Assessing the Needs of Delaware's Older Drivers

June 2007

prepared for the
Delaware Center for Transportation
and the
Delaware Department of Transportation

Institute for Public Administration
College of Human Services, Education & Public Policy
University of Delaware
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PREFACE

This report was prepared by the Institute for Public Administration (IPA), a unit within the College of Human Services, Education & Public Policy at the University of Delaware. IPA links the research and resources of the University of Delaware with the management and information needs of local, state, and regional governments in the Delaware Valley. IPA provides assistance to agencies and local governments through direct staff assistance and research projects as well as training programs and policy forums. Jerome R. Lewis is the director of IPA.

The research project is a joint project among the University of Delaware's Institute for Public Administration (IPA), the Delaware Center for Transportation (DCT), and the Delaware Department of Transportation (DelDOT). IPA staff members Bernard Dworsky and Julia O'Hanlon served as the Principal Investigators of the project. IPA graduate research assistant Richard Klepner and University of Delaware Engineering students Adam Catherine and Julie Trick also contributed to the project and writing this report. Delaware Department of Transportation (DelDOT) contributors include Mark Luszcz, Anthony Aglio, and Robert Neely. IPA staff member Andrew Homsey and GIS student Xuan Jiang contributed to the development of the GIS maps found in the Appendix. IPA staff member Mark Deshon edited the report and designed its cover.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

In light of Delaware's growing population age 60 and older (60+), it is important to plan for the state's projected increase in older drivers. Information from the United States Census Bureau (2005) indicates that Delaware is projected to have the ninth largest percentage of elderly residents to general population by 2030. Additionally, research from the University of Delaware's Center for Applied Demography and Survey Research (2006) illustrates that Sussex County is projected to experience the most significant percentage growth between 2000 and 2030.

Delaware reflects national trends in terms of its percentage of licensed drivers over the age of 65. According to the Delaware Department of Transportation (2004), in 2003, 15.3 percent of licensed drivers were over the age of 65. Many younger seniors (50-65) prefer to drive, and with few transportation alternatives in the state, dependency of private vehicles is likely to continue. However, factors that pose risks to older drivers include impaired vision, diminished cognition, and decreased motor-function (Carr, Duchek, Meuser, and Morris, 2006).

Current road designs should be reviewed to determine whether modifications are necessary to better accommodate Delaware's older drivers. Possible modifications include making intersections more driver- and pedestrian-friendly and improving traffic signs and signal design. Additionally, comprehensive assessment, education, and outreach programs can assist individuals, families, and physicians facilitate discussions about driving and promote mobility and independence among older Delawareans. Like other states that are addressing this issue, Delaware should apply resources for such modifications and initiatives to areas that pose the greatest safety concerns. Chosen areas should be based on the state's current and projected demographic trends as well as crash data. Better coordination and collaboration among state advocacy groups and agencies will also foster overall improved awareness and education for individuals and their families who are concerned about the potential risks associated with older drivers.

This paper begins with an overview of the issues and implications related to driving and long-term mobility. Sections 1-5 are part of a literature review that includes research studies, case studies, and best practices on subtopics related to older drivers. These subtopics include intersection design, traffic signs and signal design, and education and awareness programs. Finally, Section 6 provides a list of priorities and recommendations for considered by units of the Delaware Department of Transportation (DelDOT) and other state agencies based on the Delaware's demographics trends and current transportation-planning practices and resources.

INTRODUCTION

Overview

Research confirms that mobility is vital to the long-term health and independence of older adults and, therefore, a key factor in maintaining a high quality of life. Given the inverse relationship between transportation options and aging (i.e., transportation options decrease as individuals age), mobility concerns are especially acute for seniors age 65 and older (65+). As described by Giuliano, Hu and Lee (2003), "in a society where the automobile provides a level of mobility unparalleled by any other travel modes, the loss of driving ability dramatically impacts the lifestyle of the elderly."

Driving has always played a critical role in maintaining mobility and independence in many communities throughout the United States (Ball, 2006). The loss of driving privileges, whether by formal loss of license due to expiration, health impairments, or family concerns about the safety of an elderly loved one, may lessen one's accessibility to important social opportunities, work or community activities, and social services (e.g., health care). Therefore, many older adults without a reliable, accessible, and affordable alternative mode of mobility are subject to social isolation, lack of volunteer and economic opportunities, and overall poor health and decreased life expectancy (Giuliano et al., 2003).

Aging-in-Place Phenomenon

"Aging in place" refers to the idea that many older adults wish to remain living in their homes or communities as they age. Aging in the home allows seniors the opportunity to remain in familiar, comfortable surroundings instead of in a nursing or assisted-living setting. Lawler (2001) explains that "increasingly over the last ten years there has been growing acceptance of the idea that older persons do not necessarily need to relocate as their needs change, but can modify their environment by adding supportive services and reconfiguring their residence." Advantages of this phenomenon are that it provides comfortable surroundings for seniors and may lower the overall strain on the healthcare system.

However, a major disadvantage to aging in the home is that many adults have chosen residences in mostly suburban or rural settings, in which they are dependent on a personal vehicle for transportation. Like many states, Delaware has a higher number of individuals living in and moving to less dense, more suburban or rural areas of the state (Jacobson, O'Hanlon, Tuttle, Noonan, 2005). This phenomenon, as described by Rosenbloom (2003), will exacerbate the problem of having to drive to and from places of interest or need.

As seniors age, it may become difficult to maintain their homes and access areas of economic and social interest. Furthermore, suburban areas typically lack mass-transportation alternatives. Once seniors are no longer able to rely on a personal vehicle, many may find themselves "stranded." Currently, many drivers are not planning ahead for potential challenges.

Use of Private Vehicles

For seniors who have committed themselves to aging in their homes, the use of a private vehicle is currently their primary mode of transportation. By 2025, most older adults in the U.S. will have spent their adult life driving to and from places and will be living in homes located where travel by automobile is the only mode of transportation available (Bailey, 2004). Approximately 25 percent of licensed drivers will be 65+ by 2029 (AARP, 2005).

The same hold true in Delaware. According to the Delaware Department of Transportation (2004), in 2003 15.3 percent of licensed drivers were over the age of 65. Older Delawareans, whether as a passenger or a driver, were reported making 89 percent of their trips in a private vehicle (DELDOT, 2004). Based on general feedback from Delaware senior centers, many younger seniors (50-65) prefer to drive to centers to participate in activities and programs.

The overwhelming dependence on a private vehicle by older adults will only increase as baby boomers age. However, age-related cognitive and physical decline pose potential safety concerns and risks to older driver (GAO, 2007). According to Carr, Duchek, Meuser, and Morris (2006), factors that may pose risks to older adults or prevent them from driving include

- Impaired vision
- Diminished cognition
- Decreased motor-function and reaction time
- Increased difficulty maintaining vehicle
- Increasing vehicle congestion and travel speeds

According to Brody (2005), by 2020 more than 40 million American seniors will be licensed drivers and, compared with middle-age drivers, are approximately three times as likely to be involved in a car crash. Older Americans accounted for 12 percent of all traffic fatalities in 2004 (NCSA, 2004). This information is confirmed in a recent report by the U.S General Accountability Office (GAO, 2007).

While many drivers adjust their driving patterns and routines as they age, seniors may find it difficult to gauge when it is no longer safe to continue operating a vehicle. Furthermore, as recognized by AAA's *Roadwise Review* and *CarFit* programs (AAA, 2007), some drivers do not understand or fail to recognize their physical and/or cognitive limits and may even refuse to stop driving.

General Demographic Trends

As the nation's senior population increases, more states are looking at ways to address projected increases in their number of older drivers. Delaware reflects national trends in terms of overall population growth. In addition, many people who are moving to Delaware are choosing to retire in rural Kent and Sussex counties, where longer travel distances are required and access to alternative forms of mass transportation is limited.

Policy Implications and Potential Programs

Results from the 2005 White House Conference on Aging illustrate that senior citizens, their families, as well as advocates and senior service providers, consider elderly mobility a priority. As a result of national lobbying efforts and advocacy initiatives, many states and communities are beginning to carefully look at issues related to older drivers, including road design, travel patterns, safety standards, licensing and testing requirements, and alternative-transportation options. More than half of the states have implemented Federal Highway Administration (FHWA) practices in roadway construction, operations, and maintenance (GAO, 2007). States involved in such activities try to focus on areas that are of highest priority, based on crash data and/or demographic trends; however, many states try to include practices that may benefit older drivers in all of their transportation-related projects (GAO, 2007).

Road design modifications that are being reviewed and tested include the restructuring and designing of markings and curbs, intersection design, and altering the timing of traffic lights and signals. In terms of planning, management, and service delivery, states and communities are reviewing alternative-transportation and mobility options and analyzing the overall effectiveness and efficiencies of specialized transportation systems. However, as indicated by the National Council of State Legislatures (2005), the benefits of various state legislation and approaches to addressing such issues are unclear and somewhat limited in terms of promoting comprehensive services and options. In response to reviewing all states' transportation systems for the elderly, the NCSL (2005) has provided specific recommendations related to the coordination and cost-effectiveness of mobility and transportation services.

Providing safe mobility for older adults is a public policy issue; however, designing and planning requires tremendous intergovernmental coordination, as well as the efforts of a variety of agents and community stakeholders. As the nation's elderly populations continue to increase, meeting the mobility needs of society will call for a comprehensive and strategic plan. Specific approaches and strategies of addressing the increasing number of older drivers will become more important to the health, happiness, and quality of life of residents and their families. Based on its current and projected demographic trends, Delaware can benefit from the review and testing of best practices, research studies, and education programs aimed at addressing safety and mobility issues related to the increasing number of older drivers.

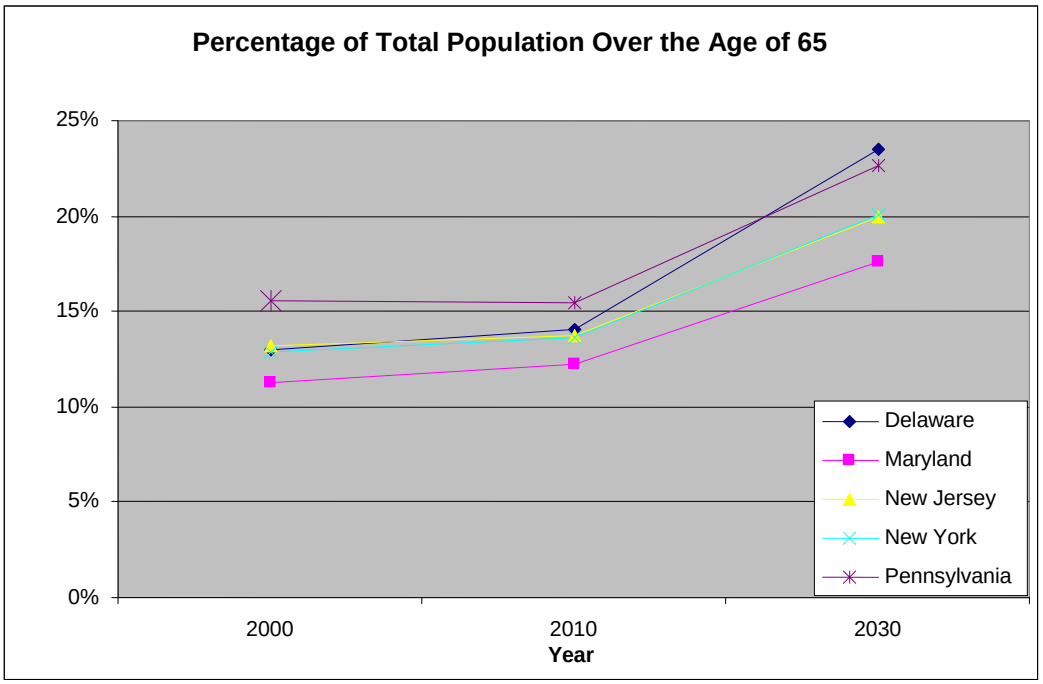
LITERATURE REVIEW

Section 1: Demographics and Statistics Related to Older Drivers

1.1 Overview

Nationally, people are living and driving longer. In 2002, 50 percent of seniors lived in the suburbs, where driving serves as a primary mode of transportation (Jacobson et al., 2001). As reported by the GAO (2007), as people age, their chances of being involved in a fatal crash increase. Individuals age 75+, although involved in fewer crashes than younger drivers, have the highest rate of fatal crashes per mile traveled. Findings based on injury liability claims indicate that older drivers are more likely to be considered "at fault" in accidents (Insurance Institute for Highway Safety, 2003). Seniors also begin to experience physical and cognitive declines, which can influence their driving abilities.

Delaware mirrors the nation in terms of overall current and expected population trends as well as the number of seniors who drive. Compared to its neighboring states, Delaware is projected to experience a significant percentage increase in its elderly population over the next several decades. According to U.S. Census projections (2005), there will be a 133 percent increase in the 65 and older (65+) population in Delaware between 2000 and 2030. Maryland is projected to see a similar increase. Pennsylvania and New Jersey will both experience increases in its elderly population, but with lower percentage increases compared to Delaware.



By 2030, Delaware will only follow Florida, Maine, Wyoming, New Mexico, Montana, North Dakota, West Virginia, and Vermont in terms of its percent of total population age 65 and older (Eggers 2006). In 2000, less than 15 percent of Delaware's total population was in the 65+ population, but by 2030, that percent will climb to 23 percent.

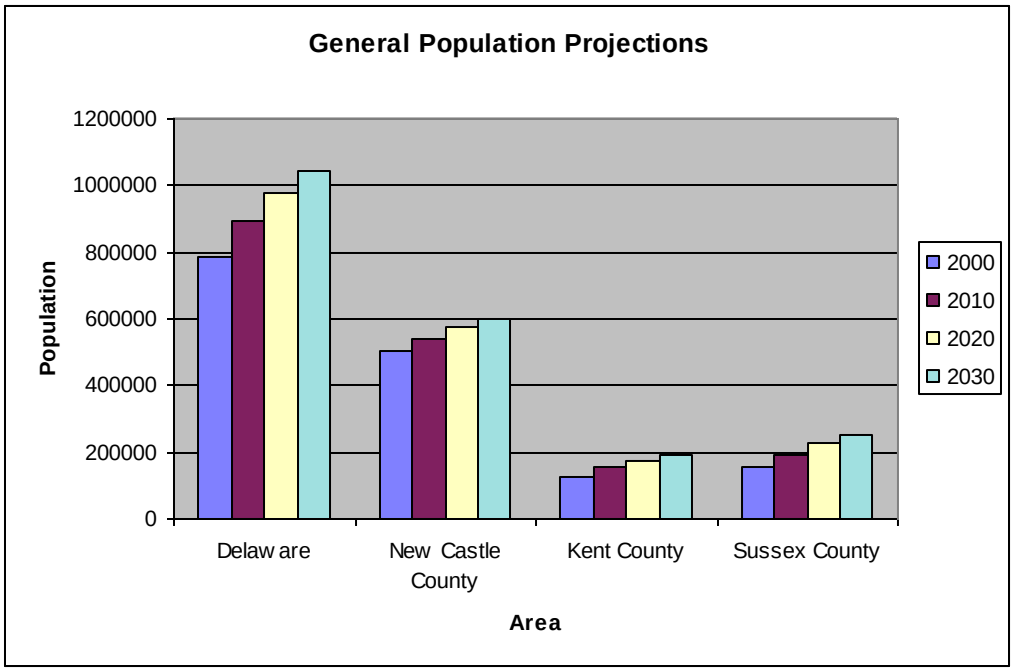
1.2 Why Seniors are Moving to Delaware

There are several reasons why Delaware has become a popular place for seniors. To begin, Delaware has a very favorable tax policy compared to other Mid-Atlantic states. In fact, Delaware was ranked third lowest in the nation by *Kiplinger's Personal Finance Magazine* (1995) for the amount of annual taxes spent by an average elderly couple. This is because Delaware has no sales tax and low property taxes compared to its neighboring states. Pennsylvania ranked 23rd, New York 43rd, Maryland 45th, and New Jersey 49th.

As indicated by *Delaware Real Estate Taxes* (www.delawarerealestatetaxes.com), Delaware also has a favorable climate and relaxed environment. Its climate, coupled with the state's coastal communities, makes Delaware a very popular place to retire. In fact, this helps explain why Sussex and Kent Counties are experiencing a larger percentage increase of seniors compared to New Castle County. Finally, Delaware is within reasonable driving distance of many large and historical cities. For example, New York City, Philadelphia, Washington, D.C., and Baltimore can each be visited in a day.

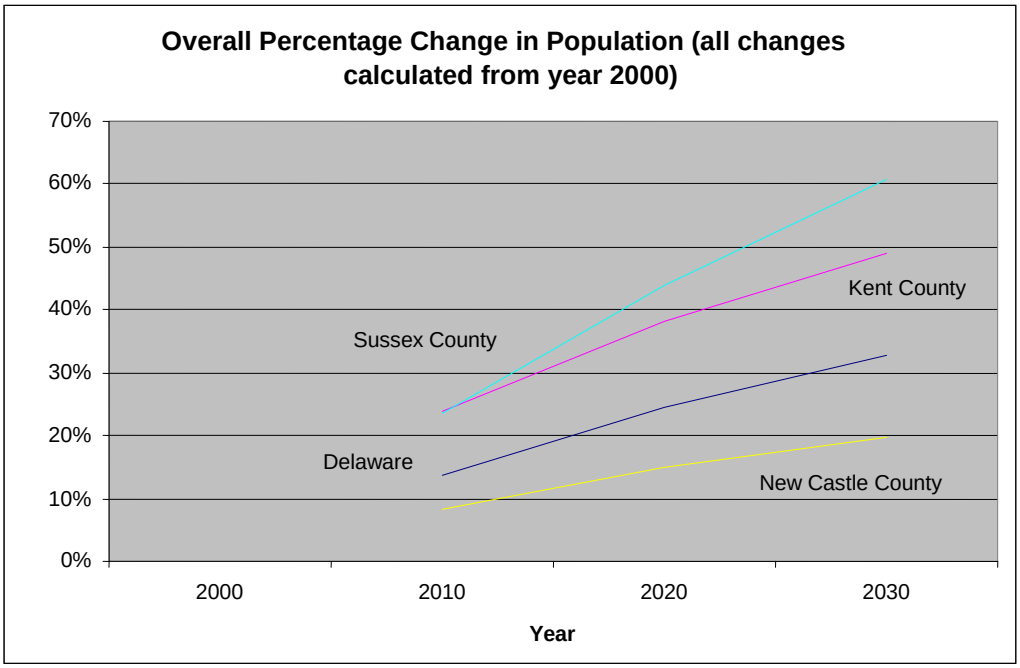
1.3 Review of Delaware's Demographic Projections

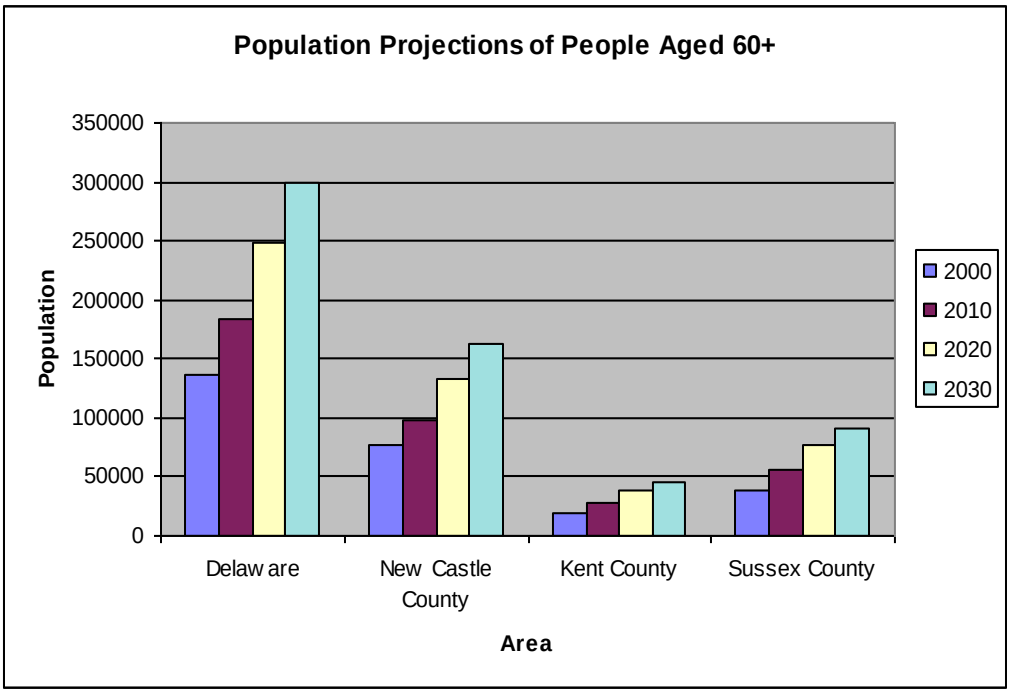
Since this project aims to address issues related the safety and mobility of all Delaware drivers, it is important to understand how the state's overall population will expand. Two issues are of prime importance in addressing estimated increases in Delaware's elderly population. The first is the large number of senior citizens who will continue to reside in New Castle County. The second is the significant increases projected in Kent and Sussex Counties.



Overall, Delaware is projected to have a 33 percent increase between 2000 and 2030. However, Sussex and Kent Counties' population percentage increases are projected to be much higher than the state's percentage, while New Castle County's is projected to be much lower.

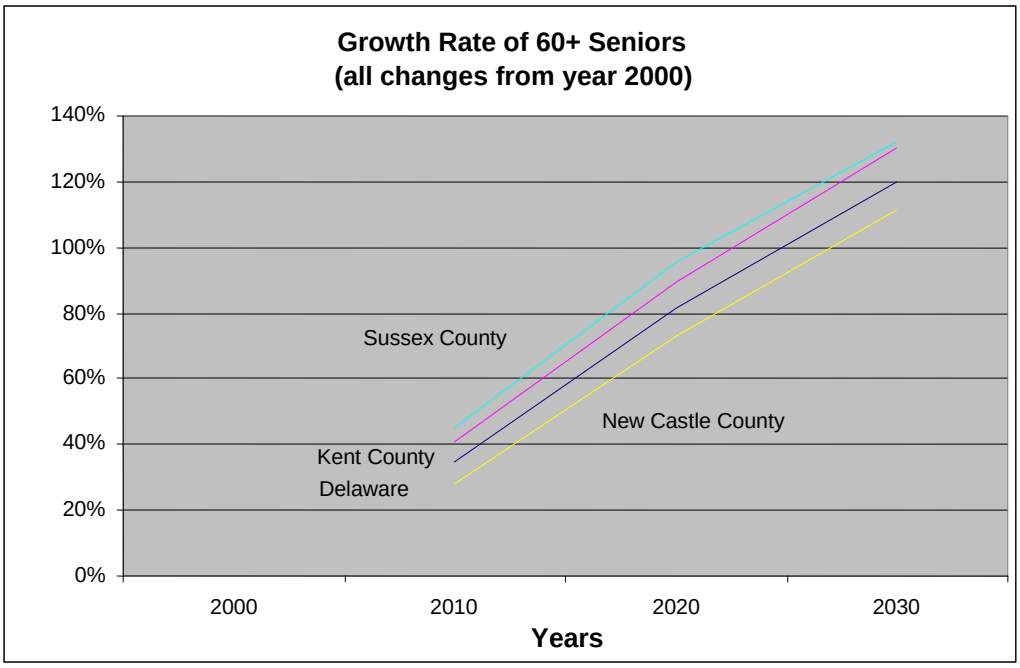
Sussex County is projected to have the most growth during this time period, with a 61 percent increase in total population. Kent County is projected to have a 51 percent increase, while New Castle County is projected to have a 20 percent increase.





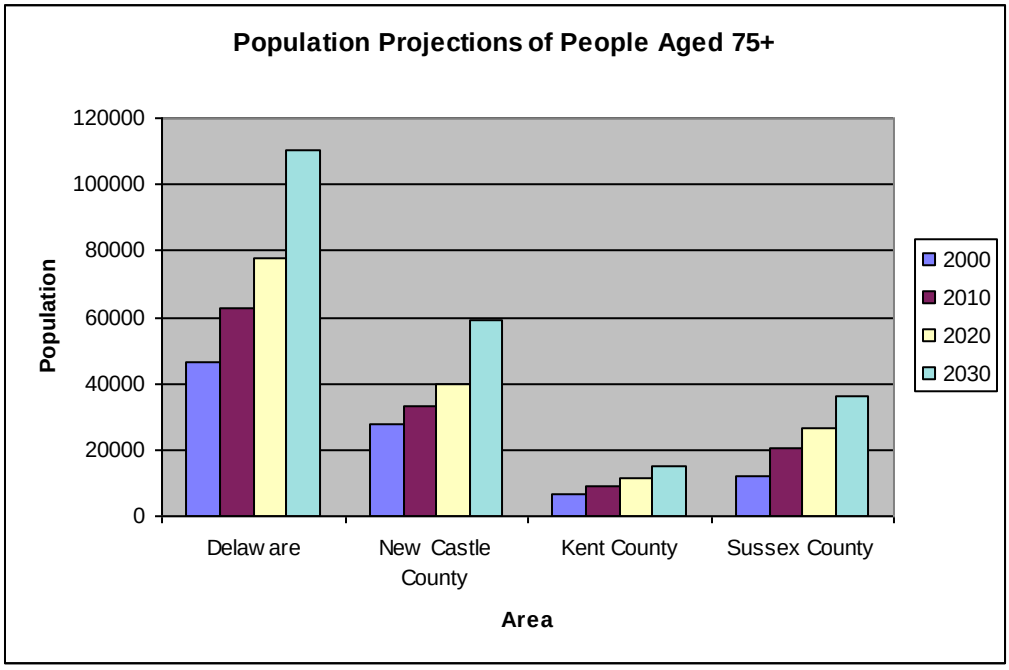
A majority of the state's 60+ population will reside in New Castle County over the next several decades.[1] However, Kent and Sussex Counties will experience larger growth rates in their 60+ population than New Castle County. Sussex County is projected to experience a 132 percent increase between 2000 and 2030, while Kent County is projected to experience an increase of 130 percent. New Castle County, however, is projected to experience a 111 percent increase in its 60+ population.

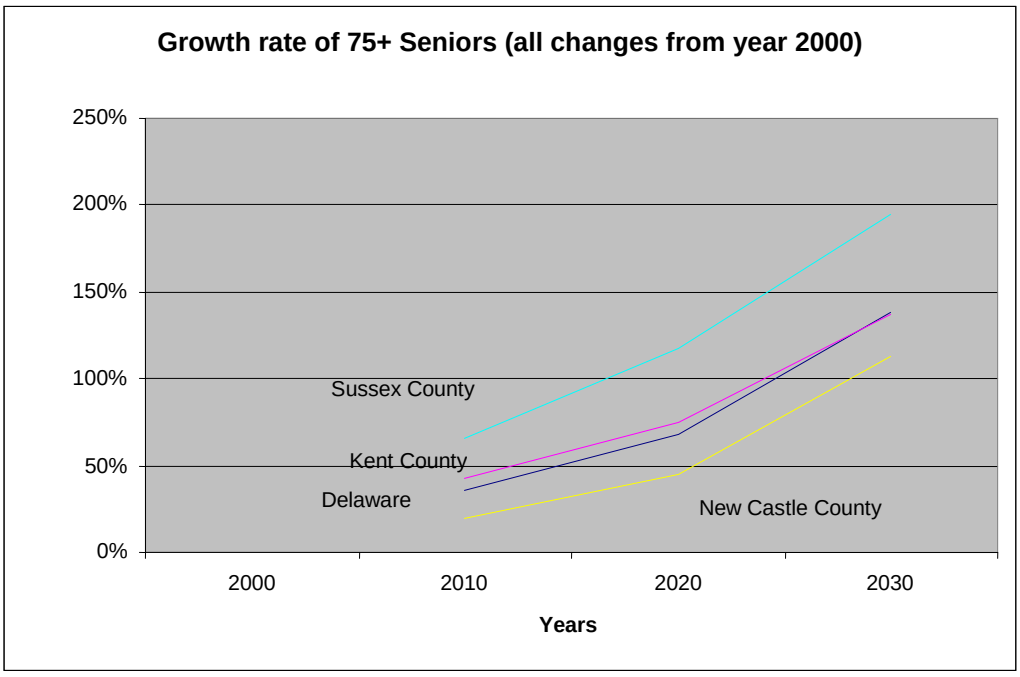
[1] Sixty and older (60+) was used in the Center for Applied Demography and Survey Research population projections. U.S. Census projections use 65 and older (65+).



Very similar projections have been made for the state's population age 75 and older (75+). Most of Delaware's 75+ population will also reside in New Castle County between now and 2030. However, like the state's 60+ population, the largest growth of the state's 75+ population will occur in Sussex County.

Sussex County is projected to nearly a 200 percent increase in its 75+ population between 2000 and 2030. Kent County is projected to have a 137 percent increase and New Castle County a 113 percent increase. Sussex and Kent's largest increases in their 75+ populations are projected to occur between 2000 and 2010, while in New Castle County the largest increase will occur between 2020 and 2030.





1.4 Accident Data and Statistics

The information presented in this section is based on data collected by DelDOT between 2004 and 2006. A synopsis of crash data and demographic information is included for each of the state's three counties — New Castle, Kent, and Sussex. To illustrate the specific location of accidents within each county in which drivers age 60+ were involved, GIS maps are included in the Appendix (Demographics/Statistics section and CD-Rom). The percentage of the 60+ population is depicted by U.S. Census block groups. Locations of assisted-living facilities and senior centers are also shown.

In addition, aerial maps of potential target areas (i.e., areas with both a high number of crashes involving individuals age 60+ and a high population concentration of individuals age 60+) are included for each county. The aerial maps depict the specific locations of accidents that occurred within the county target areas for the years 2005 and 2006 in which drivers 60+ were involved. They also indicate the light conditions and time of day for each of the accidents illustrated. The incidence of accidents should be correlated with the traffic volumes to further define problem areas. Accident fatality data and information on pedestrian involvement were not included in the data; however, this information will be helpful in initiating future studies and identifying specific target-area recommendations within each county.

New Castle County

Not surprisingly, a higher number of crashes involving drivers age 60+ occurred in New Castle County (NCCo) than Kent and Sussex Counties (for purposes of this report New Castle County information includes City of Wilmington data). This is because NCCo has the largest population age 60+ of the three counties. In 2005 and 2006 a majority of NCCo crashes involving drivers age 60+ occurred in the northern-most parts of the NCC, particularly on or near the area's main arteries, U.S. Route 13 and Interstate 95.

Aerial maps show that the majority of crashes in Newark took place either on Main Street or Cleveland Avenue. Crashes that took place in the City of Wilmington were relatively sparse in terms of their concentration in particular areas.

While NCCo will experience the lowest growth rate of its senior population over the next several years, it will still remain the county with the largest number of senior residents. As the county's current senior population continues to age and drive, more crashes are likely to occur.

Kent County

The largest number of Kent County crashes involving those age 60+ took place either on U.S. Route 13 or U.S. Route 113, high-density roads that run through the City of Dover. Dover is an area where the 60+ population is 20-30 percent of its total.

Several crashes that took place west of U.S. Route 13 near Dover involved individuals age 75+. A relatively significant number of crashes also took place on State Route 1 and U.S. Route 13 near Clayton and Smyrna, U.S. Route 13 near Camden, and State Route 1 between Frederica and Milford. The area between Frederica and Milford includes a higher percentage of people age 60+.

Sussex County

Data indicate that more crashes involving elderly drivers happen on high-density roads in Sussex County near areas where the 60+ population is greater than 18 percent. The largest number of recent crashes occurred on State Route 1, a road traveled by many who visit the state's coastal communities.

The "Five Points" area, where State Route 1 and U.S. Route 9 intersect, is particularly noteworthy. The intersections of State Routes 23 and 1 and State Routes 24 and 1 are also noteworthy in terms of overall crash incidence. A high incidence of crashes is also evident on State Route 26 near Bethany Beach and Millville, an area where the 60+ population is relatively higher than other parts of the county. In western Sussex County, data indicate a large number of crashes on U.S. Route 13 near Seaford and Laurel**.** In particular, the areas near Middleford Road and State Route 20 (Concord Road) in Seaford had a relatively high number of crashes involving individuals age 60+.

1.5 Summary

Current demographic trends and crash data, coupled with expected increases in Delaware's 60+ and 75+ populations, call for transportation planning and policy considerations in areas with high concentrations of older residents. As Delaware's elderly population increases over the next few decades, roadway and intersection designs, in addition to education and awareness programs, will become increasingly important for state and local policymakers, agency directors, transportation planners and engineers, social-service providers, and community leaders.

Of particular interest are the overall percentage increases projected for Kent and Sussex Counties' 60+ and 75+ populations over the next several decades. As individuals continue to retire to these areas, many will continue to drive on unfamiliar roads to and from places of interest and need. Migration to more rural areas also means longer travel distances and less access to alternative forms of transportation.

While New Castle County is not expected to experience a large percentage increase in its number of elderly, it will remain the county with the highest number of elderly residents through 2030. The City of Wilmington will be the only jurisdiction to experience a decline in its elderly population, since many older seniors are moving to other areas of the state (Jacobson et al., 2001).

Section 2: Case Studies

2.1 Older Drivers and Crash Incidences

As part of an overall literature review, a series of case studies was reviewed to identify study results and recently adopted road-design policies and practices in other states. Cases for review were selected based on their relevancy to older-driver issues in Delaware. The following section includes brief summaries of each of the case studies reviewed and analyzed.

2.1.1 Braitman, Keli et al. "Factors Leading to Older Drivers' Intersection Crashes." Insurance Institute for Highway Safety, 2006.

Purpose

By the year 2030, older drivers (65+) are expected to represent a quarter of the driving-age population. Those 70 years and older have lower rates of police-reported crashes per capita than younger drivers, but crash rates increase steeply for drivers over 75 years of age (75+). It is understood that older drivers are more involved in intersection crashes compared to younger drivers, but it is not understood what factors lead to older drivers' crashes at intersections. The purpose of this study is to identify the factors that lead to intersection crashes involving older drivers.

Methodology

The study was conducted by examining crashes occurring between August 2003 and October 2004 in Connecticut. The crash reports were divided into age groups; drivers 35-54 (n=73), drivers 70-79 (n=78), and drivers over 80 (n=76) who were at fault in nonfatal crashes. The authors examined police crash reports, intersection photographs, and conducted phone interviews with the at-fault drivers. The goal of the study was to determine what caused the crashes in each case.

Results

Drivers 80 and older had fewer rear-end crashes than did their counterparts aged 35-54 and 70-79 (10). Both the 70-79 and the 80+ groups had fewer run-off-the-road crashes than their younger counterparts. However, crashes involving a failure to yield increased with age, especially at unsignalized intersections among drivers making left-turns. Drivers in the 80 and older (80+) group that were involved in this type of crash typically failed to see or detect other vehicles. Drivers in the 70 -79 cohort, who were involved in these crashes, typically misjudged the distance and timing of other vehicles.

The authors suggest the use of roundabouts to reduce failure-to-yield crashes for drivers of all ages because drivers that enter roundabouts only have to look in one direction for conflicting traffic. In addition, there are no left-turns, which helps eliminate many visibility problems. Some research also indicated that roundabouts help reduce the severity of crashes by 40 percent.

Reducing failure-to-yield crashes at signalized intersections is also important. Installing signals with protected left phasing eliminates the need for drivers to judge the position of oncoming vehicles. Other, more low-cost modifications include the installation of additional lighting and dedicated left-turn lanes.

2.1.2 Lyman, S. et al. "Older Driver Involvements in Police Reported Accidents and Fatal Crashes: Trends and Projections." Injury Prevention, 2002.

Purpose

As the percentage of older drivers in the U.S. increases, there continues to be a need to evaluate methods of increasing safety. As people age, their visual, cognitive, and perceptual functions deteriorate, which leads to an increased risk of crashes. A recent study suggested that drivers aged 70-74 were twice as likely to be killed in a crash as drivers aged 30-59. The purpose of this study was to identify the possible effects that the nation's increasing elderly population will have on highway safety.

Methodology

The study examined crashes occurring between 1990 and 1995. Driver involvement rates for all police-reported crashes were calculated per capita, per licensed driver, and per vehicle mile traveled. In addition, driver-involvement rates for fatal crashers were calculated for the years 1983, 1990, and 1995. Based on this data, projections of crashes involving drivers age 65+ were developed for the years 2010, 2020, and 2030.

Results

According to the data analysis, driver involvement in crashes decreased with age, but fatal involvement rates per capita increased starting at age 70. In addition, involvement rates per miles driven increased at age 70. The authors estimate that there will be a 34 percent increase in the number of drivers involved in police-reported crashes and a 39 percent increase in the number involved in fatal crashes of all age groups between 1999 and 2030. Older drivers will see a much larger increase; a 178 percent increase in involvement in police-reported crashes and a 155 percent increase in involvement in fatal crashes during the same time period. Drivers 65 and older will account for more than half of the total increase in fatal crashes and 40 percent of the total increase in crash involvement. Currently drivers in this age cohort comprise 14 percent of total driver fatalities, but in 2030 this percentage will increase to 25 percent.

The authors recognize the limitations of their projections and stress that older drivers are currently less likely to be involved in police-reported crashes but more likely to be involved in fatal crashes. Data show that there are an increasing number of licenses administered to older drivers, and the average annual miles traveled by older drivers is also increasing. The authors also emphasize the need for further research about their projections as well as crash-mitigation techniques.

2.1.3 Braver, E.R. and R.E. Trempel. "Are Older Drivers Actually at Higher Risk of Involvement in Collisions Resulting in Deaths or Non-Fatal Injuries Among Their Passengers and Other Road Users." Injury Prevention, 2004.

Purpose

The purpose of this study was to examine whether driver age was related to increases in risks for older drivers, their passengers, pedestrians, and other vehicle occupants.

Methodology

The study examined U.S. federal data on fatal and non-fatal crashes. Injury rates per driver were calculated for various types of road users. Drivers age 30-59 were used as references in order to evaluate the crash rates of older drivers. In addition, the authors used insurance claim data supplied by nine insurers. Insurance claims per insured vehicle year were examined by driver age.

Results

According to the data analysis, older drivers had the greatest impact on their passengers when involved in fatal crashes. Passengers of elderly drivers involved in fatal crashes were more likely die, although passengers of elderly drivers also tended to be elderly, which increased their risk of death. In terms of non-fatal crashes, elderly drivers had a larger impact on injuries to occupants in other vehicles. Insurance data showed that drivers age 85 and over had significant increases in insurance claims for injuries to other road users in crashes where they were deemed at fault. The authors conclude that older drivers do pose some risk to occupants of other vehicles, but pose the most risk to themselves and their passengers.

2.1.4 Li, Guohua, Braver, Elisa R., and Li-Hui Chen. "Fragility Versus Excessive Crash Involvement as Determinants of High Death Rates per Vehicle-Mile of Travel Among Older Drivers." Accident Analysis and Prevention, 2003.

Purpose

Personal mobility plays a large role in U.S. daily life and often corresponds to quality of life. For the elderly, the ability to drive a vehicle has a direct impact on quality of life in terms of independence and physical and mental health. Due to housing patterns, seniors in the U.S. are more likely to live in areas without mass transit and without the ability to walk to daily destinations. The purpose of this study is to compare fragility with excessive crash involvement in order to determine the fatality risk of older drivers per vehicle miles traveled (VMT).

Methodology

The study was conducted by examining United States federal data from three sources:

- 1993-1997 Fatality Analysis Reporting System (FARS)
- 1993-1997 General Estimates System (GES)
- 1995 Nationwide Personal Transportation Survey (NPTS)

The author compared older drivers (60+) and younger drivers (16-29) to drivers aged 30-59. Driver fatality data were obtained from FARS, which records data on each driver and vehicle involved in a fatal crash. GES provided a nationally representative probability sample of all police-reported traffic crashes that involved damage to property, injuries, or death. The 1995 NPTS provides data relating to the characteristics of daily personal travel.

Using the data, age and gender differences were examined for three outcome measures: driver deaths per VMT, drivers involved in police-reported crashers per VMT, and driver deaths per driver involved in a police-reported crash.

Results

According to the data analysis, driver deaths per VMT were higher for the youngest and the oldest driver groups (regardless of sex). Deaths per driver involved in crashes increased as drivers reached age 60. A large increase was observed for drivers 80+. The risk of crash involvement was constant for individuals age 30-69 and increased as people reached age 70-74. Fragility seemed to have the most effect on excessive death rates among older drivers.

The authors illustrate a need to increase the safety of elderly drivers. In particular, they identify reducing speeds and increasing seat belt use as methods that have already been used to reduce crashes for drivers of any age (234). Future driver safety measures may eventually help to reduce the risk of injury and death of older drivers.

2.2 Pedestrian Countdown Signals

2.2.1 Eccles, Kimberly A et al. "Evaluation of Pedestrian Countdown Signals in Montgomery County, Maryland." Transportation Research Board, 2003.

Purpose

Pedestrian countdown signals were installed to replace standard pedestrian signals at five intersections in Montgomery County, Md. The objective of this case study was to determine the effects of the countdown signals on pedestrian and motorist behaviors.

Methodology

A before-and-after study was utilized to evaluate the effects of countdown signals at five intersections. The study included observations of the signal indication when pedestrians entered the intersections, the number of pedestrians in the intersections when conflicting traffic was released, the conflicts between vehicles and pedestrians, and vehicle approach speeds to the intersections. These observations were compared before and after installation of the pedestrian countdown signals.

At four of the five intersections, the pedestrian countdown signals were the only upgrade to the intersections during the observation period. During the study, a survey was administered to pedestrians who had just crossed the intersections to determine their awareness and understanding of the pedestrian countdown signals.

Results

The authors concluded that the installation of pedestrian countdown signals had a positive effect on pedestrian behavior and did not have a negative effect on motorist behavior. Observations indicated that the countdown signals did not alter the vehicle approach speeds during the flashing "DON'T WALK" indication. This implies that, in response to the indication on a parallel pedestrian countdown signal, motorists are not increasing their speeds to enter an intersection before the end of the phase.

Of the 20 crosswalks observed, six experienced a significant increase in the number of pedestrians who entered the intersection during the "WALK" phase, while two intersections saw a significant decrease. This indicates that the addition of pedestrian countdown signals increased compliance with the pedestrian signals. None of the intersections had a considerable increase in the number of phases with pedestrians remaining in the intersection when conflicting traffic was released. In three of the five intersections, a statistically significant decrease was recorded for this pedestrian behavior.

For purposes of this study, a conflict was defined as an interaction between a pedestrian and a vehicle when either the pedestrian or the vehicle took evasive action (weaving, braking, or running) to avoid a collision. For a conflict to be recorded, a collision had to appear to be imminent. At the four intersections where conflicts had been recorded previously, a significant decrease in pedestrian-motor vehicle conflicts occurred after the installation of the countdown signals.

In general, the survey demonstrated that pedestrians are aware of the countdown signals and understand their indications. The majority (62.6 percent) of pedestrians correctly responded that the countdown indicated the seconds remaining to finish crossing the intersection or reach the median (if one exists). In addition, 31.8 percent said that the countdowns showed the seconds remaining before the light turned red.

2.2.2 Huang, Herman, and Charles Zegeer. "The Effects of Pedestrian Countdown Signals in Lake Buena Vista." Florida Department of Transportation, 2000.

Purpose

The purpose of this case study was to evaluate the effects of pedestrian countdown signals at two intersections in Lake Buena Vista, Fla. Pedestrian countdown signals were observed to determine the influence of countdown signals on pedestrian behavior.

Methodology

In this case, a treatment-and-control study design was utilized. Two intersections with countdown signals, the "treatment" sites, were matched with one or two nearby "control" intersections that were similar but did not have countdown signals.

A video camera was utilized to record data at each location. The measures of effectiveness used to assess the countdown signals were pedestrian compliance with the "WALK" signal, the number of pedestrians remaining in the intersection when the steady "DON'T WALK" signal appeared, and the number of pedestrians who started running when the flashing "DON'T WALK" indication appeared.

Results

After the data were collected, the results from the treatment sites were compared to those from the control sites. Huang and Zeeger concluded that the countdown signals had both positive and negative effects on pedestrian behavior. It was found that pedestrian compliance with the signal was lower (46.8 percent) at the countdown signals than at the control locations, where 58.6 percent of pedestrians complied with the signal. Compliance was defined as beginning to cross the intersection during the "WALK" phase, instead of during with flashing or steady "DON'T WALK" phases.

The study results may indicate that some pedestrians see that they have as much as 20-25 seconds remaining on the flashing "DON'T WALK" phase of the pedestrian countdown signal, and decided to "go for it" instead of waiting for the next "WALK" interval.

The study also compared the number of pedestrians who ran out of time at the control and treatment sites. Pedestrians were considered to have run out of time if they began crossing during the "WALK" or flashing "DON'T WALK" phase but remained in the intersection when the steady "DON'T WALK" indication appeared. It was determined that 10.5 percent of pedestrians ran out of time at the intersections with countdown signals, while only 7.7 percent of pedestrians ran out of time at the control sites. This difference was slight and was not shown to be statistically significant.

Huang and Zegeer indicated that less pedestrian running takes place when the flashing "DON'T WALK" first appears, which is as a potential benefit of installing countdown signals. The study showed that 3.4 percent of pedestrians at the treatment sites and 10.4 percent of those at the control sites started running when the flashing "DON'T WALK" indication first appeared. This significant difference suggests that pedestrians understand and are utilizing the countdown signals correctly.

2.2.3 PHA Transportation Consultants. "Pedestrian Countdown Signal Evaluation-City of Berkley." PHA, 2005.

Purpose

Eleven intersections in Berkeley, Calif. were studied to assess the impact of pedestrian countdown signals on pedestrian activities. Intersections were chosen to represent a variety of geographic locations, land-use characteristics, environmental settings, traffic patterns, and levels of pedestrian activities. The countdown signals were installed at various locations throughout the city, with the purpose of enhancing the pedestrian environment and safety.

Methodology

A before-and-after study was utilized to record the effects of countdown signals on pedestrian signal compliance, timing for pedestrians crossing an intersection, conflicts between motor vehicles and pedestrians, pedestrian violations of signal indications, the manners in which pedestrians cross the street (walking versus running), and pedestrian speed.

Results

It was concluded that pedestrian countdown signals made small improvements in some facets of pedestrian behavior. The addition of countdown signals increased pedestrian compliance at intersections.

After pedestrian signals were installed, the percentage of pedestrians who began crossing during the flashing "DON'T WALK" phase decreased from 99.5 percent to 94.6 percent. This indicates that the countdown signals encouraged pedestrians to wait at the curb for the next "WALK" interval.

Also, the number of late finishes dropped from 23 percent to 18 percent once the pedestrian countdown signals were added. A late finish was defined as occurring when a pedestrian began crossing the street during the "WALK" or flashing "DON'T WALK" phase but remained in the intersection when the indication changed to stationary "DON'T WALK." The five percent decrease in late finishes indicates that pedestrians are making better decisions when they see the time remaining to cross the intersection.

No obvious impact on the manner in which pedestrians cross the street was observed after countdown signals were added to the intersections. The countdown signals did not affect whether pedestrians crossed the street by walking or running. Pedestrian speeds were fairly consistent before (4.6 feet per second) and after (4.8 feet per second) countdown signal installation. This small increase is most likely due to pedestrians quickening their pace as the remaining seconds decreased on the countdown signals.

For the purpose of this study, pedestrian-vehicle conflicts were described as vehicles entering the crosswalk during the "WALK" or flashing "DON'T WALK" pedestrian phases. By this definition, conflicts did not indicate that an incident is imminent or even probable. The pedestrian countdown signals did not affect the number of conflicts between pedestrians and motor vehicles. This is primarily due to the fact that vehicles must enter crosswalks in order to turn, whether or not countdown signals are present. The term "violators" was used to describe pedestrians who began crossing the intersection while the traffic signal was green for opposing vehicles. The countdown signals also did not greatly influence the number of violators. Violators tend not to pay attention to the signal, so the addition of countdown signals would not likely influence this group.

2.3 Intersection Design and Traffic Signal Timing

2.3.1 Kibeum, Kim and Hualiang Teng. "Time Separation Between Pedestrians and Turning Vehicles at Intersections." Transportation Research Board, 2004.

Purpose

Pedestrian safety is one of the most important goals for improving overall travel safety. Most signalized intersections with crosswalks display a "WALK" signal to pedestrians, but also allow vehicles to turn at crosswalks. This creates a potentially dangerous situation for pedestrians. In large cities like New York, there are many pedestrian-vehicle conflicts per day.

Traditionally, there have been two types of signal timings used to reduce pedestrian-vehicle conflicts. The first is referred to as "scramble." During a "scramble" phase all traffic is stopped and time is give solely to pedestrians to cross the intersection (3). In this scheme pedestrians may even walk diagonally to cross. The second, time separation control (TSC) gives independent "WALK" signals for pedestrians and green signals for turning vehicles (3). The purpose of this study was to compare the operation of TSC to scramble and normal operations.

Methodology

The evaluation of the TSC was conducted by comparing certain measures of effectiveness (MOEs) between TSC, Scramble, and normal signal timings. The five MOEs used in this study were

- Pure pedestrian time-space per cycle in crosswalk
- Conflict points
- Queue length
- Vehicle delay
- Vehicle travel time

The MOEs were evaluated by modeling an intersection in the traffic-simulation model CORSIM. CORSIM was used in this study because it was calibrated in a previous study for locations that were included in this study.

The evaluation was modeled for the afternoon peak period at two locations, Broadway and Fulton in Manhattan (a one-way vs. one-way intersection), and Pelham Parkway West and White Plains Road in the Bronx (a one-way vs. two-way intersection).

Conclusions

The authors identify their results as preliminary. At the intersection of Broadway and Fulton, vehicle delay and travel time increased by approximately 0.46 seconds when using the scramble phasing and by 1.02 seconds when using the TSC phasing versus basic signal operation. The intersection of Pelham Parkway West and White Plains Road had slightly different results. Vehicle travel time and delay increased by 1.38 seconds when using the scramble phasing but increased by only 0.65 seconds when using the TSC phasing versus the basic signal phasing. Both intersections saw a decrease in conflict points and an increase in pedestrian safety and pure pedestrian time-space per cycle.

The authors address the need for further research and for a threshold to be developed that would evaluate the trade-offs between pedestrian safety and roadway operations. The proposed signal timings in this study can only be considered at locations with high pedestrian volumes. Further research is also needed in order to quantify the volume at which these signal phasing plans are appropriate.

2.3.2 Safe Routes for Seniors. "Street Design Recommendations for 135th Street, Harlem." Transportation Alternatives, 2006.

Purpose

Safe Routes for Seniors is a State of New York Department of Health–funded project based in the northern Manhattan neighborhoods of Washington Heights, Inwood, and Harlem (2). The goal of the project is to improve the quality and safety of streets and intersections in order to facilitate easier and safer walking conditions for seniors. The purpose of this study was to evaluate problems along 135th Street around the Kennedy Senior Center at 135th Street and Lenox Terrace.

Methodology

Two workshops were held at the Kennedy Senior Center in the spring and summer of 2005. The goal of the first workshop was to identify problems for pedestrians on the streets and sidewalks of 135th Street between Lenox Avenue and Madison Avenue. Ten senior citizens were involved in these workshops. The workshop identified three intersections that had safety concerns: Lenox Avenue, 5th Avenue, and Madison Avenue.

The problems identified at these intersections included

- Lack of pedestrian ramps on certain corners of the intersection
- Vehicles turning into people at the crosswalks
- Vehicles running red lights
- Lack of refuge islands
- Long crossing distances with short crossing times
- Vehicles cutting corners, especially left turns
- High vehicle speeds through intersections

The goal of the second workshop was to develop possible solutions to the problems identified in the first workshop. This study presents the results of the workshop.

Conclusions

At the conclusion of the workshop, several solutions had been defined for improving pedestrian safety along 135th Street. This study does not present the solutions that were actually implemented at these intersections. Some of the improvements include

- Extending medians to provide pedestrian refuge areas
- Installing pedestrian lead intervals on certain legs of the intersections
- Repairing and installing pedestrian ramps on all corners
- Placing bollards at the median tips, or where there are no medians, to force drivers to make a 90-degree turn

- Installing accessible pedestrian signals
- Installing cameras that identify vehicles that run red lights

2.4 Signing

2.4.1 Huybers, Sherry and Ron Van Houten. "The Effects of Prompting Signs Alone, Pavement Markings Alone, and Signs and Pavement Markings on Motorists' Yielding in Advance of Marked Crosswalks." Transportation Research Board, 2004.

Purpose

Crosswalks on streets with multi-lane uncontrolled approaches are some of the most dangerous crosswalks for pedestrians. These types of crosswalks present a pedestrian-vehicle conflict referred to as a multiple-threat crash. In this type of crash, a pedestrian is struck in a crosswalk by a vehicle traveling in the same direction in an adjacent lane to a vehicle that has stopped to allow the pedestrian to cross.

This is often caused by vehicles that yield too close to the crosswalk and obstruct the view of motorists in adjacent lanes. The purpose of this study is to examine what effect signs alone, pavement markings alone, and pavement markings with signs have on how a motorist yields in advance of a marked crosswalk.

Methodology

The evaluation of the sign, pavement markings, and the combination of the two was conducted during two separate experiments. The first experiment utilized a "YIELD HERE TO PEDESTRIAN" sign that had been used in a previous study.

It examined whether this sign alone could have an effect on yield distances and whether or not the color of the sign had any effect on driver awareness. The first experiment was conducted at four multi-lane crosswalks at uncontrolled locations in Halifax, Nova Scotia. Each site was equipped with a pedestrian-activated yellow flashing beacon placed next to an illuminated sign with a pedestrian symbol. Two out of the four intersections were used as baselines. One intersection was equipped with a "YIELD HERE TO PEDESTRIAN" sign with a white background and the other was equipped with a fluorescent yellow-green sign.

The second experiment consisted of the evaluation of the combination of pavement markings and a "YIELD HERE TO PEDESTRIAN" sign with a white background. Two multi-lane crosswalks in Halifax were examined in this experiment. Each of the intersections had the standard Canadian sign as well as right- and left-handed crosswalk signals. The experimental signs and advanced-yield markings were placed between 10 and 25 meters in advance of the crosswalks.

Conclusions

The "YIELD HERE TO PEDESTRIANS" sign, when used alone, reduced pedestrian-vehicle conflicts and increased the percentage of motorists yielding in advance of the crosswalk at three of the four crosswalks (15). The addition of the fluorescent yellow-green sign had no marked effect. Advanced yield markings, when used alone, seemed to have the greatest effect. In addition, using a combination of the sign with white background and pavement markings had the greatest effect on reducing conflicts as well as increasing the number of motorists that yielded in advance of the crosswalk.

The authors conclude that while signs may help motorists understand the pavement markings, they are not essential to the reducing conflicts and increasing motorists' yielding distances. However, while this finding may reduce the costs of crosswalk safety improvements, motorists are familiar with seeing the signs around crosswalks, and discontinuing the use of these signs could have a negative initial effect.

2.4.2 Holick, Andrew J. et al. "Evaluation of Clearview Font for Negative Contrast Traffic Signs." Texas Transportation Institute, 2006.

Purpose

"Clearview" is a new font developed for traffic signs for the Federal Highway Administration. It was developed as a result of a research program aimed at increasing the legibility and ease of recognition for positive-contrast signs while reducing halation for older drivers. In addition, the research program also examined the effect of mixed cases in signs compared to using all capital letters. In addition to developing Clearview for positive contrast signs, a letter weight was developed for negative-contrast signs.

Prior to this study, only the legibility of positive-contrast signs had been investigated. There were no studies that examined the legibility of Clearview on negative-contrast signs. Previous studies sponsored by the Texas Department of Transportation found that Clearview increases the legibility of positive-contrast signs. The purpose of this study is to examine the legibility of the Clearview font on negative-contrast signs.

Methodology

The researchers conducted a daytime and nighttime legibility and recognition experiment for ground mounted signs with Clearview font. The focus of the study was on ground-mounted right-shoulder signs such as regulatory, warning, and construction-zone signs. The signs were modified in seven ways by changing font, letter height, and letter spacing, and were compared to signs with the standard font (Highway Gothic). The study was conducted in two parts: a laptop examination, and a driving course.

The driving portion of the study examined the ability of drivers to see and recognize signs while driving on a test track. There were a total of 34 participants of varying ages who drove the course during the day and at night. The drivers were accompanied by a researcher. During the legibility portion of the exam, drivers were asked to read a word from a certain line of the sign while driving at a specified speed. During the recognition portion of the exam, drivers were asked to identify the lines of a sign with specific words. The researcher recorded the distance from the sign at which the driver was able to correctly complete each task.

During the laptop examination test, subjects were shown static images of seven types of signs. A total of 174 people from four Texas cities participated in this portion of the study. Participants were shown each sign for a brief period of time (similar to the amount of time a driver would have to recognize a sign) and then were asked to record what words were indicated by the sign.

Results

The results of the driving portion of the study show that the Clearview font does not provide any increase in legibility or recognition during daytime vehicle operations for negative-contrast signs when compared to the traditional Highway Gothic. During nighttime operations, the legibility and recognition distances for signs with Clearview increased. The laptop portion of the study also yielded no change in the recognition of signs when the Clearview font with mixed letter cases was used. It was concluded that mixed cases have no benefits over traditional signs using all-capital letters. Given the results of the study, the authors did not recommend that Clearview be used for negative-contrast signs.

2.5 Pedestrian Interaction

2.5.1 Tyrrell, Richard et al. "Nighttime Conspicuity From the Pedestrian's Perspective." Transportation Research Board, 2004.

Purpose

Drivers can have difficulty identifying pedestrians at night. Almost 64 percent of all pedestrian crashes in 2001 occurred at night. The U.S. Fatality Analysis Reporting System database indicates that as illumination decreases, pedestrian fatalities increase. Increasing the visibility of pedestrians at night is a complex problem that plagues transportation-safety experts. It is a problem that is often solved by increasing lighting in certain areas; however, increased lighting can also have negative effects on the surrounding community. The purpose of this study is to examine literature and data relating to pedestrian-vehicle collisions at night with a focus on an insufficient conspicuity of pedestrians at night.

Methodology

This study reviews literature relating to pedestrian safety at night, focusing on the fact that insufficient conspicuity of pedestrians is a critical factor in nighttime pedestrian-vehicle collisions. In addition, the authors summarize existing data in order to support the education of road users.

Conclusions

Pedestrians often lack sufficient conspicuity to approaching drivers during the night. Evidence from the literature review and data analysis suggests that road users often fail to recognize the magnitude of the conspicuity problem. In addition, pedestrians often fail to recognize the benefits of wearing reflective clothing. Recent evidence suggests that education programs may help to reduce these two problems while also helping to reduce pedestrian-vehicle crashes. It is suggested that education programs may have the greatest effect when complemented with engineering solutions such as increased lighting, improved roadway design, and the development of in-vehicle night-vision systems.

Section 3: Intersection Design for Older Pedestrians and Drivers

3.1 Summary of the Issues

As U.S. citizens continue to live longer, it is important to ensure that their transportation needs are met by modes other than driving a personal vehicle. One alternative is walking. Street systems must be modified so that they are safe and accessible for pedestrian travel by the senior population. Fear of falling is a prominent concern among elderly pedestrians. In a survey of senior citizens conducted in New York City in February 2006, 63 percent of respondents encountered trip hazards while walking, such as pavement cracks and uneven sidewalks. The majority of respondents also cited a lack of adequate time to cross intersections and the failure of turning vehicles to yield in crosswalks as impediments to walking (Transportation Alternatives, 2005).

For the elderly, intersections can be the most complex part of navigating a roadway (Lord et al., 2005). Because seniors represent the fastest growing population of drivers, risks associated with intersections are increasing. In addition to navigating intersections, reading street signs, turning, following pavement markings, and responding to traffic signals become more challenging as drivers age (FHWA, 2006).

3.2 Strategies and Recommendations

Standard Maintenance Procedures

Studies of senior citizens have identified a number of intersection improvements that should be addressed as part of standard street-maintenance procedures. Areas with high concentrations of elderly individuals should be designated as priority zones for intersection maintenance such as pavement-patching crosswalks and repairing curbs and curb ramps. Poor crosswalk and ramp maintenance increases the difficulty of ascending and descending curbs and creates slip hazards. In addition to increasing mobility for individuals who use assistance devices, ensuring that curb ramps comply with the guidelines set forth by the Americans with Disabilities Act (ADA) may increase the overall safety of older pedestrians. Crosswalk striping should also occur on a regular basis, particularly in areas with a high volume of vehicular traffic, where pavement markings will wear away more rapidly (Transportation Alternatives, 2005).

Medians and Refuge Islands

Issues related to intersection crosswalks (e.g., insufficient time to cross, failure to yield) can be mitigated by medians and refuge islands. Medians should be extended into crosswalks where possible, and refuge islands should be constructed in the crosswalks of undivided streets. Both medians and refuge islands, when located in crosswalks, somewhat protect pedestrians from turning cars and provide a safer area for pedestrians to wait if they cannot cross streets in the

allotted time. Refuge areas should include ADA-compliant curb ramps and remain free of barriers, such as signal poles that would impede pedestrian travel (Huang, 2000).

Pedestrian Countdown Signals

Pedestrian countdown signals, which display the number of seconds left to safely cross the street, are used to minimize conflicts between pedestrians and vehicles. Countdown signals are promising at intersections frequented by older populations because they provide pedestrians with additional information about the time available for crossing an intersection (Huang, 2000). Countdown signals discourage pedestrians from crossing the street at the end of the signal interval while encouraging pedestrians already in the intersection to accelerate their pace towards the end of the interval (or wait on a refuge island). Studies indicate that the installation of countdown signals decreases the number of pedestrians unable to clear an intersection before the stationary "DON'T WALK" sign appears and vehicular traffic assumes the right of way (Eccles et al., 2004).

3.3 Improving Intersection Geometry

Benekohal et al. (1992) determined that road-marking visibility becomes more difficult with age. In addition, the authors found that adequate lighting at intersections, size of traffic-signal heads, concrete lane (channelization) guides, and the width of travel lanes are all important roadway features to older drivers. The Federal Highway Administration (FHWA)(2001), in its *Guidelines and Recommendations to Accommodate Older Adults and Pedestrians*, makes suggestions on improving intersection conditions for elderly drivers. Several suggestions provided in the FHWA (2001) document include

- Redesigning skewed intersections to 90-degree intersections—This will increase the safety of elderly drivers who have difficulty turning their heads more than 90 degrees. Redesigning skewed intersections also helps improve the safety of intersections for all drivers.
- Providing rounded curb radii at 90-degree intersections—Providing larger turning radii will help older drivers navigate a turn more easily—However, increasing turning radii may increase the amount of pavement that pedestrians must cross, so each intersection should be evaluated on pedestrian as well as vehicular traffic.
- Adding left-turn lanes—These are useful at both signalized and unsignalized intersections as a method of reducing the number of rear-end collisions along main roadways. Separating turning movements should be employed whenever feasible.

Roundabouts

Roundabouts may also help reduce crashes at intersections. Lord et al. (2005) conducted a study of roundabout operations by focusing on their use by drivers aged 65+. While the modern roundabout is a relatively new concept for most states, it has proven to be a successful method in reducing crashes while providing a high capacity and continuous flow through intersections.

However, if roundabouts are employed, it is necessary to increase the effectiveness of signs. Lord et al. (2005) suggests providing advanced warning signs with a safe approach speed, identifying which lanes are to be used to exit the roundabout, informing the drivers of a need to yield to vehicles in the circle, and providing a street name or route number of the approaching exit point. These measures should increase driver awareness of the operation of the roundabout.

Section 4: Improving Signs and Traffic-Signal Designs

4.1 Summary of Activities and Issues

A number of studies and reports include information on sign and traffic-signal designs related to older drivers and their ability to safely navigate roads and intersections. Several studies specifically address differences among age cohorts in responding to signs, traffic signals, and pavement markings. In response to findings that support some age-related differences associated with responding to or understanding signs and traffic-signal patterns, a number of strategies, recommendations, and best practices are discussed in the literature.

The FHWA *Guidelines and Recommendations to Accommodate Older Adults and Pedestrians* (an update to their 1998 *Older Driver Highway Design Handbook*) provides extensive information to highway designers and engineers on road and intersection designs related to older drivers. The guidelines discuss new research and technical developments that address the needs and concerns of older drivers. Design standards specifically involving signs and traffic signals are presented, and suggestions on how to best implement appropriate strategies and recommendations are offered. Comparisons of the FHWA recommendations to standard design manuals such as the *Manual on Uniform Traffic Control Devices* (MUTCD) and the *Green Book* by the American Association of State Highway and Transportation Officials (AASHTO) are also provided.

Observational Studies

One study presented in the FHWA guidelines (2001) involved in-car driving-behavior observations of individuals between the ages of 25-70+ on a standardized testing course. Study observations disclosed that individuals falling within the older age cohorts (60-70+) demonstrated more difficulty maneuvering right and left turns at intersections and responding to traffic signals than individuals of the younger age groups. Left-turn problems by the older groups were associated with insufficient use of caution and poor road positioning during turns. Right-turn difficulties, on the other hand, were primarily the result of failing to signal (FHWA, 2001).

Stop sign problems observed among the older age cohorts included incomplete stops, poor positioning, and sudden stops. Errors identified at traffic signals included abrupt stops, failure to stop, and insufficient use of caution when approaching intersections (FHWA, 2001).

Older Drivers' Perceptions

Interview responses from seniors about intersections and traffic signs and signals support findings obtained from the in-car observations. A study was conducted of 664 senior drivers who responded to questions regarding driving activities they considered more difficult with increased age.

The sign and traffic-signal activities considered more challenging to the respondents included reading street signs in their towns or communities, following pavement markings, and responding to traffic signals. They also identified the size of traffic signals at intersections as a significant concern (FHWA, 2001).

In comparing responses from drivers ages 66-68 and 77+, interview responses identified the 77+ senior cohort as having more difficulty in reading street signs and making left turns at intersections. The 77+ group also indicated that intersection pavement markings were most important to them, followed by the number of left-turn lanes in terms of overall difficulties with intersection design and highway features (FHWA, 2001).

4.2 Strategies and Recommendations

Signs and Signals to Increase Intersection Safety

The *Federal Highway Intersection Safety Action Plan* (2006) makes various recommendations for reducing crashes at both signalized and unsignalized intersections. As indicated in the plan, there are many cost-effective solutions that can be implemented to increase safety at intersections. For un-signalized intersections, placing active warning beacons and properly marking pavement around intersections can increase driver awareness and slow down vehicles as they enter the intersection (FHWA, 2006).

In terms of cost-effective improvements for signalized intersections, the plan also recommends adding advanced warning signs, or improving existing signs, which can increase driver awareness when approaching an intersection. Active warning beacons should be employed in areas where it is difficult to see a signalized intersection due to roadway geometry, or where signals are not commonly used (especially in rural areas where distances between signals can be rather large). Elderly pedestrians also require more time to cross an intersection. Increasing pedestrian-crossing times in signal-timing equations may help to mitigate the need for refuge islands. In addition to signal timing, signal-head designs should be standard with MUTCD practices.

Standardizing the design of signal heads with MUTCD requirements (4-lens vertical stack, 5-lens vertical stack, or 5-lens doghouse) may increase driver awareness, especially for drivers from other states who may be unsure how to navigate an intersection with a non-standard signal design. Researchers found that older drivers do not understand protected/permitted phases as well as do younger drivers (TOC, 2006). Developing a standard signal-head design and educating drivers on their operations can improve maneuvers at these types of signalized intersections.

The FHWA's *Guidelines and Recommendations to Accommodate Older Adults and Pedestrians* provides design standards that address older drivers' concerns about signs and traffic signals. These design standards include

- Maintenance of a performance level of 200 candela (cd) peak intensity for an 8-in. red signal to ensure that this essential control element is easily detectable.
- Implementation of an all-red clearance interval to accommodate the decreased perception-reaction time that is associated with aging. The length of the all-red phase is determined by a set of equations provided by the Institute of Transportation Engineers.
- Use of back plates with traffic signals on a consistent basis for all roads with speeds greater than 40 miles per hour (mph). Back plates are also recommended for use on roads with lower speeds based on the potential for sun-glare problems, site history, and other variables, in order to provide a contrast to the surrounding background.

The *FHWA Intersection Safety Action Plan* (2006) recommends medium- to high-cost solutions at intersections with high-crash incidences. These plans should be analyzed and implemented case by case with particular consideration in areas with a high crash rate and large concentration of elderly.

Recommended improvements include

- Use of dynamic warning signs at un-signalized intersections—Dynamic warning signs can detect vehicles in an un-signalized intersection and warn drivers approaching the intersection. In addition, the signs can tell drivers on side streets when it is safe to proceed through an intersection with limited sight distances.
- Implementation of left-turn exclusive phasing—Left-turn exclusive phasing helps to reduce crashes by providing a separate phase for left turns.
- Enforcement of automated-red-light running in areas with high crash rates related to drivers running red traffic signals—It should be noted, however, that in some cases these systems increase rear-end crashes.

Improving Overall Sign Design

Sign-design standards vary among states. While the MUTCD is used in many states, various sign layouts, symbols, and methods of conveying information still exists. The FHWA has released a new type of font for signs called "Clearview." Clearview is replacing the traditional "Highway Gothic" font because studies show that it is easier to read and clearer from distances (FHWA, 2006). Clearview was developed as part of a research program to increase the sign legibility and improve recognition of road sign legends. In addition, it is intended to reduce the effects of halation for older drivers and drivers with reduced contrast sensitivity when letters are displayed on very bright, retro-reflective materials (ClearviewHwy, 2006). This font is now being used in New York and Pennsylvania, but is still not required by federal standards.

The FHWA (2006) also provides a list of signage recommendations. Those related to street-name signing include

- Use of letters with a minimum letter height of 6 in. on post-mounted street-name signs on all roads with speed limits in excess of 20 mph, and the elimination of borders around street signs to increase letter size.
- Use of overhead-mounted street-name signs with mixed-case letters at major intersections, along with the post-mounted signs. Minimum of 8-in. letter heights for uppercase letters and 6 in. for lowercase letters should be used at major intersections with approach speeds of 35 mph or less. For major intersections with speeds greater than 35 mph, letter heights should be increased to 10 in. for uppercase and 8 in. for lowercase letters.
- Use of advanced street-name plaques to accompany advanced intersection warning signs. These plaques should have 8-in. black letters on a yellow sign panel.
- Use of retro-reflective sheeting for post-mounted street-name signs at intersections with intensive land use, complex design features, and heavy traffic.
- Consistent signing of divided highways using a combination of "ONE WAY" and "DIVIDED HIGHWAYS" signs, with optional "WRONG WAY" and "DO NOT ENTER" signs included as well.
- For two-way, stop-controlled intersections, a supplemental warning sign indicating "CROSS TRAFFIC DOES NOT STOP." This additional sign should be placed below the "STOP" sign, and utilized on the basis of crash experience, where the sight triangle is restricted and where a four-way stop has been converted to a two-way stop.
- Transverse pavement striping or rumble strips located upstream of stop-controlled intersections where sight restrictions, high approach speeds, or a history of crashes resulting from running stop signs exists.

4.3 Implementation of Best Practices

The purpose of the FHWA guidelines is to provide solutions to problems of deficient designs, which become problematic for older drivers due to changes in functional ability that occur with normal aging. These design standards may be implemented where crash data have already identified intersections that lack adequate safety for older drivers. In addition, the implementation of these guidelines will provide the greater benefits of designing safer roads and identifying problems before crashes result. Implementation of these recommendations also minimizes the risk and severity of crashes while reducing the number of modifications that might be needed after construction. In this way, the FHWA recommendations bring about a reduction in the life-cycle cost of projects. The design recommendations described in the *Guidelines and Recommendations to Accommodate Older Adults and Pedestrians* may improve roadways for all users, not only the older population. If, however, these guidelines result in higher construction costs, the need for additional rights-of-way, or other logistical obstacles, improvements may have to be demonstrated before following the practices are set forth.

Section 5: Assessment, Education, and Outreach

5.1 Summary of Activities and Issues

In addition to information on engineering and road-design techniques developed to accommodate the increasing number of elderly drivers, there is a substantial amount of literature on nationwide programs designed to assess the driving capacity of older adults. Based on evidence of improved driving performance through education, remediation of medical or physical problems, and self-regulation, this literature describes programs aimed at providing better education, awareness, and outreach to older drivers and their families. Programs most widely discussed and recognized include assessment models and community-based driver education and refresher programs.

While new or upgraded road, intersection, and signage designs might mitigate the effects of age-related cognitive and physical decline, research suggests that many seniors have difficulty gauging when it is no longer safe for them to operate a motor vehicle. Others simply are unfamiliar with new engineering or design technologies introduced within their state, municipality, or community. However, assessment, education, and outreach programs assist individuals, families, and physicians facilitate discussions about elderly driving while promoting the overall mobility, well-being, and independence among older Americans.

5.2 Assessment Models and Activities

Self-Assessment (First-Tier Models)

According to Eby, Molner, Shope, Vivoda, and Fordcye (2003), assessment programs and tools play a critical role in maintaining safe driving and mobility among the elderly. The authors point out that assessment programs can be categorized into two levels according to the type of impairment that is being screened and who administers the assessment (Eby et al., 2003).

In first-tier, or self-, assessments, evaluation instruments may be administered by the driver him/herself or herself or by another person (someone who is not necessarily a specialist in the field). Gross impairments for which a driver is typically screened include declining physical and cognitive abilities, medical conditions, medication usage.

A benefit of self-assessment is that drivers have the autonomy to choose the environment in which the assessment is administered and can perform the assessment without direction from outside parties. Self-administration offers a confidential, less-threatening atmosphere, thus increasing the likelihood of overall participation and discussion about results with family members. Self-assessments are also easy to employ and facilitate, and, therefore, provide feedback without much delay.

Despite these benefits, according to Eby et al. (2003), several limitations also exist. One drawback of self-assessment is that it is restricted to individuals who are not suffering from any serious cognitive impairment. So, while cognitive impairment is found to be connected to an increased crash risk among older drivers, those who need assessment are unable to self-assess. Therefore, family members or friends are responsible for seeking alternative assessment methods (Eby et al., 2003).

Another limitation to self-assessment is the opportunity for individuals to answer questions dishonestly or discount feedback provided as a result of the assessment. Eby et al. (2003) also point out that there are only a few self-assessment instruments that currently exist. According to the authors, the two most widely distributed self-assessment instruments include the Drivers 55 Plus, an instrument conducted for the AAA Foundation for Traffic Safety, and the Older Driver Skill Assessment and Resource Guide: Creating Mobility Choices, which was created by the American Association for Retired Persons (AARP).

Both instruments are designed to increase self-awareness and motivate drivers to develop and accept new or alternative driving strategies; however, neither has been evaluated to determine their effectiveness and validity in educating older drivers about their driving abilities. Building upon the existing self-assessment instruments, the authors conducted a study and developed a new instrument, the Driving Decisions Workbook (Eby et al., 2003). Through the study, the authors sought to expand the scope of the AARP and AAA instruments to include information on medical conditions and medication use and simplify the format to avoid the need for users to calculate scores or self-administer diagnostic tests. The organizational design was also modified to discover potential problem areas more easily (Eby et al., 2003).

The primary purpose of the study and the development of the expanded workbook was to determine the workbook's usefulness in increasing overall self-awareness and general driving knowledge and in facilitating discussions among families of older drivers. In addition, the authors sought to assess whether problems identified through workbook responses actually related to problems encountered by older drivers on the road (Eby et al., 2003).

Study participants were asked to complete a three-phased examination, which included completing the Driving Decisions Workbook, submitting responses to a 27-item questionnaire, and performing a seven-mile road test on a course (featuring 28 structured maneuvers at specific locations including co2ntrolled and uncontrolled right and left turns and lane changes). A total of 99 individuals age 65+ participated in the study, 56 percent in the 65-74 age cohort and of whom were 44 percent in the 75 and older (75+) cohort. All participants were current drivers with valid driver's licenses and updated automobile insurance (Eby et al., 2003). Results of the study indicated that the newly designed assessment tool did, in fact, make users more aware of changes that could improve their driving abilities.

In addition, all respondents indicated that the workbook was at least a little useful and could help families discuss issues about older family members who still drive. Significant correlations were also found between the road test and a majority of workbook entries. Results implied that the workbook may be a useful first-tier tool for older drivers and their families. The Driving Decision Workbook, in addition to the AAA Drivers 55 Plus and the AARP instrument, is regularly identified and recommended as a credible self-assessment instrument. Others include AAA's *CarFit* and *Roadwise Review: A Tool to Help Seniors Drive Safely Longer* and the National Highway Traffic Safety Administration's *Driving Safely While Aging Gracefully*.

Physician Assessment & Counseling Programs (Second-Tier Models)

Older drivers may employ second-tier assessment models, which are typically facilitated by an expert such as a physician or driving instructor (Eby et al., 2003). Generally, an individual's decision to utilize second-tier assessments is based on self-assessment results that indicate a need for further evaluation of or feedback on a driver's capacity by a trained specialist. In a study involving older adults who had recently retired from driving, physicians' guidance and expertise was found to be particularly critical in helping driving retirees and their families determine whether or not they should continue driving (AMA/NHTSA, 2003).

Recognizing the strong influence that physicians have on individuals' decisions to modify or discontinue their driving, the American Medical Association (AMA) and the National Highway Safety Administration (NHTSA) have partnered to publish the *Physician's Guide to Assessing and Counseling Older Drivers (PGACOD)*. The guide is a response to the need for advanced assessment models and guidelines and is designed to help physicians identify and document physical or cognitive impairments and the public safety risk of elderly drivers. As indicated by Dr. Jeffrey W. Runge, Administrator of the NHTSA, while PGACOD primarily focuses on older drivers, age alone should not serve as the only measure for assessing people's driving ability (AMA/NHTSA, 2003).

PGACOD includes an overview of important assessment steps physicians should follow when working with elderly patients and their families to determine driving capacity. These steps, which help primary-care physicians identify, oversee, and treat medical barriers to safe driving, can actually help individuals continue driving longer. Included among them are performing an initial screen; determining whether or not a patient is "at risk" (this step taken if initial screen is positive) by assessing visual acuity, cognition, and motor function; prescribing health maintenance or prevention advice if a patient is determined to be "not at risk;" referring patient to a Driver Rehabilitation Specialist (DRS) if assessment and/or diagnosis determine such intervention is necessary; and counseling patient with follow-ups and advice on driving alternatives (AMA/NHTSA, 2003). Also discussed in the guide are ethical considerations for physicians in assessing driving capacity. These include considerations related to state driving laws and regulations, ways to promote family involvement and support, and best practices such as patient confidentiality and protection (AMA/NHTSA, 2003).

Based on PGACOD, when a primary-care physician refers a patient to a DRS, despite intervention and treatment, the physician has determined that functional deficits may continue to have significant effects on the patient's ability to safely operate a motor vehicle. A DRS can perform further, more in-depth assessments and make appropriate recommendations based on the severity of functional deficits identified through the evaluations (AMA/NHTSA, 2003). A DRS plans and develops driving services for individuals with disabilities. Often, a DRS is an occupational therapist, who has undergone driver-rehabilitation training through organizations such as the Association for Driver Rehabilitation Specialists. Services can often be found within a private practice and are affiliated with hospitals, rehabilitation centers, state licensing agencies, and driving schools.

DRS evaluations are broken into 1) driver evaluation, which includes clinical assessment, functional (on-road) assessment, communication of assessment results, and recommendations to patient, 2) passenger assessment, which includes vehicle assessments and modifications and consideration and support and assistance to patients' families, and 3) treatment and intervention, which include adaptive driving instruction or retraining, coordination of vehicle inspections, modifications, and recommendations (AMA/NHTSA, 2003).

Driver assessment and rehabilitation programs vary and are dependent on the extent of services provided. Typically, full assessments range from $200-$400, with rehabilitative services costing about $100 for one hour. The use of adaptive equipment and special-assistance technology affect costs (AMA/NHTSA, 2003). Worker's compensation and Vocational Rehabilitation programs both pay for driver assessment; however, many elderly drivers do not qualify for these programs and cannot always rely on insurance coverage from Medicare or Medicaid. Generally, Medicare does not reimburse individuals for driver-rehabilitation services. However, the American Occupational Therapy Association (AOTA) is currently lobbying for better and more consistent Medicare coverage of occupational therapy–based driver assessment and rehabilitation. AOTA's contentions are that such services fall within the scope of occupational-therapy services and that driving is an instrumental activity of daily living that should be supported (IADL) (AMA/NHTSA, 2003).

5. 3 National Education and Community Awareness Programs

Many states and communities nationwide offer driver safety or refresher programs, which typically are not very costly. Many insurance companies even provide auto policy discounts after successful completion of the courses. In addition to courses offered by the National Safety Council and the Driving School Association of Americas, Inc., AARP and AAA offer programs (described below) that are specifically designed for educating older drivers (AMA/NHTSA, 2003).

AARP and AAA Driver Safety and Education Programs

The AARP offers a *Driver Safety Program* (formerly known as the *55 Alive Program*) for individuals 50 and older, which is designed to update and enhance knowledge of road rules and regulations, provide information about normal age-related physical changes, and reduce the risk of traffic violations and crashes. In addition, the program provides an insurance discount to seniors who participate (auto insurance companies in most states provide a multi-year discount program to take the course).

Courses are typically structured into eight units, including *Recalling the Rules of the Road*, *Understanding Physical/Mental Changes that Occur as One Ages*, *Roads*, *Signs*, and *Markings, and Vehicle Safety Features*. Courses are available in classroom settings within the community (e.g., senior centers, community centers, higher education facilities) or online.

Despite the benefits to older adults of receiving insurance discounts and gaining confidence in their driving abilities, these courses typically do not include a "behind the wheel" component. And, according to AARP, only about one percent of the eligible driving population (age 50 and older) participates each year. In Pennsylvania, for example, the classes are only reaching about two percent of total eligible drivers (Kurutz, 2006). This is according to the state's AARP state coordinator of drivers' safety programs. According to one Pennsylvania senior resident, in recognizing the prevalence of more suburban living, everyone eligible should be required to take a driver safety program. As described by this resident, "you don't live in a community where the grocery store and the drugstore are just down the street anymore. So we have to drive to do it, and we have to be careful…" (Kurutz, 2006).

AAA also offers a *Mature Operator Program* to drivers aged 55 and older. Often, AAA members receive course fee discounts. However, states offering the *Mature Operator Program* are responsible for establishing program facilitation logistics, including where it is offered, length of the sessions, and course fees. For example, Northern New England offers a six-hour lecture and DVD–combined program in which participants receive three credit points on their driver licenses for successfully completion. Pennsylvania, Maryland, D.C., and Virginia, on the other hand, offer eight-hour courses that follow the standard guidelines established by AAA. Course fees are consistent across these states and include a range of topics such as natural changes and driving abilities, vision and aging, compensating for impairments, medications and impaired driving, and crash prevention. Delaware and New Jersey currently do not offer the AAA *Mature Driver Program*.

Benefits of state AAA *Mature Operator Programs* include insurance-premium discounts (depending on the state and insurance companies), improved driver confidence, information on traffic laws and signs, explanations and discussions on new vehicle technologies, and methods to help drivers and their families plan safer driving routes to daily designation points.

Law-Enforcement Programs for Older Drivers

Many states, including Delaware, offer programs for older drivers that include partnerships with local police departments. Several states, based on their size, offer more than one program. Florida, because of the state's large senior population, offers a variety of programs (U.S. Department of Transportation, 2004). Law-enforcement participation can be found in many of the elderly driver education programs described above (AARP, AAA). State programs are outlined in the *Compendium of Law Enforcement Older Driver Programs* (2004). A common partnership described in the compendium is the National Association of Triads. A triad is a collaborate initiative between local law enforcement and communities through a signed agreement to decrease senior victimization. Many state triads have implemented driver safety programs as part of their focus and service (U.S. Department of Transportation, 2004).

The Delaware State Police Community Service Section offers presentations to the state's AARP Driver Safety Program instructors during the semiannual instructor workshops (U.S. Department of Transportation, 2004).

Community Outreach and Coalition Initiatives

In addition to the driver awareness and refresher programs mentioned above, several states have become involved in collaborative community outreach and coalition initiatives to address issues related their increasing percentage of elderly drivers**.** In a report by the General Accountability Office (GAO, 2007), five states were identified as having formed multidisciplinary coordination groups to strategize and implement programs to improve awareness and older-driver safety. These include California, Florida, Iowa, Maryland, and Michigan. Included among the agencies and community groups taking part in such state coordination efforts are government, medical, academic, and social service organizations.

In their *Final Plan of Action* of the *Elderly Mobility and Safety—The Michigan Approach*, the Southeast Michigan Council of Governments (1999), in collaboration with the Michigan Department of State's Office of Services to the Aging and Office of Highway Safety Planning, has offered several general recommendations for developing collaborative education and awareness activities to address the various needs of the elderly and their families:

- Establish a statewide mobility resource center offering the elderly, their families, and caregivers' skill evaluation, rehabilitation, and improvement; education, support, and referral; and alternative transportation resources and training.
- Educate the general public about the importance of lifelong-mobility planning and techniques/resources needed.
- Host periodic statewide mobility summits to increase awareness of current issues and solutions related to elderly mobility.

As a result of the council's work, the Senior Mobility Work Group was formed to continue updating the plan and develop strategies and recommendations to state agencies and the Governor's Traffic Safety Advisory Commission (GAO, 2007).

In terms of outreach and marketing programs, the American Association of Motor Vehicle Administrators (AAMVA) and its partners in the District of Columbia, Maryland and Virginia, have created *GrandDriver*, a pilot program that provides information about aging and driving (GrandDriver, 2007). The *GrandDriver* program urges older drivers and their families to learn more about the impact of aging on the ability to drive. It promotes self-assessments, physician input, and education and awareness programs for individuals and their families through collaboration and coordination with AAA, AARP, and other state-specific partnerships with organizations that address the elderly and/or transportation and mobility issues (GrandDriver, 2007).

The AAMVA supports *GrandDriver* programs with specific marketing and outreach packets and tools. Based on the success of pilot programs in Virginia and Florida, these states have used these marketing tools to take their *GrandDriver* programs a further step to offer an array of education, awareness, and support resources and information. These resources provide older Virginians and their families' suggestions on improving driving skills and information that will help older drivers compensate for age-related changes so they can continue to drive as safely, and for as long, as possible. Specific resources include online publications and information through a detailed website, as well as listings of upcoming events and presentations that might benefit older drivers. Virginia's program is supported by the Virginia Department for the Aging, sponsored by the National Highway Traffic Safety Administration, and administered by the Virginia Department of Motor Vehicles (Virginia GrandDriver, 2007). For more information on Virginia's program, visit *www.granddriver.net*.

Florida's GrandDriver program is primarily administered through the Department of Highway Safety and Motor Vehicles but is supported though partnerships with the American Society on Aging (ASA), AAA, AARP, the Florida TRIAD Program, and the state's Department of Elder Affairs. Highlights of the Florida GrandDriver website include online assessment tools and methods of reporting unsafe drivers (Florida GrandDriver, 2007). For additional information on Florida's program, visit *www.floridagranddriver.com*.

Other state coalitions, which are slightly different but similar to *GrandDriver* programs, are found in Iowa and California. Iowa's Department of Transportation, based on objectives of the Governor's Traffic Safety Board, has put together resources and forums on safe mobility for older adults. Sponsors include the Iowa Safety Management System, the Offices of Drivers Services and Traffic Safety, the Federal Highway Administration, the University of Iowa's Center on Aging, the NHTSA Region VII, AARP, and AAA Minnesota/Iowa (Iowa Safety Management Systems, 2002).

As a result, Iowa's Older Driver Target Area Team now helps identify strategies and provides consulting services to the Iowa Department of Transportation (GAO, 2007). Included among the strategies identified at the Iowa Safe Mobility Decisions for Older Drivers Forum held in 2002 were the following:

- Provide or require ongoing education or enrichment programs.
- Plan comprehensively by providing resources, incentives, and political power to implement changes.
- Improve overall public awareness that keeps concerns related to older drivers in mind.

In California, an Older Driver Task Force Traffic Safety Center for Injury Prevention Policy and Practice has been created through the coordination of the California Highway Patrol (CHP) and San Diego State University. In addition to its agenda of building a comprehensive, statewide system to reduce traffic-related injuries among older adults and promoting land-use policies that simplify driving for seniors, CHP also works with the state's AARP organization to facilitate safety courses.

Section 6: Priorities and Recommendations for Delaware

6.1 Overview

Addressing the needs of Delaware's drivers will require a deliberate and sustained effort focused on promoting mobility and safety on the state's roadways. In addition, it will require a continual review of issues and the collaboration of various stakeholder groups to develop specific strategies and long-term solutions. The following is a series of priorities and recommendations for consideration in addressing current issues related to Delaware's older drivers. They are based on the research and best practices provided in the case study and literature review sections of this report. Each recommendation is briefly described and includes specific action strategies and a comparison of Delaware's current practices.

Information regarding Delaware's current practices and programs was obtained by meeting with DelDOT staff, reviewing current manuals and guidelines (including the Delaware MUTCD and Sign Design Manual), and reviewing questionnaire responses from local and regional stakeholder groups (see Appendix, Priorities and Recommendations section). Delaware should consider the FHWA's *Highway Design Book for Older Drivers and Pedestrians* into any future road design plans. In addition, DelDOT's capital budget should reflect potential pilot projects aimed at improving older-driver safety and mobility. Pilot projects should be targeted to areas with both a high percentage of elderly and a high crash rate (see GIA maps in Appendix, Demographics/Statistics section). Finally, these recommendations should be analyzed and implemented on a case-by-case basis, taking into consideration the demographic trends and issues facing Delaware's three counties and local jurisdictions.

6.2 Assessment, Education, and Outreach

RECOMMENDATION 1
Convene a Series of Public Forums and adopt a multi-faceted, older-drivers campaign.

Description: Similar to campaigns formed in other states, a Delaware Older Drivers Campaign would involve the collaboration and coordination of multiple state agencies, community-based organizations, and advocacy groups to continually review issues related to Delaware's older drivers and develop detailed strategies for addressing the needs of older drivers and their families.

Specific Action Strategies: Establish an Older Drivers Advisory/Working Group (including AAA, AARP Delaware, Delaware Aging Network, DelDOT, Division of Aging, DMV, Office of Highway Safety, Division of Aging, higher education institutions, law-enforcement agencies, MPOs). This group, comprise the individuals representing organizations and agencies in all three counties, would meet to discuss their representative concerns and issues related to Delaware's older drivers.

In addition, they would serve as the primary research and advocacy group charged with gathering information, education materials, and resources about the importance of long-term mobility and the need for appropriate transportation planning. Furthermore, this group could serve as a Governor's Advisory Group. Through this initiative, formal outreach programs could be developed (if deemed necessary) including a Delaware *GrandDriver* Program that urges older drivers and their families to learn more about a variety of related issues. Marketing resources including a website offering safety tips, online research and publications, self-assessment tools, and information on planned events, workshops, or driving programs could eventually emerge from this initiative as well. In addition, information obtained from the working or advisory groups could be used to update the state's current State Highway Safety Plan (SHSP).

The first step in initiating the campaign is to hold a series of forums to discuss the research findings presented in this report and how they impact each of the state's primary jurisdictions. Forum participants should include representatives from various stakeholder groups, who would establish issues and priorities for each of the areas. The work of each local forum would then be presented to the larger Older Drivers Advisory Group to review and discuss as part of a statewide planning and outreach effort.

In addition, DelDOT staff, as well as representatives of AAA and AARP Delaware, should meet with representatives of neighboring states' (Va., Md.) coalition programs and campaigns to discuss best practices, costs and benefits, and potential implementation in Delaware.

Projected Costs: Initial costs associated with the development of a task force or advisory group would be minimal. Funding support for research, marketing, and events could be shared among several state agencies including DelDOT, DMV, and the Division of Aging. Several University of Delaware research centers could potentially assist in convening or facilitating events such as forums or workshops. In addition, federal funding might be attainable through the National Highway Traffic Safety Administration or other national organizations including AAA, AARP, and the Administration on Aging (AoA).

Current Practice(s) in Delaware: The Delaware Aging Network meets regularly to discuss a variety of issues related to older Delawareans (transportation, nutrition, Medicare, social services) and is coordinating with WILMPACO and other planning groups to create a statewide mobilizing plan (*United We Ride* program,). The state's senior centers periodically offer driver safety courses or refresher programs. Additionally, the Delaware State Police Community Service Section offers presentations to state AARP Driver Safety Program instructors. The AAA offers older-driver programs through the Mid-Atlantic Safety Foundation and is heavily involved in strategic planning efforts that are influenced by the need to accommodate the needs and interests of older Delawareans. Finally, the Delaware AARP works with the Delaware Insurance Commissioner to keep driver safety classes a priority and has testified on the benefits of older-driver safety to the community as a whole.

AARP Delaware has also participated in the Delaware's *United We Ride* initiative and currently holds a seat on the Public Advisory Council of WILMAPCO. These practices could be better integrated and/or marketed together as part of a comprehensive program of the Older Driver's Campaign.

RECOMMENDATION 2
Provide information and education to DelDOT staff on assessing the needs of Delaware's older drivers.

Description: Given the Delaware's increasing senior population, DelDOT staff should become familiar with the issues related to older drivers in Delaware and knowledgeable about how the FHWA guidelines should be considered and/or employed in Delaware.

Specific Action Strategies: Inform staff about the findings and recommendations included in this report. In addition, contact a federal or regional representative to meet with DelDOT staff on the FHWA's *Guidelines and Recommendations to Accommodate Older Adults and Pedestrians* that could assist in planning for elderly drivers' safety and mobility in Delaware. A DelDOT planning staff person could be designated to serve as a point person and agency expert on older driver issues and guidelines. This person also could eventually serve as the DelDOT representative to participate in an older-drivers campaign and attend scheduled forums or public workshops on related issues.

Projected Costs: Low

Current Practice(s) in Delaware: DelDOT currently offers no formal training to staff on the FHWA *Guidelines and Recommendations to Accommodate Older Adults and Pedestrians*. Delaware, which currently uses a Traffic Control Manual and Signal Design Manual, is in the process of developing its own MUTCD (based on current manual). Some of the FHWA guidelines, depending on their applicability in Delaware, should also be referenced in Delaware's final MUTCD as well as its Strategic Highway Safety Plan (SHSP) and State Transportation Plan (STIP).

RECOMMENDATION 3
Update current transportation safety plans and improvement plans.

Description: The state's SHSP and STIP plans should both be updated to include sections specifically dedicated to older drivers' mobility and safety.

Specific Action Strategies: Review Delaware's current SHSP and update to include a section that is devoted solely to older road users' safety and mobility. Review and update Delaware's current STIP to include projects or programs the main purpose of which is the improvement of older-driver safety.

Both the SHSP and the STIP should be reviewed and update regularly to include information and resources necessary based on research conducted by working groups established for the older-drivers campaign. The FHWA *Guidelines and Recommendations to Accommodate Older Adults and Pedestrians* would be an appropriate resource for updating both plans.

Projected Costs: Relatively low, if updated regularly

Current Practice(s) in Delaware: According to findings from a recently conducted GAO survey, Delaware's current SHSP and STIP do not include sections specifically dedicated to older drivers' mobility and safety. In addition, Delaware has not identified any projects the main purpose of which is the improvement of older-driver safety in its Federal Fiscal Year (FFY) 2007 STIP.

RECOMMENDATION 4
Incorporate older driver and transportation-planning strategies into state and local planning activities.

Description: The Office of State Planning Coordination (OSPC), working with DelDOT and regional and local agencies, would determine short- and long-term planning strategies for the state and its local jurisdictions on transportation-planning activities related to older drivers.

Specific Action Strategies: Based on information from working groups established for the older-drivers campaign, OSPC and DelDOT should work together to determine broad-based approaches to promoting the mobility and safety of older drivers in Delaware. During the comprehensive-planning process, local governments would consider specific strategies for addressing older drivers' needs within their communities. These needs and issues would be based on current and projected demographics, crash data, and long-range plans for development and growth. Specific strategies related to older drivers should be included in the infrastructure and/or transportation sections of local comprehensive plans as well as regional, state, and local transportation plans.

Projected Costs: Low

Current Practice in Delaware: State law requires that Delaware municipal governments develop and regularly update land-use plans. Smaller cities and towns (populations under 2,000) are required to develop a municipal development strategy. Larger cities and towns are required to develop more detailed comprehensive land-use plans. OSPC has prepared checklists designed to help municipalities and counties review and develop plans for their communities related to housing, annexation, redevelopment potential, land use, infrastructure needs, and transportation.

However, according to findings from the GAO survey referenced above, Delaware does not currently employ other methods of working with local governments to improve older-driver safety and mobility (e.g., develop programs with area MPOs or the Local Technical Assistance Program).

RECOMMENDATION 5
Review the Delaware DMV's role in promoting the safety of the state's older drivers.

Description: In its Physician's Guide to Assessing and Counseling Older Drivers (2003), the American Medical Association (AMA) encourages driver-licensing agencies to have a greater role in promoting the safety of older drivers. In particular, the AMA urges state licensing authorities and driver-rehabilitation programs to examine the use of technologies to increase the accessibility of reliable driver-assessment services to the public. Information-sharing and public outreach through manuals and website development are appropriate first steps in this process.

Specific Action Strategies: Periodically revise the Delaware DMV manual to include updates and/or changes in driving laws, licensing renewal procedures, traffic patterns, and road-design standards. A specific section within the manual should be dedicated to this type of information. This information could benefit all Delaware drivers, as well as older drivers and new residents. For example, Virginia's DMV manual includes a website that provides up-to-date information on new driving laws and an exam on general driving knowledge and traffic signs. The DMV manual should include a section specifically dedicated to older drivers with tips on driving at night, self-assessment tools, licensing standards, and information on safety courses and assessment technologies.

In addition to manual revisions, the Delaware DMV website should be revised to include information specific to older drivers. Florida's DMV website, for example, includes tips and information on courses for mature drivers.

Projected Costs: Relatively low, if updated regularly

Current Practice(s) in Delaware: The current Delaware DMV manual includes information on driver-examination procedures, how to address or report medical conditions, and a section on approved behavioral modification and information. In the "Rules of the Road" and "Be in Shape to Drive" sections, there are general safety tips related to vision and hearing. In addition, there is basic information on defensive-driving courses available within the state. However, there is no information on self-assessment and how assessments might benefit drivers between license renewals. Currently, there is no section that references recent or projected modifications in traffic or driving laws or road-design standards. Finally, there is no section in the driver manual or on the website that is specifically devoted to older drivers.

6.3 Pedestrian/Driver Interaction

RECOMMENDATION 6
Adjust signal timings for pedestrian walkways.

Description: Elderly and disabled pedestrians often walk at a much slower rate than the rates used for current signal-timing calculations. Adjusting signal timings in areas with a high percentage of elderly will provide more time for an elderly pedestrian to safely navigate an intersection.

Specific Action Strategies: Signal timings and phases for current signals should be evaluated on a regular signal-maintenance schedule. As part of scheduled signal maintenance, data on the number of pedestrian-walkway users could be collected, especially in areas outlined by the GIS maps presented in the Appendix (Demographics/Statistics section). For example, areas of the state where the elderly currently (or are projected to) represent a large percent of the population should receive particular consideration.

These areas should be considered for a reduction in average signal speeds (4 feet per second to 2 to 3 feet per second). The Delaware MUTCD should include warrants for reducing pedestrian walking speeds for signal timings such as:

1. Intersections within census blocks with elderly populations exceeding 20 percent.
2. Intersections within areas with low-auto-ownership rates (20 percent or more households with no vehicle)
3. Intersections located near senior centers or retirement communities (e.g., within 0.5 miles)
4. Intersections with a pedestrian volume greater than 50 peds/hour based on the MUTCD's signal warrant for pedestrian traffic

Projected Costs: Low

Current Practice(s) in Delaware: For intersections needing adjustments (pedestrian or otherwise), pedestrian times are being re-calculated based on a 3.5 ft./sec. walking speed (consistent with draft ADA recommendations).

RECOMMENDATION 7
Provide advance warning lane markings and signs alerting drivers to crosswalks.

Description: Marking the pavement in the approach to a crosswalk has a significant impact on a driver's awareness of an upcoming pedestrian crosswalk (unsignalized). Studies presented in the previous sections show that pavement markings had a greater effect on the number of drivers who stopped at an intersection than signs alone.

Striping, such as a pedestrian symbol or yield triangles, can be implemented in conjunction with signs to increase driver awareness of unsignalized crosswalks.

Specific Action Strategies: Any regulatory or warning sign can be drawn on the roadway surface. Delaware's draft MUTCD might include a provision for advance-warning striping or signals at crosswalks. Striping should follow current MUTCD rules and regulations for luminescence and reflectivity. Advance warning symbols could include a pedestrian figure, similar to those used on advance-warning signs. These types of symbols should be used in areas with moderate-to-high levels of pedestrians, or where there may be elderly or disabled pedestrians. Appropriate yield identifiers should be placed in front of all unsignalized pedestrian crosswalks. In addition, standard advanced warning signs should be considered for areas where crosswalks may be unexpected, such as more rural communities in southern Delaware. Advance-warning signs with beacons should be implemented for crosswalks in areas where drivers may have difficulty seeing a crosswalk (areas of low visibility).

Cost: Low to moderate

Current Practice(s) in Delaware: Delaware's MUTCD draft requires that "shark teeth" be located before pedestrian mid-block crossings.

RECOMMENDATION 8
Provide medians and refuge islands for pedestrians navigating large or complex intersections.

Description: A refuge island or median can be useful for pedestrians. They provide pedestrians a place to stop if they cannot safely cross the entire intersection in the time allotted. In addition, they are often used as traffic-calming measures to reduce speeds and increase the visibility of unsignalized crosswalks.

Specific Action Strategies: Traffic engineers should evaluate intersections on a case-by-case basis during regular maintenance or where there is a high incidence of crashes involving pedestrians. The traffic engineer should have discretion to determine whether the number of crosswalk users warrants any of the following:

1. Signalized intersections in which pedestrians must navigate more than six lanes of traffic (this includes any separate turn lanes)
2. Any skewed intersection where visibility of pedestrians is obscured or where a pedestrian's ability to see approaching traffic is obscured
3. Any signalized intersection with a green time less than the required pedestrian crossing time.
4. Unsignalized crosswalks in communities that wish to incorporate traffic calming

5. Any urban arterial with an unsignalized crosswalk that is utilized by a moderate to high number of pedestrians and that spans across four or more lanes and where there is not a signalized intersection within a reasonable walking distance (0.2 miles)

Projected Costs: Moderate to High

Current Practice(s) in Delaware: Currently, Delaware uses islands to provide separation between turning movements, opposing traffic flows, and for pedestrian and bicyclist refuge. Delaware should continue its policy for signalized intersections but review the use of islands for traffic calming and for the visibility of unsignalized crosswalks as described above.

RECOMMENDATION 9
Apply pedestrian countdown signals in areas with moderate-to-high pedestrian volumes.

Description: Pedestrian countdown signals provide pedestrians with an estimated time to cross the street. Unlike traditional "Walk/Don't Walk" pedestrian signals that leave many pedestrians unsure about the amount of crossing time allotted, countdown signals display the number of seconds remaining in the phase in which a pedestrian can cross safely. These help to prevent pedestrians from entering the intersection too late.

Specific Action Strategies: Delaware should revise its MUTCD to include the use of the pedestrian countdown signals and audible signals in areas with a high number of pedestrians. These countdown signals could be implemented on a trial basis in downtown Wilmington, downtown Newark, and at the beach communities (all of these areas have moderate-to high pedestrian volumes). After successful implementation at these sites, other sites in Delaware should be examined, especially sites in communities with a higher-than-average number of elderly or disabled pedestrians.

Projected Costs: Moderate

Current Practice(s) in Delaware: Delaware has not implemented pedestrian countdown signals. The state's current Signal Design Manual, which is scheduled to be revised within the next year, does not reference countdown signals.

6. 4 Intersection Geometry

RECOMMENDATION 10
Add auxiliary left-turn lanes at intersections.

Description: Constructing auxiliary left-turn lanes at both signalized and unsignalized intersections separates the straight and turning movements and provides left-turning vehicles with a safe haven, so that drivers can wait for an acceptable gap in opposing traffic.

Specific Action Strategies: This recommendation should be considered at signalized intersections with moderate left-turn volumes, and at unsignalized intersections with moderate left-turn volumes and moderate-to-high through volumes. Priority should be given to intersections with high left-turn crash rates and high left-turn volumes. Specifically, implementation should focus on areas with high volumes of elderly drivers and particularly at intersections with high left-turn crash rates for the older-age cohort. GIS maps, which show the crash statistics and density of elderly population, could be used to determine locations for adding left-turn lanes (see Appendix). Adding a separate left-turn lane increases the length of pavement pedestrians must cross at an intersection, so each intersection should be evaluated from the perspective of elderly drivers and pedestrians. Separate left-turn lanes should also be considered at new intersections, particularly where high left-turn volumes are expected.

Projected Costs: Moderate to High

Current Practice(s) in Delaware: Auxiliary left-turn lanes are discussed at length in DelDOT's *Road Design Manual*. Currently, separate left-turn lanes are recommended at signalized intersections where left-turn volumes exceed 20 percent of the total approach volume, or where left-turning vehicles exceed 100 vehicles during the peak hour. At unsignalized intersections, auxiliary left-turn lanes are advised for approaches with limited sight distances, non-stopping approaches of rural arterials and collectors, and other approaches on the basis of capacity and operational analysis.

RECOMMENDATION 11
Replace conventional intersections with modern roundabouts.

Description: Single-lane, low-speed roundabouts limit vehicle speeds at intersections, provide for one-way traffic flow, separate opposing-vehicle paths, and eliminate the need for drivers to judge gaps in fast, head-on, opposing traffic. Left-turn movements are replaced by right-turn exits off the circulating roadway. Roundabouts are a possible intersection design alternative for minor arterials, major and minor collectors, local roads, and major and minor collector subdivision streets.

Specific Action Strategies: Single-lane roundabouts should be used only at intersections with fewer than 20,000 vehicles per day. Intersections with high crash rates and high densities of elderly population should be evaluated, and roundabouts should be constructed to replace conventional intersections on an as-needed basis. Roundabouts should also be considered as an alternative in new-intersection design or major redesign projects. At locations where conventional intersections are replaced with roundabouts, signing is particularly important to alert drivers of the change and inform drivers on navigation of the roundabout.

Projected Costs: High

Current Practice(s) in Delaware: According to DelDOT's *Traffic Calming Manual*, roundabouts can be considered at intersections with combined approaches of fewer than 20,000 vehicles per day, grades of no more than 6 percent, and speeds of 45 mph or less. For analysis and design issues related to roundabouts, DelDOT uses the FHWA roundabout guide as we as the National Cooperative Highway Research Program (NCHRP) Report 572 (recently released). Additionally, an *ad hoc* Roundabout Committee, which includes DelDOT Planning, Project Development, Traffic, and Public Relations, meets to discuss roundabout issues and implementation in Delaware. Several roundabouts have recently been developed in Delaware.

RECOMMENDATION 12
Position rounded-curb radii at intersections.

Description: Rounded-curb radii at 90-degree intersections allow drivers to navigate turns more easily.

Specific Action Strategies: Rounded curb radii should be used at intersections with a high density of elderly residents or drivers, including intersections near senior centers, assisted-living facilities, and retirement communities.

This intersection improvement should be considered on a case-by-case basis, with particular attention to areas scheduled for construction of new residential retirement developments/communities. Rounded-curb radii may increase the intersection width that pedestrians must cross, so each intersection should be evaluated on the basis of both pedestrian and vehicular traffic.

Projected Costs: Moderate

Current Practice(s) in Delaware: Delaware's Road Design Manual specifies certain turning radii for design vehicles which will relate to curb radii. However, Delaware does not discuss rounding curb radii to reduce the difficulty of a turn for certain drivers.

RECOMMENDATION 13
Realign skewed intersections.

Description: Skewed intersections have an internal angle of 70 degrees or less, requiring drivers to have a greater range of motion for turning their heads to observe conflicting traffic from the crossing roadway. Skewed intersections can be re-aligned to a 90-degree configuration.

Specific Action Strategies: Re-design of skewed intersections should be considered whenever a major intersection is being designed or retrofitted. In addition, skewed intersections with the highest traffic volumes, crash rates, and elderly populations should be examined for possible re-alignment.

Projected Costs**:** High

Current Practice(s) in Delaware: Skewed intersections in Delaware are discussed in both the *Rules and Regulations for Subdivision Streets* and the *Road Design Manual*. The guidelines for subdivision streets recommend a 90-degree intersection configuration and prohibit intersections with angles less than 70 degrees. However, the *Road Design Manual* allows for angles of approximately 60 degrees or greater for intersections, noting that an angle of 60 degrees produces only a minimal reduction in visibility, which often does not merit realignment to 90 degrees.

6.5 Signs and Traffic Signals

RECOMMENDATION 14
Use standard signal head sizes and designs at all intersections.

Description: In an attempt to standardize signal-head designs, the MUTCD offers a series of standard designs that should be used in order to reduce driver confusion. Signal-head sizes and designs may dramatic impact the ability for drivers to see and understand the signal.

Specific Action Strategies: All signals should be upgraded to 12-inch lens heads. Delaware's T signals should be replaced with the more commonly used 5-head doghouse design or the 3-head protected left-turn arrow, depending on intersection function (MUTCD Figure 4D-3 c,o). Intersections in areas with a high volume of elderly drivers should be slated for signal-head replacement priority.

Projected Costs: Low to Moderate

Current Practice(s) in Delaware: Most DelDOT signals have 12-inch heads. Some also have a less traditional T- and inverted T-signal-head design. A DelDOT study will soon examine the possibility of replacing T-heads to protected-only heads. Virtually all DelDOT signal lenses are light-emitting diode (LED) lenses.

RECOMMENDATION 15
Install advance traffic-signal warning signs.

Description: Advance traffic-signal warning signs can alert motorists traveling along high-speed roadways or along roadways, where a traffic signal may be unexpected or difficult to see, that they are approaching a traffic signal. Currently, 14 states use the advance-warning signs at all of their traffic signals on high-speed roadways. Using these signs on high-speed roadways can help reduce driver speeds as they approach intersections and will help to eliminate dilemma-zone issues.

Specific Action Strategies: The advance-warning signs should read "Be Prepared to Stop When Flashing" and be accompanied by two flashing signal heads, which are activated a few seconds before a signal turns from green to yellow, and should last until a few seconds after the signal has turned from red to green. Advance traffic-signal warning signs should be considered for the following locations:

1. In advance of a traffic signal that is located on a roadway with speeds of 50 mph or greater where the signals are difficult to see, given the roadway geometry.
2. In advance of a traffic signal that is located on a rural roadway with speeds of 40 mph or greater in areas where a traffic signal may be unexpected or difficult to see given the roadway geometry.

Projected Costs: Low to Moderate

Current Practice(s) in Delaware: More often than overhead signs, DelDOT installs ground-mounted warning signs with beacons. No changes to the Delaware MUTCD are required to allow for these types of signs.

RECOMMENDATION 16
Advance lane-use signs.

Description: Advance lane-use signs are important in providing elderly drivers with information in advance of an intersection so that they have more time to move their vehicle to the desired lane. The MUTCD recommends placing these signs at the lane tapers or right after the beginning of a turn lane. These signs can be placed on the shoulder or can be mounted overhead.

Specific Action Strategies: Advance lane-use signs should be applied in advance of signalized intersections between major arterials (with four or more lanes). These advance lane-use signs should be mounted overhead and be placed at the beginning of a turn lane.
In addition, advance lane-use signs should be applied in urban areas in advance of an intersection between a major and secondary arterial (with four or more lanes), or in advance of an intersection with reduced visibility or confusing lane configurations. These signs can be overhead or on the shoulder.

All signalized intersections with turn bays should have lane marking signs should be placed at the intersection. These will still provide some advance assistance, especially for intersections where traffic may cover lane use markings on the pavement.

Projected Costs: Low to Moderate

Current Practice(s) in Delaware: Currently, Delaware is using the MUTCD guidelines for advance-warning signs at signals. Overhead lane-use signs have been implemented on high-speed and high-volume corridors but have not been widely used. Neither advance lane-use signs nor lane-use signs placed overhead at an intersection are being used at many intersections across the state. Delaware should consider implementing advance lane-use signs, or at a minimum, mounting them overhead at the intersection.

RECOMMENDATION 17
Utilize advance street-name signs.

Description: Advance street-name signs can help a driver that is looking for a particular street to prepare in advance of the street. Currently, many street signs are small and difficult to see, especially at night. The required letter size for most street-name signs is too small for an elderly driver to see in advance of the street. Advance street-name signs can free a driver from having to search for a street and allow him/her to concentrate on driving. Many state DOT's have begun to install these signs in advance of signalized and unsignalized intersections along major roadways.

Specific Action Strategies: All signalized intersections and unsignalized intersections along major roadways should require an advance street-name sign in suburban and rural areas. These can sometimes be incorporated with the lane-use signs recommended above. All advance street-name signs should also include a measure of distance such as "1/2 mile" or "Next Signal," and be written in white letters on a green background. Rural street-name signs can still be included on intersection-warning signs. In urban areas these advance street-name signs should be applied to major arterials in advance of an intersection with another major or secondary arterial.

Projected Costs: Low to Moderate

Current Practice(s) in Delaware: Currently, Delaware is using the MUTCD guidelines for advance street-name signs. They are being applied at most signalized intersections along major roadways and are often applied in rural areas. Delaware should consider implementing these on a wider basis in areas with a higher-than-average number of elderly drivers or drivers visiting from other states.

RECOMMENDATION 18
Increase font sizes and incorporate "Clearview" font.

Description: Clearview is a new font that is designed to increase the visibility and understanding of a road sign without having to significantly increase the letter sizes. Increasing the visibility of street-name signs, warning signs, and freeway signs has been shown to improve a driver's awareness.

Specific Action Strategies: All freeway signs should be replaced with Clearview during a normal maintenance schedule. In addition, warning signs and street signs should be upgraded to Clearview during normal sign maintenance. Street-name signs and other informational signs with font less than 6 inches in height should be increased to at least 8 inches in height in areas where a large number of elderly drivers exists or is projected.

Projected Costs: Low to Moderate

Current Practice(s) in Delaware: Currently, Delaware is using the MUTCD-guidelines sign design and does not incorporate the Clearview font. The MUTCD recommends a letter size of at least 6 inches on all guide and informational signs along a high-volume or high-speed roadway, and a letter size of at least 4 inches along a low-volume or low-speed roadway. DelDOT does plan to use Clearview starting with the I-95 Fifth Lane Project, which begins in June 2007.

6.6 Roadway Lighting

RECOMMENDATION 19
Providing or upgrading roadway lighting at intersections and crosswalks.

Description: Providing or upgrading roadway lighting at intersections and crosswalks can be important to all drivers, but especially to elderly drivers with reduced vision. Studies conducted in other states indicate that areas with increased lighting, especially rural intersections, experience a 25 to 50 percent reduction in nighttime crash frequency.

Specific Action Strategies: Most urban intersections in Delaware currently have some form of illumination, but many rural intersections lack adequate lighting. Lighting should be provided or upgraded along major arterials in rural areas where they come in contact with an intersection with another major or secondary arterial. Lighting at intersections with subdivision streets should also be considered especially for developments containing a high number of elderly residents or drivers. Lighting should also be increased around intersections in areas defined by GIS maps as having a high incidence of nighttime crashes.
In addition to intersections, lighting should be provided or upgraded around unsignalized cross walks with a moderate-to-high number of pedestrians or crosswalks that are not within an acceptable walking distance of a lighted signalized intersection.

Projected Costs: Moderate

Current Practice(s) in Delaware: Currently, Delaware has warrants established for the implementation of roadway lighting. They also reference the AASHTO roadway lighting manual. Since roadway lighting can be expensive, AASHTO currently has warrants that recommend the minimum use of lighting. Delaware should consider implementing roadway lighting in areas with a high number of elderly residents or drivers, or areas with a lot of pedestrians.

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