U.S. Department
of Transportation
National Highway
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DOT HS 809 582 May 2003

Model Driver Screening and Evaluation Program

Final Technical Report

Volume I: Project Summary and Model Program Recommendations

This document is available to the public from the National Technical Information Service, Springfield, Virginia 22161

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 809 582		

4. Title and Subtitle	5. Report Date / 6. Performing Organization Code
MODEL DRIVER SCREENING AND EVALUATION PROGRAM FINAL TECHNICAL REPORT VOLUME 1: PROJECT SUMMARY AND MODEL PROGRAM RECOMMENDATIONS	5. Report Date: May 2003 6. Performing Organization Code: 1478
7. Author(s)*	**8. Performing Organization Report No.**
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9. Performing Organization Name and Address	**10. Work Unit No. (TRAIS)**
The Scientex Corporation 4817 B Eisenhower Avenue Alexandria, VA 22304 *TransAnalytics, LLC* 1722 Sumneytown Pike Box 328 Kulpsville, PA 19443	11. Contract or Grant No. DTNH22-96-C-05140
12. Sponsoring Agency Name and Address	**13. Type of Report and Period Covered**
Office of Research and Traffic Records National Highway Traffic Safety Administration 400 Seventh Street, S.W., Room 6240 Washington, DC 20590	Final Technical Report Oct. 1996 – Mar. 2003 14. Sponsoring Agency Code

15. Supplementary Notes
COTR: Ms. Esther Wagner, NTS-30 and Dr. John Eberhard, NTS-31

16. Abstract

This research project studied the feasibility as well as the scientific validity and utility of performing functional capacity screening with older drivers. A Model Program was described encompassing procedures to detect functionally impaired drivers who pose an elevated risk to themselves and others; to support remediation of functional limitations if possible; to provide mobility counseling to inform and connect individuals with local alternative transportation options; and to educate the public and professionals about the link between functional decline and driving safety—all within a larger context of helping to preserve and extend the mobility of older persons. Early in this project, a questionnaire was developed and distributed to Driver License Administrators in the U.S. and Canada to broadly determine cost and time parameters, while identifying legal, ethical, or policy implications that could influence implementation of Model Program activities. Subsequently, a battery of functional tests was developed and pilot tested in Motor Vehicle Administration sites, and in the community. A database of scores on functional ability measures, driving habits information, and crash and violation history was created for over 2,500 drivers in three samples drawn from license renewal, medical referral, and residential community populations. Cost estimates for functional capacity screening and related Model Program activities were developed for research and production settings. A 477-page *Safe Mobility for Older People Notebook* (DOT HS 808 853) was developed to support program initiatives promoting the safe mobility of older persons across all States and Provinces, including an *Annotated Research Compendium of Driver Assessment Techniques for Age-Related Functional Impairments.* A set of guidelines for motor vehicle administrators was also produced to update the 1992 publication by NHTSA and AAMVA of the same title.

17. Key Words	18. Distribution Statement
Driver, Safety, Mobility, Age, Functional Impairment, Functional Testing, Road Test, Licensing, Screening, Vision, Attention, Perception, Physical Ability, Dementia, Epidemiology, Remediation, Education, Training, Counseling, Alternative Transportation, Mobility Options	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	48	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: Volumes greater than 1000 l shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

ACKNOWLEDGEMENTS

The authors are indebted to Dr. John Eberhard and Ms. Esther Wagner of NHTSA, who together provided the impetus to launch this project and the perseverance to complete it. Their vision and guidance are reflected in each of the products of this research.

Equally critical to bringing the concept of a Model Driver Screening and Evaluation Program to life are all those who supported and collaborated in this effort as members of the Maryland Research Consortium. Thanks go first to Dr. Robert Raleigh, Chief of the Maryland Medical Advisory Board and Consortium director, who has advanced the proposition of "safe mobility for life" immeasurably through his singular dedication and inspiration over the course of this project—and beyond. For her enduring support of Dr. Raleigh and public commitment to the goals of this project, we are also most grateful to Ms. Anne S. Ferro, Administrator of the Maryland MVA.

Next, the day-to-day activities of the Maryland Pilot Study could not have proceeded without support from and coordination by the staff of the Maryland MVA's Office of Driver Safety Research, in particular Mr. Jack Joyce, Senior Research Associate, and Ms. Jane Valencia, Research Associate. Essential technical support for the Maryland Pilot Study also was provided by Mr. Gary Golembiewski , a former colleague; and by Dr. Karlene Ball of the University of Alabama at Birmingham and Dr. Dan Roenker of Western Kentucky University. Key equipment resources used in the Pilot Study were made available through a National Institutes of Health/National Institute on Aging Grant held by Dr. Ball.

A number of Consortium members in the social service and health care arenas made notable contributions to the planning and performance of the Pilot Study. These include Ms. Phyllis Madachy, Administrator for the Howard County, Maryland, Office on Aging, and her associates Ms. Trisha Olsen, Ms. Kenda Sovero, Ms. Barbara Miller, and Mr. Hugh Forton. Occupational Therapists who were key to the success of this project included Ms. Kim Harwood-White, Dr. Anne Long Morris, Ms. Carolyn Isackson, Ms. Janie B. Scott, and Ms. Betty Cox.

Finally, we are thankful for the efforts of the MVA personnel who collected screening data with license renewal drivers in the Glen Burnie, Bel Air, and Annapolis field offices and with residents of Leisure World in Montgomery County, Maryland: Mary Fauver, Tina Ferm, Melissa Johnson, Chuck Nellis, Theresa Rogers, Josie Simmons, Susan Simmerer, Judie Willie, Mary Gray, and Nancy West. In addition, thanks are given to the Driver License Examiners and their managers in the 11 MVA field offices where medically-referred drivers were screened in the Pilot Study. These included Ms. Pamela Minton and Mr. Ronald White (Bel Air Branch office under management of Ms. Linda Colden); Mr. Robert Foote and Mr. Jim Hudson (Cumberland Branch Office, under management of Ms. Lenna Morgan); Ms. Michelle Walls and Mr. Ronald Stafford (Easton Branch Office, under management of Mr. Don Howeth); Mr. Walter Campbell, Ms. Mildred Davenport, and Ms. Mary Joe Lofland (Elkton Branch Office, under management of Ms. Patricia McQuaide); Ms. JoAnn Fleishell, Ms. Sharon Watts, and Mr. Lewis Waugh (Frederick Branch Office, under management of Ms. Betty Thompson); Mr. Paul Duvall, Ms. Liliana Reyes, and Ms. Barbara Walker (Gaithersburg Branch Office, under management of Ms. Natalie Liewllyn); Mr. Al Wolfe and Ms. Cheryl Totten (Glen Burnie Office, under management of Ms. Donna Meadows); Lt. Terry Acre, Mr. Jerry Allen, and Mr. Steve Moyer (Hagerstown Branch Office, under management of Ms. Rebecca Snyder); Ms. Barbara Bates and Mr. Ed Novak (Largo Branch office, under management of Ms. Nancy Elkins); Ms. Robin Russell and Ms. Remonia Finney (Salisbury Branch Office, under management of Ms. Debbie Taylor); and Sgt. Lorraine Dawson, Ms. Ann Marie Haley, Cpl. Thomas Way, and Lt. Beth Wilkerson (Waldorf Branch Office, under management of Ms. Sharon Semler).

MODEL DRIVER SCREENING AND EVALUATION PROGRAM FINAL TECHNICAL REPORT - VOLUME 1: PROJECT SUMMARY AND MODEL PROGRAM RECOMMENDATIONS

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CHAPTER 1: EXECUTIVE SUMMARY

The National Highway Traffic Safety Administration (NHTSA) research project, "Model Driver Screening and Evaluation Program," was initiated in 1996, with its ultimate objective to update the guidelines published in association with the American Association for Motor Vehicle Administrators (AAMVA) for screening and evaluating medical fitness to drive. This research was undertaken as a proactive response to the unprecedented number and proportion of older persons who will make up the driving population of the early 21st century, and the mounting evidence that age-related declines in the functional abilities needed to safely operate a motor vehicle, under everyday traffic conditions, result in significantly greater odds of causing a crash. The consequent increases in injuries and fatalities that will be experienced by our nation's seniors (and by others who share the highways with them) are expected to define a major public health concern, demanding innovative policies and practices to reduce the incidence of "driving while *functionally* impaired" while extending the benefits of safe mobility to our oldest citizens.

Early project activities were directed to identifying: (1) functional limitations resulting from normal aging, and from diseases and pathologies that are more prevalent with advancing age, that impair safe driving; and (2) currently-available test procedures that offer the highest validity to detect functional loss and that can be feasibly administered by licensing agencies. These goals were met in part through a comprehensive review and synthesis of technical information that culminated in the *Annotated Research Compendium of Age-Related Functional Impairments and Driving Safety* and the *Safe Mobility for Older People Notebook*. These research products may be accessed online at www.nhtsa.dot.gov/people/injury/olddrive/safe/.

Additional guidance in meeting the initial project goals was received from a Delphi panel of experts in relevant fields of medicine and driving rehabilitation. The list of specific sensory (visual) functions, attentional-perceptual processes, and medical factors (including dementia) that are most critical to safe driving was narrowed through the panel's input, then was sorted to reveal the most significant gaps in the existing state-of-the-knowledge. These gaps defined priorities for the pilot tests planned later in the project, in terms of domains of functional ability, and suggested specific measurement procedures that could be applied within those domains.

Next, a clear understanding of the possible barriers to implementing a driver screening and evaluation program—especially as seen from the perspective of State and Provincial Driver License Administrators—was needed, to preclude a set of research findings with scientific merit but no practical value to those who would ultimately be charged with carrying out a majority of Model Program recommendations. With the support of AAMVA, a survey was distributed and responses received from 58 of the 62 licensing jurisdictions in North America that identified the legal, policy and cost implications of screening as contemplated under the Model Program

With the information gained thus far, the design for the Maryland Pilot Older Driver Study proceeded. This effort, accounting for by far the largest expenditure of project resources, was a collaboration between the NHTSA research team, the Maryland Motor Vehicle Administration (MVA) and its Medical Advisory Board (MAB), and a group of additional partners from Government, universities, non-profit organizations, and the private sector collectively identified as the Maryland Research Consortium (MRC). With guidance from the MRC, the MAB implemented a battery of functional screening measures in MVA field offices and in community settings, using specially-trained agency staff to administer and score the test procedures and obtain driving habits information from the study samples for later analysis by the research team. Functional screening data were collected and analyzed for three distinct samples of drivers age 55 and older—a population-based sample of 1,876 drivers, who visited field offices for license renewal or other transactions; 366 drivers referred by various sources to the MVA for medical evaluation because of suspected driving impairments; and 266 drivers in a suburban, residential community for seniors who used the services of a mobile MVA office that made periodic visits to their facility.

Analyses of Pilot Study data focused on the relationships between the measures of functional ability in the screening battery and a range of traffic safety outcome measures. The safety outcomes were three categories of crashes (all crashes, at-fault plus unknown-fault crashes, and at-fault crashes only) plus three categories of moving violations (all moving violations, all moving violations except speeding, and all moving violations except speeding and occupant restraint violations). Outcomes measures were tabulated from Maryland State Highway Administration (SHA) databases for each study participant, keyed to individuals' dates of testing. All events in a period of time bracketing the functional screening date for a driver by one year prior, and (on average) two years after the test date, were eligible for analysis. Odds ratios (OR) were calculated for each screening measure investigated in the Pilot Study; by expressing the odds of experiencing a crash or moving violation if a driver fails a given test versus the odds if he or she passes the test, this analysis technique can provide an index of the predictive value of measuring changes in a driver's functional status.

The Pilot Study results provided strong evidence that functional capacity screening, conducted quickly and efficiently in office settings, can yield scientifically valid predictions about the risk of driving impairment. Four domains of perceptual-cognitive ability were highlighted*: 1) directed visual search, 2) information processing speed for divided attention tasks, 3) the ability to visualize missing information in an image,* and *4) working memory*. Two physical functions also emerged as measurement priorities*: 1) lower limb strength*, and *2) head/neck mobility (rotation)*. It may be noted that visual abilities, which are already assessed as part of the licensing process, were not addressed in the Pilot Study data collection activities. Cost analyses, based on MAB experience, support cost-per-driver-screened projections of $5 or less.

At a finer level, the Maryland Pilot Study confirmed that certain, specific procedures have utility for performing functional screening and, in some cases, identified candidate cutpoints for pass-fail determinations using those procedures. Model Program recommendations from this research remain focused on the domains of functional ability that should be targeted by screening activities, however. In the anticipation that future work will contribute data verifying the obtained predictor-criterion relationships, and the promise of new and more cost-effective testing methods—included automated testing—than were available at the initiation of the Pilot Study, interested parties are encouraged to contact a NHTSA program officer in this area for guidance about the most current options for implementing functional capacity screening.

In a broader sense, this research reinforces the notion that functional screening to assure the "driving health" of older persons is rightfully viewed in the context of injury prevention. As such, its potential benefits to individuals and to society are profound, *if* integrated with education and counseling to improve awareness about the risks associated with functional loss, referrals for remediation of functional loss whenever possible, and connection to alternative transportation resources to preserve—instead of penalizing—the independent mobility of affected drivers.

CHAPTER 2: INTRODUCTION AND BACKGROUND

The preferred personal mobility solution for aging Americans remains the private automobile by a wide and growing margin, as public transit and private transportation services are either unavailable, unaffordable, or unacceptable for reasons of convenience, accessibility, or (perceived lack of) security.[1] More than 70 percent of persons age 75+, the fastest growing segment of our population, live in suburbs and small towns that have been designed to accommodate automobile use. Housing areas are typically not close to shops and services, so walking is not often a sufficient mobility solution. In this context, recent projections indicate not only that older persons will dramatically increase in numbers in the U.S., but also that more older people—females as well as males—will retain their licenses and will drive more miles than today' seniors (cf. U.S.DOT, 1997).

What has stimulated this research project is the fact that as we age, albeit in our own unique fashion, we are all at increasingly greater risk of experiencing deficits in the various functional capabilities needed to drive safely. These include the visual abilities needed to detect hazards, while effectively directing attention to critical driving tasks in the face of mounting distractions. Also essential are the perceptual skills needed to accurately judge gaps in traffic, and the cognitive functions necessary to make rapid and appropriate maneuver decisions. Not least are one's physical abilities, including the head and neck flexibility to scan for safety threats before turning, backing, changing lanes, or merging, as well as the arm and leg strength and stamina needed for effective control of the vehicle under normal and emergency response conditions. For virtually everyone in our modern society, to safely operate a motor vehicle demands a higher level of functional ability and functional integration than any other activity of daily living.

Whether a functional deficit results from normal aging, or from diabetes or dementia or any of a number of other diseases that become more prevalent as we grow older, there is reason for serious concern that the result will be driving impairment leading to increased crash risk. Department of Motor Vehicle studies have found that unrestricted drivers with certain medical conditions have significantly higher crash and conviction rates than control groups without impairments (Diller, Cook, Leonard, Reading, Dean, and Vernon, 1999). Given current practices and demographic trends, analysts project a sharp increase in both the number and proportion of traffic fatalities related to the frailties of aging over the first quarter of the 21st century—even to an extent that exceeds alcohol-related fatalities (Burkhardt et al., 1988).

Therefore, as background for this research, it may be asserted that driving while impaired due to functional loss deserves the same recognition as a public health concern, as other types of impaired driving. With the development of recommendations for a Model Driver Screening and Evaluation Program, the National Highway Traffic Safety Administration has set the stage for an injury prevention effort that could have profound and lasting consequences. As its primary focus, the Model Program is designed *to keep people driving safely longer, while protecting the public through the identification of functionally impaired drivers*. Additional, complementary recommendations designed to help meet seniors' needs to remain independently mobile if they cannot or choose not to continue driving also have emerged as a Model Program priority.

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[1]Baltimore Region Elderly Activity Patterns and Travel Characteristics Study, 1999.

An early and consistent emphasis throughout this project was the need for *improved detection of deficits in the functional abilities most important for safe driving*. Detection—especially early detection—of functional loss resulting in driving impairments is at least as important to the health and well-being of the older individual who wishes to keep driving, as it is to an agency seeking to fulfill its public safety mandate.

On a population basis, steady declines in visual acuity and contrast sensitivity, in attentional and perceptual processes, in memory and cognition, and in physical strength, flexibility, and range of motion can be very reliably associated with advancing age. But because there are vast individual differences in how people age, chronological age alone is a poor indicator of functional status. While practical considerations may rule out screening at younger ages where deficits are extremely rare, the Model Program assumes a need for direct measurement of key functional abilities, without regard to age *per* se.

Given this premise, the feasibility of functional capacity screening becomes paramount. Who will perform screening procedures, in which settings, and at what cost? Should drivers be screened regardless of prior history or precipitating conditions, or only if there is evidence of a problem based on crashes or a credible referral for medical review?

Contacts between licensing agencies and older drivers in North America come about principally through the renewal process. The population that would be affected by a broad requirement for screening as a condition of license renewal would vary from one jurisdiction to another, determined by the number of licensed drivers exceeding some age threshold set by the jurisdiction and by the fraction of that number eligible for re-licensure each year according to the prevailing renewal cycle. During Model Program development, this policy was acknowledged as a possibility, but was not promoted explicitly.

Barring mandatory screening, a functionally impaired driver may be detected through direct observation by licensing agency personnel assuming an in-person renewal process—which *is* promoted, strongly, within the Model Program. Such cases are typically referred for medical determination of fitness-to-drive to a Medical Advisory Board (MAB) or comparable entity within or external to the licensing authority. The MAB also receives referrals from physicians, police and the courts, family and friends, and other sources who are concerned about individuals' abilities to drive safely. Finally, depending on the jurisdiction, a driver may be required to undergo a medical review after accumulating a specified number of crashes or convictions on his/her driving record, or after self-reporting the existence of one or more medical conditions included on a checklist on the license renewal application form.

An essential point is that it is the diminished visual, perceptual-cognitive, and physical abilities themselves, not the underlying medical conditions that may have produced a functional loss, that are of principal concern in determining fitness-to-drive. This has at least two important implications for the Model Program.

First, physicians and other health care professionals who counsel their patients—and may ultimately need to refer them to a DMV—need guidance about the types of driving impairments that are associated with different medical conditions. Recent guidelines issued by the American Medical Association (AMA) Council on Ethical and Judicial Affairs state that "*physicians* [*have*] *legal and ethical obligations with respect to reporting physical and mental conditions which may* *impair a patient's ability to drive"* (AMA, 1999). The CODES analyses undertaken in different states in collaboration with NHTSA (cf. Diller et al., 1999) have provided valuable data in this regard. Information provided in a literature synthesis performed on behalf of the Association for the Advancement of Automotive Medicine (AAAM) and NHTSA is a major contribution.[2] Together these resources have supported development by the AMA of a Guide for Physicians that includes, but is not limited to, a catalog of medical conditions that may impair driving performance.[3] In a broader sense, the success of the Model Program similarly rests upon education and outreach—to the general public as well as to health care professionals and other providers of services to seniors—to increase awareness about the relationship between functional capacity and the ability to drive safely.

Second, because of the practical considerations for conducting functional screening on a cost-effective basis, relatively quick and inexpensive procedures will be applied, having certain recognized limitations. Chief among these are levels of sensitivity and specificity that are less than ideal—screening measures are designed to detect *gross* impairments, and as such are prone to "misses" (impaired drivers who pass the screen) as well as "false alarms" (functionally intact drivers who fail the screen). Obviously, it is important to minimize each of these outcomes; but even more important is to ensure that no restrictions on driving privileges result from screening outcomes alone. Because a functional deficit may be the product of disease or pathology, the proper interpretation of a "failed" screen is that it establishes a priority for further evaluation. A more in-depth, sophisticated, diagnostic procedure may identify a medical condition, previously unknown and untreated, that is amenable to remediation. The Model Program, if implemented, is expected to extend the safe driving years for many individuals when screening initiates events leading to the remediation of functional loss.

Under the Model Program, specific procedures used to screen drivers for gross functional impairments can be expected to share a number of attributes. As already discussed, feasibility of administration is essential, especially if implemented by a licensing agency subject to tight budget controls. Of course, the functional domains targeted by driver screening activities must demonstrate scientific validity as predictors of safety outcomes—crashes, in particular, plus moving violations accepted as common precursors of crashes (e.g., failing to stop at a stop sign). In addition, the abilities measured during driver screening should be perceived by the public to have a clear relationship to driving task demands; in other words, high *face validity* can increase the acceptance of screening activities by drivers. All of these considerations guided selection of the functional domains and specific screening procedures investigated in this research.

Finally, a Model Program that has the potential to meet the goals set forth earlier must include a component to provide appropriate and constructive feedback to drivers about screening outcomes. Individuals who decline to be tested and voluntarily cease driving, as well as those who score poorly and are referred for additional testing, eventually leading to a restriction or revocation of privileges by the licensing authority, must be not only apprised of but *connected to* alternative transportation resources in the community. Equally important, individuals who are screened and demonstrate intact functional abilities must be counseled about changes to expect with increasing age, and adjustments in their driving habits that can help to compensate for them.

[2] Source: Dr. Bonnie M. Dobbs, "Medical Conditions That May Affect Driving." *AAAM/NHTSA Consensus Meeting Guidelines*, June 2000.
[3] *pers. comm.*, Dr. Joanne Schwartzberg, Director, Aging & Community Health, AMA, July 29, 2002.

In fact, the functional abilities baseline established through screening with drivers who have yet to experience any significant loss may be one of the greatest benefits of the Model Program.

The Model Program components identified in this introduction—detection of diminished functional abilities, education and outreach efforts, referrals for remediation, and counseling to help older persons remain safely mobile—circumscribe the scope of activities performed in this research project. Early project efforts exhaustively reviewed and summarized technical sources to select a candidate battery of screening measures. Licensing officials were surveyed to gather first-hand information about the feasibility constraints in implementing a driver screening and evaluation program. And the centerpiece of this work, an ambitious pilot implementation of program activities, was undertaken in collaboration with the Maryland Motor Vehicle Administration plus an extraordinary array of partners under the umbrella of the *Maryland Research Consortium*. This multi-year "study within a study" generated invaluable data to describe cost-benefit relationships, while gauging the scientific merit of the included procedures and producing research products with broad applications to other venues.

This report volume gives a synopsis of each stage of the project, concluding with a general discussion and recommendations for the Model Program supported by present findings. A companion volume details the performance of the Maryland Pilot Older Driver Study.

CHAPTER 3: FUNCTIONAL LIMITATIONS REVIEW

The project activities covered in this chapter established the limits of scientific knowledge relating to age-related functional limitations (and medical conditions associated with diminished functional abilities) which are likely to result in driving impairments, and the influence of such changes on the likelihood of crash involvement. A review of recent and in-progress studies was conducted to identify and contrast alternative tests and procedures for assessing drivers' functional ability, and their relationship to crash risk or to performance measures of driving competency. To provide a concise overview while maximizing the accessibility of the findings drawn from this large body of literature, a tabular format was selected to present the initial product of this research—the *Annotated Research Compendium of Age-Related Functional Impairments and Driving Safety*—which was later incorporated into the *Safe Mobility for Older People Notebook.*

Using the *Compendium* as a resource, a consensus among prominent researchers and experts in specific domains of functional assessment was sought regarding impacts of measured deficits on driving performance, taking into account the varying demands of the driving task in different settings and circumstances. This activity was undertaken using an iterative, structured survey approach known as a "Delphi" exercise, with separate groups addressing each of three domains: (1) sensory processes/vision; (2) attentional and perceptual processes; and (3) physical and medical factors and dementia. The output of this effort was a set of tables prioritizing the types of functional tests to perform in a screening program.

SAFE MOBILITY NOTEBOOK AND COMPENDIUM OF RESEARCH FINDINGS

The review of the literature describing older driver diminished capabilities as they relate to unsafe driving performance leading to increased crash risk began with a review of three comprehensive reports on the topic by Janke (1994), a draft manuscript of Hu, Trumble, Foley, Eberhard, and Wallace (1998), and Staplin, Ball, Park, Decina, Lococo, Gish, and Kotwal (1997). In addition, e-mail and telephone contacts were made with the researchers of the projects identified below requesting updates on research in-progress, throughout this task.

- "Develop Performance Assessment Techniques" (NHTSA).
- "Identifying At-Risk Older Drivers" (Andrus Foundation).
- "Physician Assessment Tools" (Andrus Foundation).
- "Role of Cognitive Style in Driving Skills" (Andrus Foundation).
- "Validation of the Senior Driver Research Inventory" (Ontario Ministry of Transport).
- "Analysis of the Useful Field of View" (Ontario Ministry of Transport).
- "Evaluation of a Behavioral Intervention to Reduce Crash Involvement and Injuries in Older Drivers" (National Institute on Aging).
- "Dementia and Driving Performance" (National Institute on Aging).
- "Effects of a Cognitive Training Intervention on Crash Involvement" (National Institute on Aging).
- "Effects of Cognitive Training or a Simulator-Training Intervention on Actual On-the-Road Driving" (National Institute on Aging).
- "Elderly Driver Referral" (Centers for Disease Control).

- “Driving Ability and Car Crashes in Old Age and Dementia” (Centers for Disease Control).
- “The Safe Older Driver: Sensory and Medical Characteristics” (Andrus Foundation).
- “Predictors of Safe and Unsafe Driving in the Elderly” (Andrus Foundation).
- “Longitudinal Study of Health Status and Driving Risk of Older Drivers” (Centers for Disease Control).

The research studies cited in the Staplin et al. (1997) report were performed between 1960 and 1992, and where possible, the technique of meta-analysis was used to facilitate the integration of the large body of findings relating functional capability to crash risk. This document also includes text discussing the results and implications of the cited research findings and was useful for the determination of *what* sensory, perceptual, and physical capabilities are important for safe driving, but not necessarily *how* these capabilities should be measured. The literature review performed by Janke (1994) is a comprehensive report that describes normal impairments associated with aging, medical conditions associated with aging, instruments used for assessing functional abilities necessary for driving, and licensing programs for older drivers. Survey data and crash data were the basis of the Hu et al. (1998) document, used to generate a model to identify factors placing older drivers at risk for crashes, and factors that relate to driving cessation.

The information contained in these documents, while thorough, was unwieldy for the purposes of the current project. To try to simplify the task of prioritizing measurement needs and potentially useful tools and procedures to meet them, research-in-progress and research completed within the past 10 years bearing on the effectiveness of tests *vis-à-vis* the driver performance-versus-safety relationship was synthesized and reformatted into tabular format. This table became the *Annotated Research Compendium of Age-Related Functional Impairments and Driving Safety*.

The *Annotated Research Compendium* contains six columns with the headings: Test; Subjects; Procedure/Test Description; Where Applied; Findings; and Researchers. Each row in the table is dedicated to a description of one test that has been applied in a single research study to evaluate how predictive it is of the research subjects’ driving performance. There are multiple rows for tests that have been employed by multiple researchers. It was frequently the case that a researcher employed a battery of tests in one study; but wherever possible, each test was broken out and is presented separately in its own row in the *Compendium*.

The information contained in these reviews was used as the starting point for a “Delphi” exercise, described below, that sampled the opinions of experts in each of three “functional area working groups” regarding the relationships between diminished capability and driving safety.

It must be noted that the identification of fair, accurate, and administratively-feasible screening procedures to detect functionally-impaired drivers was the first—but not the only—information need addressed in this project task. Loss of mobility is a serious health and quality of life issue for older people. Accordingly, the Model Program recommendations emerging from this research must also address a host of related issues, most notably the potential for remediation of impairing conditions; the need for education and counseling for older drivers faced with restriction or cessation of driving; and the availability of safe and accessible alternative transportation options. The literature review and synthesis culminating in the *Compendium* also revealed a great deal of pertinent information about these related topics. This information was assembled, together with the *Annotated Research Compendium*, into one comprehensive volume titled the *Safe Mobility for Older People Notebook*. This document was intended to serve as a resource, providing a snapshot of current knowledge and practices *circa* 1999, which could support a broad array of program initiatives.

Notebook topic areas include:

- Identification of high-risk older drivers.
- Counseling and remediation of at-risk drivers.
- Public information and educational tools to support program implementation.
- Mobility options and alternatives to transportation for seniors.

Coverage of topics in the *Notebook* within each of these areas is provided in 70 subtopic discussions, containing three sections each: (1) a summary of outcomes in relevant research studies and implementation efforts; (2) conclusions/preliminary recommendations pertinent to the development of a national Model Program; and (3) references identifying data sources. The S*afe Mobility for Older People Notebook* may be accessed using a link on NHTSA's website at www.nhtsa.dot.gov/people/injury/olddrive/safe/.

EXPERT PANEL RECOMMENDATIONS

A key activity in this task was to pinpoint functional deficits which can be most confidently linked to a "significant increase in motor vehicle crash risk." Three Functional Area Working Groups were established, and then half a dozen nationally renowned experts were sought as members of each group. The three Working Groups focused respectively on: (1) sensory (visual) processes; (2) attentional and perceptual (cognitive) processes; and (3) medical factors/dementia. The membership of each group is presented in table 1.

The collective judgments of experts in each Working Group were obtained in a Delphi exercise, based on an iterative, confidential ranking and sorting of responses. This procedure was chosen because of its three main characteristics: anonymity of groups; interaction with controlled feedback; and statistical summaries of group response (Gustafson et al., 1975).

The Delphi exercise was conducted via fax and e-mail. Prior to initiating the exercise, a request was made of each member to provide a candidate list of critical dimensions of functional capability for which they believed it was most likely that deficits would lead to increased crash risk. This input was used to create a matrix of functional capability-by-driving task demand for the Delphi exercise. The functional abilities emerging from this inquiry are listed in table 2.

Next, four driving situations were defined, in recognition that varying task demands will result in varying probabilities of driving errorCand, presumably, risk of a crashCfor a given level of functional deficit. Two key variables influence task demand: (1) traffic speed, and (2) the overall complexity of the traffic operations in the setting. The first variable is straightforward; it

Table 1. Functional area working group membership.

Sensory (Visual) Processes	Attentional & Perceptual/Cognitive Processes	Medical Factors/Dementia
Cynthia Owsley, Ph.D. Professor, Dept. of Ophthalmology School of Medicine/ Eye Foundation Hospital University of Alabama at Birmingham Mark Bullimore, O.D., Ph.D. The Ohio State University, College of Optometry Ronald Klein, M.D., MPH Department of Ophthalmology University of Wisconsin Chris Johnson, Ph.D. Director, Optics and Visual Assessment Lab Department of Ophthalmology University of California, Davis Kenneth W. Gish, Ph.D. Senior Human Factors Psychologist TransAnalytics	Karlene Ball, Ph.D. Professor, Department of Psychology The University of Alabama at Birmingham Allen R. Dobbs, Ph.D. Director, Center for Gerontology University of Alberta Alison Smiley, Ph.D. Human Factors North Toronto, Ontario Jane Stutts, Ph.D. Manager, Epidemiological Studies UNC/Highway Safety Research Center Sherry Willis, Ph.D. College of Human Dev. and Family Studies Pennsylvania State University	Richard Marottoli, M.D., M.P.H. Yale University School of Medicine Department of Geriatrics Phiroz (Phil) Hansotia, M.D. Staff Neurologist Marshfield Clinic and Research Institute Linda Hunt, M.S., OTR./C Occupational Therapy Program Washington University School of Medicine Germaine Odenheimer, M.D. Associate Professor, Neurology University of South Carolina Desmond O=Neill, M.D. Director, Centre for Mobility Enhancement Adelaide and Meath Hospital Dublin Holly Tuokko, Ph.D. Centre on Aging University of Victoria Victoria, Canada

Table 2. Functional abilities identified as inputs to Delphi exercise.

Sensory (visual) processes	Attentional/perceptual processes	Medical factors/dementia
Static acuity (photopic)	Information processing speed	General cognitive function
Dynamic acuity (at angular velocity ~3 to 5 deg/s)	Directed visual search/sequencing	‘Executive’ functioning (planning, reasoning)
Static acuity (low luminance)	Selective attention	Proprioception and somato-sensory processes
Static contrast sensitivity	Divided attention	Coordination of visual and motor processes
Dynamic contrast sensitivity (~ 3 to 5 deg/s)	Attention switching speed	Strength & range of motion
Visual fields	Complex reaction time	
	Speed/distance (gap) judgment	
	Working memory	

determines the time constraints on a driver for all required information processing operations needed to result in safe and effective vehicle control. The second variable is less well-defined, but is assumed to include the perceptual "texture" of the environment (e.g., visual clutter along the roadway); the number and spatial distribution of other road users (potential conflicts); the level of adjacent land development, with the associated problems of uncontrolled access into the traffic stream; and, the complexity of the roadway geometry and operational rules. Fundamentally, this scheme was designed to account for gross differences in the nature and amount of information that must be processed while driving.

Thus, the classification scheme for driving situation was as follows:

I. High speed, high complexity (e.g., high-volume urban/suburban arterials, expressways, and freeways).
II. High speed, low complexity (e.g., low-volume suburban and rural freeways).
III. Low speed, high complexity (e.g., downtown streets and high-volume suburban arterials with heavy commercial development).
IV. Low speed, low complexity (e.g., low-volume streets in less developed suburban and residential environments).

A "functional criterion matrix" was then created for each Working Group, described by columns labeled according to the functional abilities within each domain, from table 2, and rows labeled by the driving situations listed above, which were the same for each Group. Each member of each Working Group was provided with the appropriate functional criterion matrix, the *Annotated Research Compendium*, sections from the Staplin et al. (1997) and Janke (1994) documents, and a set of instructions including descriptions of the four roadway types and their associated driving task demands (e.g., vehicle control requirements, roadway information sources, and potential conflicts).

By design, the Delphi was to proceed in a series of step, as follows:

- **Step 1.** Instructions were provided to each Group member: *Please make an entry in every cell in your functional criterion matrix to indicate a level of decline for the indicated functional ability that 'more often than not' will lead to a significant increase in crash risk, for the identified driving situations.* It was hoped that Group members would take into account differences in task demands from one driving situation to another, and tailor their responses accordingly. Group members were also encouraged to provide a rationale for their responses.

- **Step 2.** Group members' responses within each cell of the matrix were ordered from maximum to minimum values. Measures of central tendency and dispersion were identified to summarize the range of responses received from each Group.

- **Step 3.** Group members were provided with the measure of central tendency from Step 2, as a benchmark, plus the dispersion in the Step 2 responses. They were then asked to submit a new response, with an explanation if it deviated from the benchmark. In this manner, the range of responses as narrowed, with the goal of a single, consensus value.

At Step 2, a criterion was adopted whereby over 50 percent of respondents must enter a value in at least one cell under a given column heading, for that functional ability to be retained in the Delphi exercise. Therefore, if more than half of the respondents left the column blank, citing either insufficient knowledge to provide a defensible input, or stating that in their opinion the capability in question *a)* was not relevant, *b)* could not be measured in a valid or reliable manner, or *c)* was redundant with another measure included in the table, that column was rejected for further consideration. Using this criterion, dynamic acuity and dynamic contrast sensitivity were dropped from the *Sensory (Visual) Processes* Group matrix; and proprioception and somatosensory processes, and strength and range of motion were dropped from the *Medical Factors/Dementia* Group matrix. The Delphi responses derived from Step 3 for each of these respective Working Groups, for the functional abilities remaining under consideration at this stage of the exercise, are presented in appendix A.

Unfortunately, the responses generated within the domain of *Attentional/Perceptual Processes* did not permit the Delphi to advance beyond Step 1. More than half of the members of this Group provided responses that may be paraphrased as "insufficient data to pick a 'best measure,' let alone a specific score" for the functional abilities included under this heading.

Even so, the Delphi exercise provided valuable insights that assisted with planning of the Maryland Pilot Study. Specifically, the research team, in conjunction with NHTSA, was influenced by these findings to concentrate the more ambitious data collection activities to follow in this project on the areas where experts' opinions indicated the greatest deficit of knowledge. A goal for continuing research efforts in these areas was thus established: to build a database describing population norms (i.e., for older drivers) and to enable analyses measuring the strength of relationship with traffic safety for, first, attentional/perceptual processes and second, physical strength and range of motion, as highlighted in this work.

In addition, candidate measures for assessing functional status were suggested by the experts participating in the Delphi exercise, for each of the abilities emerging as a column heading in the functional capabilities matrix. These suggestions, together with the exhaustive survey of related work comprising the *Annotated Research Compendium*, provided the basis for a preliminary selection of measurement (screening) procedures for use in the Maryland Pilot Study.

CHAPTER 4: SURVEY OF STATE LICENSING OFFICIALS

PURPOSE

A number of issues bearing on Model Program development that were considered in this research hinged on a better understanding of the population for whom jurisdictions might implement screening and evaluation activities. Accordingly, a questionnaire was developed and distributed to Driver License Administrators in the 50 United States and 12 Canadian Provinces to broadly establish the cost and time parameters that could influence implementation of Model Program activities, while addressing details of the Model Program concept which conceivably could be impacted by their legal, ethical, or policy implications in each licensing jurisdiction in North America.

A central concern at this point in the project was the potential scope of screening and evaluation programs. Most important was to discover whether, in the opinion of licensing officials, expanded driver screening activities would likely apply to: (a) *all* drivers over a given age applying for license renewal; (b) only a (presumably much smaller) subgroup of "high-risk" drivers who are referred to the DMV through various sources including physicians, occupational therapists, or other health care professionals, friends or family, social service providers, law enforcement or the courts; or (c) both of these sets of drivers. This primary question was asked first in the survey, and defined the "frame of reference" for licensing officials as they responded to the additional queries.

A total of 16 items were clustered in four groups on the survey: (1) the initial question addressing the potential scope of screening and evaluation activities within a jurisdiction; (2) the feasibility of specific screening program enhancements; (3) the cost justification needed to expand screening activities within jurisdictions; and (4) the time constraints on conducting expanded screening activities.

METHODOLOGY

The survey questionnaire was reviewed by NHTSA and by the American Association of Motor Vehicle Administrators (AAMVA) prior to distribution. It was produced as an AAMVA Memorandum on AAMVA letterhead and was mailed to Driver License Administrators in the 50 United States plus Washington, DC, plus the 12 Canadian Provinces existing at the time, under the signature of AAMVA's Director of Driver Services. The survey form is included in appendix B.

Initially, responses were received and tabulated from officials in 58 of the 62 jurisdictions contacted, and a draft summary of results was presented at the AAMVA conference held at Incline Village, NV, in 1997 with a request for corrections to ensure that the information subsequently reported did not misrepresent any Agency's policies or practices. The results reported below reflect corrections received from one jurisdiction, plus data from two additional jurisdictions that returned their surveys after the AAMVA conference, yielding a total of 60 respondents—47 States and the District of Columbia, plus 12 Canadian Provinces.

RESULTS

Results are presented for the 60 AAMVA member jurisdictions participating in the survey by summarizing the number and percentages selecting each response alternative for each item, as follows.

(1) *Is it your sense that new/expanded driver screening procedures, if implemented in your jurisdiction, should be applied to (a)* all *drivers over a specified age who apply for license renewal, (b) only a "high risk" subgroup of drivers, likely to include a disproportionate share of older persons, who are brought to the DMV's attention through various referral mechanisms, or (c) both of these sets of drivers?*

(a) *all* drivers over a specified age who apply for license renewal	(b) only a "high risk" subgroup of drivers, likely to include a disproportionate share of older persons, who are brought to the DMV's attention through various referral mechanisms	(c) both of these sets of drivers?
Arkansas Connecticut Florida Kansas Maine Quebec	Alaska Alberta Arizona California Kentucky Louisiana Massachusetts Michigan Minnesota Missouri Montana Nevada New York North Dakota Nova Scotia Oklahoma Pennsylvania Prince Edward Island Rhode Island Saskatchewan Texas Utah Virginia Washington (State) West Virginia Wyoming Manitoba Wisconsin	Alabama British Columbia Colorado Delaware Hawaii Idaho Illinois Indiana Iowa Maryland Nebraska New Brunswick New Hampshire New Jersey Newfoundland & Labrador North Carolina Northwest Territories Ohio Ontario Oregon South Carolina South Dakota Tennessee Vermont Washington, DC Yukon

Only 6 respondents (10 percent) replied that all drivers over a specified age should be targeted for expanded screening procedures upon application for license renewal (answer a). Responses from the remaining jurisdictions were almost equally divided between alternatives b and c. The larger share of respondents (28 of 60, or 47 percent) replied that the expanded driver screening procedures should be applied to only the "high risk" subgroup (answer b), while 26 of 60 (43 percent) replied that both sets of drivers (answer c) should undergo expanded functional screening.

(2) Please base your responses to the following items on your answer to Question (1) above. Postponing considerations of the cost (of testing equipment and/or test administrators) and time required to conduct test procedures for drivers referred into a Model Screening/Evaluation Program, is it your sense that current policies and priorities in your Department would be make it feasible to:

2a. Extend the practice of graduated licensing, which many states have applied to phase in full privileges for the novice driver, to the older driver as well, by implementing progressively more restrictive licensing actions as an individual's capabilities suffer progressive decline? Would this require a change in legislation?

The majority of the respondents (40 of 60, or 67 percent) answered in the affirmative. The remaining 20 respondents (33 percent) replied that graduated licensing for seniors would *not* be feasible. Of the 40 respondents who reported that graduated licensing would be feasible, 26 reported that this would require a change in legislation and 14 replied that no change in legislation would be required. Of the 20 respondents who replied that graduated licensing was *not* feasible, 16 replied that a change in legislation would be necessary, and 4 did not respond to the second half of this question.

2b. Implement a community outreach/public education activity for drivers that would provide information on aging and safe driving practices, techniques for self testing (which could also encourage individuals to refer themselves into a screening/evaluation program), and, when needed, provide advice on transportation alternatives in the individual's home area?

Eighty-five percent of the respondents (50 of 59) responded in the affirmative and 15 percent (9 of 59) responded that this was *not* feasible.

2c. Implement screening/evaluation program activities wholly within the DMV, or privatize some or all license qualification assessments for passenger vehicles (assuming that standard, certified procedures are implemented uniformly throughout your jurisdiction)? Please choose among: (1) DMV provides all screening activities; (2) DMV provides some screening activities and some are privatized; (3) All screening activities are privatized.

Twenty-seven of the 60 respondents (45 percent) replied that the DMV would provide all screening activities; 38 of the 60 respondents (63 percent) replied that the DMV would provide some screening activities while others would be privatized, and 1 respondent replied that all screening activities would be privatized. It should be noted that responses to these three questions were not mutually exclusive; 6 States/Provinces replied "yes" to the first two items (Alberta, Colorado, Illinois, North Carolina, Vermont, and Washington State), and Oregon responded "yes" to all three items.

2d. Modify existing vision test procedures for drivers who have been referred to the DMV for functional impairment screening, such that acuity is measured using new techniques, provided that they are more accurate and/or reliable?

Seventy-six percent of the respondents (44 of 58) responded that this would be feasible, while 24 percent (14 of 58) replied that it would not. Two jurisdictions did not respond to this survey item.

2e. Modify existing vision test criteria such that lower levels of performance (e.g., 20/80, 20/100, or worse) do not necessarily result in the loss of all driving privileges, but instead may result in restrictions (such as daylight only driving)?

Seventy-two percent of the respondents (43 of 60) replied in the affirmative, while 28 percent (17 of 60) replied that this practice would *not* be feasible.

2f. Expand vision test procedures to include abilities which are not presently tested (dynamic visual acuity; contrast sensitivity; low luminance acuity) but which have been shown in research to be more strongly related to crash risk than the present (static) visual acuity measure?

Eighty-five percent of the respondents (51 of 60) replied that this practice would be feasible, and 15 percent (9 of 60) responded that it would *not* be feasible.

2g. Adopt criteria for functional capabilities other than vision as the basis for licensing action (restriction or revocation), which would include—though not necessarily be limited to—measures of attention, perception (of speed and distance relationships), memory and cognition, decision making, navigational problem solving, or "situational awareness"?

Seventy-eight percent of the respondents (47 of 60) responded in the affirmative, while 22 percent (13 of 60) responded that this practice would *not* be feasible.

2h. Conduct tests to assess functional capabilities for individuals referred into a screening/evaluation program, regardless of when this occurs in the driver's renewal cycle, i.e., without waiting until the end of the current cycle for removal or restriction of driving privileges if warranted by test results?

Ninety-seven percent of the respondents (57 of 59) replied that this practice would be feasible, and 3 percent (2 of 59) replied that this would *not* be feasible (Massachusetts and Montana). One jurisdiction did not respond to this survey item.

2i. Conform to uniform (national/ North American) standards—to be developed—for referral of drivers into a screening/evaluation program based on the diagnosis of medical conditions including, though not necessarily limited to, dementia (Alzheimer's and other dementias); stroke; Parkinson's disease; seizure disorders; diabetes; heart disease, arrhythmias, and related cardiovascular conditions.

Eighty-six percent of the respondents (50 of 58) replied that this would be feasible, while 14 percent (8 of 58) replied that it would *not* be feasible. Two jurisdictions did not respond to this survey item.

2j. Tailor retesting requirements (nature and frequency) for license renewal or retention of driving privileges to specific medical conditions (e.g., Alzheimer's, Parkinson's, diabetes), for physician referrals or self reports of medical conditions to the DMV ?

Ninety-two percent of the respondents (55 of 60) replied that this practice would be feasible while 8 percent (5 of 60) replied that it would *not* be feasible.

2k. Refer drivers who are undiagnosed by a physician, but who are believed by family, friends, and/or others in the health care/social services fields to suffer functional impairment, into a screening/evaluation program, which would mandate subsequent functional tests with the potential for licensing action?

Ninety percent of the respondents (54 of 60) replied that this practice would be feasible while 10 percent (6 of 60) replied that it would *not* be feasible.

2l. Implement a referral mechanism for functional screening/evaluation in which DMV counter personnel use a checklist to record a brief, structured set of observations, and/or question-and-answer responses, for members of the driving public who appear before them?

Sixty-four percent of the respondents (38 of 59) reported that this practice would be feasible to implement while 36 percent (21 of 59) replied that it would *not* be feasible. One jurisdiction did not respond to this survey item.

2m. Tailor on-road examination procedures for drivers who have been screened for functional impairment, to the specific area of functional decline which places that individual at greater crash risk—i.e., administer road tests with varying content or areas of emphasis for varying impairments?

Seventy-eight percent of the respondents (47 of 60) indicated that this practice would be feasible, while 22 percent (13 of 60) responded that it would *not* be feasible.

(3) With specific regard to the cost of new test procedures, to what extent would such costs have to be offset by savings in other Department activities within the short term (present or next fiscal year) to permit implementation? (Check one response):

___ *a. Substantially or completely (100 percent, or close to it) regardless of expected payoffs in improved safety.*

___ *b. To a significant extent (50 percent or greater) but not completely, given a solid expectation of measurable safety benefits.*

___ *c. Only minimally, or not at all (less than 50 percent, down to zero) if significant safety benefits have been demonstrated in another state or a pilot program.*

The majority of respondents (30 of 58, or 52 percent) chose response "a," that costs of new test procedures would need to be offset substantially or completely by savings in other Department activities. The balance of the responses were distributed equally between alternatives "b" and "c." Twenty-four percent of the respondents (14 of 58) indicated that savings would need to be offset to a significant extent (response "b"), while 24 percent of the respondents (14 of 58) chose response "c," that costs would have to be offset only minimally or not at all by savings in other Department activities. Alberta responded that they would only support a user-pay system. Two jurisdictions did not respond to this survey item.

(4) With specific regard to the administration of functional testing requirements as addressed in this survey, what is the practical upper limit on the time of testing within your jurisdiction? (Check one response):

___ *a. under 15 minutes*

___ *b. 15 to 30 minutes*

___ *c. 30 to 45 minutes*

___ *d. 45 minutes to 1 hour (or no limit)*

This question produced the most variation in responses, with approximately one-quarter of the respondents choosing each of the four alternatives. Twenty-five percent of the respondents (15 of 59) stated that the upper time limit for testing would be under 15 minutes (response "a"). Twenty-nine percent of the respondents (17 of 59) indicated that testing could feasibly last for 15 to 30 minutes (response "b"). Twenty-five percent (15 of 59) stated that testing could utilize from 30 to 45 minutes (response "c"). The smallest percentage of the respondents (20 percent, or 12 of 59) indicated that testing could last 45 minutes to 1 hour or more (response "d"). Rhode Island did not choose any of the alternatives, and instead responded only that test times vary greatly. One jurisdiction did not respond to this survey item.

Overall, the responses to this survey indicated substantial differences among licensing officials across North America regarding the potential for changing the policies and practices in this area. Current project efforts were encouraged by the consistently large majorities that provided affirmative responses to the series of questions under Item 2 addressing the feasibility of expanded and/or or enhanced screening activities. At the same time, while there is flexibility with respect to the amount of time that an agency could allocate to driver screening, Model Program recommendations are not likely to be implemented unlikely unless the associated costs can be offset "to a significant extent" or completely by savings in other Department activities.

CHAPTER 5: THE MARYLAND PILOT OLDER DRIVER STUDY

This chapter presents an overview of the project activity having the greatest impact on Model Program development, the Maryland Pilot Older Driver Study. Pilot Study development and data collection; analyses and results; research products; and cost-benefit considerations are covered below. For in-depth discussion of these and related topics, see Volume 2.

STUDY DESIGN AND LOGISTICS

The Pilot Study was carried out through the combined efforts of the Maryland Medical Advisory Board, the MVA's Office of Driver Safety Research, the NHTSA research team, and numerous partners in the Maryland Research Consortium. Key individuals who contributed most significantly to the success of the Pilot Study are recognized in the Acknowledgements section. The material below highlights our principal considerations in selecting the included screening measures; training the staff who would administer the functional tests; choosing the physical locations for data collection; and meeting technical support needs to compile and check the quality of data analyzed during the Pilot Study.

Two goals were established during planning for the Pilot Study—to *examine the validity* and to *evaluate the administrative feasibility* of measuring drivers' functional status to help detect individuals at higher risk of driving impairments and crashes. Construct validity for a group of ten measures spanning designated perceptual-cognitive and physical abilities linked to safe driving was established through a synthesis of prior research, plus expert opinion solicited as described in the preceding chapter. Empirical validity was to be examined through predictor-criterion relationships denoted by odds ratios, calculated using functional status and driving history data collected and analyzed in the Pilot Study. The odds ratio technique was selected because of its ability to illustrate how the predictive value of a given functional measure changes when different pass-fail "cutpoints" are applied, something of clear interest for any broader implementations that might emerge from this research.

The potential for broader implementation of research findings also depends strongly upon the judged feasibility of recommended screening activities. Additional criteria in selecting measures for the Pilot Study thus included brevity; low cost; and the ability to be administered by non-professionals (i.e., general office staff), with limited training, in diverse settings. A field test of candidate measures was carried out in a "pre-pilot" study, using subjects and research assistants participating in the Johns Hopkins University Salisbury Eye Evaluation (JHU/SEE) project.[1] This effort focused on test instructions, materials, measurement methods, scoring procedures, and data entry requirements, as well as other problems or concerns on the part of the subjects or the JHU research assistants trained as test administrators.

Ultimately, validity and feasibility considerations were balanced to define a battery of "gross impairments screening" (GRIMPS) measures in the two domains indicated below:

- *Physical measures* — Rapid Pace Walk; Foot Tap; Head-Neck Rotation; Arm Reach.
- *Perceptual-cognitive measures* — Motor-Free Visual Perception Test (Visual Closure subtest); Trail-making Test, Part B; Cued/Delayed Recall; Scan Test.

[1] Directed by Dr. Gary Rubin, Lions Vision Center, Johns Hopkins University, Baltimore, MD.

The physical measures concentrated on domains of functional ability including *lower limb strength and mobility*, *upper limb strength and mobility*, and *flexibility of the neck and upper torso*. The perceptual-cognitive measures addressed domains of functional ability that included *directed visual search*, *divided attention*, *information processing speed*, *working memory*, *visuospatial abilities*, and the *organization of drivers' scanning patterns*.

Given the prior existence of established protocols for vision testing by the MVA, no visual performance measures were included in the Pilot Study.

After the GRIMPS battery was narrowed to the procedures listed above, two perceptual-cognitive measures were added. A PC-based test labeled "Dynamic Trails" was incorporated into the screening battery added after data collection with the other measures had begun; it automated and modified the "Trail-making, Part B" procedure. Also, one component of the Useful Field of View test (Subtest 2, Information Processing Speed and Divided Attention) was included in the Pilot Study, under the sponsorship of the National Institute on Aging.[2] Thus, functional status data were collected and analyzed using a total of ten procedures—six perceptual-cognitive measures and four physical measures—in the Pilot Study, which together could be administered by trained data collectors in 20 to 30 minutes.

A "Mobility Questionnaire" addressing the nature and extent of the study participants' driving habits was developed for administration in conjunction with the functional status measure. Subjective estimates of miles driven on a weekly basis were obtained, plus categorical responses indicating annual miles driven as well as the frequency with which specified driving situations were avoided (nighttime, adverse weather, etc.).

The personnel who collected functional status data in the Pilot Study were employees of the MVA. At the outset of the study, in November, 1998, data collection responsibilities were met by "line personnel" assigned to the project by the MVA. Over a 2-day period, these individuals received training that included classroom lecture on general research principles (e.g., the importance of consistency in test administration), video tape demonstration of methods, hand's-on demonstration of methods, and practice with observation and feedback. Continued observation at random intervals during the following weeks reinforced training lessons.

During the final year (2000) of data collection, responsibilities were shifted to staff designated by the MVA as Driver License Examiners. Similar training was provided to these individuals. This change was prompted by a less-than-desired level of consistency in test administration methods that persisted among the initial group of data collectors; the latter group, already accustomed to performing a range of examination functions, in fact demonstrated greater diligence and attention to detail as hoped.

The physical locations in which Pilot Study data were collected reflect the different sampling strategies pursued in this research. A *License Renewal* sample (n = 1,876) and a *Medical Referral* sample (n = 366) were tested in MVA field offices; 11 separate locations were utilized Statewide, each with a private conference/training room that was dedicated to screening

[2] Provided for use in the Maryland Pilot Older Driver Study by the Roybal Center for Applied Gerontology at the University of Alabama at Birmingham, in collaboration with Western Kentucky University.

activities. A *Residential Community* sample (n = 266) was tested on-site at Leisure World in Montgomery County, MD.

The randomly selected License Renewal sample was deemed sufficiently representative of its age cohort to permit generalization to the broad population of older drivers, with respect to crash and violation experience; it served as the test bed for project data analyses examining the relationship between functional ability and crash and violation safety outcome measures. The Medical Referral sample, as the name suggests, was comprised of individuals already identified as likely to be impaired. The Residential Community sample, by contrast, included a more affluent, self-selected group of “well elderly” drivers.

A fourth location for data collection was planned in a social service setting: Senior Centers operated by the Howard County, Maryland, Office on Aging. Early experience at this site determined that driver functional screening as required to meet the objectives of this research could *not* feasibly be completed. The greatest, though not the only difficulty was the very low response from older citizens in the county; concern that test results would be shared with the MVA—despite explicit assurances to the contrary—was the apparent reason. Data collection activities were curtailed in the Senior Centers in the spring of 1999.

Also deserving mention in this chapter is the necessary work to prepare analysis files, an essential and quite involved step en route to the numerous summary tables, graphs and figures, and statistical test results emerging from this research. In partnership with the MVA Office of Driver Safety Research, safety data were extracted from Maryland State Highway Authority (SHA) databases and filtered as described below to create a primary project database for analyses relating drivers’ functional status to crashes and moving violations. This was keyed to a unique period of time—relative to each individual’s test date—during which driving history variables would be analyzed.

Original data tables as received from the MVA were imported into MS Access 97 for analysis, using the driver record (Soundex) number as the linking variable. Data sorting using MVA system codes defined specific outcome variables of interest—at-fault crashes, unknown-fault crashes, and all crashes; as well as moving violations with and without speeding and occupant restraint violations. Before proceeding with summary analyses and statistical tests, the data were further examined to confirm that variability in driving experience observation intervals inherent in the pilot study design (because of test dates that differed by driver, coupled with a common study end date for sampling crash and violation data) was random with respect to crash-involved versus non-crash-involved populations. Having addressed concerns about this potential bias in the data, the Access tables were imported into SPSS SYSTAT (v. 9.01) using an Open Database Connectivity (ODBC) feature, and the analysis of Pilot Study results could proceed as described in Volume 2.

FUNCTIONAL STATUS AND SAFETY ANALYSES AND RESULTS

Pilot Study analyses initially compared the age distributions for each study sample, plus functional performance distributions for each included screening measure. The License Renewal sample was approximately 10 years younger (mean age = 68.3) than the Medical Referral sample (mean age = 76.8) and Residential Community sample (mean age = 77.1). In terms of functional ability, however, the Residential Community sample mirrored the population-based License

Renewal sample very closely, especially with respect to perceptual-cognitive tests, while the Medical Referral sample was consistently skewed toward greater functional loss. This result was not surprising, and only reinforced the premise that functional status, not age *per se*, is of primary importance.

By contrast, the Residential Community and Medical Referral samples were more alike in terms of self-reported mobility restrictions. It thus appears that drivers of similar age but differing in functional ability may make similar behavioral adaptations in the ways they limit their driving habits to compensate for a perceived increase in driving risk.

The nature and strength of relationships between the various included screening measures and safety outcomes were assessed using odds ratio (OR) analyses. As noted earlier, three levels of crashes (at-fault only, at-fault plus unknown fault, and all crashes) and three levels of moving violations (all moving violations, all except speeding, and all except speeding and occupant restraint violations) were examined in the Pilot Study analyses. These safety outcomes were tabulated for analysis for each driver, bracketing his/her test date with one year of prior data plus as much later driving history data as available. In addition, crash analyses were repeated using prospective data only.

The OR calculations were performed in SPSS/SYSTAT with significance tests (chi-square) applied at functional performance levels where peak valid OR values were obtained. As explained in more detail in Volume 2, this analysis technique expresses the odds of experiencing a given outcome (e.g., crash involvement) if a person *fails* a test than if the person *passes* the test. By noting where the maximum OR value is attained, a candidate cutpoint for pass-fail decisions may be identified for each measure where an OR greater than 1.0 is demonstrated; OR values below 1.0 indicate that a test has no predictive value.

Although quite popular in studies of this kind, the calculation of an odds ratio—along with the similar analysis technique "relative risk"—is subject to strict limitations on its validity. With reference to the four cell matrix defined by the combinations of "pass" and "fail" versus "crash" and "no crash" outcomes, OR cannot be calculated when any of the cell values are zero. Paradoxically, this includes instances where the measure is a *perfect predictor*, i.e., where there are no "misses" (where a driver passes the test but still has a crash) or "false alarms" (where a driver fails the test but remains crash-free). Also, an OR calculation when there are fewer than 5 observations in any cell in the aforementioned matrix is statistically unreliable and easily susceptible to misinterpretation. This requirement for valid OR calculations was applied in the analysis and interpretation of Pilot Study results <u>without exception</u>.

The analysis results demonstrated significant predictor-criterion relationships in all domains of functional ability studied except upper limb strength/mobility and the organization of drivers' visual scanning patterns. The most prominent example relates to the detection of functional decline in <u>visuospatial abilities</u>, specifically, the ability to visualize whole objects or patterns when there are missing elements and only partial information is available. Performance on the *Motor-Free Visual Perception Test/Visual Closure Subtest* easily evidenced the strongest relationships to safety outcomes, at the highest levels of statistical significance. Moreover, this finding was consistent across not only crash analyses, but also in relation to convictions for moving violations.

Next, the importance of detecting losses in drivers' divided attention abilities is highlighted by the significant results obtained for the *Trail-making, Part B* and *Useful Field of View Subtest 2* measures in the (at-fault) crash analyses. *Trail-making, Part B* also demonstrated statistically significant results in the analyses of moving violations; and again there was close agreement between analysis results using crash and violation outcome measures.

The solid results demonstrated for *Trail-making, Part B* in this research also highlights directed visual search as a functional ability that, when compromised, significantly impairs safe driving.

The significant result for *Useful Field of View Subtest 2* in the crash analyses, noted above, focuses attention on information processing speed as another functional ability where decline may be reliably associated with increased risk of driving impairment. None of the results obtained in the analyses of moving violations were significant for this procedure, however. It also may be noted that variation in the actual size of the "useful field of view" was *not* evaluated as a safety predictor in this research.

A decline in working memory was shown to be a significant predictor of impaired driving through the analyses relating performance on the *Delayed Recall* measure to at-fault crashes. But, significant results were not demonstrated for this measure in the analyses of moving violations.

With respect to physical measures, the importance of lower limb strength and mobility was indicated by significant results for the *Rapid Pace Walk* measure in the crash analyses; results for this measure failed to reach significance for the analyses of moving violations, however, and the related *Foot Tap* measure approached but failed to reach significance for both sets of analyses. A significant outcome in the crash analyses for the *Head/Neck Rotation* measure indicated that flexibility of the neck and upper torso can be a useful predictor of driving impairment; unfortunately, a valid based on moving violation experience was not permitted as too few drivers failed this test in the study sample.

Other measures which were found to have negligible value as predictors of driving risk in the Pilot Study included the *Arm Reach* and *Scan Test*. In both cases, virtually all drivers were able to perform the measure without error or deficit; without any variance in functional ability, a measure cannot discriminate between different levels of crash or conviction experience.

The analysis results, beyond providing evidence that functional capacity screening can yield scientifically valid predictions about the risk of driving impairment, also supported the identification of preliminary cutpoints for pass-fail decisions for selected measures. However, in a number of cases, the rationale for selecting cutpoints depended less on an isolated, peak OR value than on broader trends in the distributions of crash-involved versus non-crash-involved drivers. In particular, candidate cutpoints were chosen where there was a clear performance-versus-safety transition, signified by a level of functional loss where the proportion of drivers involved in crashes began to consistently exceed the proportion of drivers remaining crash-free. In fact, the analysis results provided evidence that supports the notion of not one, but two cutpoints for each functional measure adopted for use in a screening program—one keyed to *prevention*, at a modest level of decline, and another keyed to *intervention*, where gross impairments in functional ability are detected. Volume 2 presents additional details about analysis methods and outcomes, while the importance of these findings for Model Program development is discussed in the concluding chapter of this report.

DEVELOPMENT AND APPLICATIONS OF PILOT STUDY PRODUCTS

This section identifies and describes research products developed to support Maryland Pilot Older Driver Study activities which, like the *Safe Mobility for Older Persons Notebook*, have demonstrated a sustained value in applications extending well beyond the present investigation. These include educational materials; software and materials for conducting functional screening; and a database proposed as the primary test bed for longitudinal study of the relationship between functional status and traffic safety.

How Is Your Driving Health? Brochure

A key objective in the Pilot Study was to help older drivers in Maryland gain a better understanding of their functional abilities, the changes in abilities to expect with normal aging, and how these changes relate to safe driving. Educational materials were developed in this project with these specific goals in mind, most notably the *"How Is Your Driving Health?"* brochure distributed to its customers by the MVA.

This brochure, reproduced in appendix C, contained contact information tailored to the particular jurisdiction (Maryland) of the Pilot Study. But it also contained general information to raise awareness that safe driving depends upon intact functional abilities; examples of declining abilities common among older persons; and suggestions for changes in driving habits to help compensate for certain kinds of diminished capabilities. By design, the self knowledge that an older driver gains from thoughtful consideration of the brochure's contents will lead to a more frank discussion about medical fitness-to-drive with the individual's physician, and with his or her spouse and family members as well.

Much of the material developed for the "*How Is Your Driving Health?*" brochure subsequently was adopted by NHTSA for a publication produced in cooperation with the USAA insurance company, *Driving Safely While Aging Gracefully*.

GRIMPS Test Kits and Dynamic Trails Screening Software

The functional screening data for the Pilot Study was, for the large majority of included measures, collected manually by MVA staff using materials and procedures developed for this purpose. Nine of the ten measures obtained in the Pilot Study were elements of the Gross Impairments Screening (GRIMPS) battery emerging from earlier work in this project.[3] GRIMPS data collection was supported by test kits including:

- A three-ring binder containing stimulus materials and forms for administering and scoring the screening procedures.
- Written instructions for each procedure and a script for their administration.
- A stop watch for recording timed procedures.

[3] The exception was the Useful Field of View Subtest 2, provided for use in the Maryland Pilot Study through a National Institutes of Health/National Institute on Aging grant held by Dr. Karlene Ball.

- Materials explaining the relationship of each procedure to driving tasks, for answering questions and providing feedback to study participants.
- An instructional video demonstrating how to properly conduct the test procedures.

After initial development of the contents listed above, accomplished under this research contract, materials could be reproduced and assembled into kits at a cost of approximately $100 each. GRIMPS test kits were distributed to all MVA staff involved in data collection at field offices Statewide, following preliminary training exercises to familiarize them with their use.

Following its introduction in Maryland, the GRIMPS battery has also been implemented for research purposes and in driver evaluation and rehabilitation settings that have no formal linkage to the Pilot Study. Per request from the responsible parties, GRIMPS test kits were provided at no charge or at cost, with an understanding that data sharing to support the development of population norms for the included procedures would be allowed at a future point in time. The venues in which the GRIMPS battery has been applied, using test kits supplied by project staff, include:

- Florida Atlantic University, Lifelong Mobility Center (Boca Raton, FL)
- Tampa Bay Regional Planning Council, Getting in Gear Project (St. Petersburg, FL)
- University of Pittsburgh Medical Center, Rehabilitation Services (Pittsburgh, PA)
- University of Michigan Transportation Research Institute (Ann Arbor, MI)
- Geriatric Research, Education, and Clinical Center (Minneapolis, MN)
- Stan Cassidy Centre for Rehabilitation, Adaptive Driving Service (Fredericton, New Brunswick, Canada)
- University of Florida (Gainesville, FL)
- Monash University, Accident Research Centre (Clayton, Victoria, Australia)

A novel software application was also developed in this project, spurred by Maryland MVA desires to automate screening procedures wherever feasible—especially those that are most time-consuming and prone to test administration errors that threaten data quality. According to these criteria, the Trail-making test measuring visual search and sequencing and divided attention abilities was identified as the priority for automation. Software subsequently developed with this goal in mind resulted in a derivative procedure, labeled “Dynamic Trails.”

The Dynamic Trails procedure is a PC-based test that maintains the mixed letter and digit stimuli used in the traditional paper-and-pencil Trail-making procedures; however, instead of the blank, white background used in the traditional protocol, Dynamic Trails presents a compressed video image of a freeway driving scenario, in color. This approach was selected to incorporate an additional element of distraction into the test procedure. At the same time, the overall number of stimuli (letters and digits) superimposed on the moving traffic background was reduced. A shorter but more challenging measure of perceptual-cognitive abilities related to safe driving, with high face validity to examinees, was the intended result.

As reported in Volume 2, the analysis of Dynamic Trails data collected in the Pilot Study was complicated by difficulties in test administration, and because of a reduced sample size resulting from the introduction of this procedure after data collection with the rest of the battery had already been underway for several months. Nevertheless, valid odds ratios greater than 1.0

were calculated when examining how well this measure could predict at-fault crashes among the License Renewal sample. Also, significant methodological improvements were undertaken after data collection was concluded; these included software refinements for better data capture, the use of a touch-screen interface instead of a light pen, and the addition of audio as well as text instructions to standardize an element of test administration that was often inconsistent during the Pilot Study.

Apart from the research in Maryland, the enhanced Dynamic Trails protocol was applied in a 2001-02 study of functional impairment and driving safety by the Florida Aging Driver Council. It has also been selected for use by a Continuing Care Retirement Community (CCRC) in the Peninsula United Methodist Homes (PUMH) network in the state of Delaware, which is offering a functional screening service with counseling about safe driving habits as an educational benefit for its residents.

MaryPODS Database

The Pilot Study analyses, detailed in Volume 2, were performed upon a MS Access 97 database comprised of functional screening data, and crash and moving violation data provided by Maryland DOT officials. Coordination between the State Highway Authority (SHA) and the Motor Vehicle Administration (MVA) permitted the aggregation of the raw data files; extensive error checking and filtering of these data to determine the period of time—relative to each of more than 2,000 individuals' test dates—for which driving history variables should be examined resulted in the final analysis database for the Maryland Pilot Older Driver Study (MaryPODS).

The MaryPODS database itself is a valuable resource for continuing study of the relationships presently under investigation. Currently shared among all research partners participating in the Pilot Study, including NHTSA and Maryland MVA, this Access database establishes a baseline against which future changes in functional status and crash and violation experience can be compared. Relationships documented through longitudinal study with the same Maryland drivers that are consistent with the cross-sectional analyses reported herein, would provide a compelling argument for functional capacity screening to detect high-risk drivers. In addition, the performance distributions (for the License Renewal sample) that are recorded in this database—supplemented to the greatest extent practical by data collected in other venues employing a common methodology—may be fairly considered as a starting point for the development of population age norms for each included measure of functional ability.

COSTS AND BENEFITS OF DRIVER FUNCTIONAL SCREENING

It was found in the Survey of State Licensing Officials conducted in this project, that implementation of the types of screening and evaluation activities envisioned under the Model Program would depend, to a large extent, on a Department's ability to offset the costs associated with such activities. This section of the report compares the estimated costs for conducting screening activities in a "production" environment by a licensing agency, derived through consultation with the Maryland Motor Vehicle Administration (MVA), to benefits (cost savings) that are realized through increased efficiencies in the performance of certain, indispensable components of a medical determination of fitness to drive.

Fitness-to-drive determinations are required for drivers referred to a motor vehicle agency, through means that can vary greatly from jurisdiction to jurisdiction. Using Maryland as our example, drivers suspected of (functional) impairment of one sort or another may be referred by physicians, occupational therapists, and other health care providers; law enforcement officers or the courts; social service providers, including those who perform geriatric assessments for the State; by MVA personnel (e.g., counter staff) based on in-person observations of particular behaviors associated with possible impairment; by family, friends, or other citizens; and by the motorist himself/herself via acknowledgements of one or more medical conditions (stroke, cardiovascular conditions, diabetes, visual problems, seizure disorders, etc.) that are included on checklists attached to License Renewal forms and Learner's Permits.

Under the Model Program, it is anticipated—though not specifically advocated—that jurisdictions may, in the future, require some type of assurance that all individuals applying for license renewal are free of any gross functional impairments. Alternately, individuals above a designated age only may be subject to such a requirement, based on evidence showing that the incidence of functional loss resulting in driving impairment increases sharply somewhere between the mid-60's to mid-70's, depending on the individual; and that, accordingly, it is extremely inefficient to broadly screen for functional deficits when they are so rarely detected in young and middle-aged drivers. *If* such a policy were implemented in Maryland for individuals age 65 and over, 452,591 drivers or 12.7 percent of the licensed population, apportioned according to the (5-year) renewal cycle in that State, would have been affected in the year 2000. By comparison, the number of drivers age 75 and older in Maryland in 2000 was 182,530; on a 5-year renewal cycle, approximately 36,500 individuals would be affected annually.

Whatever mechanisms drive the number of persons for whom a motor vehicle agency makes fitness-to-drive determinations each year, each of those customers must be evaluated in terms of criteria including, at a minimum, health history information provided by the individual plus a current physician's report. A case review file containing this and any additional information deemed important by a jurisdiction is forwarded to the professional—an agency employee (e.g., Medical Advisory Board) or outside consultant—who ultimately provides a recommendation for disposition of the matter. Generalizing from the Maryland experience, this discussion assumes that three outcomes are possible at this stage, i.e., a determination of (1) OK to drive (with or without restrictions); (2) NOT OK to drive (license suspended or revoked); or (3) HOLD pending further information.

An evaluation was performed in the Maryland Pilot Study to see what impact, if any, on the disposition of cases referred for review by a Medical Advisory Board (MAB) physician would result from providing functional capacity screening data in addition to the other information (driver's self-reported medical history and personal physician's report) contained in the traditional case review file. MAB physicians initially reviewed each of 450 cases *without* access to the screening data; then, blind to their earlier recommendations for disposition, conducted another review where the results for all of the Pilot Study screening measures were included in the driver's file.

The functional screening data for this evaluation were obtained from the Medical Referral sample using procedures described in Volume 2 of this report. The consequences of including the screening data on the dispositions of the MAB physicians are shown in figure 1.

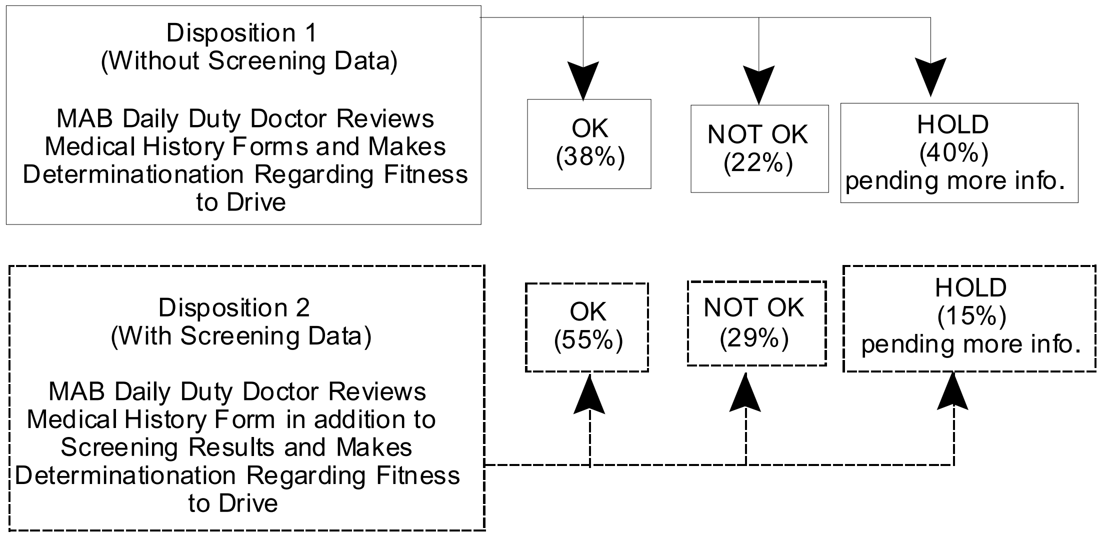

Figure 1. Impact of functional screening data on initial fitness to drive determinations.

As indicated, these Pilot Study findings indicate an *increase* in the proportion of cases with a disposition of "OK" (from 38 to 55 percent) and "NOT OK" (from 22 to 29 percent), coupled with a *decrease* from 40 percent to 15 percent in the proportion of "HOLD" outcomes. In real numbers, including functional screening data in the MAB review process for medical determination of fitness to drive reduced the number of drivers placed on "HOLD" status from 180 to 68, a 38 percent decline.

The benefit that may be attached to this shift is gauged in terms of the relative costs of the screening procedures, applied in a production setting, versus the procedures that historically would be applied in cases where a disposition is on "HOLD" pending further information. In Maryland, such information is obtained through one or more of the following:

- An in-person or remote (videoconference) interview by the MAB with the driver.
- An external evaluation performed by an Occupational Therapist (Certified Driving Rehabilitation Specialist).
- A diagnostic laboratory test.
- A medical specialty review in the area of vision, cardiology, neurology, psychiatry, endocrinology, or other areas.
- A behind-the-wheel (closed course) drive test conducted by the Motor Vehicle Administration.

While the costs of lab tests, medical specialty reviews, and OT/CDRS evaluations are typically borne by the driver, the MVA bears the costs of interviews and drive tests. Excluding equipment, facilities, and miscellaneous overhead expenses, an estimate of the cost-per-driver to administer these procedures calculated just in terms of the associated labor costs of agency personnel may be derived.

According to the MVA,[4] two Driver License Examiner-level staff at fully loaded rates of $20/hr and one physician at a rate of $100/hr are involved in each driver interview. The DLE's perform scheduling, coordination, and record keeping activities that require one-third hour each per driver, while one-half hour of the physician's time is engaged in preparations for and interaction with each driver interviewed. Together, these labor costs total an estimated $63.20 per driver. Each closed course drive test, by comparison, can be performed by a single DLE; this activity requires one-third hour, at an estimated cost of $6.67 per driver.

It is important to note that the closed-course drive test used by the Maryland MVA was developed to provide assurance that novice drivers could demonstrate basic competency in handling a vehicle. It may therefore be suited to assessing maneuvering skills, but insufficient to determine whether a driver is able to meet the attentional and perceptual-cognitive demands experienced across a range of traffic conditions encountered in everyday driving. For this reason, the MVA in some instances applies a road test, in traffic, to reach a fitness-to-drive determination; this requires between 45 to 60 minutes of DLE labor, or $15 to $20 per driver tested.[4]

To calculate the overall cost experienced by the MVA for interviews and (closed-course) drive tests to reach a disposition of cases initially placed on "HOLD" pending further information, both the number of "HOLD" cases and the percentage of cases that receive an interview alone, versus an interview-plus-drive test, must be specified. Historically, roughly 30 percent of all cases referred for medical review result in a driver interview, and approximately one-third of those interviewed, or 10 percent of cases, also require a drive test before a disposition can be reached.[5] Per 1,000 drivers who are referred under current agency practices for a medical determination of fitness-to-drive, then, it is expected that 300 will be interviewed at an aggregate (labor) cost of $18,960, and that 100 of these will also receive a (closed-course) drive test at an aggregate (labor) cost of $667. A conservative estimate of the supplemental cost to the MVA to reach a disposition of cases placed on "HOLD" status after their initial review by the MAB, which *does not include* any costs for on-road assessments, is therefore $19,627.

As reported earlier, Pilot Study results point to an expected 38 percent reduction in the number of drivers referred for medical evaluation that will be placed on "HOLD" status if physicians are provided with functional capacity screening data at the time of initial review. This translates to a savings of $7,458 using the figures developed in the paragraph above. According to the cost analysis described in Volume 2 of this report, it was concluded that the cost-per-driver to conduct functional screening in a production environment could be brought down to a five dollar ($5.00) range allowing for automation of certain test procedures performed manually in the Pilot Study. Per 1,000 drivers, an aggregate cost of $5,000 to perform functional screening therefore yields an *estimated net reduction* in costs experienced by the MVA of nearly $2,500.

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[4] *pers. comm.*, Mr. Jack Joyce, Senior Research Associate, Office of Driver Safety Research, Maryland Motor Vehicle Administration, August 23, 2002.
[5] *pers. comm..*, Dr. Robert Raleigh, Chief, Medical Advisory Board, Maryland Motor Vehicle Administration, January 20, 2002.

It is understandable, given these findings, that the MVA will extend functional screening beyond the term of the Pilot Study for all drivers referred for medical determination of fitness to drive. But can a cost-benefit analysis justify functional screening for *all* renewing drivers?

Again relying on Maryland Motor Vehicle Administration data, to perform functional capacity screening for all 36,500 annually renewing customers age 75 and older would cost the agency—using optimistic but defensible projections—something approaching $200,000, in round numbers. Obviously, only a portion of this sum would be offset by increased efficiencies of the nature described above; this amount would depend, at least in part, on the percentage of this population cohort who would be expected to be referred to the agency for medical evaluation through the various existing mechanisms. The greater problem, though, is that this entire line of inquiry is constrained by adherence to an *intervention* model governing policy and practices in the area of medical fitness to drive. All of the drivers who were subjects of the preceding analysis have already manifested problems of sufficient magnitude, that one or more referring parties judged the individuals' safety and the safety of others to be at <u>immediate risk</u>.

When screening is performed "across the board," for a designated cohort of drivers, the most profound benefits are foreseen within the context of a *prevention* model. Functional screening not only improves the detection of impairments signifying immediate risk, but also provides individuals and their health care professionals with early warning of functional decline in the abilities needed to drive safely. This can only enhance the potential for remediation of a wide range of deficits, resulting in more older persons driving safely longer, if they choose to do so. According to recent NHTSA estimates, the overall cost to society of a single traffic fatality or critical injury approximates $1 million (cf. Blincoe, Seay, Zaloshnja, Romano, Luchter, and Spicer, 2002), which significantly exceeds the projected expense of implementing a driver screening and evaluation program in all but the largest states. Additional and very substantial benefits to society will accrue from the lower levels of assistance that must be provided to an elderly population that remains independently mobile. Benefits to individuals from meeting their own transportation needs with dignity, meanwhile, are incalculable.

Finally, the considerations detailed above do not speak to the costs *or* benefits of conducting screening activities in health care, social service or other settings, with results submitted to the DMV according to an established protocol with safeguards to ensure data quality, confidentiality, etc. These and other ways in which prevention and intervention components could be integrated into a Model Driver Screening and Evaluation Program are examined in the following discussion.

CHAPTER 6: DISCUSSION AND MODEL PROGRAM RECOMMENDATIONS

The underlying premise for this research is that driving while impaired due to declining functional abilities defines an emerging public health priority. This is borne out by the surge in population of our nation's oldest citizens, their continuing reliance on private automobiles to meet essential transportation needs, and—as underscored by the present findings—the increasing odds of serious violations and crashes associated with the loss of functional abilities that decline with advancing age. In response, this project has investigated the validity and administrative feasibility of specific practices designed to promote safe mobility for older people and all people in the U.S. Project results support recommendations for an integrated set of functional testing, education, counseling, and referral-and-remediation activities collectively labeled the NHTSA "Model Driver Screening and Evaluation Program."

A starting point is the education/outreach component of the Model Program. There is a universal need for improved awareness of the relationship between functional decline and the risk of injury to older drivers themselves. With greater involvement in serious violations and crashes, and a higher vulnerability to injury and death due to their frailty, older drivers and their families are a primary audience for safety materials explaining why it is important to detect changes in specific functional abilities, how to self-test these abilities, and what can be done to adjust one's driving habits to compensate for functional loss. The "*How Is Your Driving Health?*" brochure developed as a product of this research (see appendix C) may be recommended for distribution in public and private sector settings, including Senior Centers and other social service settings visited by older persons and/or their adult children. This brochure can also be used to complement the exemplary community outreach activities in this area already initiated in certain jurisdictions around the country.[1]

Education and outreach activities directed to physicians, occupational therapists, and other professionals in the health care community are also critical. Older persons, when asked who they trust the most to give them advice about fitness to drive, and whose advice to restrict or cease driving they would most likely heed, typically name their personal physician. In addition, physicians have been sensitized to issues relating to medical fitness-to-drive due to changes in States' reporting laws or in the enforcement of those laws in some jurisdictions,[2] as well as new guidance from the American Medical Association in this area.[3] But, in many cases these professionals require a better understanding of the driving impairments resulting from functional loss associated with specific medical conditions; also, they may find that the screening tools examined in this research are useful in helping to assess their older patients' fitness-to-drive.

The results of the Maryland Pilot Older Driver Study have been offered as evidence that functional capacity screening to detect deficits in the abilities most important for safe driving can be performed, practically and reliably, in a variety of (office) environments. Granting the use of

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[1]e.g., *The Safe Riders Program for Older Adults* developed by the Texas Department of Health in conjunction with the Texas Department of Transportation, Randall D. Deavers, M.S., Coordinator.

[2]An information campaign in Pennsylvania emphasizing the legal consequences of failure to report impaired drivers resulted in a four-fold increase in the number of physician reports, of whom 72 percent had impairments significant enough to merit temporary or permanent recall of their driving privileges.

[3]American Medical Association Council on Ethical and Judicial Affairs, Report on Impaired Drivers, December, 1999.

automated testing procedures to acquire the screening data, wherever possible, a cost-per-driver at or below five dollars ($5) including administrative and support services may be projected with confidence. The Pilot Study analyses, building on the earlier synthesis of technical information documented in the *Annotated Research Compendium*, have targeted the domains of visual, mental, and physical ability shown in table 3 as measurement priorities in a screening program. The approximate duration of testing is also noted in this table.

Table 3. Measurement priorities in a functional capacity screening program for drivers.

Targeted Functional Ability	Test Method and Duration of Testing
1. Visual Acuity (Near *and* Far)	Manual Test Administration: 1 minute Automated Test Equipment: 1 minute
2. Visual Contrast Sensitivity	Manual Test Administration: 1 minute Automated Test Equipment: 1 minute
3. Field of View	Automated Test Equipment: 1 minute
4. Working Memory	Manual Test Administration: 1 minute
5. Directed Visual Search	Manual Test Administration: 6 minutes Automated Test Equipment: 3 minutes
6. Visual (Divided) Attention Processing Speed	Automated Test Equipment: 4 minutes
7. Visualization of Missing Information	Manual Test Administration: 3 minutes Automated Test Equipment: 3 minutes
8. Lower Limb Strength and Mobility	Manual Test Administration: < 1 minute
9. Head-Neck Rotation	Manual Test Administration: < 1 minute

Recommended vision tests include the measurement of (1) *near* and *far acuity* and (2) *contrast sensitivity*, and testing for (3) *visual field loss*. These visual functions help determine how well and under what conditions a person can sense objects in the roadway environment. As performance in visual function declines, the probability that hazards, traffic control messages, navigational cues and other safety-critical information will be detected early enough so that a driver can understand and apply the information to maneuver safely falls to an unacceptably low level.

Both manual and automated techniques that are effective for performing acuity and contrast sensitivity testing are commercially available. In the latter case, both standalone testing machines and computer-based testing programs are available; respectively, these require proper maintenance and careful adherence to instructions regarding viewing distance and control over ambient lighting conditions. These same concerns also apply with manual techniques (e.g., wall charts). Testing for limitations in visual field size is more difficult. Manual (sometimes called "confrontational") techniques are notoriously unreliable. While vendors of standalone vision testing machines commonly advertise this measurement capability, a clinical (ophthalmological) perimetry evaluation is most reliable.

Recommended tests of mental functions include the measurement of (1) *working memory* plus (2) *visual (divided) attention processing speed*, (3) *directed visual search*, and (4) the ability to *visualize missing information*. These capabilities enable motorists to seek and acquire information needed for everyday driving, to recognize and anticipate safety threats, and to make timely and appropriate maneuver decisions to avoid hazards and conflicts with other road users.

The measurement of working memory, of directed visual search, and of a person's ability to visualize missing information can all be accomplished using manual methods drawn from neuropsychological test batteries. Automated (computer-based) methods are also available, as used in the Maryland Pilot Study. Obtaining manual measures of how fast a driver can divide and switch his or her attention is problematic, however. Because response times are measured in fractions of a second, only computer-based testing of this ability is feasible.

Recommended tests of physical ability include tests of drivers' (1) *lower limb strength and mobility* and (2) their *head-neck rotation* capability. Measures of the former ability predict how quickly a driver can move his or her foot from the accelerator to the brake in an emergency situation, while the latter ability influences how well the driver can scan the environment for conflicts, especially at intersections and when merging or changing lanes.

The Summary and Conclusions chapter in Volume 2 of this report emphasizes that the present research findings, while highlighting the most important domains of functional ability to measure in a driver screening program, leaves open the question of the "best" measurement techniques. The procedures described in Volume 2 were selected based on practical as well as scientific considerations; while the specific screening techniques applied in the Pilot Study are represented here as effective options to accomplish the recommended measures of functional status, they are not represented as the *only* options. This is an active area of research and development, where it is more likely a question of "when" than "if" more cost-effective testing methods become available. It is recommended that interested readers contact NHTSA staff in this program area to learn about currently available measurement options.

Regardless of the specific method(s) applied to determine a driver's functional status, the role of screening as envisioned in the Model Program remains constant: *Screening outcomes serve as a trigger for other educational, counseling, referral, or diagnostic evaluation activities, <u>not</u> as grounds, in themselves, for any licensing decision or action.*

Based on the interpretation of broad trends in the screening data analysis results from the Maryland Pilot Study (see Volume 2), the results of screening procedures should be used to assign a driver to a low versus a high priority for further evaluation. This assignment, in turn, will reflect two different performance thresholds or "cutpoints" for each measure of functional ability included in a screening battery. These respective cutpoints connote an emphasis on *prevention* versus *intervention* activities at different levels of functional loss, as diagrammed in figure 2.

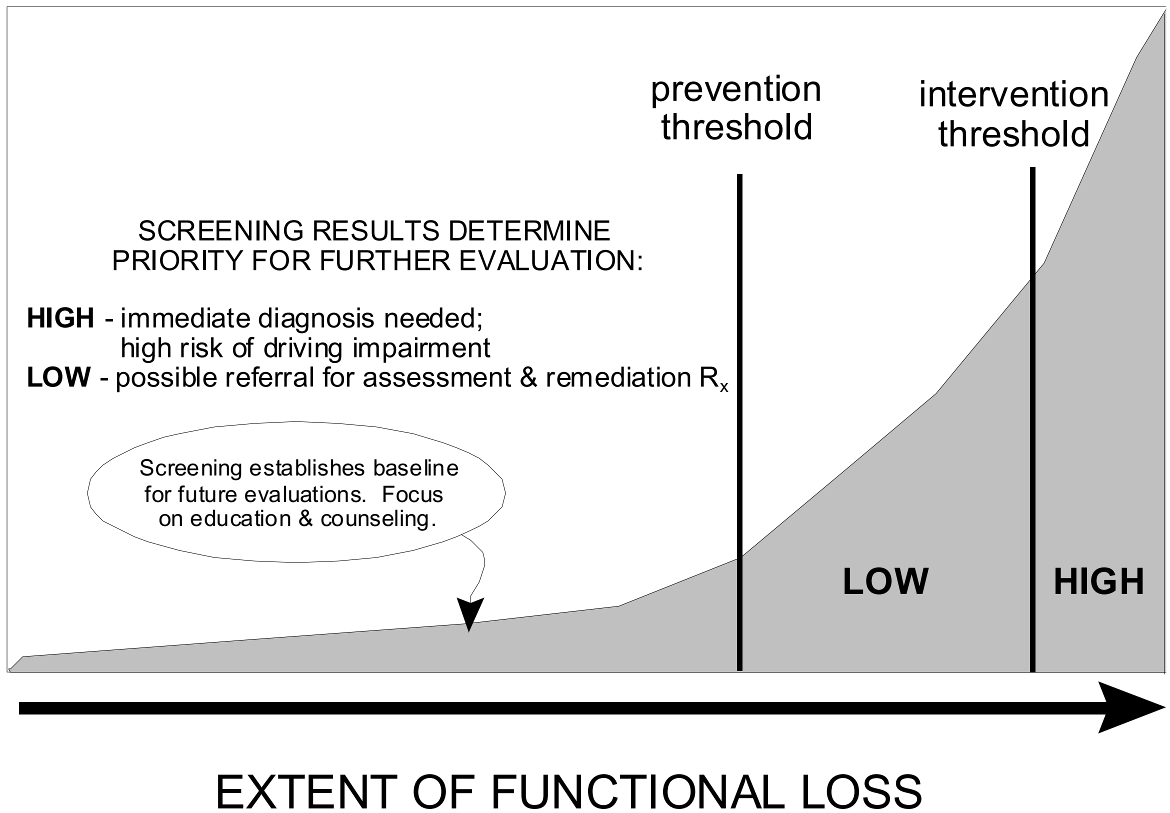

Figure 2. Multiple cutpoints established for prevention and intervention activities, depending upon the extent of functional loss.

Within this framework, individuals who score above (i.e., those who perform *better than*) the "prevention threshold" on all functional measures in the screening battery effectively receive a clean bill of health. For these persons, a functional performance baseline will be established against which future decline may be monitored. This may be accomplished through screening by a licensing agency as part of the renewal process; through testing by others, in particular physicians and other health care providers; or by self-testing. Educational materials should be provided to these intact, healthy individuals to underscore the importance of early detection of functional loss.

In the Model Program, individuals who score below the "prevention threshold" on one or more functional measures in the driver screening battery would receive further evaluation. It is assumed that these evaluations would either be performed by a licensing agency, or by others acting in accordance with procedural guidelines and requirements established by a licensing agency. The nature and the urgency of such evaluations would depend upon *how far below* this threshold a driver scores. If an individual scores below the "prevention threshold" but above a second cutpoint connoting an "intervention threshold," he or she has the lowest priority for further evaluation. It is at this point that the opportunities for remediation or to make changes in driving habits to keep driving safely longer are greatest.

Individuals having the highest priority for further evaluation are those who not only score below the "prevention threshold," but also fail to perform at or above the lower cutpoint, or "intervention threshold." This cutpoint connotes a more advanced stage of decline on one or more functional measures, where immediate diagnostic testing is necessary for the protection of both the individual and the general public, and the risk of driving impairment is high.

Establishing the cutpoint scores identifying a "prevention threshold" and an "intervention threshold" is obviously a key aspect of any driver screening program. These scores should reflect analyses of very large, population-based samples that provide an accurate understanding of *(a)* how functional abilities change with normal aging, and *(b)* the extent to which functional decline can be related to motor vehicle crash involvement, in particular "at fault" crash involvement. The analyses performed and the [MaryPODS] database developed in the Pilot Study represent an important step in this process; but, they must be augmented with more data—ideally including analyses based on *longitudinal* study of functional status predictors versus safety outcome criteria—before a more definitive assignment of cutpoints will be permitted. In the interim, candidate cutpoint values for the specific screening measures investigated in the Pilot Study can be found in Volume 2. As before, it is recommended that interested readers consult a NHTSA program officer with responsibilities in this area, to get an update about the current state-of-the-knowledge.

To adhere to a core objective in the Model Program to *keep people driving safely longer*, the prospect of functional capacity screening with a potential for subsequent diagnostic assessment should lead, as often as possible, to adaptive or remedial strategies. In this regard, the availability of counseling services to help explain test results and answer drivers' questions about what to do next is a necessary accompaniment to functional screening, wherever it is performed.

In the Pilot Study, counseling services, employing occupational therapists, were provided only for the sample of drivers screened at Leisure World—although this was a central element planned for the program activities introduced briefly but then discontinued at the Howard County Area Agency on Aging (Senior Centers). The cost-benefit relationships considered in this report posit counseling for at least a subset of individuals who are impaired with respect to one or more safe driving abilities. These individuals need some appraisal—even when further evaluation is pending—of whether continued driving, albeit with restrictions, is an option. If so, the nature of the restrictions the DMV might impose, and their impact on the driver's mobility and quality of life should be discussed. If continued driving depends upon remediation of a functional deficit, the nature and amount of time required to complete the remediation, its eligibility for coverage under Medicare or other insurance, and its prospects of restoring full or partial driving privileges should be addressed empathetically but realistically. A useful resource in these subject areas is provided by the *Safe Mobility for Older Persons Notebook* completed in this project.

Counseling is most critical for persons determined through screening and assessment activities to be at too high a risk of impairment to continue driving, and for whom there is no realistic potential for remediation of functional deficits. These individuals must be "connected" to alternative transportation options in the community. Alternative transportation provides the "safety net" that allows individuals who cannot or choose not to continue driving to maintain the dignity and quality of life afforded by independent mobility. It may be noted that in the vast majority of cases an older person who ceases driving will *not* choose to use a publicly-funded alternative transportation option, whether fixed-route or demand-responsive (e.g., paratransit). Connecting persons in need of alternative transportation to appropriate providers thus begins with accurate and up-to-date information describing public and private options, the names and numbers of contact persons, hours of service, fees, and restrictions, if any, on the availability and nature of service. For example, door-to-door services must be distinguished from curb-to-curb services. Though outside the scope of the present research, the need under the Model Program to acquire and regularly update such information on a city, county, and regional basis cannot be emphasized too strongly.

Perhaps most daunting is the challenge of translating the various program components identified in this chapter into a real-world application; to move from an abstract, disassociated discussion of recommended practices to a fully-integrated infrastructure of people and processes sufficient to accomplish the stated goals of the Model Program. For practical purposes, it must be assumed that a significant number, if not all, of the functional screening, education and counseling, and referral-for-remediation components referenced herein will fall under the purview of a motor vehicle administration or DMV. Following the experience of the Pilot Study, it will be further assumed that a Medical Advisory Board or similar entity in a given jurisdiction will be the key organizational unit for coordinating and carrying out driver screening and evaluation program activities.

Within that context, a framework for evaluating a person's medical fitness to drive is shown in figure 3. This model closely parallels the operations that have been put in place in the State of Maryland, in large part as the result of this research. Certainly we recognize that each jurisdiction engaged in driver screening and evaluation activities will face different challenges in delivering services that are both cost-effective and acceptable to the public, and will develop somewhat different solutions. At the same time, lessons learned in the Maryland Pilot Study suggest a general framework for program organization and flow of program operations that should broadly benefit all jurisdictions in meeting common safety and mobility goals. These lessons learned are embodied in a pending publication, *Model Driver Screening and Evaluation Program: Guidelines for Motor Vehicle Administrators* (NHTSA, 2002).

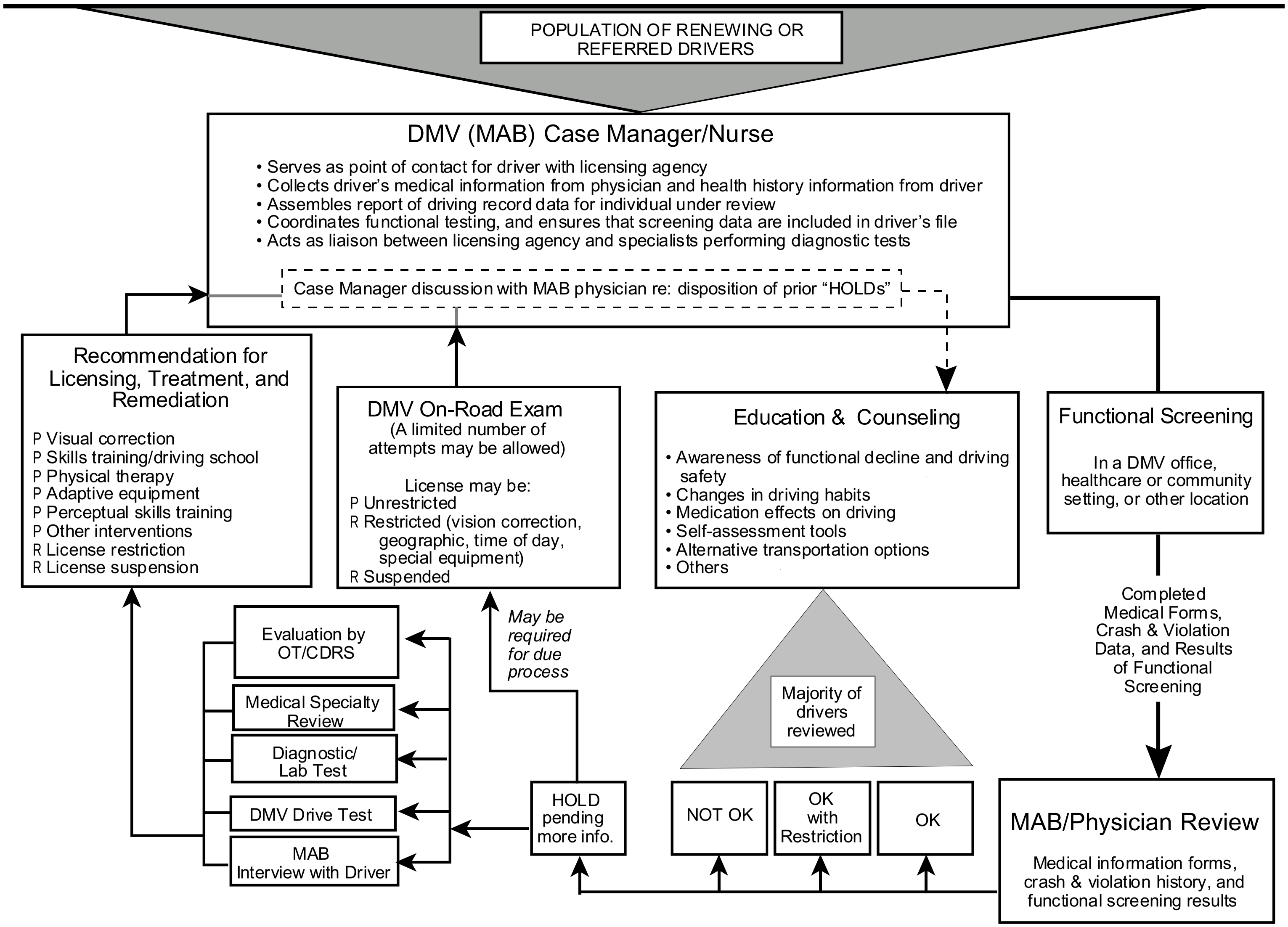

Figure 3. Framework for evaluating fitness to drive.

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APPENDIX A: STEP 3 RESPONSES BY DELPHI PANEL OF EXPERTS

Table 4. Step 3 responses for Sensory (Visual) Processes Delphi, where each cell addresses minimum performance requirements for a critical dimension of functional capability (A. - D.) in an identified driving situation (I. - IV.).

Driving Situation	Measure of Functional Capability: Sensory (Visual) Processes A. Static Acuity (photopic)	B. Static Acuity (low luminance: mesopic)	C. Static Contrast Sensitivity	D. Visual Field Sensitivity
I. High Speed/High Complexity (e.g., Principal Arterials)	20/40 20/40 20/40 20/40 20/40	20/50 20/80 20/100 20/60 < 20/80	CS=30 @15 cpd 1.5 log CS 1.35 log CS 1.4 log CS < 1.35 log CS on Pelli Robson Chart	120E total (high contrast spot) 120E total 120E total H120ExV90E total 120E total
II. High Speed/Low Complexity (e.g., Freeways)	20/40 20/60 20/60 20/60 20/40	20/50 20/120 20/100 20/80 <20/80	CS=30 @15 cpd 1.2 log CS 1.35 log CS 1.4 log CS < 1.35 log CS	120E total (high contrast spot) 120E total 120E total H120ExV90E total 120E total
III. Low Speed/High Complexity (e.g., Downtown Streets)	20/60 20/40 20/40 20/60 20/40	20/75 20/80 20/100 20/80 <20/100	CS=20 @15 cpd 1.5 log CS 1.35 log CS 1.4 log CS < 1.35 log CS	140E total (high contrast spot) 90E total 120E total 120E total (60E monocular) 120E total
IV. Low Speed/Low Complexity (e.g., Residential Streets)	20/60 20/80 20/60 20/60 20/60	20/75 20/160 20/100 20/100 <20/100	CS=20 @15 cpd 1.2 log CS 1.35 log CS 1.4 log CS < 1.20 log CS	140E total (high contrast spot) 90E total 120E total 120E total (60E monocular) 120E total

Table 5. Step 3 responses for Medical Factors/Dementia Delphi, where each cell addresses minimum performance requirements for a critical dimension of functional capability (A. - C.) in an identified driving situation (I. - IV.)

Driving Situation	Measure of Functional Capability: Medical Factors/Dementia A. General Cognitive Function	B. AExecutive Functioning@: (e.g., planning, reasoning, and decision making)	C. Coordination of Motor Processes: [e.g., hand /eye (tracking) and coordination of legs to control brake and accelerator]
I. High Speed/High Complexity (e.g., Principal Arterials)	• Mini-Mental Status Examination (MMSE) < 18 • MMSE = 24 • Modified Mini-Mental Status Examination (3MS) = 80/100 • Trails B completed in 90 s • Short Blessed Test with cutoff score =8 • Traffic Sign Recognition Tests • MMSE: to pass screen, S must score at least 24, <u>and</u> get item 30 correct as well as all 3 of the 3 memory tasks correct • MMSE with cutpoint <18 or <24	• Trails B completed correctly by 300 sec • Trails B, score 2 sd below the mean for age-appropriate samples • Number Cancellation, score 2 sd below the mean for age-appropriate samples • Standardized road test or simulation (e.g., Wash. Univ. Road Test) • Trails B: Time to complete = 1 sd below the mean if used in license setting as a trigger for further clinical assessment; 2 s.d. below the mean if used as the stand-alone determination of impairment in license setting. • Trails B: > 2 sd above (worse) age and education adjusted normative values for more exclusive criterion, >1 sd above adjusted normative values for more inclusive criterion.	• Foot-Tapping Speed 2.5 sd below normal mean = ? rate • Grooved Peg Board: dominant hand = 150 sec; non-dominant hand = 178 sec. • Purdue Pegboard, score 2 sd below mean on age-appropriate norms • Road test or simulator to test coordination of legs to control brake & accelerator • Hand/Eye Coordination - Grooved pegboard; Mobility - Gait Speed. Cutpoints > 2 s.d. above (worse) than age appropriate norms for more exclusive; > 1 s.d. above norms for more inclusive criterion.

Table 5 (continued). Step 3 responses for Medical Factors/Dementia Delphi, where each cell addresses minimum performance requirements for a critical dimension of functional capability (A. - C.) in an identified driving situation (I. - IV.)

Driving Situation	Measure of Functional Capability: Medical Factors/Dementia		
	A. General Cognitive Function	B. AExecutive Functioning@: (e.g., planning, reasoning, and decision making)	C. Coordination of Motor Processes: [e.g., hand /eye (tracking) and coordination of legs to control brake and accelerator]
II. High Speed/Low Complexity (e.g., Freeways)	• MMSE < 18 • MMSE ≤ 17 • 3MS = 75/100	• Trails B completed correctly by 300 sec • Trails B, score 2 sd below the mean • Number Cancellation, score 2 sd below the mean	• Foot-Tapping Speed 2.5 sd below mean • Grooved Peg Board: dominant hand = 150 sec; non-dominant hand = 178 sec. • Purdue Pegboard, score 2 sd below mean
III. Low Speed/High Complexity (e.g., Downtown Streets)	• MMSE < 18 • MMSE ≤ 17 • 3MS = 75/100	• Trails B completed correctly by 300 sec • Trails B, score 2 sd below the mean • Number Cancellation, score 2 sd below the mean	• Foot-Tapping Speed 2.5 sd below mean • Grooved Peg Board: dominant hand = 150 sec; non-dominant hand = 178 sec. • Purdue Pegboard, score 2 sd below mean
IV. Low Speed/Low Complexity (e.g., Residential Streets)	• MMSE < 18 • MMSE ≤ 17 • 3MS = 75/100 Trails B completed in 120 s.	• Trails B completed correctly by 300 sec • Trails B, score 2 sd below the mean • Number Cancellation, score 2 sd below the mean	• Foot-Tapping Speed 2.5 sd below mean • Grooved Peg Board: dominant hand = 150 sec; non-dominant hand = 178 sec. • Purdue Pegboard, score 2 sd below mean

APPENDIX B: AAMVA/NHTSA SURVEY OF STATES/PROVINCES ON AMODEL DRIVER SCREENING/EVALUATION PROGRAM@ DEVELOPMENT

(1) Is it your sense that new/expanded driver screening procedures, *if* implemented in your jurisdiction, should be applied to (a) *all* drivers over a specified age who apply for license renewal, (b) only a Ahigh risk@ subgroup of drivers, likely to include a disproportionate share of older persons, who are brought to the DMV=s attention through various referral mechanisms, or (c) both of these sets of drivers?

Check one only: a. ________ b.________ c. _________

(2) Please base your responses to the following items on your answer to Question (1) above. Postponing considerations of the cost (of testing equipment and/or test administrators) and time required to conduct test procedures for drivers referred into a Model Screening/Evaluation Program, is it your sense that current policies and priorities in your Department would be make it feasible to:

a. Extend the practice of Agraduated licensing,@ which many states have applied to Aphase in@ full privileges for the novice driver, to the older driver as well, by implementing progressively more restrictive licensing actions as an individual=s capabilities suffer progressive decline? Would this require a change in legislation?	YES ___ ___	NO ___ ___
b. Implement a community outreach/public education activity for drivers that would provide information on aging and safe driving practices, techniques for self testing (which could also encourage individuals to refer *themselves* into a screening/evaluation program), and, when needed, provide advice on transportation alternatives in the individual=s home area?	YES ___	NO ___
c. Implement screening/evaluation program activities wholly within the DMV, or privatize some or all license qualification assessments for passenger vehicles (assuming that standard, certified procedures are implemented uniformly throughout your jurisdiction)? *DMV provides all screening activities* *DMV provides some screening activities; some are privatized* *All screening activities are privatized*	YES ___ ___ ___	NO ____ ____ ____
d. Modify existing vision test procedures for drivers who have been referred to the DMV for functional impairment screening, such that acuity is measured using new techniques, provided that they are more accurate and/or reliable?	YES ___	NO ___
e. Modify existing vision test criteria such that lower levels of performance (e.g., 20/80, 20/100, or worse) do not necessarily result in the loss of all driving privileges, but instead may result in restrictions (such as daylight only driving)?	YES ___	NO ___
f. Expand vision test procedures to include abilities which are not presently tested (dynamic visual acuity; contrast sensitivity; low luminance acuity) but which have been shown in research to be more strongly related to crash risk than the present (static) visual acuity measure?	YES ___	NO ___

g.	Adopt criteria for functional capabilities *other than* vision as the basis for licensing action (restriction or revocation), which would include--though not necessarily be limited to--measures of attention, perception (of speed and distance relationships), memory and cognition, decision making, navigational problem solving, or Asituational awareness@?	YES ___	NO ___
h.	Conduct tests to assess functional capabilities for individuals referred into a screening/evaluation program, regardless of when this occurs in the driver=s renewal cycle, i.e., without waiting until the end of the current cycle for removal or restriction of driving privileges if warranted by test results?	YES ___	NO ___
i.	Conform to uniform (national/ North American) standards--to be developed-- for referral of drivers into a screening/evaluation program based on the diagnosis of medical conditions including, though not necessarily limited to, dementia (Alzheimer=s and other dementias); stroke; Parkinson=s disease; seizure disorders; diabetes; heart disease, arrhythmias, and related cardiovascular conditions.	YES ___	NO ___
j.	Tailor retesting requirements (nature and frequency) for license renewal or retention of driving privileges to specific medical conditions (e.g., Alzheimer=s, Parkinson=s, diabetes), for physician referrals or self reports of medical conditions to the DMV ?	YES ___	NO ___
k.	Refer drivers who are undiagnosed by a physician, but who are believed by family, friends, and/or others in the health care/social services fields to suffer functional impairment, into a screening/evaluation program, which would mandate subsequent functional tests with the potential for licensing action?	YES ___	NO ___
l.	Implement a referral mechanism for functional screening/evaluation in which DMV counter personnel use a checklist to record a brief, structured set of observations, and/or question-and-answer responses, for members of the driving public who appear before them?	YES ___	NO ___
m.	Tailor on-road examination procedures for drivers who have been screened for functional impairment, to the specific area of functional decline which places that individual at greater crash risk--i.e., administer road tests with varying content or areas of emphasis for varying impairments?	YES ___	NO ___

(3) With specific regard to the cost of new test procedures, to what extent would such costs have to be offset by savings in other Department activities within the short term (present or next fiscal year) to permit implementation? (Check one response):

____ a. Substantially or completely (100 percent, or close to it) regardless of expected payoffs in improved safety.
____ b. To a significant extent (50 percent or greater) but not completely, given a solid expectation of measurable safety benefits.
____ c. Only minimally, or not at all (less than 50 percent, down to zero) if significant safety benefits have been demonstrated in another state or a pilot program.

(4) With specific regard to the administration of functional testing requirements as addressed in this survey, what is the practical upper limit on the time of testing within your jurisdiction? (Check one response):

____ a. under 15 minutes
____ b. 15 to 30 minutes
____ c. 30 to 45 minutes
____ d. 45 minutes to 1 hour (or no limit)

DON=T IGNORE THE WARNING SIGNS

HAS THIS HAPPENED TO YOU?

- A friend or family member has expressed concern about your driving.
- You sometimes get lost while driving on routes that were once familiar.
- You have been pulled over by a police officer and warned of poor driving behavior, regardless of whether or not you received a ticket.
- You have had several moving violations, near misses, or actual crashes in the past three years.
- Your doctor or other health care giver has advised you to restrict or stop driving.

C C

✔ Listen to what people tell you who know you best and care the most about you.

✔ Discuss driving with your doctor--he or she can evaluate the interactions and side effects of all the medications you may be taking.

✔ Refresh your knowledge of safe driving practices and learn about new traffic control & roadway design features through a mature driver class.

✔ Begin planning for alternative ways of meeting your mobility needs. Now is the time to learn about mobility options in your community -- try them out...see what works best for you.

SELF AWARENESS: THE KEY TO SAFE DRIVING

While we all want to keep driving for as long we can, none of us wants to be a threat to ourselves or to others because we are no longer able to drive safely. A leading cause of accidental death among older persons is automobile crashes.

C ✷ C

It=s important to remember that most seniors *are* capable, and have a lifetime of valuable driving experience. Decisions about a person=s ability to drive should never be based on age alone.

C ✷ C

Fortunately, most seniors take appropriate steps when they detect a problem with their driving. But it=s not always obvious when a general health problem, vision problem, or a side effect of medications will lead to a driving impairment.

C ✷ C

Self awareness is the key. People who can accurately assess their fitness to drive can adjust their driving habits, and stay safe on the road. They will retain the personal mobility that comes with driving, while limiting the risks to themselves and to others.

C ✷ C

This brochure can increase your awareness about different problems that lead to unsafe driving. It also gives you tips to help keep you behind the wheel. For more information, contact:

To find a driver rehabilitation specialist in your area:

$Association for Driver Rehabilitation Specialists (ADED)
(608) 884-8833, www.driver-ed.org

$American Occupational Therapy Association
(301) 652-2682, www.aota.org

To find a mature driver education class in your area:

$AARP/55-Alive. 1-888-AARP-NOW (1-888-227-7669)

$ AAA Safe Driving for Mature Drivers
(Call your local AAA club for availability of classes)

For information about benefits & services for older persons provided by the Agency on Aging in your area:

$ Eldercare Locator 1-800-677-1116
State contact info: www.aoa.gov/aoa/pages/state.html

How Is Your Driving Health?

A Self-Awareness Checklist

&

Tips to Help You Drive Safely Longer

A product promoting *Safe Mobility for Life* from the Maryland Research Consortium on older drivers.

VISION

Good driving health begins with good vision. With declining vision, your responses to signals, signs, and changing traffic conditions become slower, increasing your crash risk.

Warning Signs

$ You have problems reading highway or street signs, or recognizing someone you know across the street.

$ You have trouble seeing lane lines & other pavement markings; curbs & medians; and other vehicles & pedestrians, especially at dawn or dusk, and at night.

$ You are experiencing more discomfort from the glare of oncoming headlights at night.

Tips

Make sure your corrective lenses have a current prescription, and always wear them. If you lose or break your glasses, don=t rely on an old pair; replace them right away with your new prescription.

Do not wear sunglasses or tinted lenses at night. This reduces the amount of light that reaches your eyes, and makes driving much more hazardous.

Keep your windshield and headlights clean, and make sure your headlight aim is checked when your vehicle is inspected.

Sit high enough in your seat so that you can see the road within 10 feet in front of your car. This will make a big difference in reducing the amount of glare you experience from opposing headlights at night. Use a cushion if your car seats don=t have vertical adjustment.

People age 61 and older should see an optometrist or ophthalmologist every year to check for cataracts, glaucoma, macular degeneration, diabetic retinopathy, and other conditions for which we are at greater risk as we grow older.

PHYSICAL FITNESS

Diminished strength, flexibility, and coordination can have a major impact on your ability to control your vehicle in a safe manner.

Warning Signs

$ You have trouble looking over your shoulder to change lanes, or looking left & right to check traffic at intersections.

$ You have trouble moving your foot from the gas to the brake pedal, or turning the steering wheel.

$ You have fallen down to the floor or ground C *not counting a trip or stumble* C once or more in the previous year.

$ You walk less than 1 block per day.

$ You can't raise your arms above your shoulders.

$ You feel pain in your knees, legs, or ankles when going up or down a flight of stairs (10 steps).

Tips

With your doctor=s approval, do some stretching exercises, and start a walking program. Walk around the block, or in a shopping mall. Also, check your local health clubs, YMCAs, senior centers, community colleges, and hospitals for fitness programs geared to the needs of seniors.

Get examined by a podiatrist if you have pain or swelling in your feet. If you have pain or stiffness in your arms, legs, or neck, your doctor may prescribe medication and/or physical therapy.

An occupational therapist or a *certified driving rehabilitation specialist* may be able to prescribe special equipment for your car to make it easier to steer and to use your pedals.

Eliminate your driver=s side blind spot by re-aiming your mirror. First, lean your head against the window, *then* adjust your mirror outward so that when you look at the inside edge you can barely see the side of your car. *If* you use a wide-angle mirror, get *lots* of practice judging distances to other cars before using it in traffic.

ATTENTION AND REACTION TIME

Driving often requires quick reactions to safety threats. As we grow older, it becomes more difficult to divide attention and to make rapid responses.

Warning Signs

$ You feel overwhelmed by all of the signs, signals, markings, pedestrians, and other vehicles that you must pay attention to at intersections.

$ Gaps in traffic are harder to judge, making it more difficult to turn left at intersections, or to merge with traffic when turning right.

$ You take medications that make you drowsy.

$ You often get lost or become disoriented.

$ You aren=t confident that you can handle the demands of high speeds or heavy traffic volumes.

$ You are slower in recognizing cars coming out of driveways or side streets, or realizing that another car has slowed or stopped ahead of you.

Tips

Plan your route. Drive where you are familiar with the road conditions and traffic patterns.

Drive during the day, and avoid rush hours.

A passenger can serve as a Asecond pair of eyes.@ But don=t get distracted in conversation!

When approaching intersections, remember to stay alert for cars and pedestrians entering from the side unexpectedly.

Leave enough distance between you and the car ahead to react to a sudden stop, but understand that *too* large a gap will invite others to cut in front of you in heavy traffic. A gap of 3 seconds or more is most desirable, conditions permitting. Look for a tree, sign, etc. When the car ahead of you passes this point count A1001, 1002, 1003.@ If you can count to 1003 by the time you get to the same point, this equals a 3-second gap.

DOT HS 809 582
May 2003

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