CONCLUSION

People are living longer and many older adults are licensed drivers now more than ever before. Based on these trends, a surge in the number of licensed older drivers over the next 10 years can be expected. These changes may also include a significant rise in the number of collisions, injuries, and fatalities among older drivers unless action is taken now to weed out at-risk drivers. As our population significantly increases over the next 50 years, the demand for more effective driver's license screening tools intensifies. These issues need to be addressed in each state and country now as the older driver population grows and necessitates adequate accommodations to improve safe driving. The new systems and procedures ESRA now presents may also reduce the incidence of fraudulent schemes and issuances of driver's licenses, commercial driver's licenses, and hazardous materials transportation licenses.

The core of the problem of adequately identifying visually impaired drivers not only relates to the vision testing methods, but also to the fundamental definition of vision loss, which, according to the International Council of Ophthalmology (2002), is based on visual acuity.

Quantification of visual standards that account for other ocular features, in addition to visual acuity, are direly needed to improve safety and vision, both on and off the roads. Snellen acuity measurements, the most widespread within the United States and in other countries, account for less than 0.1 percent of the visual field (Fink and Sadun, 2004). The visual standards for operating motor vehicles in the United States largely stem from 1925 (Black et. al, 1937). Increases in the number of U.S. roads, improvements in road and motor vehicle designs, and dramatic shifts in population changes are apparent from 1925. However, according to Arizona Administrative Code, Title 17, section R17-4-503, 2002, Vision standards, visual screening equipment or the Snellen Chart is used at the ADOT Motor Vehicle Division for testing purposes. New visual standards that incorporate the current visual acuity measures, will facilitate the process and procedure of comprehensively identifying all transportation licensees through application of the ESRA DVAT™.

For the sake of driver safety, an increasing number of states modify driver's license policy, renewal procedures, and vision testing frequencies. Florida, most recently, follows a newly enacted law for all drivers age 80 years and older to either complete an on-site vision screening test at a local driver's license bureau or obtain certified vision testing results from a physician. A similar law follows enactment in Virginia. In Oregon, vision screening is tested on-site for every licensed driver age 50 years and older at the time of license renewal every eight years. While these on-site driver's license bureau examinations may, in the short term, allow for limited identification of drivers with visual impairments, they completely fail, in the long term, to improve the actual vision testing process and screen the most at-risk drivers. The methodology remains unchanged so a placebo effect is effectively created. However, the State of Arizona is the first to commission such a unique study and to allow ESRA to present its designs of a new fully automated system (ESRA DAT™) for driver's licensees and applicants.

This includes a new vision testing system, the ESRA DVAT™. In the event our recommendations are accepted, our ESRA DVAT™, a comprehensive and automated vision testing system (Figure 7) will be the first of its kind in a driver's license bureau in Arizona and, possibly, the world, to implement the most sophisticated technology available to screen drivers for vision condition, function, and disease. The ESRA DAT™, including the ESRA DVAT™, may also benefit other transportation agencies, including but not limited to licensees within aviation, rail, and maritime areas.

Despite abundant research in other areas, little is known about the relationships between driver's license visual testing methods and collision risks. The current testing methods appear to be inadequate. No empirical evidence is available to support the effectiveness of these products. A lack of automation and comprehensive screening measures may account for this dearth of data. Nevertheless, it is likely that little or no relationship has been established between visual acuity and collision risk. We, therefore, support the Florida At-Risk Driver Council's (2004) recommendation, "Like visual acuity, other vision deficits must be managed more frequently and corrected whenever possible to provide a safer driving environment." Hence it is equally important for us to demonstrate the safe and effective use of the products we identify in whole and/ or in part of the ESRA DVAT System ™ and ESRA DAT™ System. Networking capabilities are essential for expansion and integration of other features, such as cognition, driving skills, and written tests, among other elements, associated with transportation licensing procedures. Bilingual testing features, particularly in the United States, are also crucial for licensees whose primary language may not be English. Driving simulators, such as the STISIM models, that have been successfully tested and peer-reviewed, over long periods of time, through published studies, especially on both novice and older drivers, are particularly useful because of the needs of older drivers that not all driving simulators address.

While our objective is to identify the best product available to incorporate for an implementation phase and a pilot study for Arizona driver's license vision testing, clearly, there exists no all-in-one product, a panacea, that provides a wide range of automated tests to assess visual factors, diseases, and conditions that can impact driving performance. Nevertheless, it is necessary to design a system of products that merit implementation, review, and research in the Arizona Motor Vehicle Division in order to screen all drivers, and, in particular, older and at-risk drivers. The implementation phase, to follow, allows for immediate application of products that are independently tested and published and widely distributed. The B1Max™, for example, is now available for deployment after widespread distribution through the AAA Roadwise Review™ and demonstrated procedural reliability by its use as part of the DHI, the DRIVINGHEALTH® INVENTORY. The DHI is a tool used for driver evaluations by the Medical Advisory Board of the Maryland Motor Vehicle Administration. Additionally, the pilot study, to follow, serves to determine the effectiveness of use of the other components of the system we herein developed.

Future RAIR studies may include other variables, such as gender or race of drivers, pavement conditions, etc., in the analyses. These studies are needed in order to further

identify and assess the visual abilities of various drivers and, for example, the effectiveness of certain pavement and road designs. Outreach programs may be needed.

Interestingly, the ESRA Vision Assessment Procedure for Transportation™ (ESRA VAPT™) complements the vision testing component of the NHTSA "Model Driver Screening and Evaluation Program"(Staplin *et al*., 2003a) for a fitness to drive determination. For example, the vision testing component of the NHTSA Model measures near and far acuity, contrast sensitivity, and visual field loss testing. The ESRA Dynamic Vision Assessment for Transportation™ (ESRA DVAT™) (Figure 7), as envisaged, provides a fully automated, comprehensive, and cost-effective approach through the testing of vision function, vision condition, and vision status. It expands and improves existing technology. The vision function element of the ESRA system includes high- and low-contrast visual acuity screening measures. The vision condition element covers the visual field and, more specifically, the detecting of eye diseases and injuries that may adversely impact driving abilities. The vision status element screens at-risk drivers and drivers age 50 years and older for dementia and other conditions that are associated with visual difficulties yet cannot be detected through contemporary vision testing techniques. It includes a driving simulator with ambient light and weather conditions.

Therefore, ADOT may provide a model for license testing improvements for all other states, countries, and agencies to follow if the ESRA Vision Assessment Procedure for Transportation™ (ESRA VAPT™) (Figure 6), the ESRA Dynamic Vision Assessment for Transportation™ (ESRA DVAT™) (Figure 7), and the ESRA Dynamic Assessment for Transportation ™ (ESRA DAT™) (Figure 8) are implemented as a pilot test and, ultimately, a statewide system.