus voluntary physician reporting) on drivers age 55 and older (categorized as 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and 85+). Drivers age 40–54 were also included as a reference group. He included several potential confounders in the analysis including *per se* blood alcohol concentration laws, speed limits, seat belt use laws, state unemployment rates, state per capita personal income, gasoline prices, and seasonal effects. Findings indicated that mandatory in-person renewal was associated with a 28% reduction in fatal crash involvement rates of drivers age 85 and older, after controlling for potential confounders and other licensing requirements in place along with in-person renewal. This reduction increased to 31% after taking into account concurrent changes in the fatal crash involvement rates of the reference population (drivers age 40–54). Similar to Grabowski et al. (2004), the author cautioned that without being able to determine the mechanism by which policies affect crash rates, it is unclear whether results were attributable to the effective identification of potentially unsafe drivers at in-person renewal or premature driving cessation by some drivers still able to drive safely.

More recently, Agimi, Albert, Youk, Documet, and Steiner (2018) examined the role of state physician reporting laws and other licensing policies on crash hospitalizations among older drivers with dementia. The records of 136,987 hospitalized drivers age 60 and older (categorized as age 60–69, 70–79, and 80+) from 37 U.S. states reporting data to the State Inpatient Databases of the Agency for Healthcare Research and Quality from 2004–2009 were examined. Hospitalized drivers age 60–69 in states with in-person renewal laws were 37–38% less likely to have dementia than drivers in other states, after adjusting for covariates. They concluded that their study results point to in-person renewal as an effective means of older driver safety. As with earlier studies, the authors noted that it was unclear whether the mere presence of in-person renewal led drivers to stop driving voluntarily or whether licensing authorities took away people's driving privileges at the in-person renewal.

Contrary findings on the effectiveness of in-person renewal came from an analysis of crash fatality rates of adults over age 65 in the 50 U.S. states, using data from the Centers for Disease Control and Prevention's web-based Injury Statistics Query and Reporting System database from 2006–2010 (Bell, Qiao & Zarzaur, 2015). They also included several state level covariates (average miles driven among drivers age 65 and older, population density, average temperature and precipitation, percentage of older population with a college degree, overweight or obese, with Medicare coverage or access to different levels of care, gas prices, and driver license fee amount) in the analysis. The authors did not find any significant negative or positive effects of in-person renewal on crash fatality rates among older drivers age 65 and older. They did find that average temperature, gas price, and ratio of emergency medicine physicians to population size were significant negative predictors of crash fatality rates. Positive predictors of fatality crash rates included the percentage of the population overweight or obese and the percentage over age 65 with college degrees. Their findings are not truly comparable to Grabrowski et al. (2004) and Tefft (2014) because they examined fatality rates for the entire population over age 65, rather than breaking this known heterogeneous population into more meaningful age subgroups as was done in the other studies.

Collectively, with the exception of Bell et al. (2015), study findings on in-person license renewal for older drivers suggest that this licensing policy has beneficial effects on driving safety, at least for drivers age 85 and older. The impact on mobility for this segment of the population is less clear, given the lack of detailed state-by-state data on the in-person renewal process. The implications of in-person renewal for licensing agencies themselves is complex. Such renewal can add costs to agency budgets, when many agencies already face considerable financial constraints. At the same time, in-person renewal can benefit agency practices by offering opportunities for licensing staff to observe and/or examine drivers in-person to help identify gross impairments in functioning, as well as provide them with information and educational materials to help them remain safely mobile (see Staplin & Lococo, 2003). For example, the opportunity for licensing staff to interact directly with older drivers at the in-person renewal was considered to have a significant effect on safety by licensing staff interviewed in licensing agencies in Illinois, Iowa, Kansas, and New Hampshire (Thomas et al., 2013). In addition, as noted by Grabowski et al. (2004), drivers identified by licensing examiners as potentially at-risk may be referred for medical evaluation, which may include more sophisticated testing such as neurological examinations, comprehensive visual examination, simulator tests, and road tests.

Accelerated renewal: Unlike mandatory in-person license renewal, there does not appear to be support for the safety benefits of accelerated license renewal. In the study by Grabowski et al. (2004), more frequent license renewal was not found to be independently associated with the fatality rate among older drivers, as measured by data from FARS for 1990–2000 for the 48 contiguous states in the U.S. Similarly, Tefft (2014) reported that requiring more frequent license renewal was not associated with statistically significant reductions in fatal crash involvement rates of older drivers, after accounting for concurrent changes in the fatal crash involvement rates of drivers in the reference group (drivers age 40–54). Bell et al. (2015) found that a shortened renewal cycle was associated with a higher crash fatality rate among drivers over the age of 65. They speculated that this finding could be due to legislators in states with already higher crash fatality rates being more likely to pass older driver licensing laws. They also considered the alternative explanation that their results were due to unintended consequences of renewal policies. They gave two examples:

first, older drivers might consider such policies to be discriminatory and potentially unsafe drivers may end up being more motivated to renew their licenses; and second, safe drivers who are removed from driving by these policies may end up relying on drivers in age groups at higher crash risk. The previously discussed systematic review conducted by Dugan et al. (2013) found no evidence that accelerated renewal for older drivers reduced crashes or fatalities. The other systematic review by Stav (2008) did not include the topic of accelerated renewal.

In terms of effects on mobility, Kulikov (2011) found that accelerated renewal was associated with reductions in driving but not cessation of driving. She concluded that this and other renewal policies appeared to correct for premature driving cessation and reduction, while encouraging the reduction or abstention from driving when necessary. One potential benefit in terms of licensing agency practice is that with a shorter license length, states are able to stay more informed of changes occurring to individuals over time (Coley & Coughlin, 2002). Kelly, Nielson, and Snoddon (2014) evaluated Canadian policies related to license renewal frequency in terms of their cost-effectiveness, equity, transparency, and feasibility. They concluded that the use of age as a trigger for increased frequency of renewal and testing should continue, and recommended a trigger age of 75. According to the authors, such harmonization would eliminate a source of inequity and contribute to transparency and feasibility. At the same time, they argued that a shorter renewal period should be combined with better testing and education, given that shorter renewal periods by themselves do not result in improved safety.

Vision, knowledge, and road tests at license renewal: Study results with regard to knowledge, vision, and road tests at license renewal are mixed; results vary across studies and by the type of test. Vision tests have been the most extensively studied. In fact, the effects of vision testing of older drivers on crashes and crash-related injuries and fatalities has been the focus of three systematic reviews published by the Cochrane Library (Desapriya et al., 2014; Desapriya et al., 2011; Subzwari et al., 2009). All reviews were conducted by the same general investigative team, with each successive review representing an update of the earlier review. All used the same selection criteria: "randomized controlled trials (RCTs) and controlled before-and-after studies comparing vision screening of drivers age 55 and older, and which assessed the effect on road traffic crashes, injuries, fatalities, and any involvement in traffic law violations" (Desapriya et al., 2014, p. 2). No studies were identified that met the selection criteria. However, each review included a background discussion of selected study findings on vision testing at license renewal (e.g., Grabowski et al. 2004; Levy, Vernick & Howard, 1995; McGwin, McCartt, Braitman & Owsley, 2008; McGwin, Sarrels, Griffin, Owsley & Rue, 2008; Shipp, 1998). It is instructive to review these studies (as well as more recent studies) despite their not meeting the selection criteria for the Cochran reviews, given that RCTs are often not feasible in research on older driver safety and mobility.

Two early studies cited in the systematic reviews found support for the use of vision tests at license renewal. Based on analysis of FARS data for U.S. states from 1985–1989, Levy et al. (1995) found that state-mandated vision tests were significantly associated with lower crash fatality rates among drivers age 70 and older. Using FARS data from 1989–1991, Shipp (1998) found that vision tests at license renewal were significantly associated with lower vehicle occupant fatality rates of drivers age 60 and older. Contrary results came from three studies that also used FARS data for the 48 contiguous U.S. states (Bell et al.,

2015; Grabowski et al., 2004; Tefft, 2014). Grabowski et al. (2004) found that state laws mandating vision tests were not associated with a lower fatality rate among older drivers. They cautioned that vision tests, road tests, and in-person renewal are not mutually exclusive categories; in their analyses, each of these variables was used to capture the independent effect of the particular policy on the crash fatality rate, holding the other two policies constant. They noted that previous studies of vision test policies neglected to account for in-person renewal by grouping all states without such policies together in the control group, regardless of whether the state had in-person license renewal. Tefft's (2014) results were similar. When in-person renewal was not required, mandatory vision tests were associated with a 36% reduction in the fatal crash involvement rates of drivers age 85 and older. However, when in-person renewal was required, and vision testing was a component of that process, vision tests were not associated with any additional reduction in rates of fatal crashes beyond that associated with in-person renewal. Bell et al. (2015) examined crash fatalities for the age group 65 and older overall and did not find vision testing to be significantly associated with lower rates.

A before-and-after study design was used by McGwin and his colleagues to examine the impact of a law requiring vision testing for all drivers age 80 and older implemented in Florida at the beginning of 2004 (McGwin, Sarrels et al., 2008). The authors noted that the true change resulting from the law was the requirement of a certificate for in-person renewals documenting that the driver had passed a vision test. They examined FARS data from 2001–2003 (pre-law) and 2004–2006 (post-law) in Florida and two adjacent states that did not change their older driver licensing laws (Alabama and Georgia). In Florida, the fatality rate among drivers age 80 and older decreased significantly by 17% from the prelaw to post-law period, after adjusting for age, race, and sex (compared to a 6% increase for drivers of all ages). By comparison, there were no significant changes in fatality rates among older drivers in Alabama and Georgia between 2001 and 2006. The authors recognized the concerns raised by Grabowski et al. (2004) about the need to control for in-person renewal, but noted that the extent to which in-person license renewal versus vision testing accounted for the observed decline in fatality rates was unclear, given that prior to 2004, the distribution of in-person, and non-in-person renewal was unknown. They also addressed concerns that the law would remove a significant number of drivers from the road, concluding that this was not the case based on a Florida survey of older drivers (n=1,242) that found the law was not a deterrent to seeking or obtaining license renewal (McGwin, McCartt et al., 2008). At the same time, they raised the possibility that some segment of the older driver population denied licensure might, in fact, be low risk, pointing to the need for a better understanding of the mechanism by which the law resulted in reduced crash fatalities.

More recent work by Agimi et al. (2018) on the effects of vision tests on crash hospitalizations among older drivers with dementia found that states with vision testing at in-person renewal had a significantly lower proportion of hospitalized older drivers with dementia. Specifically, vision tests were associated with a 28% lower likelihood of a dementia diagnosis but only among hospitalized drivers age 60–69 in states with vision testing at in-person renewal. Kulikov (2011) also found some benefits of vision tests in looking at effects on mobility. Her results indicated peripheral vision testing was associated with decreased driving reduction and cessation.

One possible explanation for the mixed findings across studies regarding the effectiveness of vision tests is that visual acuity and visual fields (most often measured in vision tests at renewal), appear to be only weakly correlated with safe driving (e.g., Bohensky, Charlton, Odell & Keefe, 2008; Johnson & Wilkenson, 2010; Silveira, Jolly, Heard, Cluna & Kay, 2007). For example, Bohensky et al. (2008) argued that "driving involves a complex set of skills and information processing, and vision and functional capabilities need to be considered in the context of the driver's health and abilities overall" (p. 309). Johnson and Wilkenson (2010) suggested that these measures remain in place because they are practical; in particular, visual acuity has been shown to be effective in providing a quick, accurate, and easily administered test relevant to the driving task, with a standardized methodology for assessment. They called for the U.S. to adopt a uniform vision standard for driver licensure, similar to the United Kingdom and other countries, rather than maintain different standards across jurisdictions.

Knowledge tests at license renewal have been less frequently studied than vision tests. However, findings across studies are more consistent in their lack of support for such testing. Neither Levy et al. (1995) nor Tefft (2014) found evidence that knowledge tests independently reduced fatal crash involvement rates among older drivers. Grabowski et al. (2004) did not examine knowledge tests in their study.

To assess the safety effects of road tests in Illinois (the only U.S. jurisdiction requiring a road test at license renewal) and New Hampshire (a state that had such a law until 2011), the Highway Loss Data Institute (HLDI, 2016, 2017) conducted analyses of insurance claims for the two states, and groups of surrounding comparison states. Results indicated that Illinois' requirement that drivers age 75 and older renew their license frequently (every 4 years for drivers age 80 and younger, every 2 years for drivers age 81-86, and every year for drivers age 87 and older) and pass a road test at renewal was associated with reduced insurance claims among older drivers. However, no such effects were found for New Hampshire (with a 5-year renewal cycle for all drivers, regardless of age). The investigators concluded that Illinois' requirements led to fewer older drivers than would be expected, with those older drivers remaining on the road being somewhat less risky than drivers in nearby states. They noted that their analyses were not able to separate out the effects of the road test from the effect of the specific renewal cycles, which might have accounted for some of the differences between the states. Another difference mentioned was the greater availability of public transportation options in Illinois, especially in urban areas where the greatest reductions in claims occurred.

Grabowski et al. (2004) also examined the effects of mandatory road tests at license renewal and found no effects on fatal crash rates; the authors noted that only two states had such policies in place at the time but did not identify the states. Similarly, an Australian study that compared crash rates in Sydney, a city requiring drivers age 80 and older to undergo a medical assessment and road test, to Melbourne, a city without such requirements, found no safety benefits associated with mandatory age-based requirements (Langford et al., 2004). Another study compared the Australian states of New South Wales and Victoria, states with and without mandatory age-based requirements for a medical certificate and road test, respectively (Langford et al. 2008). They found no significant differences in fatality rates. However, neither of these studies tried to separate out effects of the road test from the medical review.

The lack of consensus about the effectiveness of testing and the age(s) at which it should be required is not the only hindrance to improving the testing process for older drivers. Coley and Coughlin (2002) argued that most agencies "barely have the institutional capacity to accomplish the missions they have today" (p. 48), with changes or additions in testing requiring large capital outlays, training of personnel, and/or physical changes to facilities.

Restricted/conditional licensing: A systematic review was undertaken recently to examine the effectiveness of restricted/conditional licenses in reducing crashes and traffic violations, and facilitating continued independent mobility for older drivers (Asbridge et al., 2017). Seven studies met the criteria for inclusion (Braitman, Chaudhary & McCartt, 2010; Crancer & McMurray, 1968; Langford & Koppel, 2011; Marshall, Spasoff, Nair & van Walraven, 2002; Nasvadi & Wister, 2009; Stutts, Stewart & Van Heusen-Causey, 2000; Vernon et al., 2002). Most were considered to be of high quality with low risk of bias. Six of the seven were population-based; all seven reported crashes as the primary outcome, and collectively included more than 2.1 million drivers with or without a driving restriction. Based on the collective results of these studies, Asbridge et al. (2017) concluded that restricted licenses may be effective in reducing crash risk among older drivers with few health conditions and those with few restrictions (see individual study descriptions below for specific results). They noted, however, that they were unable to draw conclusions about the effects of restricted licenses on independent mobility due to a lack of data on driving patterns and exposure before and after licensing restrictions were imposed. In addition, the percentage of drivers who received restricted licenses was generally found to be quite small.

Given the differences across studies in terms of methods and specific results, it is worthwhile to review each study separately. Braitman et al. (2010) surveyed 522 drivers age 70 and older in Iowa before and after renewing their license. Of the 93 drivers who received restrictions, many reported already driving fewer miles than drivers without restrictions and were driving less often at night and on high-speed roads. Drivers with restrictions were more likely to report decreased average weekly mileage following license renewal, as well as decreased likelihood of driving under the conditions restricted (those related to headlights, geographic area, or speeds). The restricted group reported more visual impairment, prescription medications, and physical mobility limitations. The authors concluded that driving exposure was reduced among drivers receiving restrictions but noted that the overall safety benefits of license restrictions are still unknown.

Langford and Koppel (2011) and Nasvadi and Wister (2009) also compared drivers with and without restrictions, but used objective crash and exposure data rather than self-reports of driving exposure. Both studies found that drivers with restricted licenses had lower crash rates than drivers without such restrictions. In the study by Langford and Koppel (2011), less than 10% of older drivers in Victoria, Australia, had a restriction (32,932 cases versus 376,708 controls) and among those who did, the restriction was almost always related to wearing corrective lenses. Nasvadi and Wister (2009) examined licensing and insurance claim data for all drivers age 66 and older in British Columbia, Canada, between 1999 and 2006. Results of their analyses showed that restricted drivers had an 87% lower risk of causing a crash compared to drivers without restrictions. Among those with restrictions, the most common was a combination of daylight driving only and a maximum speed of 80 km per hour. The authors also reported that restricted drivers retained their license for a longer period of time and continued to drive crash free longer than drivers without restrictions.

The number of restrictions and the specific medical conditions leading to the restrictions were found to influence the effectiveness of restricted licenses, both in terms of crashes and violations. Based on an analysis of 771,269 licensed drivers age 65 and older in North Carolina in 1999, Stutts et al. (2000) found that drivers with one license restriction (corrective lens) had significantly lower crash rates than the general population, but drivers with multiple restrictions had moderately higher crash rates. They were not able to determine the reason for the latter finding from the available data. Both Crancer and McMurray (1968) and Vernon et al. (2002) examined records of drivers of all ages; they found that drivers with a restricted license due to diabetes had significantly higher crash rates than the general licensed population. In the Crancer and McMurray (1968) study, restricted drivers with epilepsy and fainting also had significantly higher crash rates than the general licensed driver population in Washington (comparing records of 39,242 medically restricted drivers to 1.6 million licensed drivers overall). However, a significantly higher crash risk was not found for restricted drivers with epilepsy in the Vernon et al. (2002) study, which evaluated the crash rates of 68,770 Utah drivers with medical conditions from 1992–1996.

With regard to traffic violations, lower rates were found for drivers with restricted licenses due to medical impairment (Crancer & McMurray, 1968) and one or more medical conditions (Vernon et al. 2002), compared to the general population and controls, respectively. Rates were higher for restricted drivers whose restrictions were not due to medical impairments (Crancer & McMurray, 1968). Marshall et al. (2002) analyzed records for licensed drivers of all ages in Saskatchewan, Canada, from 1992 to April 1999 (707,758), of which 3.3% had a restricted license. They found lower violation rates for drivers with restrictions compared to those without restrictions. In addition, the adjusted violation rates decreased by 10% after restrictions were imposed. Although restricted drivers had a higher crash rate than unrestricted drivers, this rate was lower than among male drivers, and the at-fault crash rate decreased by 12.8% after restrictions were imposed. The authors estimated that license restrictions likely prevented up to 861 crashes and 751 violations; they concluded that restricted licensing appears to provide a significant decrease in the rates of crashes and violations.

More recently, Joyce et al. (2018) used a multi-pronged approach to examine restricted licensing including: a review of the literature; a panel of experts from California, Florida, Iowa, and Virginia (consisting of licensing administrators, driving rehabilitation specialists, law, enforcement, and physicians); analysis of driver licensing, crash, and citation data in the four states; and a small naturalistic driving exposure study (five drivers with restrictions and 17 controls). The authors reported that older drivers complied with imposed licensing restrictions, although such restrictions were infrequent, and that crash rates for restricted drivers were lower after restrictions were imposed upon them, but not as low as among similar unrestricted drivers. They concluded that restricting drivers rather than suspending their license did not pose an unacceptable safety risk but did help them maintain mobility. However, they cautioned that they had difficulty obtaining sufficient data to address their research questions due to two states being unable to provide violation data, having only a small number of crashes to analyze due to the low frequency of restrictions and crashes, and problems recruiting restricted drivers into the naturalistic driving study.

One specialized form of restricting licensing involves the use of bioptic telescopes for drivers with low vision. The specific criteria and provisions for licensing policies related to bioptic telescopes vary across jurisdictions (e.g., minimum acceptable level of visual acuity through the carrier lens, whether it applies to each eye or binocular viewing; Owsley, 2012). Research on the safety benefits of policies for bioptic telescopes is quite limited. Vincent, Lachance, and Deaudelin (2012) used a quasi-experimental design to examine the driving performance of drivers using bioptic telescopes; however, they only had a sample of 10 such drivers and all were under age 35. Owsley, McGwin, Elgin, and Wood (2014) noted that a few studies have examined crashes among bioptic drivers, with inconsistent results; however, all of these studies were conducted between 1970 and 1996 (most in the 1980s), which is outside the scope of this review. In terms of setting future research priorities in this area, Owsley (2012) called for: a national database or registry of licensed bioptic drivers in the U.S.; the use of instrumented vehicles to examine the driving performance of people with bioptic telescopes; comparisons of the safety profiles of bioptic drivers in states with different types of laws; and examination of the efficacy of requiring drivers with moderate visual acuity impairment to wear bioptic telescopes.

There has been some research focusing on the implications of bioptic telescopes for meeting the mobility needs of drivers. For example, Bowers and his colleagues (Bowers, Apfelbaum & Peli 2005; Bowers, Sheldon, DeCarlo & Peli, 2016) surveyed via telephone 58 bioptic drivers (mean age 47) with moderately reduced visual acuity and 31 bioptic drivers with age-related macular degeneration (median age 76, mean not provided), respectively. Collectively, results suggested that the bioptic drivers found bioptic telescopes to be useful when driving, reported enhanced quality of life, and had relatively unrestricted driving habits. The authors called for further research to examine the safety effects of bioptic telescopes using objective driving data (Bowers et al., 2016). Owsley et al. (2014) found that bioptic drivers with central visual loss (n=23) reported no or little difficulty in many driving situations (e.g., left turns, rush hour), similar to age-matched normally sighted drivers (n=23). However, the bioptic drivers reported more difficulty under poor visibility conditions and in unfamiliar areas, and drove fewer miles per week, but had similar driving space (i.e., the spatial extent they drove in their environment). In addition, all but one bioptic driver used the telescope in at least one driving task, and over half used it in three or more tasks. The authors also found that bioptic drivers' judgments about the quality of their driving were very similar to backseat evaluators' ratings.

Considering the use of restricted/conditional licenses overall, one challenge is that restrictions applied by the licensing authority must be enforceable by police, or in the case of adaptive equipment, in place at the time of the driving examination or evaluation (Staplin & Lococo, 2003). The effectiveness of the restrictions may also be limited if drivers are already restricting their driving under the conditions imposed by the licensing authority. For example, Hanson and Hildebrand (2011), using GPS-based travel diaries to survey 60 rural drivers age 54–92 in New Brunswick, Canada, found that most drivers did not drive at night or on the highway, and for those who did, most of their trips were in rural areas where enforcement was likely limited. The authors concluded that restricting night and highway driving for the oldest rural drivers (age 75 and older) may have limited usefulness. However, a significant benefit of restricted/conditional licenses is that they provide licensing agencies with an option beyond the directive to simply "drive or not drive" as they try to balance the need to protect public safety and help older drivers maintain mobility (Snook & Cohen, 2008).

Physician Reporting and Other Referrals

Background and Overview of Policies by Jurisdictions

The determination of medical fitness to drive starts with a "trigger," or a referral, that brings the driver to the attention of the licensing agency. For example, every licensing authority in the U.S. accepts external referrals from professionals and non-professionals in the community, including physicians and other health professionals, law enforcement, friends and family, and others, if they have concerns about an older driver (Richard, Magee, Bacon-Abdelmoteleb & Brown, 2018). Referrals can also be internal to the licensing agency. Two such internal referral practices are license examiner observation of functioning and review of crash/violation records. With regard to the former, in states that require periodic in-person renewal, the driver needs to interact with licensing agency personnel. This interaction provides an opportunity for a license examiner, through observation and interaction, to determine if the driver may need a medical review. This practice is a component of Staplin and Lococo's (2003) Model Driver Screening Program. Seventeen U.S. states report that driver assessment referrals from licensing personnel are allowed and many states offer specialized training about older drivers and medical conditions that can impact driving (Lococo, Stutts, Sifrit & Staplin, 2017). Licensing agencies also maintain, or at least have access to, driver crash and violation records. The Model Driver Screening Program recommends that these records serve as an internal trigger when certain conditions are met (Staplin and Lococo, 2003). Eleven states report that certain crash and/or violation circumstances serve as an internal referral (Lococo et al., 2017).

The specific requirements for other practices related to reporting and referring older drivers also vary across jurisdictions. With regard to physician reporting, there are differences with regard to whether physician reporting is mandatory, and whether there are protections in place for confidentiality and legal protection (see Appendix C for state-by-state information). For example, six states require mandatory physician reporting. However, most states provide protection of confidentiality and legal protection to reporting physicians. Eby et al. (2019) reviewed the referral process in the U.S. for others in the community; they noted that in about half of U.S. states, forms are available for members of the public to complete to refer an older driver to the licensing agency they consider unsafe or about whom they have concerns. More generally, in many states, automatic referrals are generated, based on information routinely collected by licensing authorities (e.g., involvement in a fatal crash, involvement in three or more negligent crashes within 2 years, exceeding some threshold of demerit points, a conviction for violating license restrictions or conditions).

Implications for Safety, Mobility, and Practice

Physician and other health professional reporting: Physician and other health professional reporting (both mandatory and voluntary) was one of the topics in the systematic review by Dugan et al. (2013). They found that, overall, only a small percentage of older drivers were reported (termed medical reporting). Similar results were found by Redelmeier, Venkatesh and Stanbrook (2008) who examined mandatory reporting using data on hospitalized drivers in life-threatening crashes in Canada. Results indicated that, out of 1,605 injured

drivers, only 3% of the drivers with a reportable condition who had seen a physician in the year before the crash had been reported to a licensing authority.

Dugan et al. (2013) noted that it was not possible to determine whether mandatory or voluntary reporting was more effective, given the paucity of research on this topic. However, they did find that reporting in general (mandatory and voluntary) was effective in forcing reported drivers to cease driving based on several studies reviewed (Meuser, Carr & Ulfarsson, 2009; Snyder & Ganzini, 2009; Strathman, Bronfman & Dong, 2010). For example, in the study by Meuser et al. (2009), only 3.5% of 4,100 people reported by all sources in Missouri during the study period retained their driver license after the process (i.e., reporting, physical evaluation, and testing). Snyder and Ganzini (2009) found less than 20% of drivers who lost their licenses in Oregon requested retesting or a hearing, and only about 10% of those whose licenses were suspended regained their driving privileges.

Collectively, findings from these and other studies reviewed by Dugan et al. (2013) indicated that: reported drivers were generally age 80 and older, frail, male, and functionally impaired; a high percentage of reported drivers stopped driving during the process; cognitive impairment/confusion was the most common reason for reporting and was associated with a 70% increased risk for delicensure; medical assessment does not always correspond to actual driving performance (Ott et al., 2005); and feeling an obligation to assess competence to drive does not always translate into reporting, and there is often a lack of information about reporting requirements (Miller & Morely, 1993; Turnipseed, Vierra, DeCarlo & Panacek, 2008). Dugan et al. (2013) concluded that while medical reporting was effective in taking medically unfit drivers off the road, several barriers to reporting need to be addressed, including uncertainty about how, what, and when to report, as well as the need for better education and training in determining driving fitness. They also noted that legal liability is a barrier to reporting, and that many states assure legal immunity to physicians who report in good faith.

Barriers to reporting have also been the subject of several survey-based studies. Aschkenasy, Drescher, and Ratzan (2006) surveyed representatives of legal departments of U.S. state Departments of Motor Vehicles (DMVs). Among their findings were that: not all physicians are in a position to evaluate the extent or effect of an impairment, such as is the case with short-term treatment; many physicians are concerned about undermining the physician-patient relationship; and in addition to considerations about risk of harm and efficacy of reporting, there are concerns about the social costs associated with loss of mobility. Results from a survey of 62 geriatricians and neurologists in Arkansas, a state with no reporting policy, indicated that there is considerable uncertainty about the process of assessing and reporting at-risk drivers with dementia. There was strong support for optional reporting but not mandatory reporting (Gergerich, 2016). Jang et al. (2007) surveyed Canadian family physicians (n=445) and found that they lacked confidence in performing driving assessments, and felt that reporting put them in conflict of interest with their patients and jeopardized their relationship with them.

Among the few studies examining the effectiveness of mandatory versus voluntary reporting on crash risk, Tefft (2014) did not find significantly higher or lower fatal crash involvement rates of older drivers in states with mandatory reporting laws compared with states with voluntary reporting. He noted that only six states required mandatory reporting during the study period and that no such laws had been enacted or repealed during the

period, precluding examination of changes in laws. More recently, Agimi et al. (2018) examined the role of state physician reporting laws and other licensing policies on crash hospitalizations among older drivers with dementia. The records of 136,987 hospitalized drivers age 60 and older from U.S. states reporting data to the State Inpatient Databases of the Agency for Healthcare Research and Quality from 2004–2009 were examined. Physician reporting laws, mandated and/or legally protected, were not associated with a lower likelihood of dementia among crash hospitalized drivers.

Referrals from law enforcement and family/friends: Referrals from law enforcement are important because officers have the opportunity to observe older drivers directly on the road at traffic stops or crashes (Richard et al., 2018). Eby et al. (2019) reviewed several studies that have assessed the referral process in the U.S. and Australia (e.g., Di Stefano, Cai, & Williams, 2012; Lococo, Decina, Branche & Wagner, 2013; Meuser et al. 2009; Muir et al., 2016; Soderstrom et al., 2009, 2010). The collective findings of these studies as reported by Eby et al. (2019) were that: most police referrals of older drivers result from crashes; the most common declining ability among referred drivers was cognition, followed by movement abilities; very few referred older drivers retain full driving privileges after the assessment (4%–17% depending on the study); and another 10% to 20% were allowed to drive with some restrictions. Based on these findings, the authors concluded that: 1) many referred older drivers are likely not able to drive safely and are at higher risk of crash, highlighting the value of law enforcement use of the referral process; and 2) not all referred drivers will lose full driving privileges. An important barrier to reporting identified for law enforcement officers is the lack of clarity with regard to the reporting process (Hill, Rybar, Stowe & Jahns, 2016). To that end, there have been efforts to provide law enforcement with training and education on how to identify medically impaired drivers (e.g., Hill et al., 2016; International Association of Directors of Law Enforcement Standards and Training, IADLEST, 2018); however, these have not been evaluated in terms of how they translate into referrals to DMVs or the outcomes of such referrals.

Many states have in place procedures for family members and friends to refer drivers whose abilities they consider to be impaired (Richard et al. 2018). While jurisdictions vary in terms of the specific people allowed to refer and the process for referring, few states or provinces accept anonymous reports or provide absolute confidentiality for the person providing the report (Eby et al., 2019). Meuser, Carr, Unger, and Ulfarsson (2015) examined referral reports for 689 older drivers referred to the Missouri DMV by family members, from 2001–2005. Results indicated that 448 of these drivers were reported to have some type of cognitive issue (e.g., confusion, memory loss, becoming lost while driving), and that 365 cases had a diagnostic label listed. Of this latter group, half failed to submit the required physician evaluation and were delicensed immediately. Of those evaluated by a physician, diagnostic agreement between family members and physicians was 100% for Alzheimer's disease, 97% for acute brain injury, and 75% for cognitive impairment/dementia. Of all drivers referred, few retained their license (about 2%). The authors concluded that family members may be in the best position to recognize older drivers with medical-functional impairments that can compromise safe driving, and their observations should be taken into account by physicians when assessing fitness to drive.

Earlier work by these same investigators (Meuser et al., 2008) focused on referrals more generally. They found that among 4,100 drivers age 50 and older referred to the Missouri licensing authority between 2001 and 2005, 16% came from family members, 30% from law

enforcement, 27% from licensing personnel, and 20% from physicians. The authors compared these 4,100 referred drivers with age/gender matched controls to assess outcomes of the referral process. The majority of referred drivers were age 75 and older at the time of report (with 15% of these drivers age 90 and older), and many were frail or otherwise medically compromised (as evidenced by 38% being listed as deceased only 1 year after the referral period). A high proportion of referred drivers required to submit medical reports and/or undergo testing were found to have medical-functional impairments that could compromise safe driving. In terms of crash risk, the proportion of referred drivers involved in crashes was four times higher than that of control drivers in 2001–2002 (9% versus 2%), and one-third of referred drivers had one or more crashes during the six-month period prior to the referral date. Finally, and arguably most importantly according to the authors, almost all of the referred drivers (97%) were delicensed and ceased driving (whether voluntarily or not) within weeks to a few months. The authors concluded that Missouri's voluntary law appears to work as a package, with drivers considered unsafe to drive being reported and delicensed. They cautioned, however, that because so few retained their license, they could not determine how different parts of the referral process contribute to this outcome. They also pointed to the importance of considering the mobility and well-being of drivers after driving cessation, both of which are beyond the scope of the reporting law.

License examiner observation of functioning: No empirical data on the effectiveness or impacts of license examiner observation of functioning were identified. Staplin and Lococo (2003) present the following guidelines for practice:

- Examiner personnel should receive training on the medical conditions and medications that can impact medical fitness to drive.
- Jurisdictions should have guidelines and procedures for the observation of functioning and interacting with the suspected medically unfit driver.
- "Verifying questions" should be used such as "Please verify your name and address" rather than "What is your name and address?"
- The abilities that should be assessed visually and through interactions are: lower body strength, range of motion, and mobility and coordination; upper body strength, range of motion, and arm/hand coordination; hearing; seeing; thinking, understanding, perceiving, and remembering; normal consciousness and bodily control; normal social, mental, and emotional state of mind.

Review of driver crash/violation records: Because crashes and driving violations are direct measures of driving safety it makes sense that these records be used as an internal trigger for medical review. The specific circumstances that trigger a referral for drivers of all ages vary from state-to-state (Lococo et al., 2017). For example, a driver examination in Delaware is required if a driver is involved in a second crash resulting in injury, death, or property damage within a 2-year period. In other states such as North Carolina, a reexamination is triggered if a reviewed crash report has an indication from law enforcement that the driver may have had a medical condition that contributed to the crash. Some states review and combine both crashes and violations such as in Michigan where a referral may be required for: a fatal crash; accumulation of 12 or more license points in 2 years; three negligent crashes in 2 years; or a violation of a license restriction.

No empirical data on the effectiveness or impacts of using driver history records as a referral source were identified. However, opinion-based practice guidelines have been developed for this practice (Staplin & Lococo, 2003):

- Crash and violation history should be considered over the past 3 years.
- All license renewals should include a driver history record review.
- The trigger for reexamination should be any crash in which the investigating officer reports one or more of the following violations or driver contributing factors: ran signal or stop sign; passing or interfering with another vehicle; left of center and not passing; failure to control vehicle; failure to yield right-of-way in any circumstance; violation of a license restriction; and failure to yield at an uncontrolled intersection.

Medical Review/Assessment Processes

Background and Overview of Policies by Jurisdictions

As discussed by several researchers and practitioners, with aging into older adulthood comes a higher likelihood of having medical conditions, and taking medications for these conditions, that can adversely affect abilities needed for safe driving (e.g., Dickerson et al., 2007, 2017; Eby et al., 2019). Therefore, a critical component of licensing practices and policies for older drivers is having information about a person's medical fitness to drive. As defined by Meuser et al. (2012, pg. 8), a 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." The inclusion of medical information is a critical aspect of licensing policy in nearly all jurisdictions including the U.S., Canada, Australia, and the European Union (Lococo et al., 2017; Meuser et al., 2012; White & O'Neill, 2000).

Licensing policies and practices related to medical review vary by jurisdiction but generally include the following process. First, the potentially unsafe driver is brought to the attention of the licensing agency. This can happen through a referral from a health professional, law enforcement, license agency counter personnel, or family/friends; self-reported medical conditions; application for a disability parking permit; results of a screening test; license renewal or birthday at certain ages; or a driver's history of crashes and violations (Lococo et al., 2017). The licensing agency often then requests a medical evaluation conducted by the driver's physician. In the U.S. and Canada, licensing agencies require the physician to complete a standard medical evaluation form. According to Meuser et al. (2012), all U.S. states and Canadian provinces use a medical reporting form, or forms, of some sort. This form, often along with self-reported information by the driver, is submitted to the licensing agency for review. The agency may require further testing, such as on-road testing. The agency either uses in-house staff with specialized medical training or a medical advisory board (MAB) to assess the individual cases. As shown in Appendix C, 37 states have MABs, 34 of which provide advice on individual cases. There are several possible outcomes from the review: the driver may be allowed to drive unrestricted, drive with restrictions, or have his or her license suspended or revoked.

There is little empirical research into the impacts or effectiveness of these policies and practices. Here the descriptive research on three components of the medical review process is discussed: health professional review and assessment; medical advisory boards; and self-reporting of medical conditions.

Implications for Safety, Mobility, and Practice

Health professional medical review/assessment: Health professionals (e.g., physicians, physician assistants, nurse practitioners, occupational therapists, optometrists, psychologists) are highly skilled at diagnosing and treating medical conditions and at gathering functional ability information. This information is crucial for determining medical fitness. However, health professionals are often also called on to determine whether or not a driver can drive safely. In an analysis of medical reporting forms across the U.S. and Canada (Meuser et al., 2012), researchers found that 81% required the medical professional to judge whether the driver was safe or unsafe and more than one-half asked the health professional to recommend license restrictions. Despite recent detailed guides to help physicians assess medical fitness to drive (Canadian Medical Association, 2017; Wang et al., 2003), many health professionals are unaware of the jurisdiction's requirements for fitness to drive, do not know which functional tests they should perform, and do not feel qualified to assess medical fitness to drive (Carr, 2008). For example, a survey of clinicians in a large hospital system in South Carolina found that 97% reported that the physician's practice was not the most appropriate place for screening older drivers, 72% reported that physicians were not the most qualified professional to determine driver fitness, and 68% either strongly or somewhat agreed that reporting the driving fitness of their patients presented a conflict of interest (Brooks et al., 2011). A representative sample of 1,000 English-speaking physicians across Canada found similar results (Jang et al., 2007). This survey found that 45% of physicians lacked confidence in assessing driving fitness and did not consider themselves to be the most qualified professionals for determining driving fitness. About 70% agreed that reporting a patient's lack of driving fitness to the licensing agency placed them in a conflict of interest and had a negative impact upon their relationship with their patients. A further complication for health professional medical review/assessment is the lack of standardization and evidence-based information that can be used to determine medical fitness to drive (Molnar, Byszewski, Marshall & Man-Son-Hing 2005; Sebo et al. 2018; White & O'Neill, 2000; Vrkljan, Myers, Crizzle, Blanchard & Marshall, 2013). Based on a systematic review of more than 1,500 articles, Molnar et al. (2005) concluded that while screening and assessment tools existed and were used, these tools had not been evaluated for their value in predicting unsafe driving and crashes.

Medical advisory boards: According to Lococo et al. (2017, p. 3), an MAB is: "a group of physicians and other medical professionals who are either employed or contracted by the licensing agency, or serve as volunteers to advise the agency regarding medical criteria and vision standards for driver licensing, and/or to provide medical opinion to the licensing agency regarding fitness to drive for drivers referred for medical review or for those appealing the licensing agency's determination as a result of medical review."

The responsibilities of an MAB vary by jurisdiction, but can include providing advice on medical policy, providing advice on individual cases, and participating in the appeals process when medical fitness to drive is in question. MABs are considered a critical component of a model driver screening program in the U.S. (Staplin & Lococo, 2003) and are considered as a promising practice by several organizations (AAA, 2004; Goodwin et al. 2015; National Transportation Safety Board [NTSB], 2004).

No empirical studies of the impacts or effectiveness of MABs were identified. Several studies, however, suggest that MABs may impact mobility. Soderstrom et al. (2010)

examined the outcomes of 240 drivers age 75 and older who were referred to the licensing agency by law enforcement and reviewed by the Maryland MAB. Of these drivers, about 80% lost driving privileges (57% did not pursue licensure). Of those who retained driving privileges, 18% had restrictions placed on their license. In total, 17% of referred drivers retained full driving privileges. Other work has assessed the medical review outcomes in other states, but does not distinguish whether the State's MAB reviewed the cases or provided advice. These studies support the Maryland results. For example, a review of 100 drivers in Virginia referred by law enforcement for medical review found that 88% of these drivers received some license sanction (Lococo et al. 2013). A study in Missouri of 689 drivers who were referred by family members to the licensing agency found that only 2% of drivers retained driving privileges (Meuser et al., 2015). Finally, a study in Victoria, Australia, examined the medical review outcomes for 194 drivers referred to the licensing agency for a visual field loss (Muir et al., 2016). Of these drivers, 22% lost driving privileges and 72% were allowed to keep driving with or without restrictions (the percentage with restriction was not reported).

These studies suggest several things. First, the drivers referred to licensing agencies have a high likelihood of being unsafe drivers and are in need of an assessment of medical fitness to drive. Second, the fact that a majority of drivers referred for a medical review of driving fitness decide not to pursue licensure suggests that the process may be upsetting or fear-provoking, leading to some older adults losing driving privileges when that might not have been the outcome of the review and they may have been able to drive safely under limited circumstances (decreased mobility). Third, research is needed on the effectiveness and safety impacts of MABs.

Medical self-report: As discussed previously, driver self-report of medical conditions is one way in which licensing agencies are alerted to potentially medically unfit drivers. Some research has found that drivers who reported certain medical conditions had significantly worse crash histories than a comparison sample, indicating the potential value of this type of self-report (Janke & Hersch, 1997). All but two U.S. states require at least minimal self-reporting of medical conditions at first licensure and in most states at license renewal (Lococo et al., 2017). No U.S. states require a medical self-report outside of the license renewal or medical review processes. Several Australian states also mandate self-reporting of medical conditions (e.g., Williams, 2013). In the U.S., the level of self-reporting varies greatly. Many states have a general question that requires the driver to assess their own ability to drive such as the question used in Iowa "Do you have any mental or physical disability which would affect your driving?" (Lococo et al., 2017). Other states have the driver certify that they are medically fit such as in Connecticut: "I hereby certify that I do not have any health or vision problems that prevent me from driving safely" (Lococo et al., 2017). A handful of states have detailed medical self-reports that ask about the presence and severity of symptoms for several conditions such as the application form used in Nebraska, which asks about loss of voluntary control, loss of consciousness, vertigo, dizziness, fainting, disorientation, seizures, impairment of memory, memory loss, foot/leg impairment, upper body strength impairment, range of motion impairment, hand/arm impairment, neurological/neuromuscular disease, and whether existing conditions have worsened since the last license renewal (Lococo et al., 2017).

Medical self-report is a component of the Model Driver Screening and Evaluation Program and the following guidelines for medical self-report best practices are presented (Staplin & Lococo, 2003):

- Medical fitness questions should address the presence of diabetes, cardiovascular conditions, pulmonary conditions, neurologic conditions, epilepsy, learning and memory conditions, psychiatric conditions, alcohol and drug dependence/addiction, vision conditions, musculoskeletal conditions, and functional motor impairments.
- The wording of the questions should use common language so that it will be understood by all drivers.
- The form should include a certification that the provided information is accurate.

The review found no research on the impacts of medical self-reporting on safety, practice, or mobility.

Conclusions

This review of the literature examined a broad range of licensing policies and practices for older drivers. Among those related to license renewal (in-person and accelerated renewal; knowledge, vision, and road tests; and restricted/conditional licenses), the strongest evidence of safety benefits was found for in-person renewal beginning at age 85 (and in one study age 75), followed by restricted/conditional licensing, although the effects of the latter depended on the number and type of restrictions. Evidence of crash reduction was lacking for accelerated renewal and mixed for testing at renewal, with vision tests being the most frequently examined and found to be beneficial by several researchers. In the decade since the North American Licensing Workshop (Eby & Molnar, 2008; Molnar & Eby, 2008), surprisingly few new studies have been conducted on the safety benefits of renewal policies. In addition, the studies that have found safety benefits for some policies have not been able to identify the specific mechanisms leading to these outcomes, nor tease out the specific effects of various components of the policies. Despite researchers recognizing the need for more work in this area, little has been done to examine, in detail, the implementation process and outcomes of policies in individual states, which might help address some of the unanswered questions. This is reminiscent of early research on graduated driver licensing, which examined overall effects of the system but could not delineate the contribution of specific components such as supervised driving, and night and passenger restrictions (Shope, Molnar, Elliott & Waller, 2001). Further research on license renewal policies is needed to do the following:

- Identify the mechanisms by which policies that have been shown to reduce crashes actually lead to these outcomes.
- Delineate the individual effects of different components of policies and steps in the process by which these policies are implemented.
- Examine the effects of individual policies, while controlling for the effects of other policies that might be in place, as well as taking into account the heterogeneity of the older driver population by analyzing segmented age groups rather than treating all drivers age 65 and older as a single unified group.

There was little support for mandatory reporting by physicians. However, similar to the recommendations of the North American Workshop, a strong case was made by many

researchers for the value and promise of voluntary reporting/referring by physicians and other health professionals, law enforcement, family members and friends of older drivers, and other appropriate members of the community. Such reporting was seen as a way to bring potentially impaired drivers to the attention of the licensing authorities. Immunity and protection of confidentiality were considered to be important to this process. Another common theme was that effective reporting/referring systems require not only the engagement and commitment of community members, but also clear and well publicized procedures for reporting. Thus, reporting/referring systems are centered in the licensing authority but extend throughout the entire community and require an informed and knowledgeable public. Future research needs in this area include the following:

- Evaluation of safety outcomes (i.e., crashes and violations) associated with different types of referrals.
- Evaluation of training and education programs for various professionals that focus specifically on outcomes (e.g., referrals, crashes, violations) rather than simply improved knowledge or participant satisfaction.

Although medical review and assessment is a cornerstone for effective licensing policy and practice, there is very little empirical research that assesses the impact of health professional assessment, medical advisory boards, or medical self-reporting on driver safety and/or mobility. Instead, these practices are implemented based on opinion and practicality. These areas could benefit from empirical and descriptive research that helps to determine the effectiveness and long-term impacts of these policies and practices. For example, work is needed to develop a template medical reporting form, which that can be completed unambiguously and accurately, that contains the information that is needed by the licensing agency and MABs. As discussed by Rapoport et al. (2007), the current medical review process puts the personal physician in a policing role without evidence-based tools to assess fitness to drive. These authors further present an analogy comparing the driver fitness process to the reporting of suspected child abuse (Rapoport et al., 2007, p. 601): "Physicians are not expected to perform the assessments of abuse themselves. Instead, government-sponsored independent experts are enlisted to perform individualized assessments." Given the issues and lack of comfort by health professionals in assessing medical fitness to drive, research is needed to determine whether the review process would be more effective if health professionals assessed only medical fitness and the determination of medical fitness to drive were made by the licensing agency and MABs. Finally, the recommended guidelines for medical self-reporting should be empirically assessed to see if such detailed reporting is more effective than the single questions used by several states.

A critical component of the medical review process is referring potentially medically unfit drivers to the licensing agency. Given its special role in this process, the licensing agency is well-positioned to identify these drivers through license examiner observation of functioning and reviews of crash/violation records. There is a clear need, however, to determine empirically the impacts of these practices on licensing agency efficiency, driver safety, and older adult mobility. More specifically, more research on the following topics is warranted:

- How accurately and effectively can license examiner personnel identify declines in ability related to driving based on visual observation and interaction with the driver?
- What specific training is needed for license examiner personnel to serve the role of identifying drivers in need of further screening and assessment?
- How cost-effective are driver history reviews to determine drivers who may be in need of further screening and assessment?
- What specific combinations of crashes and/or violations yield the highest "hit rate" for identifying medically unfit drivers?
- How effective are the opinion-based guidelines in the Model Driver Screening Program (Staplin & Lococo, 2003) for the practices of license examiner observation of functioning and reviews of crash/violation records?

Collectively, results of the review are fairly consistent with findings from the 2008 North American License Policy Workshop. Most of the policies and practices viewed positively by Workshop participants continue to show promise. However, research on the effects of these policies on actual crash risk is still sparse. Importantly, even for policies for which there is evidence of crash reduction, little is known about the mechanisms by which these outcomes are achieved and what consequences these policies might have on the mobility and well-being of drivers who cease driving. One of the most consistent calls from investigators has been for greater examination of individual state-level policies. Given these findings, there is a tremendous opportunity to delve deeper into licensing policies in specific jurisdictions to better understand how various policy components may be linked to safety outcomes and to identify implementation and evaluation outcomes that may not yet be published.

In-Depth Interviews

Background and Approach

In-depth interviews were conducted with representatives of driver licensing agencies in six U.S. states, which came from a larger list of states put together by the research team in conjunction with AAAFTS. The original goal was to have representation from the five states in which the AAA LongROAD study is being conducted, as well as five additional states not involved in that study. A member of the research team contacted a representative from each selected state whose role was to coordinate activities at the state level in one or more capacities for that state's licensing policies and practices. Each representative was invited to participate in the project by completing an interview, or to recommend someone else in the agency considered to be more appropriate to talk with. Of those contacted, six agreed to and were able to complete an interview (five via telephone and one providing written responses to the interview guide questions). They represented licensing agencies in four of the AAA LongROAD states (California, Colorado, Maryland, and Michigan) and two other states (Florida and Iowa).

All interviews were conducted by an experienced moderator, using a structured interview guide adapted specifically to the particular state represented by the person being interviewed (see Appendix D for master guide). The moderator was assisted by at least one other member of the research team in each interview. All interviews were digitally recorded after permission was obtained from the interviewees. Detailed notes were also taken by the researchers. The guide included questions on each state's license renewal policies for older drivers (e.g., in-person and/or accelerated renewal, testing, and conditional licenses), reporting of at-risk drivers by physicians and others (e.g., law enforcement, family members, and friends), and the medical review/assessment process, including MABs.

The structured interview guide was developed based on information from the literature review and discussions with AAAFTS. The interview was designed to take about 1 hour. After the guide was administered to the first state representative, minor changes were made to improve clarity and ensure that it was sensitive to state differences in terminology and organizational structure.

All but one of the states represented by the interviewees had a formal licensing agency; licensing responsibilities in the remaining states were handled by the state Department of Transportation. The six interviewees served in varying capacities in their respective agencies, ranging from communications and customer service to research and development to medical assessment, review, and compliance. One common theme was that they did not set policy; however, many of them were in a position to make recommendations about changes to existing or new policies. Several noted that their main areas of responsibility lay outside of license renewal, but rather were more concentrated in the referral or medical review processes. In addition, while the general responsibilities of the interviewees did not focus solely on older drivers, this segment of the population received a great deal of their attention, given that older drivers make up a high proportion of medical review and reexamination cases in licensing agencies. Most interviewees had been at their respective agency for many years; three each had over 20 years of service. The shortest length of service was 11 months and the longest 42 years.

Results

Using the interview notes and audio recordings (the latter as needed for clarification purposes), the structured interview data were analyzed by the lead investigators using an open, focused coding process (Strauss & Corbin, 1998). Codes (i.e., summary terms using the words of the respondents) were assigned through a line-by-line, cross-interview analysis of the thematic data. From the codes, focused code categories that exemplified specific themes that emerged from the data were developed. Using a method of constant comparison (Strauss & Corbin, 1998), those coding categories and themes were revised and refined based on an examination of internal homogeneity and discussion among the investigators (Patton, 2001). Themes are discussed below by topic area. It should be noted that these results are intended to provide higher-level insights into licensing policy-related issues rather than compare and contrast each state's specific licensing policies. Full details on state licensing policies can be found in the literature review section of this report.

License Renewal Policies

Discussions with the interviewees about license renewal policies for older drivers reinforce the findings from the project's review of the literature that policies are not uniform across jurisdictions. Each state represented in the interviews had its own combination of license renewal policies specific to older adults.

One state requires in-person renewal every 2 years for drivers over age 72 (rather than the standard 8 years), with the license expiration age for those renewing between age 67 and 72 restricted to age 74. Vision tests are required at renewal, while knowledge tests are only required if deemed necessary. A second state only allows renewal by mail for drivers under age 70. Beginning at age 70, drivers must renew their license in person and take a vision and written test at each renewal. Accelerated renewal is not based on age; however, drivers with a progressive visual/physical condition, as diagnosed by a physician, are put on an accelerated renewal schedule and are required to take a driving test at each renewal. In a third state, drivers over age 65 are ineligible to review online; however, they may renew by mail if they also submit documentation from an eye doctor that they passed a vision exam. For drivers renewing in person, a vision test is required but not a knowledge test. There is no accelerated renewal for older drivers. Two states do not have special provisions for older adults for either in-person or accelerated renewal. The final state does not require in-person renewal for older drivers but does have accelerated renewal for certain groups beginning at age 80 (with renewal every 6 years instead of the standard 8 years). All of these last three states require a vision test at renewal but not a knowledge test. None of the six states require a road test at renewal.

All six states allow some type of restricted/conditional licenses (either at renewal or during reexamination) but the exact combination of restrictions/conditions varies across jurisdictions. However, there is a core set of restriction options common to each of the six states that includes daylight driving only, corrective lenses, auto-transmission only, and specially equipped vehicle (e.g., hand-controls for brakes, knob attachment to steering wheel, full hand controls). Other conditions common to most of the states are restricted driving area and requiring additional outside mirrors. One state does not require additional mirrors but will maintain this requirement for people driving in the state who had it imposed by their home state. Two or more states restrict freeway driving, impose speed

restrictions, or restrict vehicle type. Only one state restricts driving in inclement weather. However, most states have the latitude to impose any restrictions deemed necessary (e.g., those specified by the older driver's physician).

When asked if the safety effects of these license renewal policies had been measured or evaluated in their jurisdiction, all but one interviewee reported that they had not and that there were no plans to do so. The most common reason reported for the absence of such evaluations were lack of resources (both monetary and human) and competing priorities. In some cases, competing priorities had more to do with higher-level organizational or structural needs (e.g., modernizing data storage and management) rather than specific service delivery areas. A few interviewees pointed to more general traffic safety evaluations conducted by external organizations such as the National Highway Traffic Safety Administration but noted that none had focused specifically on licensing practices. In the one state where evaluation had been done, it was noted that many of the evaluations were more focused on operational considerations or more general populations. One finding from evaluation of the written knowledge test was that multiple failures may be associated with cognitive decline. Interest was expressed by this state's representative in looking more closely at the potential for limited-term license renewal policies such as having drivers with vision disorders come in every 2 years versus every 5 years to take a driver test.

For the most part, interviewees thought that their state licensing renewal policies were generally working well from a safety standpoint, or at least they did not express any negative views about their outcomes. For many, views about renewal policies were embedded in or intertwined with other aspects of the licensing system and broader efforts to keep older drivers safe. For example, it was noted that the effectiveness of renewal policies depends on older drivers being honest (e.g., disclosing reportable conditions as they arise). One interviewee pointed to their state's broad-based initiative to support older drivers, of which licensing is an integral part. Another noted that as long as they are aware of concerns, they believe that they can effectively respond to them.

Interviewees were asked to identify the biggest challenges they face in implementing their license renewal policies for older drivers and what has helped them overcome these challenges. One reported challenge had to do with compliance-related issues such as older drivers sometimes having to report/provide vision or other examination results for a second straight year, or more generally, not understanding what was expected of them. Reported approaches for overcoming this challenge involved improved communication and marketing to educate older drivers about renewal requirements, as well as streamlining administrative codes. Other reported challenges were tied to larger licensing agency or societal issues. For example, one interviewee pointed to the tension in licensing agencies in terms of their core mission/purpose (i.e., improve safety or deliver excellent customer service). It was also mentioned that while high-profile pubic incidents can lead to positive legislative efforts, they can also lead to policy solutions that are too far reaching or otherwise inappropriate. One approach highlighted for addressing these larger issues was to have a research and development branch within the licensing agency to support new research, lend expertise, and ensure that policy is informed by data and data analysis.

Collectively across all interviewees, there were few suggestions offered for any changes in terms of license renewal they would like to see in their jurisdiction to improve the safety and mobility of older drivers. One interviewee suggested that a driving test be required

beginning at age 80, but noted that this was not actually a change being considered and would likely not be pursued. Another interviewee noted more generally that tracking demographics to ensure safety over the long term is important, given the aging of the population and subsequent increase in the older driver population. As noted earlier, several of the interviewees were reluctant to speak to challenges/changes in the area of license renewal, as their main responsibilities lay elsewhere.

Physician Reporting and Other Referrals, and Medical Review/Assessment Process

Only one of the states represented in the interviews has mandatory physician reporting, although all have some sort of immunity or confidentiality protection for physicians who report (whether voluntarily or under mandate). Interviewees from two states also mentioned that immunity/confidentiality extends to some other health professionals as well (most commonly, optometrists). In addition to mandatory or voluntary reporting by physicians, states rely on referrals from others, especially law enforcement and families/friends of older drivers. A majority of states represented offer some sort of immunity and/or confidentiality for others who refer older drivers, albeit with restrictions (e.g., one state only protects immediate family members). In most of the states, the role of license examiners includes observing drivers at the counter for signs of impaired physical or mental functioning that could affect the ability to drive, and referring such drivers for further evaluation or in some cases, creating medical reports themselves. However, the extent to which license examiners are formally trained to make such observations varies across jurisdictions. The main reason cited by one state for not conducting at-the-counter observations is lack of training and clear guidelines, which can lead to inconsistencies and potentially age-based discrimination according to the interviewee.

Three of the states represented in the interviews have an active MAB and three do not. One of the latter states is authorized to have an MAB and did have an MAB at one time, although it ceased operations about 10 years ago. All three active MABs have voluntary membership, although the specific details of how each operates (e.g., requirements for the type and length of training and certification; organizational structure; how often meetings are held; and roles, responsibilities, and decision making authority) varies. For example, one state's MAB is comprised of 12 members, with a full-time chair and half-time co-chair. There must be one physician over the age of 60 and one chiropractor. Members serve a 4-year term. In another state, the MAB is comprised of panels of three to five physicians, which are targeted to different types of cases matched to their specialties (e.g., two ophthalmologist groups for vision cases, two neurological groups for everything else).

Across the six states represented in the interviews, physician assessments, medical reports, and on-road testing all play a role in the medical review process, although they may be employed in different ways. Each state has a multi-stage process in place, with the exact sequence and timing of activities sometimes varying both across jurisdictions and within jurisdictions, depending on the circumstances. Typically, it is the physician's assessment and/or medical report (which are synonymous in most jurisdictions) that trigger a referral for a formal driving assessment (road test). Sometimes it is the driver's physician who refers them for a formal driving evaluation by an occupational therapist (OT); however, any recommendations made based on the results of the evaluation must come from the referring physician and not the OT. In other cases, the request for a road test comes directly from the licensing agency, sometimes from the MAB if one is in place. In one state with an MAB,

medical reports are first reviewed by nurses who then make recommendations to the MAB. In other states, reports are first reviewed by the MAB itself or, in the absence of an MAB, by other personnel responsible for that function, who in turn, may refer drivers for a road test (e.g., done in-house by another set of personnel in one jurisdiction).

Most interviewees reported that the safety effects of their reporting/referral policies and medical review process had not been measured or evaluated in their jurisdiction, and that there were no plans to do so. However, some research was highlighted by one interviewee that focused on non-safety aspects of the referral process (although not published) and on a larger pilot screening and assessment program. It was noted by another interviewee that while the licensing agency does not actively measure the safety effects of its referral process, it does provide information on driver crashes to other agencies in the state tasked with tracking driver safety data. Despite the absence of formal evaluation, interviewees generally considered their reporting/referral policies and medical review process to be effective in terms of the safety of older drivers. One pointed out that these policies removed thousands of unsafe drivers annually. Another expressed confidence that their state is "catching" those drivers who are at risk, and a third expressed confidence that if they are aware of at-risk drivers, they can "treat the issue." Aspects considered to be working especially well included confidentiality for those reporting and referrals by law enforcement, identified by one interviewee as the largest source of referrals. In addition, one state's move to electronic referrals was considered to have made the process easier and quicker for law enforcement, and led to increased referrals.

Interviewees were asked if they were able to reach any conclusions about the effects of their reporting/referring policies and medical review process on the mobility (apart from safety) of older drivers. Of interest was whether they could separate out those drivers who were obviously unfit and had their license taken away, from those drivers who voluntarily decided not to complete the review or stopped driving on their own. Interviewees generally reported that they were not able to do so. Several noted the possibility that some drivers might end up getting delicensed prematurely. This was considered to be less likely in rural areas where drivers with fewer transportation alternatives would want to hold onto their licenses. It was also pointed out that the reporting/referral policies and medical review process focus on unsafe drivers; however, states have broader efforts in place to support older adults who stop driving (e.g., websites and phone apps with information on transportation alternatives).

Several challenges were identified that states face in implementing their reporting/referring policies and medical review process for older drivers. The most commonly reported challenges were those related to physician reporting. These included underreporting by physicians because of potential adverse effects on their relationship with their patients, as well as difficulty understanding or interpreting new or excessively complicated policies with multiple layers of conditions (such as a particular physician immunity policy enacted in one state). Lack of knowledge of driving-related effects of physical and mental impairments, as well as requirements for reporting at-risk drivers was also seen more generally as a barrier to physician reporting. Other concerns mentioned included; lack of consistency in procedures; increased workload and sometimes unnecessary testing, especially in response to high-profile incidents; lack of or limited training for licensing staff; absence of mechanisms for direct input from OTs; and more generally,

difficulty in getting people to understand policies and use available resources from the licensing agency and more broadly.

In thinking about what had helped or could help states overcome these challenges, many of the efforts highlighted involved educating and/or working more closely with important stakeholders in the community. These included older drivers themselves and their families/friends, as well as the medical community, the research community, and broader community organizations with a stake in promoting the safe mobility of older adults. For example, several interviewees noted that their licensing agency engages in outreach to older drivers (e.g., through community presentations), as well as has a resource guide/booklet specifically targeted to older drivers that provides information about aging and driving, as well as the licensing process. One interviewee highlighted agency outreach efforts to family members to make them aware of their responsibility to be responsive to changes in older drivers' driving, and to report if they had concerns. In another state, periodic meetings are held with certified driver rehabilitation specialists to get their input on how to make their licensing program run more smoothly. Similarly, another interviewee saw potential benefit in talking with physicians and other health professionals about what would make their jobs easier in terms of reporting.

Other reported efforts focused on creating new programs or departments within the licensing agency. For example, one interviewee pointed to a new education department within the agency to provide staff training (both online and regional in-person training). Another interviewee mentioned two beneficial departments/programs within his licensing agency: an in-house research and development branch and a Senior Ombudsman program, whose staff give community presentations and serve as advocates to help referred older drivers navigate the process. It was also suggested by this interviewee that there should be increased attention on streamlining or "tightening up" some aspects of the referral process, particularly through reexamination of some required forms that are quite complex, to eliminate information that is not used but retain key pieces of information. A final theme had to do with partnering with external organizations to make use of existing resources or create new resources. For example, one state has integrated the American Association of Motor Vehicle Agencies (AAMVA)'s knowledge test into their licensing practices and makes use of AAMVA's certification courses. Two states called attention to their active involvement in (and in one case leadership of) broader statewide, multi-organizational coalitions focused on supporting older adults at all stages of driving and non-driving, using websites and other resources.

Interviewees were asked about changes they would like to see in their jurisdiction to improve the safety and mobility of older drivers. Very few were reported and there was little overlap among states. One interviewee stated that no changes were needed at the moment but that better data and data analysis could help identify areas for improvement. Another saw an opportunity to refine the referral process by eliminating "unnecessary" elements (e.g., allowing people to retake road/knowledge tests three times). A third wanted to see her state adopt mandatory reporting for physicians. A fourth stated that he is comfortable with the current process and thinks it has been well refined. On a more general note, one interviewee said that he would like to see more interest in having better empirical evidence of what works and what does not work, so that more informed decisions could be made about where to spend public dollars.

In thinking collectively about their entire program or package of licensing policies for older drivers, and how well it works to promote safety and mobility, most interviewees considered their state to be doing a pretty good job. Some caveats or challenges were noted such as having high proportions of part-time residents and/or older drivers in general, and lack of standardization in vision requirements across states. One interviewee brought up an important context for thinking about the effectiveness of the licensing program—he noted that it is mostly based on incident reporting (e.g., crash or medical event) and therefore set up to be almost entirely reactive rather than proactive or preventative. Within this context, the interviewee noted that they do a pretty good job, "but only after the fact." Two interviewees responded from the perspective of unsafe drivers in general, rather than older drivers *per se*. One expressed confidence in the agency's ability to screen unsafe drivers through medical review. The other noted that the agency strives to ensure that trained and capable drivers are on the road regardless of age, and works to ensure that they have the same mobility privileges as drivers of all ages. Interviewees were also asked how their state compared to other states, but most interviewees were not able to make specific comparisons because they felt they lacked detailed information about the policies in other states.

When asked if there were any other thoughts they wanted to share, the need for more certified rehabilitation specialists was also noted by one interviewee. Another expressed the thought that not having age-based renewal requirements seems to make people feel equally treated. Finally, several interviewees expressed interest in having better information and data on which to base decisions. The range of information mentioned included best practices in other states, vision requirements across states (and the research basis for these standards), and better empirical evidence of licensing outcomes within the state to figure out what needs to be done to improve their licensing programs and policies for older drivers.

Conclusions

Collectively, the in-depth interviews provided the project with not only practical, detailed, and hands-on information about the policies and practices, but also with information on how they are actually implemented in a select number of licensing agencies. Several themes emerged across states and topic areas. First, license policies and practices for older drivers are not uniform across jurisdictions, with each state having its own combination of license policies and practices. This is, perhaps, not surprising given that states vary in needs, resources, and priorities. Despite the variability across states, general agreement was found for several areas of policy and practice. For example, all six states: accepted referrals; allowed for restricted/conditional licenses; provided some sort of immunity/confidentiality for physician reporting; and included interview, physician assessment, medical reports, and on-road testing in the medical review process. These similarities suggest that there are certain core policies and practices that should be regarded as promising approaches for licensing agencies.

In several areas covered in the interviews, the benefits of partnerships, collaborations, and outreach efforts were mentioned by interviewees. These ranged from presentations to community groups, to active medical advisory boards, to participation in statewide coalitions to improve older adult safety and mobility. These results speak to the critical need for licensing agencies to work with community partners, and older adults themselves, when developing and implementing policies and practices for older driver licensing. The study also found that while interviewees generally reported that their collective policies

and practices improved the safety of older drivers, few formal evaluations of the impact on older driver safety or mobility had been conducted. The reasons most often cited for the lack of evaluation included inadequate resources and a lack of priority. Several interviewees mentioned that they would like to have better empirical data on what works and what does not work relative to older driver policy and practice. Such results highlight the importance of future research on the safety and mobility effects of older driver licensing policy and practice.

Analysis of AAA LongROAD Data to Examine Policy Effectiveness

Background and Methods

As noted earlier, the AAA LongROAD project is a multi-site prospective cohort study of aging drivers (2,990 at baseline), designed to generate objective and subjective data for understanding the role of medical, behavioral, environmental, and technological factors in driving safety. Participants come from sites in five states in the U.S. (California, Colorado, Maryland, Michigan, and New York), and were recruited from health clinics associated with the respective health systems at each site. To be eligible for the study, participants needed to: be age 65–79 at enrollment; have a valid driver license; drive at least 1 day per week by self-report; score at least 4 on the Six Item Screener (Callahan, Unverzagt, Hui, Perkins, & Hendrie, 2002) to make sure they had the capacity to consent to be in the study; drive a primary vehicle of model year 1996 or newer; drive that vehicle at least 80% of the time if they also drove other vehicles; have no plans to be outside the study area for more than 2 months each year; and plan to remain in the study area for the next several years. Each participant completed an in-person baseline visit, during which written informed consent was obtained; driving, health, and functioning data were collected; and their vehicle was inspected by a trained researcher and installed with a device for collecting objective driving data. Each site received approval from its respective institutional review board (see Li et al. (2017) for full detail on methods and procedures).

Data Sources and Measures

Dependent variables examined in this study included: police-reported crashes; self-reported crashes; and the number of potential restrictions that each AAA LongROAD state can impose on drivers as part of its restricted/conditional licensing policy. Police-reported crash data were obtained by each state following state-specific protocols (Li et al., 2017). At baseline, crash data were collected for participants for five years prior to their enrollment in the study (these pre-study crashes are referred to as baseline in this report). Police-reported crash data were also collected for the first year of driving for participants after they enrolled in the study. Data on self-reported crashes were collected through a health and driving questionnaire administered to all participants at baseline and also at the 1-year follow-up. Specifically, participants were asked "How many accidents have you been involved in over the past year when you were the driver?" The number of potential restrictions for each state came from the literature review.

Independent variables included: the various licensing policies of interest; sex and age; composite variables of self-reported driving lapses, errors, and violations; objectively measured proportions of night driving, freeway driving, and driving less than 15 miles from home; objectively measured turns per mile; and a measure of population density, urbanization, and daily commuting (rural-urban commuting area, RUCA). Sex and age came from the baseline driving and health questionnaire. Driving lapses, errors, and violations also came from the baseline questionnaire, using items from the Driving Behavior Questionnaire (DBQ; see Parker et al., 2000). Parker et al. (2000) define lapses as primarily attentional failures that cause embarrassment but are unlikely to directly affect safety, errors as mistakes that have potentially dangerous consequences, and violations as risky driving behaviors engaged in deliberately. The objective driving measures were derived from GPS/datalogger data from AAA LongROAD participants' vehicles. The devices

automatically recorded driving information when the vehicle was turned on, and also determined whether or not it was the participant who was driving. Because raw GPS data do not allow examination of driving patterns directly, the dependent driving measures of interest for the study were derived following procedures described in previous research (Molnar et al., 2013). Travel patterns were determined primarily based on GPS measurements that included location, time of day, vehicle speed, heading, and GPS quality indicators. Information on solar angle (based on latitude/longitude coordinates and GPS time) was used to determine daylight, twilight, and nighttime. Daylight was defined as 0–89 deg solar angle, civil twilight as 90–96 deg solar angle, and nighttime as solar angle greater than 96 deg. Percent of trips during nighttime was determined based on the percent of trips during which at least 80% of the trip was during nighttime. High-speed driving (a proxy for freeway driving) was defined as speeds of 60 miles per hour or higher for at least 20% of the trip taken. The process of determining the ratio of left to right turns involved several steps. The first step was to identify turns by taking the vehicle heading data from the GPS and developing a yaw rate (rate of change of heading). Yaw rate was derived from the GPS heading data at times when the vehicle was moving and GPS-fixed quality was considered good (i.e., at least three satellites). The yaw rate was then smoothed using a binomial filter over a 5-second period. Yaw rate was used to identify periods when a vehicle was turning or in a curve; these were defined by having an absolute value of yaw greater than 0.09 deg/s. Vehicle speed was then divided by yaw rate to obtain instantaneous turn radius. Turning events were defined as those with a heading change of between 70 deg and 110 deg with the sign of the heading indicating the direction of the turn. RUCA codes were identified based on participant zip codes following Hall, Kaufman, and Ricketts (2006).

Analysis Approach

As noted above, the core of the analysis was based on data from year 1 of AAA LongROAD, which included naturalistic driving data, demographic data, police-reported crashes, and a driving and health questionnaire. The year 1 police-reported crashes (i.e., crashes occurring during the first year that participants were enrolled in the study and denoted as study year 1) were augmented with baseline crash history data spanning 5 years (i.e., crashes occurring in the 5 years prior to enrollment in the study, with the most recent year of baseline denoted as baseline 1, the second most recent year of baseline denoted as baseline 2, and so forth, with the most distant year of baseline denoted as baseline 5). As noted above, the self-reported crash data from the baseline questionnaire were augmented with corresponding data from year 1 gathered during a telephone questionnaire at the end of year 1 to provide a more robust set of self-reported crashes. These data were used to construct two analysis datasets: one for police crash reports and one using self-reported crashes and police stops.

Police-reported crashes were allocated to study years by month using the enrollment date, with the first year of the study being 12 months from the enrollment (including the enrollment month). After allocating crashes in this manner, a number of events were excluded because they occurred outside the relevant period of the study. The “study year 2” and “baseline >5” rows of Table 1 show 19 crashes that were excluded for this reason. An additional two cases were excluded in Colorado because the driver did not have the complete naturalistic driving data required to evaluate exposure. Finally, there were variations in completeness in the police-reported crash records from some of the states in some study years (e.g. baseline 3–5). To avoid undercounting crashes while maintaining the

equal influence of all five states, the police-reported crash analysis was limited to study year 1 and baseline years 1–2. As a result, the total number of crashes considered in the analysis was 225.

Table 1: Police-reported crashes by site and by study year

	Site					
	California	**Colorado**	**Maryland**	**Michigan**	**New York**	**Total**
Study Year 2	12	1	0	2	0	15
Study Year 1*	18	16	1	16	16	67
Baseline 1*	27	23	6	33	11	100
Baseline 2*	15	9	0	27	14	65
Baseline 3	8	15	0	22	9	54
Baseline 4	0	14	0	24	5	43
Baseline 5	0	16	0	18	0	34
Baseline >5	0	4	0	0	0	4
No Driving Data	0	2	0	0	0	2

* Year used in analysis.

For the self-reported event analyses, data were available from the baseline and study year 1 questionnaires. Collectively, these produced 664 self-reported crashes and 705 self-reported police stops.

Based on previous exploration of state licensing laws, there were a limited number of different licensing policies active in the five states in AAA LongROAD. After removing laws that would be inseparable from the state effects (due to applying to the entire population of a single state), three types of laws remained for analysis: mandatory in-person renewal for older drivers, required vision testing at each renewal, and the number of allowable restrictions on driver's licenses. Table 2 shows the status of these three laws in each state. The different coverage of these laws required different modeling approaches, which are outlined in the sections below.

Table 2: State driver licensing laws investigated

Law	**California**	**Colorado**	**Maryland**	**Michigan**	**New York**
Only In-Person Renewal	Age 70+	No	No	No	No
Vision Test at Every Renewal	Age 70+	Yes, within last 3 years	No	No	No
Number of License Restrictions Allowed	7	6	10	10	3

Quasi-Poisson Regression

The core of all three analyses were models of the law's association with event rate per 10,000 miles. The crash data were aggregated within each driver by year as outlined above and then associated with an estimated mileage over the same period to produce data suitable for estimating the crash rate. Although the most common model for crash rates is Poisson regression, these data consistently demonstrated overdispersion, meaning that

there was more variability than expected from a Poisson distribution. As such, these analyses used quasi-Poisson, a generalization of the standard procedure that estimates a scale parameter in addition to other model terms that estimates the amount of variability (Faraway, 2004). This maintained the benefits of Poisson regression (e.g., familiarity and ease of interpretation) while also protecting from erroneous conclusions due to the overdispersion.

In these models, miles traveled was used as an exposure term, with two sources available: observed mileage in the first year of the study and self-reported mileage from the questionnaires. The correlation between self-reported and observed mileage over the same period was only 0.47, and 75% of drivers drove more per week on average than they reported. Given the discrepancy, this analysis used the observed mileage from the first year of the study for all years (scaled up for baseline years to account for missingness of driving data as needed).

Inverse Probability Weighting

AAA LongROAD is an observation study and, as such, it can be difficult to determine causality due to "self-selection" into the study sites. That is, the impact of an in-person renewal law in California could be due to the California-specific driving behaviors of the local drivers, rather than the law itself. Inverse probability weighting (IPW) is a method to weight an observational sample to estimate the effect of a treatment on the overall population. IPW constructs a weight for each observation using a propensity score, which is an estimate of the probability that an observation belongs to the treatment group. In this case, this is the probability that a driver is in the location affected by the laws given their characteristics. There are a variety of different weighting schemes that target various populations, including average treatment effect (ATE), which is the average effect of the treatment in the population overall, and average treatment effect on the treated (ATT), which is the average effect within the treated population. Because this analysis was focused on the impact that the licensing laws would have on the full population, ATE was the appropriate target, leading to the weighting scheme in equation 1, in which e_i is the propensity score for the i^{th} observation.

$$w_i = \begin{cases} \dfrac{1}{e_i} & \text{if in the treatment group} \\ \dfrac{1}{1 - e_i} & \text{if in the comparison group} \end{cases} \quad (1)$$

Unfortunately, under the weighting scheme in equation 1, cases with propensity scores very close to one or zero have extremely high weights and can become overly influential on the resultant model. As such, a truncated weighting scheme was used instead. The truncated weight formula is shown in equation 2, where the $\mathbf{1}(\cdot)$ term is an indicator function, i.e., value is 1 when the condition is true and 0 otherwise. These weights limit the model to cases where there was sufficient overlap between the treatment and comparison populations (see Li, Morgan, & Zaslavsky, 2018).

$$w_i = \begin{cases} \dfrac{\mathbf{1}(0.05 < e_i < 0.95))}{e_i} & \text{if in the treatment group} \\ \dfrac{\mathbf{1}(0.05 < e_i < 0.95))}{1 - e_i} & \text{if in the comparison group} \end{cases} \quad (2)$$

For purposes of this analysis, propensity scores were estimated using logistic regression. This was done by modeling the probability of being in the treatment group in terms of the various covariates available. Due to the period of study data available, substantially more data were available for the first year of the study than during baseline, including the first driver functioning questionnaire as well as the naturalistic driving data collected in year 1. As such, the propensity scores for participants were calculated based on their year 1 behavior, providing access to the widest array of data to identify differences in the state populations. The propensity models are provided, as appropriate, in Appendix E along with corresponding quasi-Poisson models.

California In-Person Renewal Law Analysis

In California, individuals age 70 years or older were required to renew their driver's license in person rather than via mail or online. As individuals aged into the relevant cohort, they came under the auspices of the law but remained unaffected by it until their scheduled license renewals. This, combined with California's four-year renewal schedule, divided AAA LongROAD drivers in California into three categories. Those between the ages of 65 and 69 were not impacted by the law, while those age 73 years or older must have had at least one in-person renewal. The middle group, age 70 to 72, had an ambiguous status, as they may or may not have experienced the law (i.e., a driver who renewed at age 69 would not need to renew again until age 73). As such, the core comparison within California was between drivers age 65 to 69, definitely unaffected by the law, and those age 73 or more, definitely affected by it.

If the law markedly improved safety, it would follow that the drivers age 73 or older in California were safer, relative to 65- to 69-year-olds in the state, than their counterparts in other states were relative to the younger drivers in those states. This implied an interaction effect between being in California and being age 73 or older. As such, as outlined in Table 3, the effect of the in-person renewal law was evaluated by testing for an interaction between age and California residence in the quasi-Poisson rate model.

Table 3: Setup for the California in-person renewal law analysis models

Model Characteristic	Setting
Propensity Score "Treatment" Group	California Drivers
Population Limits	Drivers age 65–69 or 73+, No police reports for MD
Quasi-Poisson Model Predictors	California (Y/N), Age (65–69 vs. 73+), California*Age Interaction

Required Vision Test Analysis

There were two laws in AAA LongROAD states that included a requirement for vision tests. The California in-person renewal requirement had an implied vision test, since during an in-person renewal the driver must demonstrate sufficient visual acuity. Colorado had a

more explicit condition, requiring that drivers have undergone a vision test within the past three years at time of renewal. Since the Colorado law already had built-in timing leniency in the three-year grace period, the grey area of ages 70–72 in the California licensing law mentioned above was not considered problematic for this analysis. As such, the affected population for the vision test law was set as all Colorado drivers and California drivers age 70 or older.

Unlike the in-person renewal law, there were state differences and an age component within the population affected by the law. While both require a vision test, the specifics in California and Colorado are slightly different, and the California version only applies to an older population. As a result, rather than a simple categorical age and binary state categorization, as used in the previous analysis, this analysis used numeric age and included separate terms for each state. The vision test requirement was treated as a separate, binary term in the model. This allows for a clearer effect by utilizing the non-vision test population in California to refine the state effect.

Table 4: Setup for the required vision test analysis

Model Characteristic	Setting
Propensity Score "Treatment" Group	Colorado drivers and California drivers age 70+
Population Limits	No police reports for MD
Quasi-Poisson Model Predictors	State (CA, CO, MD, MI, NY), Age (numeric), Vision Test Requirement (Y/N)

Available Licensing Restrictions Analysis

Another feature of the licensing laws in all of the AAA LongROAD states was the ability to apply driving restrictions. Possible restrictions included time of day (e.g., no nighttime driving), road type (e.g., no highway driving) and distance (e.g., within a radius of the driver's home). Unfortunately, AAA LongROAD did not collect information about specific restrictions on drivers' licenses and the states did not automatically apply the restrictions as drivers aged. As such, the best available option was to look for differences in crash rate based on restrictions available to regulators. If specialized licensing restrictions were equally effective, the number of available restrictions, seen in Table 5, should be associated with a decrease in crash rate. More broadly, however, the count of available restrictions indicates the amount of codified flexibility available to the state to regulate drivers and provide alternatives to losing their licenses.

Table 5: Driver's license restriction availability by state

Restriction	California	Colorado	Maryland	Michigan	New York
Time of Day	Y	Y	Y	Y	N
Destination	Y	N	Y	Y	N
Home Radius	N	Y	Y	Y	N
Geographic Area	N	N	Y	Y	N
Routing	Y	N	Y	Y	N
Speed	N	N	Y	Y	N
Road Type	Y	Y	Y	Y	Y
Corrective Lens	Y	Y	Y	Y	Y
Adaptive Equipment	Y	Y	Y	Y	Y
Rehab Specialist	Y	Y	Y	Y	N
Total	**7**	**6**	**10**	**10**	**3**

Table 6: Setup for the available licensing restrictions analysis

Model Characteristic	Setting
Propensity Score "Treatment" Group	None, propensity scoring not used
Population Limits	No police reports for MD
Quasi-Poisson Model Predictors	# of restrictions, age (numeric), RUCA[a] (metro core, metro non-core, non-metro), sex, DBQ-L, DBQ-V, DBQ-E[b]

a: RUCA: Rural Urban Commuting Area
b: DBQ-L,V,E: Driving Behavior Questionnaire Lapses, Violations, Errors

Unlike the previous analyses, there was not a natural "treatment" group in this scenario because all states had some number of licensing restrictions available to them. As such, IPW was not appropriate for these models and was not used. Instead, as seen in Table 6, a more traditional approach was employed, with the major covariates being included in the quasi-Poisson model directly. In the other models, naturalistic driving data were included in the propensity scores under the assumption that the propensity score would be generally applicable to all years. In this model, fully duplicating that data for the baseline years did not seem appropriate given the possible variability between years, so it was omitted. The results of the baseline driving and health questionnaire, such as age, sex, and behavioral scores, were included in all relevant years for the driver. This was because these data were collected at enrollment, which was near the midpoint of the period given the year limits enforced. Furthermore, the driver functioning results were unlikely to change as drastically in response to road conditions and driving frequency as the naturalistic driving data.

Finally, Table 6 indicates that there was no state effect in this model. This was because the available restrictions were applied at the state level, so the covariate matrix became singular if both terms were included. In this regard, the number of restrictions can be thought of as a linearization of the state effects. That is, Maryland and Michigan had a "state effect" 3.3x greater than New York (10/3), rather than the unstructured pattern seen in a categorical state effect. Of note, this meant that any factors that produced differences between states but were not observed, such as enforcement patterns or weather differences, would hinder the effectiveness of the restrictions model.

Results

California In-Person Renewal Law Analysis

As shown in Table 7, none of the models showed evidence of a significant interaction between being age 73 or older and being in California. Given that individuals age 73 or older do not have a substantially different crash rate compared to age 65–69 drivers in California than similar age group comparisons in other states, there does not seem to be a significant impact of the in-person renewal law on any of the event rates considered.

One factor influencing this result may be the difference in driving characteristics between California and the other states. For example, as seen in the propensity model (Appendix E), having a high proportion of trips involving highway driving was strongly indicative of being a California driver. This led to very few non-California drivers having high propensity scores, shown in Figure 1, while California drivers demonstrated a much wider range. This indicated that there is less overlap between the driving behavior of California and other states than would have been optimal. Since the IPW analysis is limited to the overlap, this markedly reduced the sample size, particularly in the New York and Michigan populations, which had more drivers from rural areas.

*Table 7: Significance test of California*Age 73+ interaction by model*

Model	Interaction Rate Multiplier	t-statistic	p-value
Police-Reported Crashes	2.09	1.35	0.1760
Self-Reported Crashes	1.18	0.54	0.5880
Self-Reported Stops	0.84	−0.51	0.6070

Figure 1: Propensity scores for being a California driver (from police-reported crash model)

Additionally, there may have been unobserved patterns in some states. The Colorado population, in particular, did not appear to show increased risk for the older population. In that state, the police-reported crash rate per million miles was 4.03 for the 65–69 age group, but only 2.79 for age 73 or older. Critically, this was not seen in the other states in the unweighted sample. After weighting, New York also showed a decreased crash rate for the oldest drivers, but only due to the relatively low number of cases retained. This was not restricted to police-reported crashes, as Colorado and New York demonstrated the same pattern for self-reported crashes and Maryland and New York did so for self-reported stops. This had a substantial impact on the interaction tested in this analysis. If there was an unobserved feature of states like Colorado that caused this difference in crash rates, it would mask the impact of a licensing law like the one in question. Without knowledge of such a difference, however, it was not appropriate to remove the observed pattern from these analyses.

Required Vision Test Analysis

These data did not provide significant evidence of an impact from required vision tests. As seen in Table 8, the population affected by one of the vision-test-requiring laws did not have a significantly lower rate of police- or self-reported crashes or of self-reported police stops.

Table 8: Significance tests of vision test law effect by model

Model	Vision Test Rate Multiplier	t-statistic	p-value
Police-Reported Crashes	1.03	0.09	0.9252
Self-Reported Crashes	1.09	0.39	0.6970
Self-Reported Stops	1.02	0.08	0.9375

The addition of Colorado to the target population led to propensity scores that were less clearly divided between the two subpopulations. Figure 2 demonstrates this difference, and shows a much smaller portion of the sample with propensity scores less than 0.05 or greater than 0.95 than seen Figure 1. This resolved some of the problems stemming from population overlap mentioned in the in-person renewal analysis and resulted in fewer cases being dropped during the IPW process.

Unfortunately, several issues were not resolved. First, the states where the crash rate decreased for the older population remained influential in the model. This is complex because the population affected by the law in California was older. As such, with the overall age effect influenced by the decreasing pattern in some states, it is possible that the increased event rate for older drivers in California was attributed to the licensing law. Furthermore, the difference in implementation between California and Colorado was not accounted for beyond allowing for a state effect. The analysis did not cover differences in effectiveness between the laws' particulars, so if only one version of the law was effective, the overall law effect would be limited by the presence of the other. An interaction to address this was not considered given the lack of significance in the main effect and to avoid over-parameterization of the model.

Figure 2: Propensity scores for being a driver affected by a licensing law requiring a vision test at renewal (from police-reported crash model)

Available Licensing Restriction Analysis

Based on these data, there does not appear to be evidence of a significant relationship between the number of licensing restrictions available and the crash rate in the states. Table 9 shows the estimated rate multiplier for each licensing restriction and the corresponding tests for significance. As with the other analyses, there was not a significant relationship for any of the event types considered. It is worth noting that, while the models provided in Appendix E include all terms considered, backward selection was used to remove non-significant terms. The count of restrictions allowed did not reach significance in any of the reduced models, so they were not included in this report.

Table 9: Significance tests of number of license restrictions available effect by model

Model	Restriction Rate Multiplier (One Additional Option)	t-statistic	p-value
Police-Reported Crashes	1.05	1.29	0.1974
Self-Reported Crashes	0.97	−1.46	0.1441
Self-Reported Stops	0.99	−0.57	0.5679

It is worth noting that the count of restrictions available applied equal weight to all restrictions available to the state. If that assumption was inaccurate, because some restrictions were more effective than others, the states did not use restrictions equally, or some other reason, the inclusion of the less influential restrictions would have decreased

the apparent effect in the model. Without specific information on the implementation of the restrictions, either in the AAA LongROAD sample or the population overall, there was little that could be done to correct for this pattern. Looking at the restrictions individually was difficult due to the lack of information about which drivers each affected. Modeling the outcome of the restriction, such as proportion of trips on highways for the road type restriction, was not pursued because it was difficult to determine whether associations were due to the availability and use of the restriction decreasing/increasing the behavior or the frequency of the behavior affecting the feasibility or necessity of the restriction. In summary, the limitations of the data available dictated the form of this analysis and its implications.

Although not of primary interest in the analysis, there was some unexpected significance of elements from the driver functioning questionnaire. For the self-reported crashes, the DBQ-Lapses average was a significant predictor of the crash rate, with each unit increase in the score raising the crash rate by a factor of 1.52. The same term was borderline significant in the police-reported crash model indicating that the pattern is not entirely an artifact of the self-reporting process. Figure 3 shows a plot of the self-reported crash rate against the DBQ-Lapses score, with point size indicating the amount of mileage observed for that score. The significant positive effect observed in the model is visible even in the absence of other coefficients further supporting the association.

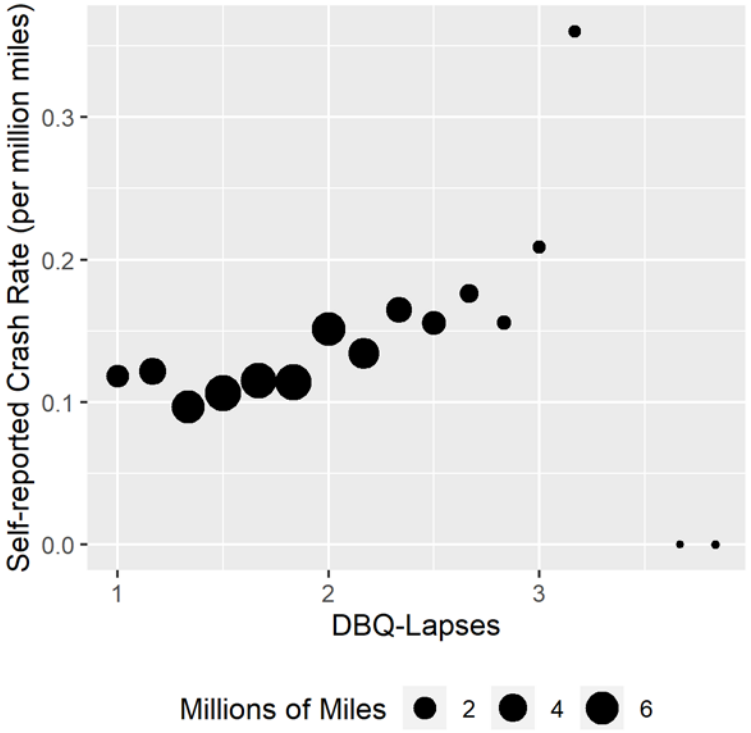

Figure 3: Self-reported crash rate vs. DBQ-Lapses score, point size is mileage aggregated over drivers with the relevant DBQ-Lapses score

Discussion

Although focused on the effects of licensing laws on crash rates, this analysis did not find any significant associations. The earlier sections of the report discussed some patterns found during the analyses, such as the lower crash risk for older drivers in Colorado, but there were broader issues that affected the form and results of the analyses overall. Many of these stemmed from the design of AAA LongROAD and the state of the study at the time of analysis, including data completeness and the states included. Some notable issues are discussed below, along with an alternative source of data for an analysis of licensing laws.

As mentioned when discussing the data used, only the baseline and first year data from AAA LongROAD were available at the time of the analysis. Under the structure of AAA LongROAD, this consisted of a number of elements:

- The demographics and survey results collected at enrollment and at the end of the first year
- The naturalistic driving data for the first year
- Crash data collected over the first year
- Historical crash data collected for five years of baseline

This meant that the naturalistic driving data, and corresponding exposure data, were only available for one year. To apply exposure to the crashes experienced during baseline, the known exposure needed to be duplicated for each year of the baseline data. Furthermore, the survey at enrollment applied immediately at the start of the first year of the study, but by the end of the year the first telephone survey could also be relevant (though it introduces missing data from dropout). There was no equivalent for the baseline data, as the enrollment survey is the closest for all baseline observations even in baseline year 5. For this analysis, data were aggregated to the year, so the enrollment survey was associated foremost with the first year of the study, but there is an implicit assumption that the drivers were mostly static for all 5 years of baseline. As AAA LongROAD grows, this will become less of an issue due to the growth in "complete" data observations, but at the time of the analysis, the baseline observations were markedly less complete and the placement of the surveys was not optimal.

Data completeness concerns were also observed with regard to recording of police-reported crashes. As shown in Table 1, the data for some states appeared to be incomplete: California, Maryland, and New York all had baseline years during which no crashes were available from police-reported crash records. After discussion, the consensus was that these years were incomplete, rather than unexpectedly safe and the analysis was limited to the years that appeared to have consistent data, study year 1 and baseline years 1 and 2. As above, this issue will become less relevant as AAA LongROAD grows and the baseline data becomes less critical to the volume of data available.

Because the AAA LongROAD data were collected from around the participant sites, the drivers at those sites had characteristics determined by the driving conditions in the area. For instance, the vast majority of drivers in California, Colorado, and Maryland were recorded as being in RUCA category "Metro Core." This was problematic for an analysis of this type because several effects end up confounded with the state effects. If most of the estimate for the effect of being in a non-metro RUCA was calculated from New York drivers, it becomes harder to differentiate RUCA from New York. The issue became more

complicated with the addition of state-level licensing laws, which lead to further confounded state effects. For a law only present in New York, such as mandatory physician reporting, it was impossible to differentiate state from law from RUCA. This extended, though less cleanly, into other factors, such as highway driving and turns per mile. The impact of these differences was seen in the in-person renewal analysis, where the limited overlap in driving behavior between California and the other states reduced the number of cases after the IPW process.

A final limitation of the AAA LongROAD locations for this analysis emerged as work on the study's early tasks commenced and more details about the licensing laws and practices in those states were obtained. Despite the breadth of licensing laws throughout the U.S., the five states participating in AAA LongROAD had relatively homogenous laws. The small number of states also meant that a number of laws were only in one state (and indistinguishable from a state effect) or were insufficiently different from the laws in other states. For example, Colorado had accelerated renewal for older drivers that only brought it into line with the other states that had substantially shorter renewal periods to start with. For a study of this type, it would have been helpful to have selected the states in the study after knowing the licensing laws in those states. Obviously, this is not a limitation for the AAA LongROAD study itself, which was not designed for this purpose, but simply a limitation of applying AAA LongROAD to this particular project.

An alternate approach to the analysis, that may resolve some of these concerns, would be to access police reports directly. This could be done either by accumulating police reports directly from the states, as the University of Michigan Transportation Research Institute and many other traffic research organizations do, or by relying on national datasets like the Fatality Analysis Reporting System (FARS), or state-level data from multiple individual states. This would allow for analysis of a wider variety of states and laws while ensuring complete collection of police-reported crashes. This removes the naturalistic driving data that AAA LongROAD provides, including the exposure data, but several factors mitigate this loss. First, these naturalistic data were already available only for a limited period of AAA LongROAD, not existing yet for any of the baseline years. Until more years of AAA LongROAD are completed, this is not a substantial weakness of the police-report based approach. Additionally, while there would no longer be a direct exposure metric, crashes for aging drivers could be compared to crashes for a younger demographic as an indirect exposure metric. Overall, this approach could allow for a wider analysis without being constrained by the different goals of the core AAA LongROAD study design.

Recommendations

As discussed previously, an important objective of this study was to identify effective licensing policies and practices for older and medically at-risk drivers, and to offer practical guidance to driver licensing officials and policymakers. As part of the background and framework for the study, recommendations for licensing policies and practices that came out of the AAAFTS-sponsored North American Licensing Workshop convened in 2008 were highlighted. The intent in carrying out the three main tasks of this study (comprehensive review of the literature, in-depth interviews with representatives of licensing agencies, and analysis of data from the AAA LongROAD project) was in part to assess whether the recommendations that came out of that workshop are still relevant and valid today. An additional aim was to refine and/or identify additional policy and practice recommendations, based on the findings from this study.

The guidelines are presented in three sections that relate directly to the broad categories of licensing policy examined in the study. These include: 1) licensing renewal; 2) physician reporting and referrals by others; and 3) the medical review process. Within each section, recommendations are presented separately for policies and practices. In addition, a fourth section presents recommendations for partnerships to promote older driver safety and mobility. These recommendations warrant their own section as they cut across multiple licensing policies and practices. Preceding each set of policy and practice recommendations, a brief background is included to provide a context for understanding why the recommendations are included, based primarily on collective results of the literature review and in-depth interviews with licensing agency representatives. The recommendations are also consolidated in Appendix A. As noted previously, results from the AAA LongROAD data analysis did not find significant associations between licensing policies and safety outcomes for a variety of reasons discussed in that section; therefore, the analysis did not inform recommendation development. In the Conclusions and Discussion section of the report, the project recommendations are considered within the context of the outcomes from the AAAFTS Licensing Workshop, and highlight potential avenues of research to support and enhance implementation of the recommendations outlined here.

License Renewal for Older Drivers

License renewal policies vary across jurisdictions in the U.S.; however, many jurisdictions have some combination of such policies including: mandatory in-person renewal; accelerated renewal periods; knowledge, vision, and/or road tests; and conditional/restricted licensing. Although more research on licensing renewal policies is certainly warranted, there is evidence that in-person license renewal is associated with lower crash fatality rates, at least for driver age 85 or older. While such fatality reductions have not been reported for older drivers under age 85, there is evidence of other benefits of in-person renewal for these drivers, as well as a lack of evidence of obvious harm in terms of loss of mobility. For example, in one study, in-person renewal for drivers age 70 or older led to driving reduction but not cessation, thus, drivers were still able to meet their basic mobility needs according to the author. In another study, drivers in states with in-person renewal were considerably less likely to have dementia among a population of crash-involved hospital patients. In-person renewal also provides an opportunity for direct interaction with licensing personnel, allowing them to observe gross impairments in functioning and make appropriate referrals for in-depth assessment, as well as provide information and education

materials for maintaining safe mobility. Results from the in-depth interviews indicated some states represented had in-person renewal (with varying details), while others did not. However, there was general consensus among interviewees that their state's licensing renewal policies were working well from a safety standpoint, regardless of whether in-person renewal was required. No concerns about negative effects of in-person renewal policies were expressed and no suggestions were made to change in-person renewal. In contrast to in-person renewal, empirical support was not found for age-based accelerated license renewal in our review of the literature. Specifically, none of the studies reviewed found evidence that accelerated renewal for older drivers was independently associated with reductions in crash fatality rates, and one study found the opposite (i.e., an association between accelerated renewal and increased fatalities). Perhaps one reason for these discrepant results is that it is difficult to compare accelerated license policies among states, because some states without age-based accelerated renewal have short renewal periods for all drivers, not just older drivers. Finally, results from the in-depth interviews suggested that while some states have accelerated renewal, it is generally triggered by medical/health conditions (e.g., progressive visual/physical conditions as diagnosed by a physician), rather than age *per se*.

Vision tests are the most common tests required at renewal and have been the most widely studied. Results from the literature review on vision tests were mixed. Some early studies supported their use, with such tests found to be significantly associated with lower crash fatality rates. Later studies, especially those controlling for in-person renewal provisions, did not find independent effects of vision tests on fatality rates. However, in one study comparing fatality rates before and after implementation of a law requiring vision testing for all drivers age 80 or older, the change in policy was associated with a significant drop in crash fatalities among that age group. In addition, the law did not appear to deter drivers from seeking or obtaining a renewed license, according to survey results from a complementary study. This was consistent with another study that found that peripheral vision testing was not associated with driving reduction or cessation. Noted benefits of vision tests are that they provide quick and accurate results, are easy to administer, and are relevant to the driving task. At the same time, results from both the literature review and in-depth interviews suggest that licensing agencies would benefit from better information about empirically defensible vision standards and more consistent standards across jurisdictions. Knowledge and road tests are rarely required as part of the license renewal process in U.S. jurisdictions and few studies have been done on their safety effects, with most finding that they do not independently reduce crash fatality rates among older drivers.

Forty-nine states in the U.S. have some form of restricted/conditional licensing. While the exact combination of restrictions varies considerably across states, many have the latitude to impose any restrictions deemed necessary (e.g., those specified by the older driver's physician). A systematic review of restricted/conditional licensing concluded that overall, this policy may be effective in reducing crash risk among older drivers with few health conditions, and those with few restrictions. More general support for restricted/conditional licensing came from a recent study combining review of the literature, expert opinion, analysis of crash and citation data, and a small naturalistic driving study. Results suggested that older drivers whose licenses were restricted complied with the restrictions and had lower crash rates after the restrictions were imposed, but not as low as among comparably aged unrestricted drivers. The main conclusion drawn from the study was that

restricting drivers rather than suspending their license did not pose an unacceptable safety risk but did help these drivers maintain mobility. While the effectiveness of restricted/conditional licensing may be weakened by the challenges associated with enforcing such restrictions or if drivers are already limiting their driving under the conditions imposed, they still offer licensing agencies an option to allow older drivers to continue to drive to maintain their mobility, but under conditions considered to be safer for them, rather than taking the license away altogether.

Jurisdictions engage in a variety of practices to support and facilitate implementation of renewal and other licensing policies; many of these focus on outreach to older adults and their families to educate them about the licensing process and other related issues surrounding safe mobility. One noteworthy practice discussed in the in-depth interviews was the development and dissemination of information booklets or brochures to older drivers and their families about license-related expectations and responsibilities, as well as more general information about maintaining safe mobility as people age. Most states represented in the interviews had an information booklet or brochure. Other practices include the establishment of specific programs within the licensing agency to help support aging drivers as they move through the licensing process (whether they are simply renewing their license or are required to undergo medical review/assessment). One example of such a program, identified in the in-depth interviews, is California's Senior Driver Ombudsman Program, whose mission is to help older adults drive for as long as they can safely do so, and to ensure that they understand the licensing process and their rights within that process (see Appendix F for more detail on this program).

Policy Recommendations

Recommendation 1

Licensing agencies should consider in-person renewal for older drivers beginning at age 70–75.

Recommendation 2

There is insufficient evidence of the safety effects of accelerated renewal for older adults to justify enactment of accelerated renewal policies, based solely on age, especially given the financial and human resources often needed to change existing policies or implement new policies.

Recommendation 3

A uniform vision standard should be adopted across jurisdictions that require vision testing, based on available empirical evidence and the experience of other countries (e.g., the United Kingdom) that have successfully implemented such an approach.

Recommendation 4

There is insufficient evidence of the safety effects of knowledge and road tests at license renewal to justify the enactment of policies requiring knowledge and/or road tests at license renewal by licensing agencies, especially given the financial and human resources often needed to change existing policies or implement new policies.

Recommendation 5

Licensing agencies should make use of restricted/conditional licensing as a tool to help balance older drivers' personal mobility with public safety concerns.

Recommendation 6

The specific set of restrictions for restricted/conditional licenses may need to be tailored to each jurisdiction, but having the latitude to impose additional restrictions as warranted is important.

Practice Recommendations

Recommendation 7

Information booklets/brochures for older adults and their families are a useful tool for educating these groups about the licensing process. While information about older drivers' responsibilities and rights need to be necessarily tied to the specific policies and practices within each jurisdiction, there is an opportunity to harmonize more general information about safe mobility across jurisdictions, to ensure that it is consistent, up-to-date, and evidence based.

Recommendation 8

Jurisdictions should consider specialized in-house programs to support older drivers' safe mobility that include community outreach, as well as one-on-one interactions with older drivers to make sure they understand their responsibilities and rights in the licensing system, and are aware of community mobility options beyond driving, when necessary.

Physician Reporting and Other Referrals

Beside the regular license renewal process, drivers can also be referred to the licensing agency based on concerns from professionals and non-professionals. Every licensing authority in the U.S. accepts external referrals from community members including physicians and other health professionals, law enforcement, friends and family, and from within the licensing agency itself. Although research has not yet established differential safety or mobility impacts of voluntary versus mandatory reporting, data do show that reporting from medical personnel is effective in getting medically unfit drivers off the road. There are, however, barriers to physician and other medical personnel reporting that include: not all medical personnel are trained to determine the extent of an impairment on driving fitness, lack of training to determine fitness to drive, concern that reporting would undermine the physician-patient relationship, and concerns about lawsuits arising from reporting. Because law enforcement has the opportunity to observe older drivers on the roadway at traffic stops and crashes, they have a unique position in identifying older adults who may not be safe to drive. Studies of these referrals show that the vast majority of drivers referred by law enforcement are not able to drive safely. Many officers, however, report that they do not have sufficient training to assess medical fitness to drive and that they are more lenient with older drivers. Family members and friends of older adults are also well-positioned to observe older drivers and refer those who may be unsafe drivers. A large study of family-based referrals found that a significant majority of them were not medically fit to drive, pointing to the value of this type of referral. Finally, licensing

agencies also have a unique insight into the safety of older drivers. Agencies have access to crash and citation records that can be assessed to determine driving safety. Most states have in place policies that include analysis of driver history that, when cutoffs are reached, initiates a driving fitness review process. The effectiveness of using driver history records as a referral source has not been empirically determined, but given the direct link between crashes, violations, and fitness to drive, this type of referral is important. Finally, to the extent that drivers are required to renew their licenses in person, the counter personnel have the opportunity to interact with the driver and notice clues that might indicate a lack of fitness to drive. No studies have assessed the impact of this practice, but some recommendations are found in the literature.

Policy Recommendations

Recommendation 9

Licensing agencies should have policies that promote either voluntary or mandatory physician reporting.

Recommendation 10

Empirically defensible criteria and/or guidelines on medical and functional fitness to drive should be developed and promoted among health professionals that interact with older drivers.

Recommendation 11

Standard reporting laws should be enacted that provide civil immunity for health and other professionals who report suspected unfit drivers.

Recommendation 12

Policies should provide some level of confidentiality for family referrals in order to encourage this practice.

Recommendation 13

Policies regarding agency driving history record review should indicate specific cutoffs that trigger a fitness-to-drive evaluation, with particular emphasis on at-fault crashes, crashes involving a fatality, crashes where law enforcement indicate a potential medical condition as a contributing factor, and violations of license restrictions.

Recommendation 14

Jurisdictions should develop guidelines and procedures for the observation of functioning and interacting with suspected medically unfit drivers.

Practice Recommendation

Recommendation 15

Standardized and specialized training and education materials should be developed and utilized for health professionals, law enforcement, family members of older drivers, and

licensing personnel to more accurately determine drivers who are not fit to drive, as well as how to properly report these drivers to the licensing agency.

Medical Review/Assessment Procedures

An important component of licensing policy and practice for older drivers is having information about drivers' health and functional abilities. Once a suspected unfit driver is brought to the attention of a licensing agency, medical information is a part of nearly all jurisdictions' assessment of medical fitness to drive. Although the specific practices vary, most jurisdictions in U.S. and Canada will require that the driver gets a medical evaluation from the driver's physician. The physician conducts the evaluation and completes a required medical reporting form (or forms), which is submitted to the licensing agency along with self-reported information provided by the driver. An analysis of medical reporting forms in the U.S. and Canada found that more than 80% required the medical professional to state whether the person was a safe or unsafe driver and more than one-half requested the medical professional to suggest licensing restrictions. Other work, however, has found that a large percentage of medical professionals do not feel qualified assessing whether a person is safe or unsafe to drive, 70% thought that providing licensing agencies with a judgement of fitness to drive created a conflict of interest with their patients, many are unaware of jurisdictions' requirements for fitness to drive, and many do not know which functional tests they should perform. Once medical and functional abilities information has been obtained, the agency may require further testing, such as on-road testing. Individual cases are reviewed by trained personnel at the licensing agency and some agencies may also utilize an MAB consisting of medical personnel who also have experience with driving and licensure. The responsibilities of MABs vary greatly among states and they are considered a promising practice by several traffic-safety-related professionals and organizations. Finally, nearly all states have a requirement for drivers to self-report medical conditions at license renewal. The level of detail in reporting of medical conditions varies greatly by state. There is little empirical literature on the safety or mobility impacts of these practices, except that of MABs. Similar to the research on referrals, cases that have been referred to an MAB have a high likelihood of having poor fitness to drive and also loss of licensure. It is not known how many drivers voluntarily stopped driving and dropped out of the assessment process prior to being reviewed by the MAB.

Policy Recommendations

Recommendation 16

The MAB should be involved in both decisions about an individual's fitness to drive and older driver licensing policy development.

Recommendation 17

Driver self-reporting of health information at renewal should include attestation of medical conditions and functional limitations that have been shown empirically to impact the ability to drive safely.

Practice Recommendations

Recommendation 18

MABs should be established with funding and they should be involved in both case review and policy development.

Recommendation 19

Medical reporting forms should restrict information collection to the areas where physicians are most qualified to assess—medical conditions, functional assessment, and medications—so that licensing personnel or a medical advisory board has the information they need to make an assessment of driving fitness.

Recommendation 20

Incentives should be provided in order to attract highly qualified medical personnel to serve on MABs.

Recommendation 21

Education and training should be provided to MAB members on issues related to medical fitness to drive and functional limitations.

Partnerships

It is widely recognized that the issues related to safe mobility for older adults are complex and multi-faceted, and necessarily require multidisciplinary solutions that come into play at various stages along the continuum of safe driving to transitioning to other community mobility options. Evidence suggests that older adults moving along this continuum are best supported by well-integrated efforts that take a more holistic approach to this process. Thus, partnerships across agencies and organizations representing not only the traditional transportation partners including licensing agencies, but also health, aging, enforcement, insurance, human services, and other community groups are often needed to ensure that older adults remain safely mobile. Such a collaborative approach is also important given that individual agencies and organizations often face scarce resources and competing priorities, making it difficult to focus efforts outside of their essential and immediate missions. The in-depth interviews pointed to this challenge for licensing agencies when they noted the absence of evaluations of their licensing policies due in part to resource constraints. Partnering with stakeholder groups allows these agencies/organizations to leverage the strength and resources of the broader community in carrying out activities to balance public safety and personal mobility. The benefits of partnerships, collaborations, and outreach efforts were noted by many of the interviewees. At the broadest level, interviewees mentioned statewide collaborations and coalitions that have successfully developed and implemented comprehensive strategies for older adults (see Appendix F for an overview of two such statewide efforts). More narrowly focused partnerships have also been useful in such efforts as helping licensing agencies identify appropriate standards for medical review and other policies and practices, conducting community outreach, and assessing the effectiveness of their licensing policies and practices (e.g., partnering with universities and others to conduct evaluations when in-house evaluation resources are lacking). The recommendations in this section include both statewide comprehensive

partnerships and more narrowly focused partnerships intended to address individual components of the licensing process.

Practice Recommendations

Recommendation 22

Licensing agencies should develop active partnerships with health professionals, health-care organizations, law enforcement, family members of older drivers, older adult community groups, and older drivers themselves to discuss policies and practices related to medical fitness to drive, referrals, and safety and mobility outcomes.

Recommendation 23

Agencies should develop active collaborations with state medical systems and societies and have regular conversations about aging, medical conditions, functional limitations, and driving safety.

Recommendation 24

Jurisdictions without a statewide comprehensive partnership in place to address older adult safe mobility should consider such development, using existing successful models in other states as a guiding framework, and adapting them to their own unique state characteristics and opportunities.

Conclusions and Discussion

Collectively, results from this study indicate that there is considerable variability across jurisdictions in terms of the combination of licensing policies and practices in place. These results reaffirm the conclusions reached by previous investigators, and are not surprising given the unique needs, resources, and priorities in each jurisdiction. At the same time, similarities were found in several areas of policy and practice, including: the use of restricted/conditional licenses, the offer of some type of immunity/confidentiality for physician reporting, provisions for accepting referrals from others, and having in place a medical review and assessment process. The recommendations for improving licensing policies and practices that came out of the study are in keeping with many of the recommendations from the 2008 North American License Policy Workshop (outlined earlier in this report). However, research on the safety effects of licensing policies and practices is still limited, even though its importance has been recognized by researchers, licensing representatives, and other stakeholders.

Earlier in this report, a number of research questions and issues of interest were identified by specific area of licensing policy and practice (see pages 25–27). Collectively, they speak to the need for continuing and expanding research on the safety outcomes associated with specific policies, taking into account the effects of other policies in place, as well as other potential confounding variables such as differences in individual and jurisdictional characteristics not related to licensing (e.g., roadway features and driving conditions). In addition, they point to the importance of better understanding the safety outcomes associated with various practices and programs such as education and training of licensing staff and professionals who refer or work with older drivers in various capacities. There is also an opportunity to more fully explore the mechanisms by which safety outcomes are realized and the effects of such outcomes on older adults' mobility and wellbeing. Finally, there would be great benefit in conducting translational research to help states design and implement comprehensive coalitions and collaborations to support older adult safe mobility of which licensing agencies would be a part, based on successful and promising elements of existing models.

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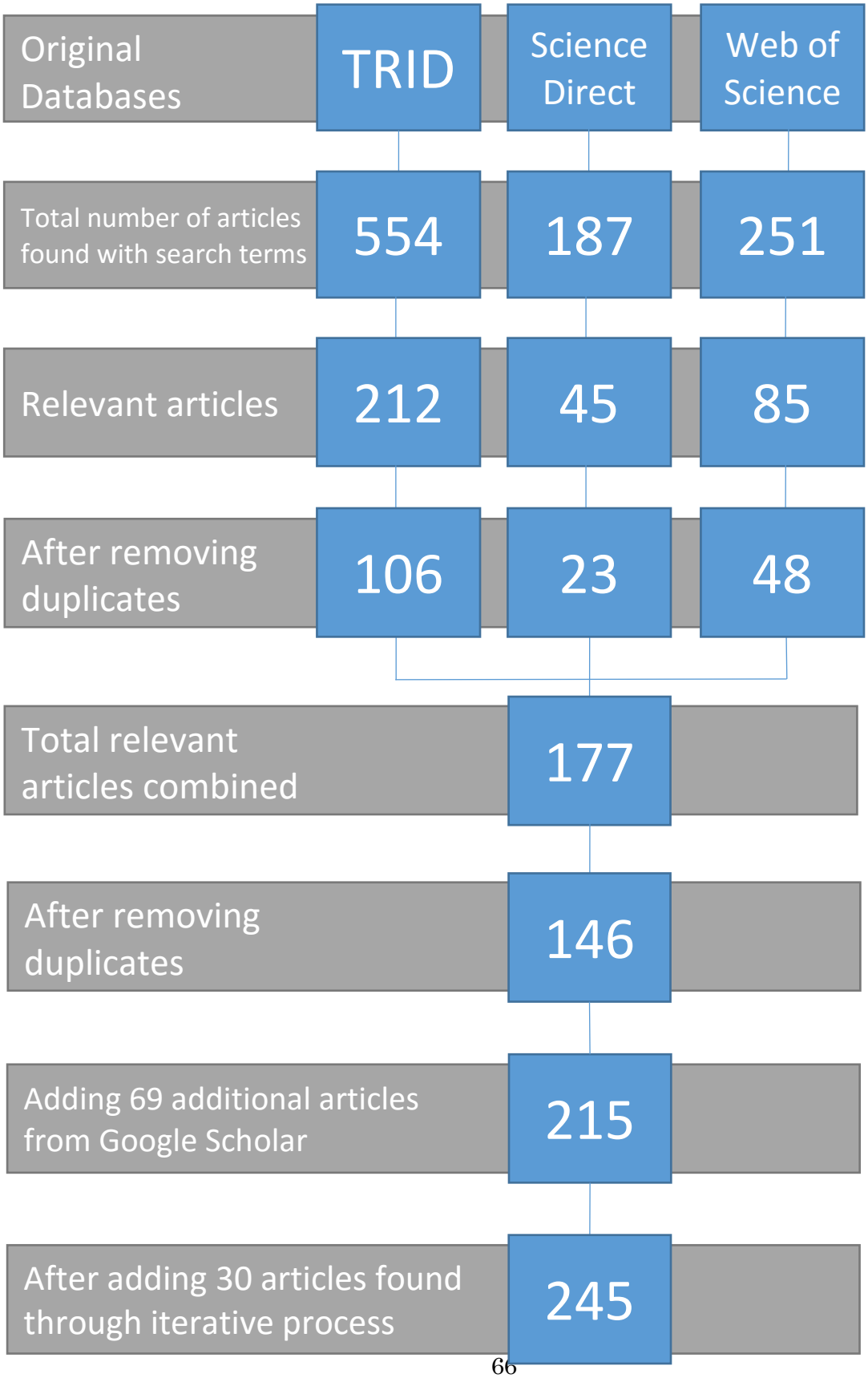
Appendix A: Consolidated Recommendations

License Renewal for Older Drivers	
Policy Recommendations	
Recommendation 1	Licensing agencies should consider in-person renewal for older drivers beginning at age 70–75.
Recommendation 2	There is insufficient evidence of the safety effects of accelerated renewal for older adults to justify enactment of accelerated renewal policies, based solely on age, especially given the financial and human resources often needed to change existing policies or implement new policies.
Recommendation 3	A uniform vision standard should be adopted across jurisdictions that require vision testing, based on available empirical evidence and the experience of other countries (e.g., the United Kingdom) that have successfully implemented such an approach.
Recommendation 4	There is insufficient evidence of the safety effects of knowledge and road tests at license renewal to justify the enactment of policies requiring knowledge and/or road tests at license renewal by licensing agencies, especially given the financial and human resources often needed to change existing policies or implement new policies.
Recommendation 5	Licensing agencies should make use of restricted/conditional licensing as a tool to help balance older drivers' personal mobility with public safety concerns.
Recommendation 6	The specific set of restrictions for restricted/conditional licenses may need to be tailored to each jurisdiction, but having the latitude to impose additional restrictions as warranted is important.
Practice Recommendations	
Recommendation 7	Information booklets/brochures for older adults and their families are a useful tool for educating these groups about the licensing process. While information about older drivers' responsibilities and rights need to be necessarily tied to the specific policies and practices within each jurisdiction, there is an opportunity to harmonize more general information about safe mobility across jurisdictions, to ensure that it is consistent, up-to-date, and evidence based.
Recommendation 8	Jurisdictions should consider specialized in-house programs to support older drivers' safe mobility that include community outreach, as well as one-on-one interactions with older drivers to make sure they understand their responsibilities and rights in the licensing system, and are aware of community mobility options beyond driving, when necessary.
Physician Reporting and Other Referrals	
Policy Recommendations	
Recommendation 9	Licensing agencies should have policies that promote either voluntary or mandatory physician reporting.
Recommendation 10	Empirically defensible criteria and/or guidelines on medical and functional fitness to drive should be developed and promoted among health professionals that interact with older drivers.
Recommendation 11	Standard reporting laws should be enacted that provide civil immunity for health and other professionals who report suspected unfit drivers.
Recommendation 12	Policies should provide some level of confidentiality for family referrals in order to encourage this practice.
Recommendation 13	Policies regarding agency driving history record review should indicate specific cutoffs that trigger a fitness-to-drive evaluation, with particular emphasis on at-fault crashes, crashes involving a fatality, crashes where law enforcement indicate a potential medical condition as a contributing factor, and violations of license restrictions.
Recommendation 14	Jurisdictions should develop guidelines and procedures for the observation of functioning and interacting with suspected medically unfit drivers.

Practice Recommendation	
Recommendation 15	Standardized and specialized training and education materials should be developed and utilized for health professionals, law enforcement, family members of older drivers, and licensing personnel to more accurately determine drivers who are not fit to drive, as well as how to properly report these drivers to the licensing agency.
Medical Review/Assessment Procedures	
Policy Recommendations	
Recommendation 16	The medical advisory board should be involved in both decisions about an individual's fitness to drive and older driver licensing policy development.
Recommendation 17	Driver self-reporting of health information at renewal should include attestation of medical conditions and functional limitations that have been shown empirically to impact the ability to drive safely.
Practice Recommendations	
Recommendation 18	MABs should be established with funding and they should be involved in both case review and policy development.
Recommendation 19	Medical reporting forms should restrict information collection to the areas where physicians are most qualified to assess—medical conditions, functional assessment, and medications—so that licensing personnel or a medical advisory board has the information they need to make an assessment of driving fitness.
Recommendation 20	Incentives should be provided in order to attract highly qualified medical personnel to serve on MABs.
Recommendation 21	Education and training should be provided to MAB members on issues related to medical fitness to drive and functional limitations.
Partnerships	
Practice Recommendations	
Recommendation 22	Licensing agencies should develop active partnerships with health professionals, health-care organizations, law enforcement, family members of older drivers, older adult community groups, and older drivers themselves to discuss policies and practices related to medical fitness to drive, referrals, and safety and mobility outcomes.
Recommendation 23	Agencies should develop active collaborations with state medical systems and societies and have regular conversations about aging, medical conditions, functional limitations, and driving safety.
Recommendation 24	Jurisdictions without a statewide comprehensive partnership in place to address older adult safe mobility should consider such development, using existing successful models in other states as a guiding framework, and adapting them to their own unique state characteristics and opportunities.

Appendix B: Summary of Review Process



Appendix C: Licensing Renewal Policies for Older Drivers

	Accelerated License Renewal			In-person renewal		Required testing at renewal		Conditional/Restricted Licenses		Comments
	in effect?	starting age	frequency (in years)	in effect?	starting age	starting age	in effect? (see key)	in effect?	Restrictions (see key)	
Alabama	**							X	DMLQHAO	
Alaska				X	68	68	V	X	LMSDTASOUQE	
Arizona	X	65	5					X	DLQGUAFMO	
Arkansas								X	LQUM	
California				X	70	70	VK	X	QWDULMAE	
Colorado								X	DSAMULQB	
Connecticut								X	DFLUMQHE	
Delaware								X	DLQUM	
District of Columbia								X	DMLUQ	
Florida	X	80	6			80	V	X	LMDUQE	
Georgia	X	64	5	X	64	64	V	X	LDMAFEOUQU	
Hawaii								X	QML	
Idaho				X	62	62	V	X	DEAQULFC	
Illinois	X	81	2 (1 at 87+)	X	75	75	RVK*	X	LDMQUA	knowledge only if record is not clean
Indiana								X	MLDAQU	
Iowa	X	72	2	X	72	72	V	X	DLSAMQUOE	
Kansas								X	LDFACQUME	
Kentucky								X	LQDAO	
Louisiana				X	70	70	V	X	LMDAFSEQ	
Maine	X	65	4			62	V	X	EADFLMQJ	
Maryland								X	MDTQA	
Massachusetts								X	LDQ	
Michigan								X	LDAQEF	

	Accelerated License Renewal			In-person renewal		Required testing at renewal		Conditional/Restricted Licenses		Comments
	in effect?	starting age	frequency (in years)	in effect?	starting age	starting age	in effect? (see key)	in effect?	Restrictions (see key)	
Minnesota								X	LDSAF	
Mississippi								X	LMDSQ	
Missouri								X	DFMQASO	
Montana								X	LMDSFWAQ	
Nebraska								X	LMQUADSO	
Nevada	X	65	4					X	LDSMQH	
New Hampshire								X	LQMD	
New Jersey								X	LQES	
New Mexico	X	75	1			75	V	X	ALQUMDJO	
New York								X	DMQE	
North Carolina	X	66	5					X	JQSFDAHMLE	
North Dakota								X	ADQLM	
Ohio								X	DLQEF	
Oklahoma								X	DFSALMUQONE	
Oregon								X	DLJASFQ	
Pennsylvania								X	DMFALUQB	
Rhode Island	X	70	2							
South Carolina								X	LDQUMSF	
South Dakota				X	65	65	V	X	UAQDOMLJ	
Tennessee								X	MLUQDW	
Texas	X	85	2	X	79	79	V	X	LDSOQUAJFE	
Utah								X	ADSQML	
Vermont								X	DLQUO	
Virginia	X	75	5	X	75	75	V	X	DLEFAUMQP	
Washington								X	EDLQ	

	Accelerated License Renewal			In-person renewal		Required testing at renewal		Conditional/Restricted Licenses		Comments
	in effect?	starting age	frequency (in years)	in effect?	starting age	starting age	in effect? (see key)	in effect?	Restrictions (see key)	
West Virginia								X	LMDA	
Wisconsin								X	DASFLEOJ	
Wyoming								X	UDFQOLEAS	

+ Information in table adapted from Lococo, K.H., Stutts, J., Sifrit, K.J. & Staplin, L. (2017). Medical Review Practices for Driver Licensing, Volume 3: Guidelines and Processes in the United States (Report DOT HS 812 402). Washington DC: National Highway Traffic Safety Administration. Data are from surveys administered to states in 2015.

Required Testing Key	
road test	R
knowledge test	K
vision test	V

Conditional/Restricted License Key			
daylight driving only	D	**outside mirrors required**	M
corrective lenses required	L	**specially equipped vehicle required**	Q
no freeway	F	**speed restriction**	S
restricted driving area	A	**only specific destinations**	J
hearing aids required	H	**auto-transmission only**	U
must drive with licensed adult	C	**can drive with driver educator only**	B
drive only under supervision of rehab services	P	**no driving in inclement weather**	W
type of vehicle	T	**golf cart only**	G
food, fruit, or candy must be within reach of driver	N	**recommendations given for future re-evaluation**	E
		any other restrictions deemed necessary	O

Physician Reporting and Other Referrals+

	Mandatory Physician Reporting	Protection of Confidentiality		Legal Protection?	Driving Record Review	Counter Personnel Reporting	*
	in effect?	in effect?	for who?	in effect?	included?	allowed?	
Alabama		X	physician	X			
Alaska		X	physician				
Arizona		X	all	X			
Arkansas		X	physician				
California	X	X	physician	X*		X	not protected for voluntary reports
Colorado		X	physician	X			
Connecticut		X	physician	X		X	
Delaware	X	X	physician	X	X		
District of Columbia		X	physician				
Florida		X	physician	X		X	
Georgia		X	all	X			
Hawaii		X	physician				
Idaho		X	physician			X	
Illinois		X	physician	X			
Indiana		X	physician	X			
Iowa		X	physician	X	X		
Kansas		X	physician	X	X		
Kentucky				X*			only if reporting seizures, no other condition
Louisiana		X	physician	X			
Maine		X	physician	X		X	
Maryland				X*	X	X	only if reporting lapses of consciousness and/or corrected visual acuity
Massachusetts		X	physician	X		X	
Michigan		X	all	X	X		
Minnesota				X			
Mississippi		X	physician				
Missouri		X	physician	X			
Montana				X	X		
Nebraska		X	physician			X	
Nevada	X	X	physician				
New Hampshire					X		

	Mandatory Physician Reporting	Protection of Confidentiality		Legal Protection?	Driving Record Review	Counter Personnel Reporting	*
	in effect?	in effect?	for who?	in effect?	included?	allowed?	
New Jersey	X	X	physician	X*	X		not protected for voluntary reports
New Mexico		X	all	X			
New York						X	
North Carolina		X	physician	X	X		
North Dakota		X	physician				
Ohio		X	physician				
Oklahoma		X	physician	X			
Oregon	X	X	all	X	X		
Pennsylvania	X	X	physician	X			
Rhode Island		X	physician	X		X	
South Carolina							
South Dakota		X	physician		X	X	
Tennessee		X	physician				
Texas		X	all	X		X	
Utah		X	all	X			
Vermont		X	physician				
Virginia		X	*	X		X	only physicians and relatives of the driver are anonymous
Washington						X	
West Virginia		X	physician	X		X	
Wisconsin		X	physician	X		X	
Wyoming		X	physician			X	

+ Information in table adapted from Lococo, K.H., Stutts, J., Sifrit, K.J. & Staplin, L. (2017). Medical Review Practices for Driver Licensing, Volume 3: Guidelines and Processes in the United States (Report DOT HS 812 402). Washington DC: National Highway Traffic Safety Administration. Data are from surveys administered to states in 2015.

Medical Review/Assessment Processes+

	Self-Reporting of Medical Conditions	MAB			
	Required?	in effect?	advise on medical policy	advise on individual cases	part of appeals process
Alabama	X	X	X	X	X
Alaska	X				
Arizona	X	X	X	X	X
Arkansas	X				
California	X				
Colorado	X				
Connecticut	X	X	X	X	X
Delaware	X	X	X	X	X
District of Columbia	X				
Florida	X	X	X	X	X
Georgia	X	X	X	X	X
Hawaii	X	X	X	X	X
Idaho	X				
Illinois	X	X	X	X	X
Indiana	X	X	X	X	X
Iowa	X	X	X	X	X
Kansas	X	X	X	X	X
Kentucky	X	X	X	X	X
Louisiana	X	X	X	X	X
Maine	X	X	X	X	X
Maryland	X	X	X	X	X
Massachusetts	X	X	X	X	X
Michigan	X				
Minnesota	X	X		X	X
Mississippi	X				
Missouri	X	X	X	X	X
Montana	X				
Nebraska	X	X	X	X	X

	Self-Reporting of Medical Conditions	MAB			
	Required?	in effect?	advise on medical policy	advise on individual cases	part of appeals process
Nevada	X				
New Hampshire		X	X	X	X
New Jersey	X	X	X	X	X
New Mexico	X	X	X	X	X
New York	X	X	X		X
North Carolina	X	X		X	X
North Dakota	X	X	X	X	X
Ohio	X				
Oklahoma	X	X	X		X
Oregon	X				
Pennsylvania		X	X	X	X
Rhode Island	X	X	X	X	X
South Carolina	X	X	X	X	X
South Dakota	X				
Tennessee	X	X	X	X	X
Texas	X	X	X	X	X
Utah	X	X	X	X	X
Vermont	X				
Virginia	X	X	X	X	X
Washington	X				
West Virginia	X	X	X	X	X
Wisconsin	X	X	X	X	X
Wyoming	X				

+ Information on self-reporting of medical conditions from Lococo, Stutts, Sifrit & Staplin (2017).
Information on MABs from AAA Foundation for Traffic Safety Driver Licensing Policies and Practices Database (last updated April 2019; see AAAFTS (2019). (http://lpp.seniordrivers.org/).

Appendix D: Interview Guide for Licensing Policy Stakeholder Interviews

[MASTER COPY]

Introduction

Good morning/afternoon. I'm [NAME OF INTERVIEWER] from the University of Michigan Transportation Research Institute and I'm here with my colleagues [NAMES OF PEOPLE SITTING IN ON INTERVIEW]. As [NAME OF PERSON WHO SET UP INTERVIEW] mentioned when he/she talked with you to set up this call, we are conducting a study funded by the AAA Foundation for Traffic Safety intended to identify effective policies and practices in driver licensing of older and medically at-risk drivers, and offer practical guidance to driver licensing officials and policymakers in the form of practice-ready recommendations. We are interested in talking with representatives of driver licensing and other appropriate agencies to learn more about current practices, successes, challenges, and needs with regard to older drivers. We appreciate your taking the time to talk with us.

As [NAME OF PERSON WHO SET UP INTERVIEW] discussed with you, we would like to audio record our conversation today with you, in case there is anything we need to clarify later on when we review our notes. Do we have your permission to do that?

Any information you share with us will remain confidential. You will not be identified in any reports resulting from this study and your comments will be presented only as part of a more general summary of our discussions across multiple organizations and jurisdictions. However, in some cases where a policy is unique to a single state or small set of states, it may be possible to attribute comments to a particular state. If you are concerned about this, you may choose to skip any of the discussion or question topics. Our first few questions are just to get some background.

1. How long have you been with [NAME OF ORGANIZATION]?

2. Could you briefly describe your role in the organization with regard to licensing policy and practice for older drivers?

3. We'd like to start with some questions about polices related to license renewal. Based on our review of available publications and websites and internal information, our understanding is that your jurisdiction:

[READ ONLY THOSE POLICIES THAT HAVE BEEN CHECKED FOR THIS PARTICULAR STATE]

- In-person renewal beginning at age [SPECIFIC AGE TO BE FILLED IN FOR EACH STATE] and required every [NUMBER OF YEARS TO BE FILLED IN FOR EACH STATE]
- No special in-person renewal requirements for older drivers
- Accelerated renewal (more frequent renewal for certain groups) beginning at age [SPECIFIC AGE TO BE FILLED IN FOR EACH STATE] and required every [NUMBER OF YEARS TO FILLED IN FOR EACH STATE]
- No special accelerated renewal requirements for older drivers
- Knowledge test at renewal
- No knowledge test at renewal
- Vision test at renewal
- No vision test at renewal
- Road test at renewal
- No road test at renewal
- Restricted/conditional licensing
    - Daylight driving only
    - Corrective lenses required
    - Bioptic lenses required
    - No freeway
    - Restricted driving area
    - Hearing aids required
    - Drive with licensed adult
    - Drive only under supervision of rehab services
    - Type of vehicle
    - Food, fruit, or candy must be within reach of driver
    - Outside mirrors required
    - Specially equipped vehicle required
    - Speed restriction

    - Only specific destinations
    - Auto-transmission only
    - Can drive with driver educator only
    - No driving in inclement weather
    - Golf cart only
    - Any other restrictions deemed necessary
- No restricted/conditional licensing

Is this information correct? [IF CORRECT, SKIP TO 4. IF NOT CORRECT, ASK 3b]

3b. What renewal policies for older drivers do you have in place?

4. Have the safety effects of these policies been measured or evaluated in your jurisdiction? [IF YES, ASK 4a. IF NO, SKIP TO 4b]

4a. [IF YES] Do you have any results or reports of those results that you can share with us?

4b. [IF NO] Do you have plans to conduct such evaluations? Why or why not? [PROBE FOR BARRIERS/OBSTACLES TO EVALUATION]

5. In general, how well do you think these policies are working from a safety standpoint? [PROBE FOR SPECIFIC POLICIES: E.G., WHICH POLICIES ARE MOST AND LEAST EFFECTIVE AND WHY?]

6. What are the biggest challenges you face in implementing these license renewal policies for older drivers? [PROBE FOR CHALLENGES ASSOCIATED WITH SPECIFIC POLICIES]

7. What, if anything, has helped you to overcome these challenges?

8. What changes in terms of license renewal would you like to see in your jurisdiction to improve the safety and mobility of older drivers?

The next few questions are about physician reporting of at-risk drivers and other referrals, as well as your medical review/assessment process for these drivers.

9. Based on our review of available publications and websites and internal information, our understanding is that your jurisdiction:

[READ ONLY THOSE POLICIES THAT HAVE BEEN CHECKED FOR THIS PARTICULAR STATE]

- Mandatory physician reporting
- No mandatory physician reporting

- Immunity/confidentiality for physicians
- No immunity/confidentiality for physicians

- Immunity/confidentiality for others (e.g., law enforcement, family/friends)
- No immunity/confidentiality for others

- Observation/screening of customer functioning by licensing counter staff
- No observation/screening of customer functioning by licensing counter staff

- Review of driver crash/violation records
- No review of driver crash/violation records

Is this information correct? [IF CORRECT, ASK 9a. IF NOT CORRECT, SKIP TO 9b]

9a. Could you talk more about the following? [ONLY ASK FOR CLARIFICATION FOR POLICIES THAT ARE IN PLACE IN JURISDICTION]

i. The general conditions under which physicians must report

ii. Which groups have protection (immunity/confidentiality) [RECORD SEPARATELY]

iii. The general process/training for licensing counter staff observation/screening

iv. The general process for review of driver crash/violation records

9b. What reporting/referring policies for older drivers do you have in place?

10. Do you have a medical advisory board (MAB) in place? [IF YES, ASK 10a. IF NO, SKIP TO 11.]

10a. Could you talk more about the makeup, requirements, and responsibilities for your MAB?

11. How do physician assessment, on-road testing, and medical reports fit into your medical review/assessment process?

12. Have the safety effects of your reporting/referral process and/or medical review process been measured or evaluated in your jurisdiction? [IF YES, ASK 12a. IF NO, SKIP TO 12b]

12a. [IF YES] Do you have any results or reports of those results that you can share with us?

12b. [IF NO] Do you have plans to conduct such evaluations? Why or why not? [PROBE FOR BARRIERS/OBSTACLES TO EVALUATION]

13. In general, how effective do you consider your reporting/referral policies and your medical review process to be in terms of the safety of older drivers? That is, how have these policies affected the crashes of older drivers in your jurisdiction? [PROBE FOR SPECIFIC POLICIES: E.G., WHICH POLICIES ARE MOST AND LEAST EFFECTIVE AND WHY?]

14. Are you able to reach any conclusions about the effects of your reporting/referring policies and medical review process on the mobility (apart from safety) of older drivers? That is, are you able to separate out those drivers who were obviously unfit and had their license taken away from those drivers who voluntarily decided not to complete the review or stopped driving on their own?

15. What are the biggest challenges you face in implementing these reporting/referring policies and medical review process for older drivers? [PROBE FOR CHALLENGES ASSOCIATED WITH SPECIFIC POLICIES]

16. What, if anything, has helped you to overcome these challenges?

17. What changes in terms of reporting/referring and medical review would you like to see in your jurisdiction to improve the safety and mobility of older drivers?

18. Thinking collectively about your entire program or package of licensing policies for older drivers, how well do you think it works to promote safety and mobility?

19. How does it compare to other states?

20. Are there any other thoughts you'd like to share on these issues we've been talking about?

THANK YOU FOR TAKING THE TIME TO TALK WITH US.

Appendix E: Models

California In-Person Renewal Law Analysis

Police-reported Crashes

Propensity Score Model

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-10.480	0.683	-15.35	<0.0001	***
Sex—Male	-0.309	0.126	-2.44	0.0145	*
DBQ—Errors	-0.723	0.226	-3.20	0.0014	**
DBQ—Lapses	0.384	0.169	2.27	0.0234	*
DBQ—Violations	1.169	0.193	6.05	<0.0001	***
Prop. Trips at Night	1.407	1.108	1.27	0.2042	
Prop. Trips Highway	14.209	0.739	19.24	<0.0001	***
Prop. Trips <15 mi	4.599	0.683	6.73	<0.0001	***
Turns/mile	2.337	0.215	10.86	<0.0001	***

Rate Model

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-3.060	0.228	-13.42	<0.0001	***
Age 73+	0.152	0.354	0.43	0.6680	
California	-0.600	0.402	-1.50	0.1350	
California*Age 73+	0.739	0.546	1.35	0.1760	
Dispersion Param.	3.481				

Self-reported Crashes

Propensity Score Model

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-9.388	0.615	-15.26	<0.0001	***
Sex—Male	-0.247	0.117	-2.11	0.0350	*
DBQ—Errors	-0.651	0.209	-3.12	0.0018	**
DBQ—Lapses	0.418	0.156	2.67	0.0075	**
DBQ—Violations	0.658	0.171	3.85	0.0001	***
Prop. Trips at Night	-1.171	1.027	-1.14	0.2542	
Prop. Trips Highway	13.665	0.666	20.52	<0.0001	***
Prop. Trips <15 mi	4.014	0.624	6.44	<0.0001	***
Turns/mile	2.279	0.198	11.54	<0.0001	***

Rate Model

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-1.901	0.136	-14.02	<0.0001	***
Age 73+	0.289	0.210	1.38	0.1690	
California	-0.239	0.215	-1.11	0.2670	
California*Age 73+	0.165	0.305	0.54	0.5880	
Dispersion Param.	3.111				

Self-reported Stops

Propensity Score Model

Same as Self-reported Crashes

Rate Model

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-2.112	0.134	-15.78	<0.0001	***
Age 73+	0.209	0.212	0.98	0.3250	
California	-0.319	0.217	-1.47	0.1420	
California*Age 73+	-0.169	0.328	-0.51	0.6070	
Dispersion Param.	2.451				

Required Vision Test Analysis

Police-reported Crashes

Propensity Score Model

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-2.447	0.411	-5.95	<0.0001	***
Sex—Male	0.117	0.096	1.23	0.2200	
DBQ—Errors	-0.500	0.175	-2.87	0.0041	**
DBQ—Lapses	-0.089	0.131	-0.68	0.4982	
DBQ—Violations	0.529	0.151	3.49	0.0005	***
Prop. Trips at Night	1.605	0.923	1.74	0.0819	.
Prop. Trips Highway	3.412	0.458	7.44	<0.0001	***
Prop. Trips <15 mi	-0.661	0.456	-1.45	0.1476	
Turns/mile	2.598	0.188	13.86	<0.0001	***

Rate Model

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-12.529	1.469	-8.53	<0.0001	***
Vision Law In Place	0.029	0.309	0.09	0.9252	
Age (years)	0.005	0.022	0.21	0.8342	
Colorado	-0.440	0.255	-1.72	0.0851	.
Michigan	-0.138	0.258	-0.54	0.5928	
New York	-0.820	0.302	-2.71	0.0067	**
Dispersion Param.	2.608				

Self-reported Crashes

Propensity Score Model

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-2.274	0.379	-6.00	<0.0001	***
Sex—Male	0.128	0.088	1.46	0.1444	
DBQ—Errors	-0.483	0.160	-3.03	0.0025	**
DBQ—Lapses	0.035	0.119	0.30	0.7684	
DBQ—Violations	0.202	0.134	1.51	0.1314	
Prop. Trips at Night	-1.206	0.785	-1.54	0.1247	
Prop. Trips Highway	4.153	0.435	9.55	<0.0001	***
Prop. Trips <15 mi	-0.486	0.416	-1.17	0.2421	
Turns/mile	2.161	0.162	13.37	<0.0001	***

Rate Model

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-1.562	0.913	-1.71	0.0873	.
Vision Law In Place	0.088	0.226	0.39	0.6970	
Age (years)	-0.005	0.013	-0.34	0.7358	
Colorado	-0.129	0.158	-0.81	0.4154	
Maryland	0.085	0.202	0.42	0.6751	
Michigan	-0.419	0.221	-1.89	0.0583	.
New York	-0.536	0.228	-2.36	0.0186	*
Dispersion Param.	2.977				

Self-reported Stops

Propensity Score Model

Same as Self-reported Crashes

Rate Model

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-2.737	0.858	-3.19	0.0014	**
Vision Law in Place	0.021	0.271	0.08	0.9375	
Age (years)	0.005	0.012	0.37	0.7112	
Colorado	0.343	0.181	1.89	0.0585	.
Maryland	0.559	0.235	2.38	0.0173	*
Michigan	0.220	0.244	0.90	0.3682	
New York	0.562	0.236	2.38	0.0172	*
Dispersion Param.	2.594				

Available Licensing Restriction Analysis

Police-reported Crashes

Rate Model

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-5.154	1.426	-3.62	0.0003	***
Age	0.020	0.019	1.06	0.2900	
Sex—Male	0.146	0.158	0.92	0.3557	
RUCA—Metro non-core	-0.197	0.202	-0.98	0.3287	
RUCA—Non-metro	-0.752	0.301	-2.50	0.0125	*
DBQ—Errors	-0.398	0.292	-1.37	0.1717	
DBQ—Lapses	0.363	0.213	1.70	0.0889	.
DBQ—Violations	0.037	0.249	0.15	0.8811	
# of Restrictions	0.047	0.036	1.29	0.1974	
Dispersion Parameter	1.287				

Self-reported Crashes

Rate Model

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-2.613	0.917	-2.85	0.0044	**
Age	0.009	0.012	0.72	0.4691	
Sex—Male	-0.194	0.098	-1.99	0.0471	*
RUCA—Metro non-core	-0.781	0.165	-4.72	0.0000	***
RUCA— Non-metro	-0.792	0.191	-4.15	0.0000	***
DBQ—Errors	-0.200	0.175	-1.14	0.2545	
DBQ—Lapses	0.421	0.128	3.30	0.0010	***
DBQ—Violations	0.017	0.147	0.12	0.9069	
# of Restrictions	-0.035	0.024	-1.46	0.1441	
Dispersion Parameter	1.457				

Self-reported Stops

Rate Model

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-3.324	0.880	-3.78	0.0002	***
Age	0.008	0.012	0.70	0.4842	
Sex—Male	0.053	0.093	0.57	0.5711	
RUCA—Metro non-core	0.093	0.128	0.73	0.4648	
RUCA—Non-metro	0.219	0.157	1.39	0.1635	
DBQ—Errors	-0.246	0.169	-1.46	0.1446	
DBQ—Lapses	0.196	0.124	1.57	0.1155	
DBQ—Violations	0.463	0.135	3.44	0.0006	***
# of Restrictions	-0.012	0.021	-0.57	0.5679	
Dispersion Parameter	1.393				

Appendix F: Case Studies of Selected Programs/Partnerships

Case Study Background and Approach

Case studies were conducted for three programs focused on older adult safety and mobility: Michigan's *Safe Drivers Smart Options: Keys to Lifelong Mobility*, Florida's *Safe Mobility for Life Coalition*, and the California DMV's *Senior Driver Ombudsman Program*. These programs were selected for case study due to their success and potential replicability in other states or jurisdictions. A member of the research team contacted an appropriate representative to request a brief telephone conversation to discuss the program. A list of general questions about the program was sent to each representatives via email ahead of each conversation. Each representative contacted agreed to provide information about their program (two via phone and two providing written responses to the case study questions).

A member of the research team guided the conversation using the case study questions, and took detailed notes. Each telephone conversation lasted approximately 30 minutes. The case study questions included items about: the program's background and overview, oversight and sustainability, stakeholder involvement, and ongoing monitoring and updating. Each program representative had been with the respective program for many years, if not since inception.

Results

The following program summaries are based on the information provided by the representatives. The information is intended to be a high-level overview of each program to provide insight for other states or jurisdictions interested in implementing a similar program.

Safe Drivers Smart Options: Keys to Lifelong Mobility (MI)

Michigan's *Safe Drivers Smart Options: Keys to Lifelong Mobility* (SDSO) is an award-winning statewide strategy that began in 2016 as the result of a three-year federally funded research project led by the Michigan Department of Transportation (MDOT) and facilitated by the University of Michigan Transportation Research Institute (UMTRI). The objective of the research project was to create a sustainable statewide strategy to enhance older adults' driving safety and overall mobility. Stakeholders and advisors from public and private industries provided guidance on the strategy throughout the project. They represented the Michigan Department of State (MDOS), MDOT, Michigan Department of Health and Human Services, Office of Services to the Aging, Michigan State Police, Office of Highway Safety Planning, Federal Highway Administration, local law enforcement agencies, the insurance industry, medical care community, Area Agencies on Aging, and senior advocacy groups (e.g. AARP), among others. At the conclusion of the research project, UMTRI provided recommendations that informed SDSO's current goals of assisting older adults in continuing to drive safely, helping older adults that need or want to transition from driving to non-driving, and supporting community mobility options for those who cannot or choose not to drive. SDSO's website (www.Michigan.gov/agingdriver) provides information and resources for older adults and their families and caregivers, as well as the professionals that work with them, to achieve those goals through education, direct intervention, and collaboration.

After the research project concluded in 2016, MDOS met with the strategy's stakeholders to develop a management structure to support and promote SDSO. Under the current structure, a roundtable meeting is held at least annually to discuss further collaborative endeavors and the resources needed to achieve and promote the strategy's goals. An Operating Committee of member organizations meets at least quarterly to discuss SDSO's objectives and help with the development of further research and strategy materials. A group within the Traffic Safety Section of MDOS provides administrative support for the strategy. There is also a communication and a healthcare subcommittee of members from state agencies and other stakeholders. Representatives from organizations related to older adult mobility, transportation, traffic safety, and other related fields can choose to participate in the strategy. As of July 2020, there are representatives from academia, law enforcement, healthcare, state government, aging and social services, insurance, traffic safety, transportation, and public health. These representatives work to promote the strategy, update the resources, and provide guidance on the Action Plan, developed to achieve the strategy's goals. The Plan is updated yearly and progress is documented by all involved in SDSO.

Safe Mobility for Life Coalition (FL)

In 2004, the Florida Department of Transportation (FDOT) State Traffic Engineering and Operations Office started the Safe Mobility for Life Program, under the guidance of the State Traffic Operations Engineer, to address the mobility needs of a rapidly growing older adult population beyond roadway improvements. In 2009, FDOT partnered with the Pepper Institute on Aging and Public Policy at Florida State University (Pepper Institute) to form the *Safe Mobility for Life Coalition*. The Coalition's goal is to reduce traffic crashes, serious injuries, and fatalities and to keep older adults connected to their community. This goal is achieved by a strategic and collaborative plan with six focus areas: program management, data, and evaluation; outreach and advocacy; licensing and enforcement; prevention and assessment; aging in place; and transitioning from driving.

The Coalition is overseen by a program manager at the FDOT State Traffic Engineering and Operations Office, alongside the Pepper Institute. The Pepper Institute houses the Coalition's resource center (including a CarFit course) and staff there coordinates the Coalition's meetings, travel, and exhibits. Each of the six focus areas has its own team leader. In recent years, the Coalition has also sought and received consultant support. FDOT provides the funding for the Coalition's program management and consultant support. A 402 Safety Grant with the Pepper Institute supports the Coalition's meetings, travel, exhibits, personnel, resource center, and print/display materials.

Twenty-nine organizations with an interest in older adult safety and mobility are represented in the Coalition (one member from each group) including those involved in: transportation, law enforcement, healthcare, and senior centers, among others. The program's manager invites members to the Coalition to help the team reach objectives. The group meets twice a year, once on data and again on outreach. Those invited to the Coalition are sent the member handbook and program fact sheet. The program's manager and team leaders work together to monitor data relevant to the Coalition's goals (traffic crashes, serious injuries, and fatalities), and its outreach (such as metrics/impressions; outreach campaigns; material distribution; number of stakeholders; social media campaigns; surveys following workshops, healthcare and needs assessments; and material

distribution). The strategic plan's tasks are monitored for completion. The Coalition adapts the program based on input from its stakeholders.

When asked what advice she would give to others interested in starting a similar program, the representative responded that others should "think about your own state" and stressed the importance of a having a strategic and collaborative plan that does not attempt to control policy, along with a strong team with a solid communication plan. The representative provided several other suggestions. First, support from stakeholders is necessary, including those representing licensing offices, law enforcement, community members, AARP (mentioned as having a strong volunteer network), AAA, senior centers, healthcare, elder affairs, state agencies, and family/caregivers. Second, a team with outreach and marketing skills helps in spreading the Coalition's message, and cost-effective outreach can be done through avenues such as radio spots and videos. Third, researchers are a key component to the success of the program, as they have the skills, for example, to lead focus groups in the community. Finally, the representative stressed the importance of the partnership with the Pepper Institute as a contributing factor to the success of the Coalition.

Senior Driver Ombudsman Program (CA)

The California DMV's *Senior Driver Ombudsman Program* started in 2005 as the result of numerous requests from senior advocacy groups. Originally started and run by the California DMV's Assistant Division Chief, and subsequently well received as a "one-man show," the program was expanded to address the needs of the community. The program's mission is to help older adults drive for as long as they can safely do so, and to ensure that older drivers understand the licensing process and their rights within that process. Ombudsmen address questions and concerns from older drivers, provide education and training resources to older adults and their families, and provide a "safety net" for older drivers to ensure they are treated fairly by the DMV. The ombudsmen are very involved in outreach in the community (e.g. at senior organizations) to explain the DMV's process to and address traffic safety concerns. Information and resources, such as the "Senior Guide for Safe Driving", are located at https://www.dmv.ca.gov/portal/driver-education-and-safety/educational-materials/fast-facts/helping-drivers-maintain-their-driving-independence-ffdl-41/.

The ombudsmen's official titles already existed within the California DMV. DMV employees applied for the ombudsmen positions as they had the necessary experience to carry out the program's mission. There are five ombudsmen including a manager, although two positions are vacant at the time of this writing. The original ombudsman managed the program until two years ago and the current manager has been with the program for the last few months. The program also includes regional administration and a driver safety chief. Each ombudsman is self-sufficient and creates his/her own schedule, addressing needs in his/her assigned area as necessary, and produces weekly reports on calls and outreach (currently limited and virtual due to COVID-19). The ombudsmen provide input on the California Highway Patrol's strategic highway safety program, are CarFit-trained technicians, inform older drivers of the AARP curriculum and its benefits, and collaborate with local police departments.

The representative's advice for those interested in starting a similar program was to bring a team together to "do the legwork." More specifically, it was suggested that they develop program goals, raise awareness of the program in the community, starting with senior centers, and collaborate with AARP, AAA, law enforcement, and other organizations to identify the needs and preferences of their older adult population to ensure that their program is responsive to them.