EXECUTIVE SUMMARY

At the turn of the century – the 20th century that is – the median age in the United States was under 30 years; America was 60% rural in nature; and there were only 36 highway fatalities all year. As we leave the 20th century behind, the route into the 21st century is very different. “Intelligent” cars speed down multi-lane “smart” highways in a nation that is 75% urban. According to the Federal Highway Administration’s *Highway Statistics*, there are 28,000 times more vehicles on the road in 2000 than there were in 1900, and these vehicles travel about 2.6 trillion miles each year. Annual fatalities resulting from highway crashes have also increased – by over 1100%.

We see other changes as well. The face of America is changing. It is growing older. In 2025, persons 65 and over will make up 18.5% of the total population. The number of persons aged 85 and over is increasing more rapidly than any other age group. More importantly, the elderly are taking more trips, driving further, and continuing to drive much later in life. These conditions lead to concerns about traffic safety.

Although the elderly are healthier and drive safer cars than they did just two decades ago, their frailty makes them more susceptible to injury than younger persons involved in traffic crashes of the same severity. In addition, visual, physical, and cognitive skills, all of which contribute to driving abilities, decrease with advancing age. The familiar “U”-shaped curve depicting the rate of fatalities per vehicle miles traveled, shows that the elderly experience a higher highway fatality rate than any other age group except teenagers. While the overall number of highway fatalities has decreased regularly since 1972, the number of fatalities of elderly travelers has continued to increase steadily. This increase is cause for concern for both the elderly driver and for other persons on the roads who might be placed in danger through crashes involving elderly drivers.

Over the past century, the numbers of highways, vehicles, and drivers have increased dramatically. It is easy to allow the imagination to run rampant concerning the upcoming quarter century, to visualize super highways and technology-enhanced vehicles and a multitude of elderly, perhaps unsafe, drivers. Because of these concerns, Oak Ridge National Laboratory (ORNL) was tasked with developing a projection system to determine the impact of the elderly driver in the future.

ORNL's system of projection models provides national estimates and estimates for each of the four Census regions, in five-year increments between the year 2000 and the year 2025, for:

- The number of older drivers in the future who will still be driving, by age group and gender,
- The average number of miles to be driven annually by an elderly driver, by age group and gender,
- The total number of elderly *driver* fatalities resulting from crashes in which older drivers are involved, and
- The total number of *all occupant and non-occupant* fatalities (all ages) resulting from crashes in which older drivers are involved.

Our approach to developing a logical, transparent, and defensible model was as follows:

- Review the literature to ascertain the current state of the research and to identify issues.
- Examine data sources to determine compatibility between modeling issues and data.
- Build a mathematical link between two national surveys so that information on health status could be included in the model.
- Develop three empirical models (percentage of drivers, miles driven, and crash rate) based on historical data.
- Formulate assumptions on the projections of independent variables in the empirical models for the years 2000-2025.

- Adjust some empirically estimated parameter values in the models, primarily time trends.
- For the years 2000-2025, project the number of older drivers, the average vehicle miles traveled (VMT) per older driver, and crash rates, in order to generate projections of highway traffic fatalities by age group, gender, and Census region.
- Analyze the projections in terms of the extent to which various factors contribute to the increased fatalities.

Thus, our approach to projecting the number of fatalities involving older drivers uses four distinct components: (1) projection of the non-institutionalized population, (2) projection of the percentage of that population that drives, (3) projection of the average miles driven per driver, and (4) projection of the fatal crash risk associated with each mile driven. Our methodology, which has its motivation in behavioral theory, separates exposure to crashes from crash risk per se. It further divides exposure into two components, VMT and the likelihood of being a driver. This component structure permits conceptually different determinants of traffic fatalities to be projected separately. It also permits finer targeting of particular aspects of projections that need improvement and closer linking of projections to possible policy instruments for influencing them.

The **first** component of our model, population projections provided by the U.S. Census Bureau, indicates that nearly all subgroups of the elderly population will increase from 50 to 150 percent by the year 2025. This enormous increase will have a substantial effect on the projection of the absolute number of casualties, even when crash risk per mile driven decreases or remains constant.

The **second** component of our projection system involves estimation of the historical determinants of people's decisions to drive. Figure ES-1 shows the projected levels of drivers between 1995 and 2025 for males and females.

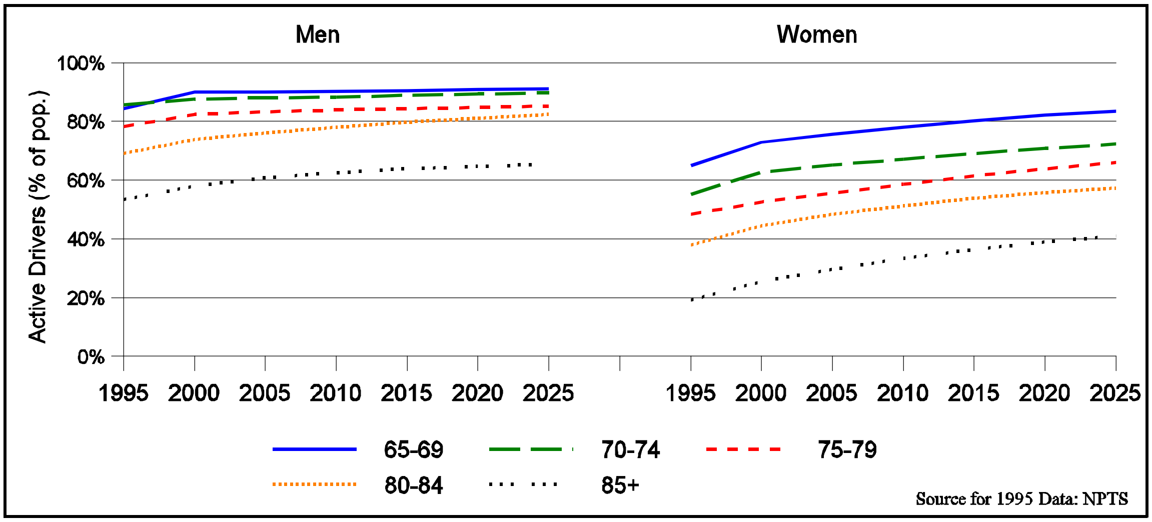

Figure ES-1. Projected Active Drivers as a Percentage of the Population

The **third** component of our projection system estimates the average miles driven for each age-gender-region group. The VMT projection on a national basis is shown in Figure ES-2, which illustrates the rapid growth in VMT for all elderly age groups, but especially for elderly women.

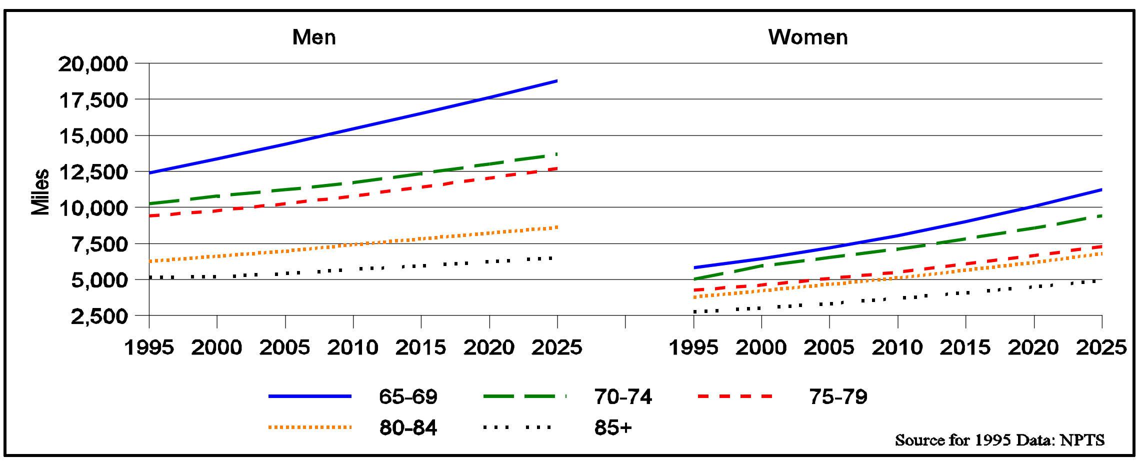

Figure ES-2. Projected Vehicle Miles of Travel per Person

The **final** component of the modeling system is the crash risk. Two crash risks were modeled, that of the elderly driver and that of the total number of fatalities associated with a crash in which an older driver is involved. The projected **driver** risk is shown in Figure ES-3. While the number of elderly drivers and the VMT of elderly drivers are projected to dramatically increase between 2000 and 2025, the crash risk is projected to decrease.

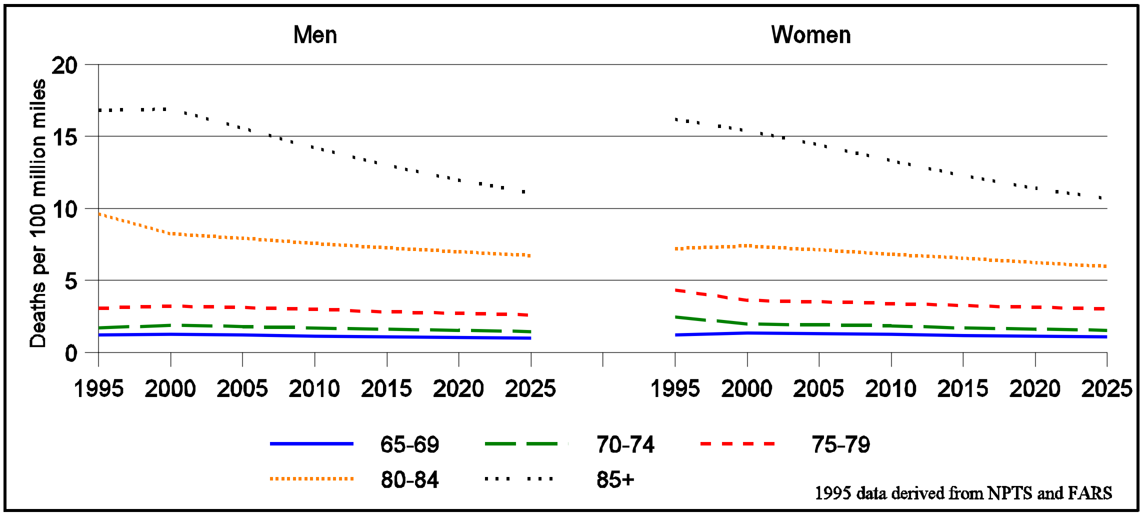

Figure ES-3. Driver Risk (deaths per 100 million miles)

Tables ES-1 and ES-2 summarize ORNL's projections of the two fatality measures used in this study, fatalities of elderly drivers and pro-rated total fatalities. It is important to note that our measurement of "total fatalities," which extends to passengers in a fatally injured elder driver's vehicle and to drivers and passengers of other vehicles in such a crash, divides the total number of fatalities among the number of vehicles involved in the crash. The concept was adopted as a concession to the absence of information on which driver in a crash was at fault.

Table ES-1. Elderly Driver Fatality Projections, Male and Female

Age Group	1995	2000	2005	2010	2015	2020	2025
65-69	881	983	1115	1425	1911	2287	2688
70-74	956	1045	1040	1158	1447	1888	2216
75-79	876	1136	1212	1235	1398	1793	2419
80-84	704	1064	1325	1448	1511	1770	2329
85+	474	670	838	1039	1202	1294	1489
Total	**3891**	**4898**	**5530**	**6304**	**7469**	**9032**	**11140**

Table ES-2. Total Fatality Projections, Male and Female

	1995	2000	2005	2010	2015	2020	2025
65-69	1120.505	1267	1464	1917	2628	3221	3871
70-74	1094.46	1221	1219	1369	1744	2333	2802
75-79	935.457	1240	1342	1400	1627	2139	2953
80-84	665.039	1022	1282	1429	1518	1803	2410
85+	376.745	530	666	840	990	1082	1265
Total	**4192.206**	**5279**	**5973**	**6955**	**8508**	**10579**	**13301**

Men and women have widely different fatality projections. Male driver fatalities continue to be greater than females in overall numbers; however, the percent of growth is projected to be less than that of female fatalities for most age groups, as shown in Table ES-3 for the year 2025.

Table ES-3. Elder Driver Fatality Projections for 2025

(as Percentages of 1995 Driver Fatalities)

Age Group	Male	Female
65-69	301.3%	457.8%
70-74	236.7%	295.0%
75-79	325.5%	297.0%
80-84	329.3%	441.5%
85+	261.1%	526.1%
Total	290.8%	375.9%

The full report contains projections by age-gender-region in five-year intervals for the number of drivers, VMT/driver, and crash risks, as well as projected fatalities. In addition to the projections provided in this report, a spreadsheet-based tool was developed that allows a user of the model to modify the assumptions we used in projecting highway fatalities. These assumptions include projections of household income, health and employment status, and other determinants of driving and crash involvement. This feature provides a mechanism to consider alternative scenarios about the future.

ORNL's methodology for deriving the fatality projections is based on a logical, well-grounded component approach. Because of data limitations, however, several assumptions were required. It is not generally possible to form direct links between data sets. Therefore, when possible, we either constructed a surrogate for a critical missing link, as in our development of the projected health status index, or simply excluded a particular projection from our model. In situations where the magnitude of historical trends, when continued indefinitely into the future yield absurd results, we logically modified coefficients of variables to provide more reasonable estimates of our modeling system components.

Additional research is recommended. Especially important research areas include the role of infrastructure and equipment, the asymptotic projection of VMT, additional and improved measures of health status, and further comparisons of younger and older drivers' behavior.