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Canada's Aging Population:
Transportation Safety and Security

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16. Abstract

This report explores the issue of Canada's aging population in relation to transportation safety and security. All modes of transportation are addressed (i.e., motor vehicles, pedestrian travel, public modes of transportation, including air, rail, intercity bus, marine transport, and public transit, and commercial transportation operations). An overview of measures for improving safety and security, and current research and initiatives is also provided. In addition, demographic, health, and socio-economic aspects related to aging and the elderly are discussed.

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16. Résumé

Ce rapport examine les liens entre le vieillissement de la population canadienne et la sécurité et la sûreté des transports. Tous les modes de transport sont abordés, autant les véhicules personnels, la marche à pied, les transports en commun (aérien, ferroviaire, maritime, transports urbains) que la conduite de véhicules commerciaux. On y fait également un survol des mesures susceptibles d'améliorer la sécurité et la sûreté des transports, ainsi que des recherches et initiatives en cours dans ce domaine. Les chercheurs examinent en outre la question du vieillissement et des personnes âgées sous l'aspect de la démographie, de la santé et des caractéristiques socio-économiques.

17. Mots clés	18. Diffusion
Personnes âgées, vieillissement, démographie, sûreté des transports, sécurité des transports, véhicules automobiles, piétons, transports en commun, conducteurs de véhicules commerciaux	Le Centre de développement des transports dispose d'un nombre limité d'exemplaires.

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Executive Summary

The study explores the issues of safety and security of the elderly in all modes of transportation. (It considers elderly drivers and passengers of motor vehicles, pedestrians, users of public modes of transportation, including air, rail, intercity bus, marine transport, and public transit, and commercial transportation operators). It suggests measures for improving safety and security, and outlines current research and initiatives. The study also discusses demographic, health, and socio-economic aspects related to aging and the elderly.

A wide-ranging literature and Internet search was used to collect information for the study. The information led to the preparation of a working paper, which was distributed to a variety of individuals and organizations for their review and comment. These comments were reviewed and incorporated in the final report.

A summary of the key conclusions and recommendations resulting from the study is presented below.

Defining the Elderly

It is generally accepted that the elderly are those 65 years of age and older. Attempts have been made to further classify the elderly, based on age sub-groups such as 65 to 74, 75 to 84, and those over the age of 85 (where the term young-old refers to those between 65 and 74, middle-old refers to those between 75 and 84, and the old-old refers to those over the age of 85).

For this study, the elderly have been defined as persons aged 65 years of age and over. However, where data permits, more detailed age groups have been used to more accurately reflect the aging process.

Recommendation: *When describing the elderly, more than one age group (i.e., 65 and over), should be used when data permits. Depending on the nature of the analysis, this could require more defined age groups than those identified above (e.g., five-year rather than ten-year age groups). Different age groups for men and women could also be considered because women have a longer life expectancy.*

Categorization of the elderly by age groups ignores the fact that the aging process varies from one individual to another.

Recommendation: *The heterogeneity of elderly persons should be recognized and assessment programs should consider individual capabilities (including physical, sensory, and cognitive).*

Societal Trends

Population projections indicate that the number of elderly persons, particularly older age groups, will increase as a proportion of Canada's total population. The number of persons with a disability will also increase, given the higher incidence of disabilities among the elderly.

These trends will increase the number of elderly persons who will be unable to drive and who will therefore require alternatives to the personal vehicle for transportation. Home care for the elderly (to reduce health care costs associated with institutional care) will also create new demands for transportation services.

Recommendation: *Measures aimed at ensuring the mobility of individuals no longer capable of driving should be encouraged. Such measures include community-based transportation services, community planning for the elderly, and a continuation of the shift towards low-floor and kneeling buses. These would help to reduce the strain on specialized transit.*

Motor Vehicles - The Driver

The key policy challenge is to help elderly drivers continue driving safely as long as possible, thus controlling pressures for alternative transportation services.

Recommendation: *Governments, particularly provincial governments, must identify those elderly individuals who are no longer "safe" drivers. It is recommended that the definition of a "safe" driver encompass physical, sensory, and cognitive capabilities and that the focus should be on driving capability rather than age.*

A definition of acceptable driving capabilities should consider time of day, nature of roadway, etc., leading to conditional licences. To ensure consistency across jurisdictions, national standardization would be necessary.

Extended testing for elderly drivers should be pursued for assessing all aspects of capability. In addition, the legal and ethical implications of such measures should be taken into consideration. To be viable, driver assessments must be straightforward, accurate, and low-cost. The use of simulators, successfully employed in training and testing pilots, should be examined as an approach to meeting this requirement.

Research, education, and information campaigns should be undertaken to help elderly drivers, friends, and family identify and adjust to the reduced capabilities of elderly drivers. The elderly themselves should be directly involved in these projects. An incidental benefit would be increased awareness among the general public of the impact of aging on driving capability.

Given its role in promoting road safety, Transport Canada should take a leadership role in developing education and information campaigns.

Motor Vehicles - The Vehicle

Further improvements could be made to private motor vehicles to increase safety for elderly road users. These measures could include user-friendly vehicle controls and displays, new in-vehicle safety features such as improved seat belts, "smart" airbags, and Intelligent Transportation Systems (ITS) applications.

Recommendation: *The high incidence of fatalities among the elderly must be addressed. In developing new in-vehicle safety features such as seat belt improvements and "smart" airbags, automobile manufacturers should be encouraged to consider the needs of elderly occupants.*

ITS opportunities should be evaluated and priority given to those that show promise of reducing the likelihood of collisions. In addition, more participation by the elderly is required in the planning and decision-making related to the development and deployment of ITS. Given the wide range of organizations involved in ITS, these efforts should be pursued by Transport Canada in partnership with organizations such as the Transportation Association of Canada (TAC), the Canadian Council of Motor Transport Administrators (CCMTA), and provincial governments.

Motor Vehicles - The Road Environment

The road environment is the third key element of road safety. Here measures for enhancing the safety of elderly road users include the clear display of traffic signage; the reduction of irrelevant stimuli; appropriate street lighting, particularly for both controlled and uncontrolled intersections; standardized left-turn signals at controlled intersections; and clear lane demarcation.

Recommendation: *Efforts should be made to ensure consistent implementation of the safety measures noted above. To facilitate the implementation of road designs consistent with the safety needs of elderly road users, Canada should monitor U.S. Federal Highway Administration (FHWA) research on the identification, development, and evaluation of engineering enhancements to the highway system to meet the needs of older road users.*

Best practices suitable for Canada's environment should be considered for implementation, while promising measures requiring modification to suit the Canadian environment should also be pursued. Appropriate funding levels should be considered when implementing these measures. To ease the implementation, Transport Canada should consider a technology transfer program aimed at all levels of government across Canada responsible for maintaining the road environment.

Pedestrians

Motor vehicle collisions involving elderly pedestrians are the most serious transportation safety-related issue next to motor vehicle collisions in general. The physiological implications of aging (such as reduced mobility) play an important role in elderly pedestrian fatalities, and intersections are the primary problem locations.

Recommendation: *Current research into traffic engineering and elderly pedestrians being undertaken by the U.S. FHWA should be monitored and best practices applicable to Canadian situations should be disseminated and implemented. Transport Canada and the Transportation Development Centre should consider developing an information campaign aimed at local and regional governments on measures available for improving pedestrian safety.*

Pilot safety evaluations involving elderly pedestrians at site specific traffic-related settings (e.g., intersections, crosswalks) should be considered by local governments (possibly supported in part by Transport Canada). These evaluations would assess first-hand the benefits of measures aimed at improving the safety of elderly pedestrians. A list of safety measures could then be developed, including such features as intersection clearance intervals, no slip surfaces, and appropriate snow and ice removal procedures.

Public Modes of Transportation - Personal Safety

For elderly local transit passengers, the risks of falling while walking to and from transit stops, within transit stations, or standing in the vehicle are primary safety issues. For intercity modes, falls in terminals are the key safety concern.

Recommendation: *To mitigate the risk of falling, advances in terminal and transit station design and appropriate maintenance standards (including snow and ice removal) should be continued. In addition, in-vehicle features, such as no-slip surfaces, grab bars, and colour contrasting, should be implemented. For trips to and from transit stops and stations, measures aimed at improving the safety of elderly pedestrians should be considered (if they are not already in place).*

Public Modes of Transportation - Personal Security

Personal security is of greatest concern to elderly users of local transit, particularly at night. In intercity travel, risks relate largely to terminals, with greater risk in intercity bus terminals than in airports.

Recommendation: *Appropriate lighting, emergency phones, surveillance cameras, and on-site personnel deployment (especially for larger urban areas) should be implemented if they are not already in place.*

In addition, for local transit, allowing off-peak patrons to exit the bus closer to their destinations, rather than at designated stops, and providing two-way communications between dispatchers and bus drivers should be implemented (again, if they are not already in place).

Commercial Operators

The elderly do not appear to present a significant safety problem in this area because they represent relatively small proportions of total commercial transportation operators (i.e., operators of trucks, taxis, buses, aircraft, and marine vessels), and licensing requirements are stringent. However, there is little information on collisions involving elderly operators to substantiate this conclusion.

Recommendation: *If licensing requirements or mandatory retirement policies are eased, the collision experience of elderly operators should be carefully scrutinized.*

Information Dissemination and Additional Needs

Current information is not comprehensive in all areas; however, a number of initiatives designed to fill some of the gaps are under way.

Recommendation: *Current and ongoing research should be monitored and the results disseminated. Given the wide range of organizations involved in transportation safety, Transport Canada, in partnership with organizations such as TAC, the CCMTA, and provincial governments, should take on this responsibility. Dissemination and sharing of research results, lessons learned, and best practices could be generated through a conference or seminar sponsored by Transport Canada, or a web page/clearinghouse arrangement.*

In addition, it is recommended that elderly persons or their representatives be directly consulted about the advantages and disadvantages of specific measures aimed at improving their transportation safety and security.

Need for Continued Action

The information collected in this study indicates that many opportunities exist to help meet the safety and security needs of Canada's aging population. However, while many measures to benefit the elderly have been or are being implemented, sustained efforts are required at all levels of government and in the private sector to ensure that the transportation system is as safe and secure as possible for this group.

Recommendation*: Transportation policy should pay more attention to the transportation safety and security of Canada's aging population. All interested parties (in both the public and private sectors) should be proactive in identifying and implementing appropriate measures, and in undertaking research and development to address unmet needs.*

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List of Exhibits

1. Introduction

1.1 Importance of Safe and Secure Transportation for the Elderly

> *Mobility is critical to well-being. Ready access to family, friends, social activities, health care and shopping centres and other social outlets are vital to one's full participation in life. (*Coughlin, Lacombe, 1997)

Safe and secure transportation is an important factor in maintaining the mobility, quality of life, and independence of elderly persons. As the Canadian National Advisory Council on Aging (NACA) states, an elderly person's ability to get out to see friends, shop or visit a health professional, in winter as well as summer, is closely tied to life satisfaction and is vital to one's full participation in life.

At the 1971 White House Conference on Aging, transportation was ranked third in importance, preceded by income and health issues. *Maximizing Transportation Choices* was one of several key resolutions resulting from the 1995 White House Conference on Aging, aimed at promoting the social well-being of older Americans.

Lack of safe and secure transportation can act as a barrier to elderly persons, affecting their mobility and quality of life. Within the context of this study, personal safety has been defined as an individual's protection from the risk of injury or death, resulting from their use of Canada's transportation system. This includes the use of personal and commercial motor vehicles, travelling as a pedestrian, and using public modes of transportation. Personal security is defined as an individual's protection from the risk of being a victim of criminal activity while travelling.

This report explores the issues of safety and security, from the perspective of all modes (i.e., drivers and passengers of motor vehicles, pedestrians, and users of public modes of transportation, including air, rail, intercity bus, marine transport, and public transit, and commercial transportation operators). It also provides measures for improving safety and security, and reviews current research and initiatives.

1.2 The Demographic Revolution

> *... history has been marked by revolutions ... the 19th century saw the industrial revolution; and the 20th century has brought us the information and technology revolution. The 21st century will be marked by the dramatic aging of our population - a demographic revolution. (*White House Conference on Aging, 1996)

This study also focuses on the issues of safety and security in the context of Canada's aging population. An aging population can be defined as a population where there is an increase in the proportion of elderly persons (i.e., persons aged 65 and over) relative to that of other age groups. Based on Statistics Canada's long-term population projections, the elderly's share of Canada's population will be approximately 23% by 2041 (based on medium growth projections), as compared to approximately 12% in 1996.

1.3 The Effects of Aging

The report addresses issues of personal health and ability, significant factors related to safe and secure mobility for the elderly. The aging process results in the decrease of physical, sensory, and cognitive capabilities due to various forms of normal deterioration and resulting from the onset of disease(s). The following are examples of individual capabilities that can be affected by the aging process, which can consequently affect an individual's mobility:

- strength, endurance, and agility;
- reaction time;
- ability to hear high and/or low frequency tones;
- ability to block out background noise;
- visual acuity at far distances;
- ability to focus on near objects;
- sensitivity to glare;
- night vision;
- peripheral vision;
- ability to ignore irrelevant stimuli;
- retrieval and processing of information;
- spatial orientation and visual-motor integration;
- ability to divide attention between two or more tasks; and
- searching and scanning abilities which require selective attention.

These and other effects related to the physical, sensory, and cognitive abilities of the elderly, are also discussed in relation to transportation safety and security.

1.4 Overview of Report

A wide-ranging literature and Internet search was used to collect information for the study. The information that was collected led to the preparation of a working paper, which was distributed to a variety of individuals and organizations for their review and comment. Comments were reviewed and incorporated into this final version of the report.

For guidance, the report is divided into the following sections:

- Section 1 (this section) provides an introduction and overview of the report;
- Section 2 presents a demographic and health profile of elderly persons;
- Section 3 profiles transportation characteristics of the elderly;
- Section 4 discusses safety and security concerns related to motor vehicles;
- Section 5 discusses pedestrian safety;
- Section 6 discusses safety and security of public modes of transportation;
- Section 7 discusses safety in relation to elderly commercial operators;
- Section 8 presents an overview of current research and related initiatives;
- Section 9 provides a summary of the research contained in this report; and
- Section 10 provides conclusions and recommendations.

2. Who Are the Elderly?

This section provides a profile of the elderly. The profile includes a discussion on demographic, health, and socio-economic issues. The discussion focuses on:

- defining the elderly;
- Canada as an aging society;
- health characteristics;
- causes of death and hospitalization;
- income;
- housing;
- distribution of the elderly between urban and rural environments; and
- personal security.

2.1 Defining the Elderly

2.1.1 Persons 65 Years of Age and Over

In North America, the elderly are traditionally defined as those persons 65 years of age and over, with the basis for this age threshold being the usual retirement age. In this report, we have considered those 65 years and over to be elderly, although for specific analysis purposes, sub-groups of the elderly have been used.

The definition of who is elderly has been changing over time, due primarily to the increase in life expectancy. For example, in 1921, life expectancy at birth was 59.7 years (for men and women combined). In comparison, by 1991, life expectancy at birth (for men and women combined) had increased to 77.8 years (74.6 years for men and 81.0 years for women). (Statistics Canada, 1997) This represents a 30% increase in life expectancy in the 70-year period between 1921 and 1991. As such, the average abilities of a 65-year-old today would be expected to be greater than an average 65-year-old in 1921. For reference, life expectancy at age 65 (1991) is 15.8 years for men, and 20.0 years for women. (Statistics Canada, 1997)

Wigdor notes, "*because of the significant changes in life expectancy and the general well-being of many older adults, we now tend to apply the definition for the word 'old' to later and later chronological age (groups)"*. (Widgor et al., 1988) This increase in life expectancy is leading to proposed legislation to increase the age of eligibility for retirement benefits, suggesting that the age threshold used to define the elderly may also increase over time.[1]

2.1.2 Three Groups

[1] With respect to retirement age, in the United States, starting in the year 2003, people born after 960 will not be eligible for full Social Security benefits until age 67 (Source: *Improving Transportation for a Maturing Society*, U.S. DOT, 1997).

Attempts have been made to further classify the elderly, based on age sub-groups. For example, Neugarten, a psychologist/gerontologist, realizing that there are many different kinds of elderly, developed the phrases *"**young-old**"*, to describe those over the age of 65 who are active, with a life style similar to those of middle age, and the *"**old-old**"*, who because of their health condition(s), may rely on others to meet some of their daily needs. Applying age groups to Neugarten's analysis, the following classification can be used to describe the elderly:

- ***young-old*** (referring to those between 65 and 74);
- ***middle-old*** (referring to those between 75 and 84); and
- ***old-old*** (referring to those over the age of 85).

2.1.3 Variable Definition

However, while some categorization of the elderly can be useful, it ignores the fact that not everyone "fits" into these categories, and one might become "old", earlier or later in life. Neugarten points out that "*we may be moving towards an 'age irrelevant' society"* that recognizes that aging is dependent on the individual. (Widgor et al., 1988) Moreover, due to the more than six year difference in life expectancy between men and women (noted on the previous page), it is unreasonable to assume that elderly men and women of the same age would have equivalent abilities. Thus, any age classification of the elderly assumes that people are essentially homogeneous within a particular age group, and does not recognize that individuals are essentially heterogeneous.

The fact that the aging process varies greatly from individual to individual is due in part to the different genetic, environmental, cultural, lifestyle, and socio-economic factors which individuals experience. Recognition of this dynamic and heterogeneous aging process has led the U.S. Department of Transportation (1997) to develop the following principles to help define and understand aging:

- *aging is universal and inevitable but not necessarily predictable;*
- *aging-related changes are characteristically detrimental in nature, cumulative and irreversible over time, but often lack sharply defined points of transition;*
- *as the human animal ages, homeostasis[2] becomes more difficult to maintain as resistance to environmental stress declines;*
- *changes begin at different chronological ages, progress at varying rates, and do not affect each body system in the same way or follow an identical course; and*
- *there are wide individual and socio-cultural variations to the aging process.*

[2] Homoeostasis - tendency to relatively stable equilibrium between interdependent elements ... as maintained by physiological processes (Concise Oxford Dictionary).

2.2 Canada's Aging Population

An aging population can be defined as a population where there is an increase in the proportion of elderly persons relative to that of other age groups. As illustrated in Exhibit 2.1, Canada can be defined as having an aging population. Based on Statistics Canada's long-term population projections,[3] the elderly's share of Canada's population will be approximately 23% by 2041 (based on medium growth projections).

As indicated in Exhibit 2.2, the elderly's share of total population will increase from approximately 12% in 1996 to almost 23% in 2041. Of the elderly population, those who are 90 years of age and over will experience the most rapid growth from 125,000 in 1996, to 635,000 in 2041 (an increase of approximately 400%).[4] Growth rates, by age group, are illustrated in Exhibit 2.3.

Exhibit 2.4 profiles the elderly by age group and gender. As indicated in this exhibit, for the years 1996 and 2041, females represent more than 50% of persons 65 and over, with their share increasing with age. For example, in 1996, while females represent 53% of persons 65 to 69, they represent 56% of persons 70 to 74, 59% of persons 75 to 79, 63% of persons 80 to 84, 68% of persons 85 to 89, and 75% of persons 90 and over.

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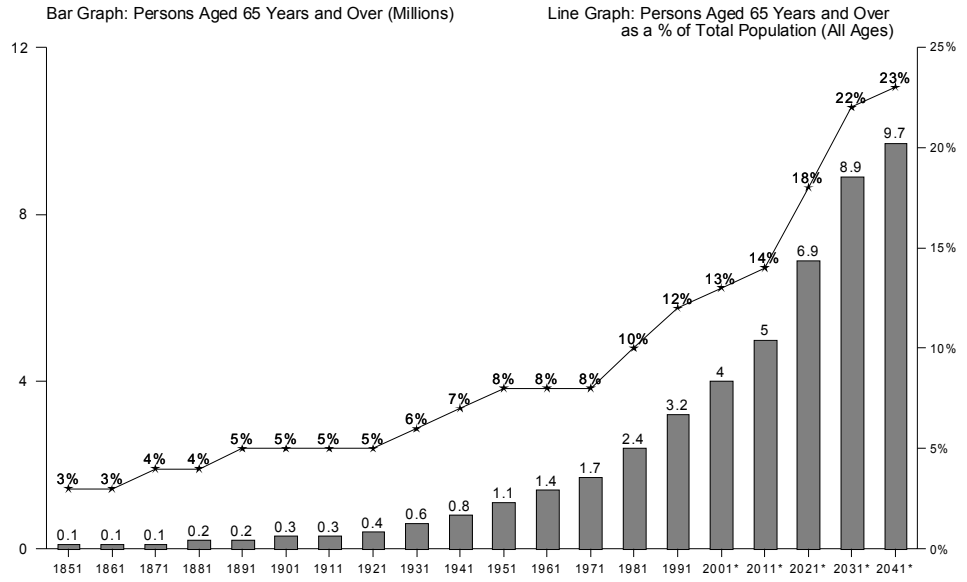
[3] These projections are based on a number of assumptions related to fertility rates, mortality rates, and emigration rates. These projections also incorporate the addition of non-permanent residents, returning Canadians, and changes to immigration policies. The 1993 postcensal preliminary estimates (adjusted for net census under coverage) were used as the base for the projections.

[4] It should be noted that at the time of the study, 1996 Census data, by age and gender, was not available, and therefore estimates for 1996 were used. Statistics Canada is expected to release 1996 Census data, by age and gender, in the Fall of 1997.

Exhibit 2.1: Canada's Elderly Population (65 Years and Over) 1851 to 2041



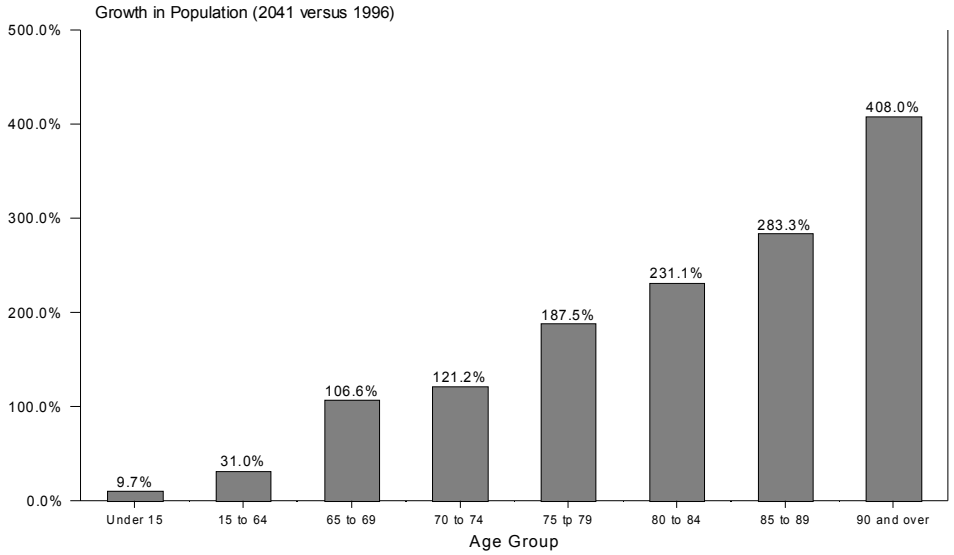
Sources: Data from 1851 to 1991 - Profile of Canada's Seniors, Statistics Canada Catalogue 96-312E (1994); *Projections from 2001 to 2041 - Profile of Canada's Seniors, Statistics Canada Catalogue 89-519XPE, Medium Growth Projections (1997) .

Exhibit 2.2: Canada's Demographic Profile, by Age Group (1996 and 2041)

Age	1996		2041		Growth Rate (2041 vs 1996)
	000s	% of Total	000s	% of Total	
Less than 15	6,064	20.2%	6,653	15.5%	9.7%
15 to 64	20,242	67.6%	26,529	61.9%	31.0%
65 to 69	1,130	1.8%	2,335	5.4%	106.6%
70 to 74	980	1.4%	2,168	5.1%	121.2%
75 to 79	705	1.0%	2,027	4.7%	187.5%
80 to 84	472	0.6%	1,563	3.6%	231.1%
85 to 89	246	0.3%	943	2.2%	283.3%
90 and Over	125	0.1%	635	1.5%	408.0%
65 and Over	3,658	12.2%	9,670	22.6%	164.4%
All Ages	29,964	100.0%	42,852	100.0%	43.0%

Source: 1996 Data: Statistics Canada CANSIM, Matrix 6900; 2041 Data: *Profile of Canada's Seniors*, Statistics Canada Catalogue 89-519XPE, Medium Growth Projections (1997).
Figures may not add up to totals due to rounding.

Exhibit 2.3: Population Growth, by Age Group (2041 versus 1996)



Sources: 1996 Data: Statistics Canada CANSIM, Matrix 6900; 2041 Data: Profile of Canada's Seniors, Statistics Canada Catalogue 89-519XPE, Medium Growth Projections (1997) .

Exhibit 2.4: Persons 65 Years of Age and Over, by Age and Gender (Total, and as a Percentage of Age Group, 1996 and 2041)

	1996				2041			
Age	Male		Female		Male		Female	
	000s	%	000s	%	000s	%	000s	%
65 to 69	536	47%	594	53%	1,133	49%	1,202	51%
70 to 74	433	44%	548	56%	1,021	47%	1,147	53%
75 to 79	289	41%	416	59%	914	45%	1,112	55%
80 to 84	175	37%	297	63%	650	42%	912	58%
85 to 89	79	32%	167	68%	345	37%	598	63%
90 and Over	31	25%	95	75%	181	28%	454	72%
Total 65 and Over	1,542	42%	2,117	58%	4,245	44%	5,425	56%

Source: 1996 Data: Statistics Canada CANSIM, Matrix 6900; 2041 Data: *Profile of Canada's Seniors*, Statistics Canada Catalogue 89-519XPE, Medium Growth Projections (1997). Figures may not add up to totals due to rounding.

This pattern of an aging population is not limited to Canada. As illustrated in Exhibit 2.5, between 1990 and 2020, the proportion of the elderly as a percentage of total population is increasing in a variety of other industrialized countries, including Japan, the United States, Germany, France, Italy, and the United Kingdom.

Exhibit 2.5: Persons 65 Years of Age and Over as a Percentage of Total Population (1990 to 2020, Selected Countries)

Year	Persons 65 Years of Age and over as a Percentage of Total Population				
	1990	1995	2000	2010	2020
Japan	12.1%	14.5%	17.0%	21.3%	25.5%
U.S.	12.5%	12.7%	12.4%	12.9%	16.1%
Germany	15.0%	15.2%	16.1%	19.2%	20.1%
France	14.0%	14.9%	15.7%	16.2%	19.7%
Italy	14.5%	16.0%	17.6%	20.1%	23.2%
U.K.	15.7%	15.5%	15.3%	15.7%	18.0%

Source: *International Comparison: Ratio of 65 Years Old and Over among Total Population (1990-2020)*, Japanese Information Network, 1997.

Further, it is estimated that the elderly will account for approximately 20% of the U.S. population by 2050 (Siegel, J., 1996), while in the United Kingdom, the number of individuals of pensionable age (65 for men and 60 for women) will account for almost 23% of their total population in 2030. (Age Concern England, 1997)

2.3 Health Characteristics

Health is a significant issue in relation to the elderly. The aging process results in the decrease of physical, sensory, and cognitive capabilities due to various forms of normal deterioration and resulting from the onset of disease(s). The following are examples of individual capabilities that can be negatively affected by the aging process:

- strength, endurance, and agility;
- reaction time;
- ability to hear high and/or low frequency tones;
- ability to block out background noise;
- visual acuity at far distances;
- ability to focus on near objects;
- sensitivity to glare;
- night vision;
- peripheral vision;
- ability to ignore irrelevant stimuli;
- retrieval and processing of information;
- spatial orientation and visual-motor integration;

- ability to divide attention between two or more tasks; and
- searching and scanning abilities which require selective attention.

To further explore the health implications of aging, this section discusses the various disability and health characteristics of elderly persons, related health conditions, and activities of daily living which may be affected by these disability and health characteristics.

2.3.1 Disability Profile

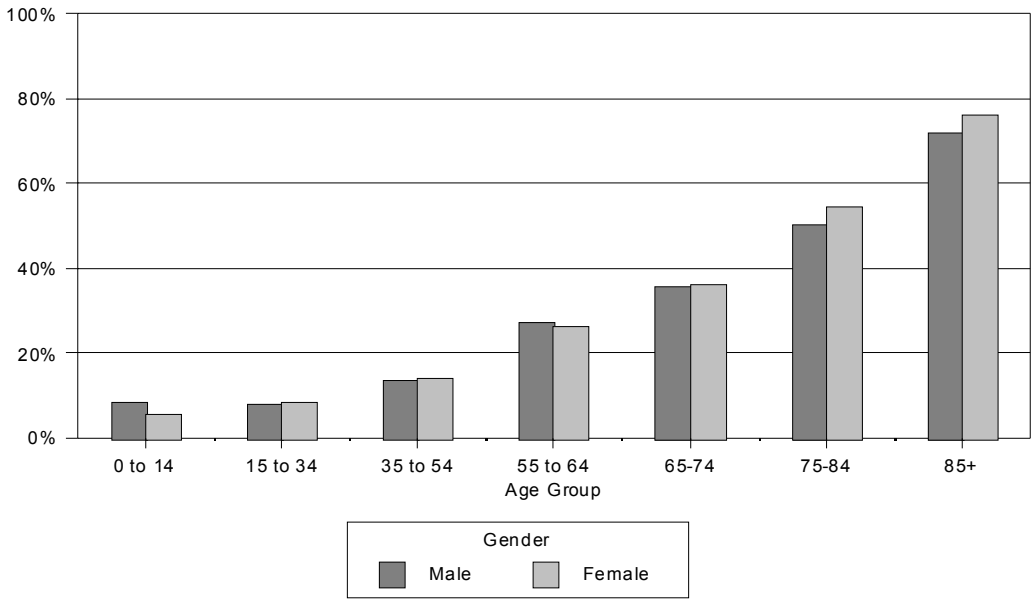
Exhibits 2.6 and 2.7 present a profile of the incidence of disability by age group and gender (for individuals in private households only). Based on the 1991 Health and Activity Limitation Survey (HALS), this exhibit illustrates that the incidence of disability increases with age.

The incidence of disability increasing with age is most clearly demonstrated by the fact that almost 43% of individuals 65 years of age and over (approximately 1.2 million individuals) reported a disability in 1991, as compared to between 7% (for the 0 to 14 year age group) and 26.6% (for the 55 to 64 year age group.)

As indicated in Exhibits 2.8 and 2.9, the elderly are most likely to have mobility or agility disabilities. In addition, the elderly have a high correlation between mobility and agility disabilities (as seen in Exhibit 2.8) and between sensory or cognitive (i.e., other) and both mobility or agility disability as well. This pattern of multiple disabilities is due to the high incidence of mobility and agility disabilities amongst the elderly. (For reference purposes, Appendix A provides definitions of the various types of disabilities.)

It should be noted that current health promotion and intervention programs, and generally healthier lifestyles, may result in the "young-old" of the future having lower disability incidence rates than those of today.

Exhibit 2.6: Incidence of Disabilities, by Age and Gender (Persons in Households, 1991)



Sources: *TransAccess Information Base* (Goss Gilroy Inc.) and *Selected Characteristics of Persons with Disabilities Residing in Households*, Statistics Canada, 1991.

Exhibit 2.7: Incidence of Disabilities, by Age and Gender (1991) (Individuals in Private Households Only*)

Age	Male		Female		Total	
	000s	% of Age Group	000s	% of Age Group	000s	% of Age Group
0 to 14	233	8.1	156	5.7	389	7.0
15 to 34	328	7.7	347	8.1	675	7.9
35 to 54	492	13.6	501	13.8	993	13.7
55 to 64	316	27.3	313	26.0	629	26.6
65 to 74	317	35.7	382	35.9	699	35.8
75 to 84	156	50.0	269	54.5	425	52.7
85 and Over	36	72.0	76	76.0	112	74.7
Total 65 and Over	509	40.8	727	43.8	1,236	42.5
All Ages	1,878	14.3	2,044	15.2	3,922	14.7

Source: *TransAccess Information Base* (Goss Gilroy Inc.) and the *1991 HALS - Selected Characteristics of Persons with Disabilities Residing in Households, 1994.*
*Figures exclude individuals in institutions.

Exhibit 2.8: Disability Characteristics of Persons 65 Years of Age and Over (1991, Individuals in Private Households Only*)

Type of Disability	000s	% of Total 65 and Over	% of Total 65 and Over with a Disability
Mobility	887	31%	72%
Agility	751	26%	61%
Hearing	508	18%	41%
Seeing	298	10%	24%
Speaking	63	2%	5%
Other**	317	11%	26%

Source: *TransAccess Information Base* (Goss Gilroy Inc.).
*Figures exclude individuals in institutions.
**"Other*" is defined as individuals who are limited in their activities of daily living due to a learning disability, a mental health condition, a mental handicap, or labeling by others.

Exhibit 2.9: Multiple Disabilities, Persons 65 Years of Age and Over (1991)

Type of Disability	Total (000s)	Percentage with Additional Disability					
		Mobility	Agility	Seeing	Hearing	Speaking	Other*
Mobility	887	--	70%	25%	39%	5%	29%
Agility	751	83%	--	27%	39%	7%	31%
Seeing	298	74%	67%	--	46%	8%	37%
Hearing	508	68%	57%	27%	--	8%	28%
Speaking	63	67%	81%	40%	62%	--	71%
Other*	317	80%	74%	35%	45%	14%	--
Total	1,372						

Source: *TransAccess Information Base* (Goss Gilroy Inc.), using the 1991 HALS (Adults in Households).
"Other" is defined as individuals who are limited in their activities of daily living due to a learning disability, a mental health condition, a mental handicap, or labeling by others.

2.3.2 Health Characteristics

To further describe the health characteristics of the elderly, the following discussion is presented on selected physiological functions. In particular, the following functions are discussed:

- psychomotor and physical functions;
- sensory functions; and
- cognitive functions.

Psychomotor and Physical Functions

The elderly can experience general psychomotor slowing which is most likely related to slower peripheral and central processing and slightly slower simple reaction time. The more complex the stimulus and the decision/response to be made, the greater the difference in reaction time between the young and old. While decreased psychomotor abilities often lead to greater time being required to perform certain task(s), the elderly may substitute accuracy and consistency for speed of response/reaction time.

In terms of strength, endurance, and agility, the elderly often experience:

- reduced hand grip, shoulder and back strength;
- reduced capacity for continued exertion;
- limitations of motor activity; and
- small but gradual decrease in muscle strength until age 60, when the decrements become more dramatic. Losses in strength are greater in women, greater in the lower than the upper extremities, and greater in fast versus slow velocity movements. In addition, most loss of strength up to the age of 70 is due to declines in use.

Health conditions which can contribute to and/or cause impairments of psychomotor and physical functions include arthritis, rheumatism, osteoporosis, osteoarthritis, chronic respiratory problems, cardiovascular disease, a reduction in muscle mass, and a decline in maximal heart rate and cardiac output.

In terms of activities of daily living, persons with psychomotor and physical disabilities may have difficulty (or complete inability) in:

- walking and moving around (without resting);
- walking up and down stairs;
- carrying objects (e.g., groceries, luggage);
- moving from one room to another;
- standing for a short period of time (e.g., 20 minutes);
- bending over;
- grasping or handling objects; and/or
- reaching for an object.

Sensory Functions - Hearing

The elderly often experience reduced hearing capacity, including:

- reduced ability to hear high and/or low frequency tones (for example, a child can hear a sound frequency of 20,000 Hz; at age 30, a person can hear up to 15,000 Hz; at age 50, the limit is 13,000 Hz);
- reduced ability to differentiate between tones; and
- reduced ability to block out background noise.

Health conditions associated with hearing impairments include presbycusis (an ongoing loss of hearing due to changes in the inner ear), tinnitus (a symptom associated with a variety of hearing diseases and disorders), conductive hearing loss (occurring when the inner ear is blocked), and sensorineural hearing loss (which occurs when there is damage to the inner ear or auditory nerve).

In terms of activities of daily living, persons with a hearing disability may have difficulty (or complete inability) hearing what is said:

- in a conversation with one other person;
- in a group conversation of at least three persons; and
- over the telephone.

Sensory Functions - Vision

Vision can be negatively affected by aging. For example, the elderly can experience:

- reduced visual acuity at far distances;
- reduced ability to focus on near objects;
- reduction in static visual acuity;
- greater sensitivity to glare;
- reduced response to visual stimuli due to reduced acuity and sensitivity to glare;
- reduced night vision and reduced ability to see in areas with low levels of lighting; and
- reduction in peripheral vision, from 170 degrees in the young adult, to 140 degrees by age 50.

Common eye conditions associated with vision impairments are cataracts, glaucoma, macular degeneration, diabetic retinopathy, and retinal detachment. The chance of having cataracts, glaucoma, and/or macular degeneration, is greater for the elderly, especially after the age of 85.

In terms of activities of daily living, persons with a seeing disability may have difficulty (or complete inability) seeing ordinary newsprint, traffic signs, and/or the face of someone across a room.

Cognitive Functions

Cognitive functions such as perception, memory, learning, and attention can be negatively affected by the aging process, resulting in:

- increased difficulty ignoring irrelevant stimuli;
- slower retrieval and processing of information;
- diminished spatial orientation and visual-motor integration;
- diminished learning rates (after the age of 75, learning rates are half that of a 20-year-old; however, reductions in learning ability until the age of 75 are small);
- reduction in ability to divide attention between two or more tasks; and
- reduction in searching and scanning abilities which require selective attention.

A primary health condition associated with cognitive impairments is dementia. Dementia, is defined as a "*clinical syndrome characterized by acquired losses of cognitive and emotional abilities severe enough to interfere with daily functioning and the quality of life*". (Geldmacher et al., 1996)

In 1991, it was estimated that slightly more than 250,000 elderly Canadians suffered from some form of dementia. Slightly less than two-thirds (64%) were diagnosed as having Alzheimer's disease, with the remainder suffering from vascular (19%) and other forms of dementia (17%). The number of persons with dementia is expected to be approximately 800,000 by 2031. (Hill et al., 1996)

Characteristics of dementia, including Alzheimer's disease and other forms of dementia, include a gradual stepwise decline in memory, orientation, visual and spatial abilities, naming, fluency, comprehension, and judgement, difficulties in making calculations and handling money, and loss of control over body functions.

Aging is considered to be the greatest risk factor related to dementia, with the prevalence of dementia doubling every five years between the ages of 65 and 85 (1% at age 65, 5% at age 75, and 15% to 25% at age 85).

Conditions which may also be a contributing factor to cognitive impairments but not necessarily related to the aging process, include learning disabilities (e.g., dyslexia, perceptual handicap, attention problem(s), hyperactivity), long-term emotional, psychological, nervous, or psychiatric condition, manic depression, schizophrenia, and drug or alcohol addiction.

Frailty of the Elderly

> *The results of the normal aging process and the presence of certain disease processes combine both to decrease the older individual's ability to withstand trauma, and to increase the likelihood of post-traumatic complications that can result in death, extension of disability or a prolonged recuperative period.* (United States Department of Transportation, 1997)

The elderly represent relatively high proportions of pedestrian fatalities and fatalities involving falls in Canada, the U.S., and Australia (relative to their share of total population in general). One explanation for the elderly's reduced ability to survive such incidents is the

increased frailty associated with health problems among the elderly, versus that of other age groups. As a result, a given accident is likely to cause greater injury to an older person, and an older person is more likely to die from a given injury.

It should be noted, however, that frailty is not necessarily in and of itself a result of aging, but is often a result of an illness, disease, and/or lack of physical activity which can result in reduced muscle tone, decreased bone strength and mass, and flexibility, and in disorders related to gait and balance. Each of these can increase an elderly person's susceptibility to injury in situations such as accidents and falls.

Use of Medication

The use of medication, including multiple medications, can produce interacting effects and/or adverse drug reactions, with the potential for impairing psychomotor, physical, sensory, and cognitive functions, and can be an important factor when considering the safety and security of the elderly in transportation situations.

The 1995 Canadian National Population Health Survey (NPHS) indicates that the use of medication increases with age. In particular, the NPHS reports that approximately 74% of persons 65 years of age and over took some form of medication (prescription or over-the-counter medication) in the two days before the survey. In comparison, approximately 33% of persons aged 15 to 24 took some form of medication in the two days prior to the survey. The results of the NPHS are presented in Exhibit 2.10.

Types of medications commonly taken by persons 65 and over in private households during the month before the NPHS include pain relievers (taken by 58.3%), blood pressure medication (taken by 28.9%), and other heart-related medication (taken by 21.1%).

Less frequently taken medication (taken by less than 10% of persons 65 and over in private households during the month before the NPHS) included cough or cold remedies, penicillin or other antibiotics, sleeping pills, asthma medication, tranquillizers, allergy medicines, and anti-depressants.

Exhibit 2.10: Percentage of Persons, Living in Private Households, taking Medication in the Two Days Prior to the National Population Health Survey (Canada, 1995)

Age	Percentage Taking:	
	At Least One Medication	Two or More Medications
15 to 24	33%	9%
25 to 34	34%	10%
35 to 44	34%	11%
45 to 54	46%	22%
55 to 64	57%	34%
65 to 74	71%	48%
75 and Over	78%	56%
Total 65 and Over	74%	51%

Source: *National Population Health Survey*, Statistics Canada, 1995.

2.4 Causes of Death and Hospitalization

2.4.1 Causes of Death

Between 1984 and 1993, coronary heart disease was the leading cause of death amongst the elderly (both elderly men and women). Other leading causes of death during this time period included lung cancer, strokes, chronic bronchitis/emphysema and asthma, pneumonia, colorectal cancer, breast cancer (among women) and prostrate cancer (among men). (Stokes and Lindsay, 1996)

Causes of death can be used to indicate the relative risk to personal safety of various activities or situations. As illustrated in Exhibit 2.11, with respect to causes of deaths related to various modes of transportation and falls:

- transportation-related incidents (all modes) accounted for a small percentage (less than 0.5%) of all deaths of the elderly age group;
- motor vehicle collisions accounted for approximately 97% of all elderly deaths related to transportation (all modes); and
- falls accounted for approximately 1.3% of all elderly deaths, while the elderly accounted for over 87% of all deaths related to falls.

Exhibit 2.11: Selected Causes of Death (1994)

Cause	All Ages		Ages 65 and Over		
	Total	% of Total	Total	% of Total (65+ only)	% of Total (All Ages)
Total Deaths (All Causes)	207,077	100%	155,703	100.0%	75.2%
Transportation Related	3,286	1.6%	528	0.3%	16.1%
Motor Vehicles	3,049	1.5%	510	0.3%	16.7%
Water Transport	135	0.07%	8	0.01%	5.9%
Air Transport	62	0.03%	4	0.002%	6.5%
Rail Transport	40	0.02%	6	0.003%	15.0%
Falls	2,347	1.1%	2,051	1.3%	87.4%

Source: *Causes of Death*, Statistics Canada, 1994.

2.4.2 Falls and Hospitalization

A key safety concern for the elderly relates to falls. Falls can occur in a number of situations, including one's home, during leisure activities (e.g., walking), and while travelling. With respect to transportation, falls can occur in terminal facilities, travelling to the mode (e.g., walking to the bus stop), and while boarding or disembarking from transport vehicles.

Falls are a major life and health threatening problem. In Canada (1994), approximately 2,350 persons died due to a fall, of which nearly 2,050 (over 87%) involved persons 65 years of age and over. Falls are the second leading cause of hospitalization for elderly women, and the fifth leading cause of hospitalization among elderly men. (Stokes and Lindsay, 1996)

The Centre for Locomotive Studies (CELOS) estimates that in the United States, over one-third of all individuals over the age of 60 suffer falls each year. As CELOS notes,

> *Mobility is a vital factor in maintaining the quality of life of an elderly individual. Therefore, the loss of mobility as the result of injury or due to a simple "fear of falling" has significant consequences. Statistics have pointed researchers towards stair descent and standing as two activities which, because of their danger, are in need of further study. Falls during standing (often characterized as "drop attacks") are frequent. One study estimated that this type of incidence represents over 25% of all falls in the elderly. Additionally, the Consumer Product Safety Commission has determined that stairs are the most hazardous consumer product in the United States. It has been found that the largest proportion of falls in public places occur on steps and that four out of five of these accidents occurred during descent.* (CELOS, 1997)

As indicated in Exhibit 2.12, the share of total fatalities in Canada due to falls for the elderly increases from 4% of total fatalities for the 65 to 69 age group to 27% of total fatalities for the

90 and over age group. One explanation for this trend is the increased frailty of the elderly versus that of other age groups, and the reduced ability of the elderly to survive the actual incident, or the trauma resulting from an incident in which the victim survives.

Exhibit 2.12: Fatalities due to Falls, by Age Group and Gender (Canada, 1994)

Age Group	Male		Female		Total	
	Total	% of Total	Total	% of Total	Total	% of Total
0 to 59	181	17%	39	3%	220	9%
60 to 64	50	5%	26	2%	76	3%
65 to 69	59	6%	30	2%	89	4%
70 to 74	91	9%	66	5%	157	7%
75 to 79	119	11%	112	9%	231	10%
80 to 85	196	19%	237	18%	433	18%
85 to 89	188	18%	327	25%	515	22%
90 and over	171	16%	455	35%	626	27%
Total	1,055	100%	1,292	100%	2,347	100%

Source: *Causes of Death*, Statistics Canada, 1994. Percentages may not add up to 100% due to rounding.

In the United States (1994), statistics indicate that 12,600 individuals died from falls, accounting for 13.5% of all fatalities due to unintentional injuries. (United States National Safety Council, 1995) Of these 12,600 fatalities, 8,100 (64%) involved persons ages 75 and over, while 1,600 (13%) involved persons between the ages of 65 and 74.

In Australia, the Australian Institute of Health and Welfare (National Injury Surveillance Unit - NISU) reports that in 1994, 1,002 fatalities occurred due to falls (14% of the total 7,189 injury-related fatalities). (National Injury Surveillance Unit, 1996) With reference to the elderly, the NISU reports that:

- the majority of fatalities due to falls involve people aged 75 and over;
- the age-adjusted rate of fatalities due to falls was 5.2 fatalities per 100,000 in 1994, for persons over 75 this ratio was 89 fatalities per 100,000, and for those 85 and over the ratio was 238 fatalities per 100,000; and
- of the 545 female falls resulting in a fatality recorded in 1994, 476 (87%) occurred to women aged 75 or more. In comparison, males 75 of more years of age accounted for 268 (58%) of all male fatalities related to falls.

2.5 Socio-Economic and Geographical Profile

2.5.1 Income

Over the last 25 to 30 years, the income circumstances of the elderly have improved considerably. For example, in 1969, slightly less than 42% of families headed by an elderly person were considered poor. This proportion dropped to 19.2% in 1980, 10.1% in 1989, and 7.1% in 1994. (Ulysse, 1997)

However, as illustrated in Exhibit 2.13, seniors have lower average incomes than all age groups, with the exception of the 15- to 24-year-old age group. A disparity also exists between elderly men and elderly women. In 1994, elderly women had an average income of slightly less than $15,000, while elderly men had an average income of more than $24,500.

Primary sources of income for the elderly (1994) included Old Age Security (including Guaranteed Income Supplements) and C/QPP. Combined, these two sources accounted for 50.6% of total income for elderly persons. Other sources of income include retirement pensions (19.1%), investment income (13.6%), employment income (7.0%), RSPs (3.8%), and other sources (1.8%).

Exhibit 2.13: Average Income, by Age Group and Gender (Canada, 1994)

Age Group	Average Income (1994 $s)		
	Men	Women	Total
15 to 24	10,837	9,361	10,118
25 to 34	30,655	21,293	26,203
35 to 44	38,882	23,944	31,779
45 to 54	41,016	24,012	33,096
55 to 64	33,331	16,871	25,841
65 and Over	24,514	14,923	19,067
Total	30,760	18,916	24,981

Source: *A Portrait of Seniors in Canada*, Statistics Canada, 1997.

In terms of transportation and income, a link can exist between low income and transportation needs. For example, elderly persons with lower incomes are less likely to own, or have access to, a personal vehicle, and as a result, must rely more on public transportation and on walking.

2.5.2 Housing

The likelihood of an elderly person living in an institution increases with age and is higher for elderly women than elderly men. Overall, 8.1% of persons 65 and over (1991) lived in an institution. In terms of types of institutions, 6.4% lived in special care homes, 0.7% lived in hospitals, 0.6% lived in religious institutions, and the remaining 0.4% lived in "other" institutions (such as correctional institutions, hotels, motels, rooming homes, etc.).

With respect to age, the following proportions of elderly persons lived in an institution:

- 36.6% of elderly persons ages 85 and over;
- 10.4% of persons ages 75 to 84; and
- 2.7% of persons ages 65 to 74.

With regards to gender:

- 40.9% of women 85 and over live in an institution, while 26.8% of men 85 and over live in an institution;

- 12.1% of women between the ages of 75 and 84 live in an institution, while 7.9% of men in this age group live in an institution; and

- 2.8% of women between the ages of 65 and 74 live in an institution, while 2.6% of men in this age group live in an institution.

The shifting emphasis towards home-based health care and the growth in retirement, or "seniors" communities, coupled with increasing numbers of elderly persons, will have implications for transportation facilities. Demands on local transportation services (including pedestrian facilities), will increase, as more elderly live in their own homes and communities, with greater emphasis on independence (when possible given an individual's health condition). In addition, affordable, or subsidized housing for the elderly, which may be located in suburban areas, can also increase the demand for public transportation, especially if the housing is located away from services such as medical offices and shopping facilities.

The growth in community developments targeted at elderly persons, with on-site social and recreational facilities, and on-site health care, financial, retail, and security services may however reduce the need individuals living in these communities have for public transportation.

2.5.3 Geographical Location

In terms of the urban/rural distribution of the elderly, 82.2% of the elderly live in urban areas while 17.8% live in rural areas. Elderly women are slightly more likely to live in an urban area versus elderly men, with 84.2% of elderly women living in urban areas (15.8% live in rural areas), and 79.3% of elderly men living in urban areas (20.7% live in rural areas).

The impact of elderly persons relinquishing their driver's licence in terms of mobility, quality of life, and independence, is likely less in urban areas than rural areas, where there are fewer, if any, public modes of transportation. To address this, several alternative rural transportation programs have been established to help the elderly maintain their independence. For example, in Antigonish, Nova Scotia, the Kinsmen Club, local businesses, and volunteers have established the CARE (Community of Antigonish Regional Expressions) Van for elderly persons who are less mobile. In Manitoba, the provincial government has established the Program for Transportation of the Mobility Disadvantaged for rural communities, while in Saskatchewan, the Rural Transportation Assistance Program was established to provide transportation between rural and isolated communities and larger towns and cities.

Exhibit 2.14 profiles the Canadian elderly population by province and territory. Combined, Ontario and Quebec account for slightly more than 62% of Canada's elderly population. The

provinces with the highest proportion of elderly persons (as a percentage of the total province's population) are Saskatchewan (14.4%), Manitoba (13.6%), and Prince Edward Island (12.9%).

Exhibit 2.14: Population Aged 65 and Over, by Province and Territory (1995)

Province	Population 65 and Over (000s)	65 and Over as a % of Total Provincial Population	As a % of All People Ages 65 and Over in Canada
Newfoundland	59.5	10.3	1.7
Prince Edward Island	17.6	12.9	0.4
Nova Scotia	119.3	12.7	3.4
New Brunswick	94.7	12.4	2.7
Quebec	872.0	11.9	24.5
Ontario	1,345.9	12.1	37.8
Manitoba	154.4	13.6	4.3
Saskatchewan	147.3	14.4	4.1
Alberta	266.8	9.7	7.4
British Columbia	477.8	12.7	13.4
Yukon	1.4	4.6	--*
Northwest Territories	1.9	2.9	0.1

Source: *A Portrait of Seniors in Canada*, Statistics Canada, 1997.
*Amount too small to be expressed.

Exhibit 2.15 profiles the elderly population of selected Census Metropolitan Areas (CMAs). Combined, Toronto, and Montreal account for slightly less than 25% of Canada's elderly population. The CMAs with the highest proportion of elderly persons (as a percentage of the total CMA's population) include Victoria (18.1%), St. Catharines-Niagara (15.4%), Winnipeg (13.4%), Trois-Rivières (13.4%), and Hamilton (13.2%).

Exhibit 2.15: Population Aged 65 and Over, by CMA (1995)

CMA	Population 65 and Over (000s)	65 and Over as a % of Total CMA Population	As a % of All People Ages 65 and Over in Canada
Toronto	481.8	11.1	13.5
Montreal	401.4	12.1	11.3
Vancouver	218.6	12.0	6.1
Ottawa-Hull	103.4	10.1	2.9
Winnipeg	90.8	13.4	2.4
Edmonton	84.9	9.6	2.6
Hamilton	84.8	13.2	2.4
Quebec City	79.8	11.4	2.2
Calgary	73.1	8.8	2.1
St. Catharines-Niagara	59.7	15.4	1.7
Victoria	56.4	18.1	1.6
London	50.5	12.2	1.4
Kitchener	41.8	10.6	1.2
Windsor	36.4	12.7	1.0
Halifax	34.4	10.1	1.0
Saskatoon	26.0	11.8	0.7
Regina	24.7	12.4	0.7
Oshawa	24.0	8.7	0.7
Trois-Rivières	19.2	13.4	0.5
St. John's	19.0	10.7	0.5
Sudbury	18.8	11.3	0.5
Sherbrooke	18.3	12.4	0.5
Chicoutimi-Jonquière	17.1	10.2	0.4
Saint John	16.9	13.1	0.4
Thunder Bay	16.0	12.2	0.4

Source: *A Portrait of Seniors in Canada*, Statistics Canada, 1997.

2.6 Personal Security

Research indicates that personal security is a major public concern. Surveys have indicated that concerns about crime have risen over time, even though violent crime rates and victimization rates appear to have remained stable, if not in decline, over the last ten years. (Corrections Research, 1994) As would be expected, fear of crime is higher among women than men, and increases with age (although older people typically have lower victimization rates than younger age groups). The fact that elderly persons are less often victims of crime has also been reported by both the American Association of Retired Persons and the U.S. Bureau of Justice Statistics.

Among the sources illustrating these patterns is the 1993 General Social Survey. The General Social Survey, conducted by Statistics Canada, probed respondents' perceptions regarding their personal safety and security, by asking them how safe/unsafe they felt walking alone in their neighbourhood after dark. Perceptions regarding lack of safety are a barrier for elderly pedestrians and elderly users of public modes of transportation. This is especially true for public transit, and intercity bus and rail terminals.

As profiled in Exhibit 2.16, 41% of individuals 65 years of age and overstated that they either

felt very unsafe, or somewhat unsafe, in this situation. In comparison, between 23% and 26% of younger age groups felt very unsafe or somewhat unsafe in this situation. The percentages were consistently higher for women across all age groups. For women 65 years of age and over, 57% stated that they either felt very unsafe, as compared to 19% of men 65 years of age and over.

Exhibit 2.16: Perceptions of Safety, by Age and Gender (Canada, 1993)

Age	Percentage Who Feel Safe/Unsafe Walking Alone in their Neighbourhood after Dark					
	Very Unsafe	Somewhat Unsafe	Reasonably Safe	Very Safe	DK/NS*	Total
15 to 24						
Men	--	5%	43%	50%	--	100%
Women	14%	26%	45%	14%	--	100%
Total	8%	15%	44%	33%	--	100%
25 to 44						
Men	3%	6%	40%	51%	--	100%
Women	14%	25%	44%	17%	1%	100%
Total	8%	15%	42%	34%	1%	100%
45 to 64						
Men	4%	7%	42%	47%	--	100%
Women	20%	21%	40%	17%	2%	100%
Total	12%	14%	41%	32%	1%	100%
65 & Over						
Men	10%	9%	37%	38%	6%	100%
Women	38%	19%	22%	13%	7%	100%
Total	26%	15%	29%	24%	7%	100%

Source: *General Social Survey*, Statistics Canada, 1993, as profiled in *A Portrait of Seniors in Canada*, Statistics Canada, 1997.
*Don't Know/Not Stated.

3. Travel Characteristics of the Elderly

The following transportation characteristics are discussed in this section:

- trip making; and
- operation of motor vehicles.

3.1 Trip Making

3.1.1 Local Vehicular Trips

The results of a study (profiled in Exhibit 3.1), undertaken by the Canadian Urban Transit Association (CUTA), provides the following details on local travel: (Canadian Urban Transit Association, 1991)

- for all age groups, the automobile was the most commonly used mode for local vehicular trips, accounting for at least 65% of all vehicular trips in the jurisdictions covered in the study;

- persons 75 years of age and over, however, relied less on the automobile for local trips, and relied relatively more on transit. However, the automobile still accounted for at least 50% of all vehicular trips for this age group in all of the jurisdictions covered in the study; and

- overall, the elderly took less vehicular trips than other age groups. However, public transit as a percentage share of total trips increased dramatically with age.

Urban Transit

As indicated in Exhibit 3.1, for all age groups, transit accounted for less than 35% of total vehicular trips taken per day. However, transit's share of total vehicular trips is higher for those aged 75 and over as compared to both the 65 to 74 age group, and the population as a whole. This implies that the elderly who are 75 and over rely more on transit for local trips than other age groups (and consequently, less on automobiles).

In addition, the elderly take the majority of their transit trips during off-peak hours. For example:

- regarding Montreal's urban transit service, 66% of transit trips taken by persons 65 to 74, and 69% of transit trips taken by persons 75 and over are off-peak; and

- in the Ottawa-Carleton area, 73% of transit trips taken by persons 65 to 74, and 83% of transit trips taken by persons 75 and over are off-peak.

Exhibit 3.1: Local Vehicular Trips* and Transit's Share, Selected Jurisdictions (1988)

Location	All Ages		Ages 65 to 74		Age 75 and Over	
	Total Trips	Transit's Share	Total Trips	Transit's Share	Total Trips	Transit's Share
Montreal	1.87	34%	1.24	38%	0.69	49%
Montreal South Shore	2.06	17%	1.28	15%	0.77	22%
Laval	2.05	11%	1.25	13%	0.52	15%
Quebec City	2.08	19%	1.3	28%	0.75	39%
Ottawa-Carleton	2.87	21%	2.63	21%	1.83	28%
Toronto	2.5	27%	1.67	24%	1.06	29%
Mississauga	2.15	13%	1.48	10%	0.93	15%
London	2.55	10%	1.81	11%	1.13	17%
St. Catharines	2.47	5%	1.84	4%	0.74	15%

Source: Case Studies and Technical Appendix, CUTA, 1991.
*Total trips include all motorized trips involving an automobile or transit.

As CUTA concluded, the increasing proportion of the elderly (ages 65 and over) is expected to increase off-peak ridership. The projected growth of the elderly population is also expected to increase demand for "community bus" type services, connecting residential areas to shopping, healthcare facilities, and community centres.

In the United States, the American Public Transit Association reports that in 1991, 7% of all transit riders were 65 years of age or over, with small cities and rural areas having a greater percentage of elderly riders. In comparison, persons 65 years of age and over accounted for approximately 12.5% of the total population.

3.1.2 Long-Distance Trips

Between 1982 and 1994, persons over the age of 65 have steadily increased their share of domestic long-distance trips.[5] As indicated in Exhibit 3.2, in 1982 persons over the age of 65 accounted for 5.2% of domestic long-distance trips; by 1994 this same age group accounted for 7.2% of domestic long-distance trips. With the projected increase in the number of people in this age group over time, one can expect this trend to continue. Unfortunately, information on the number of trips by age and mode, is not reported.

Exhibit 3.2: Total Domestic Long-Distance Trips, 1982 to 1994

[5] A "trip" is defined as travel involving a person or persons returning home from a location 80 km or more away during the survey period. A trip has a maximum duration of one year. The following types of travel are not included in the definition of a trip: travel to or from work or school; one-way travel involving a change of residence; and travel by members of operating crews.

Age	Total Trips (000s)						
	1982	1984	1986	1988	1990	1992	1994
All Ages	101,642	96,791	116,690	133,273	133,830	157,857	151,783
65 to 69	2,835	2,486	3,457	4,140	4,393	5,277	4,961
As a % of Total Trips	2.8%	2.6%	3.0%	3.1%	3.3%	3.3%	3.3%
70 and Over	2,443	2,369	3,208	3,646	4,261	5,937	6,020
As a % of Total Trips	2.4%	2.4%	2.7%	2.7%	3.2%	3.8%	4.0%
65 and Over	5,278	4,855	6,665	7,786	8,654	11,214	10,981
As a % of Total Trips	5.2%	5.0%	5.7%	5.8%	6.5%	7.1%	7.2%

Source: *Domestic Travel: Canadians Travelling in Canada,* Statistics Canada, 1994.

3.2 Operation of Motor Vehicles

3.2.1 Driver's Licence Rates

Currently, the elderly population has a lower licensure rate than younger age groups. As can be seen in Exhibit 3.3., in Ontario (1994), 60% of persons ages 65 and over had a driver's license, the lowest licensure rate among all age groups.

However, given the current high licensure rates for persons aged 16 to 64, as the current population ages, one can expect the licensure rate of the elderly population to increase. This trend is illustrated in Exhibit 3.3, in particular, between 1985 and 1994, the licensure rate for persons 65 and over (i.e., persons with a driver's licence per population group) rose from 52% to 60%. This was the second highest increase next to the 16- to 19-year-old age group (which rose from 53% to 63%).

Exhibit 3.3: Driver Licensure Rates by Age Group, Ontario, 1985 and 1994

Age Group	1985			1994			1994 vs. 1985
	Popn.*	Drivers	Rate	Popn.*	Drivers	Rate	
16-19	556	294	53%	566	359	63%	10%
20-24	831	687	83%	781	623	80%	-3%
25-34	1,546	1,443	93%	1,906	1,646	86%	-7%
35-44	1,273	1,206	95%	1,755	1,612	92%	-3%
45-54	944	806	85%	1,305	1,190	91%	6%
55-64	880	671	76%	941	771	82%	6%
65+	960	495	52%	1,314	783	60%	8%
Total	6,991	5,602	80%	8,567	6,984	82%	2%

Sources: *Ontario Road Safety Annual Report*, Ontario Ministry of Transportation, 1994; *Intercensal Estimates of Population by Sex and Age, Canada, Provinces and Territories, 1981 to 1986*, Statistics Canada; *Projected Population by Age Group and Sex, Canada, Provinces and Territories, 1994 to 2016*, Statistics Canada.
*Population figures are estimates based on above noted sources. Figures may not add up to totals due to rounding.

Data from the U.S. also indicates that licensure rates in older age groups have been increasing. For example, licensure rates for the elderly were higher in the 1990 Nationwide Personal Transportation Survey (NPTS), versus the 1983 NPTS. As Sivak et al. state:

> *One interpretation is that the (lower rates of licensure) among older people is partly a reflection of the proportion of this population group that never held a driver's license. Since current licensure rates among the younger age groups are well over 90% (U.S. figures), one would expect that most of these drivers will continue to renew their license, and that the licensure rate among the older age groups will continue to increase (as younger persons age), approaching current rates for the younger age groups.* (Sivak et al., 1995)

Given the growth in the number of persons ages 65 and over, one can expect the absolute number of persons ages 65 and over with a driver's licence to increase. This trend is profiled in Exhibit 3.4 which indicates that in Ontario, the 65 and over age group experienced the largest percentage increase in terms of licensed drivers between 1985 and 1994. The number of drivers in this age group increased from 495,000 in 1985 to 783,000 in 1994, an increase of 58%. As a percentage of total drivers, the 65 and over age group increased from 8.8% of total licensed drivers in 1985 to 11.2% of licensed drivers in 1994.

Exhibit 3.4: Number of Licensed Drivers in Ontario, 1985 and 1994

Age Group	Licensed Drivers (000s)		1985 Versus 1994	
	1985	1994	Change (000s)	% Change
16-19	294	359	+65	+22%
20-24	687	623	-64	-9%
25-34	1,443	1,646	+203	+14%
35-44	1,206	1,612	+406	+34%
45-54	806	1,190	+384	+48%
55-64	671	771	+100	+15%
65+	495	783	+288	+58%
Total	5,602	6,984	+1,382	+25%

Source: *Ontario Road Safety Annual Report*, Ontario Ministry of Transportation, 1994.

A similar trend is apparent in the United States. Between 1985 and 1995, the absolute number of persons 70 years of age and over with a driver's licence has increased (particularly for women). In addition, this age group's proportion of total licensed drivers has also increased (again, most notably for women). For reference purposes, this trend is illustrated in Exhibit 3.5.

Exhibit 3.5: Changes in U.S. Licensed Driver Rates between 1985 and 1995

Category	1985			1995 Licensed Rates (Change between 1985 and 1995)		
	All Ages (000s)	Ages 70+ (000s)	Ages 70+ as % of Total	All Ages (000s)	Ages 70+ (000s)	Ages 70+ as % of Total
Men	81,592	6,077	7.4%	90,223 (+11%)	8,170 (+34%)	9.1% (+1.7%)
Women	75,276	5,088	6.8%	87,210 (+16%)	8,282 (+63%)	9.5% (+2.7%)
Total	156,868	11,165	7.1%	177,433 (+13%)	16,452 (+47%)	9.3% (+2.2%)

Source: *Traffic Safety Facts - 1995*, NHTSA.

3.2.2 Driving Characteristics

A U.S. study analyzing results of the 1990 Nationwide Personal Transportation Survey (NPTS), concluded that elderly drivers exhibit an increased level of self-protection in their driving habits relative to middle-aged drivers (persons between the ages of 25 and 64), and tend to compensate for any declines in their health which may affect their ability to drive.

As the study states:

> *Being elderly not only makes elderly drivers reduce daily driving exposure, avoid driving at night, avoid driving during peak hours, and avoid driving on limited-access highways, but also make them drive at lower speeds, drive larger automobiles, and carry fewer passengers*. (Chu, 1994)

In particular, the following highlights resulted from the study:

- the elderly reduce their daily driving exposure by reducing not the frequency of trips, but by driving fewer vehicle miles. The elderly take as many vehicle trips as the middle aged, but their vehicle trips are shorter in distance than those taken by the middle-aged;
- the elderly are less likely to drive at night and during peak hours than the middle-aged;
- the elderly are less likely to drive on limited-access highways than the middle-aged;
- the elderly drive at slower speeds than the middle-aged; and
- the elderly carry slightly fewer passengers than the middle-aged.

A study conducted in Illinois (Benekohal, R., et al., 1994), presents similar travel characteristics for elderly drivers. Results of the study concluded that:

- 70% of the elderly drivers (i.e., persons 65 and over) surveyed used their cars at least five days a week, with a higher proportion of male drivers driving seven days a week;
- as age increased, urban road use increased and highway use decreased;
- nearly half of the elderly drivers drove less than they did ten years ago;
- the elderly drivers drove fewer miles as their age increased;
- the majority drove frequently during off-peak hours, and age is a factor in deciding when to drive during a day; and
- elderly drivers recognized significant changes in their driving capabilities.

The survey also reported on road conditions which the elderly avoided and their trip purposes. With respect to conditions avoided, Benekohal, R., et al. state that:

> *The elderly drove when conditions were the safest. The most often-mentioned condition in which older drivers purposely avoid driving was ice and snow, followed by peak hours, night, and rain. Only 3% avoided driving on the weekends. About 11% replied that they did not purposely avoid any of the aforementioned conditions. More male drivers avoided peak-hour traffic and more female drivers avoided ice and snow, and evening and night driving. As their age increased, they avoided peak-hour traffic, ice and snow, and night driving conditions.*

Regarding trip purpose, the survey reported that the predominant trip purpose was grocery and personal shopping (45% of trips), followed by personal business (15%), recreational or social trips (12%), work-related (8%), and medical or dental appointments (6%).

4. Motor Vehicle Safety

This section further explores the issue of motor vehicles and safety of the elderly, with discussions on:

- collision involvement;
- driver actions;
- physiological conditions and elderly drivers; and
- measures for improving safety.

4.1 Collision Involvement

Before discussing fatalities and injuries sustained by elderly drivers, it is useful to examine the collision experience of the elderly. U.S. figures were used for this purpose, as no recent Canada-wide statistics on collision rates per kilometres travelled, and number of licensed drivers, stratified by age, are available.

4.1.1 Number of Collisions

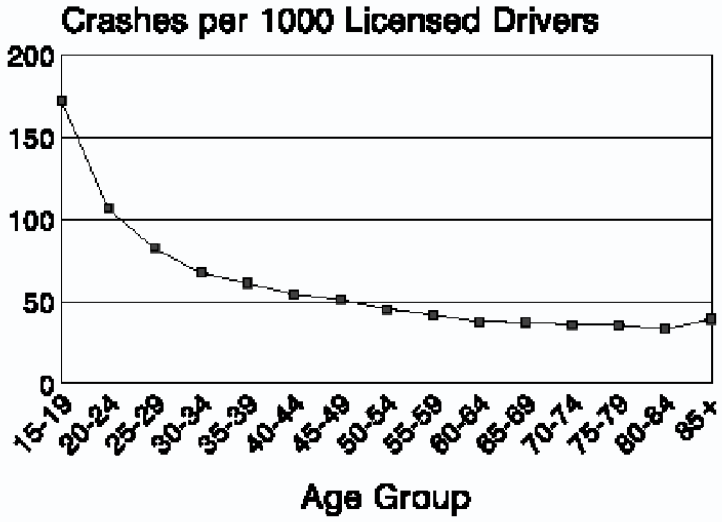
Exhibit 4.1 provides the number of collisions per 1,000 licensed drivers. This exhibit indicates that the number of collisions per licensed driver declines with age, with a slight increase for those 85 years of age and over. However, this only provides a partial picture, as it does not account for the amount of driving done by drivers in each age group. Exhibit 4.2 illustrates the collision involvement rate when the figures in Exhibit 4.1 are normalized for the amount driven.

Exhibit 4.2 indicates that collision involvement per amount driven (i.e., vehicle miles travelled - VMT) decreases rapidly until about age 25, continues to decline slowly until about age 60, increases slowly until age 80, and then increases rapidly for drivers over 80.

It is interesting to compare Exhibit 4.2 with Exhibit 4.3, which depicts the fatality rate, also normalized by the amount driven. This comparison indicates that the fatality rate for the elderly is disproportionately high relative to other age groups. By any other measure, younger drivers outnumber, travel more, are involved in more collisions and have higher fatalities than older drivers. However, once an elderly person is involved in a collision, he or she is more than three times as likely to die as younger drivers.[6] The frailty of elderly drivers is illustrated in Exhibit 4.4.

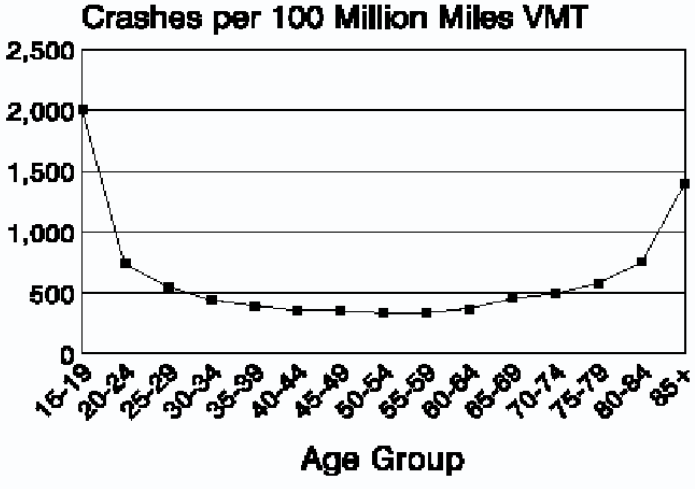
[6] A similar conclusion was made by the U.S. DOT in their report *Addressing the Safety Issues Related to Younger and Older Drivers.*

Exhibit 4.1: Crashes per 1,000 Licensed Drivers, by Age Group (U.S., 1990)



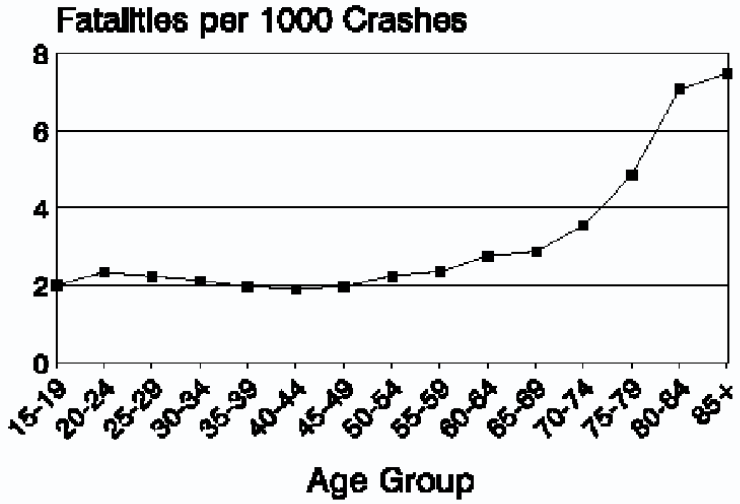
Source: Direct excerpt from *Addressing the Safety Issues Related to Younger and Older Drivers*, U.S. DOT, 1993.

Exhibit 4.2: Crashes per 100 Million VMT, by Age Group (U.S., 1990)



Source: Direct excerpt from *Addressing the Safety Issues Related to Younger and Older Drivers*, U.S. DOT, 1993.

Exhibit 4.4: Fatalities per 1,000 Crashes, by Age Group (U.S., 1990)



Source: Direct excerpt from *Addressing the Safety Issues Related to Younger and Older Drivers*, U.S. DOT, 1993.

Source: Direct excerpt from *Addressing the Safety Issues Related to Younger and Older Drivers*, U.S. DOT, 1993.

Exhibits 4.5 and 4.6 present collision involvement figures for Ontario, by age group (1994). As these exhibits indicate, approximately 10% of 16- and 17-year-old drivers were involved in collisions. This rate gradually decreases with driver age, with a slight increase for the 75 and over age group, where 3.3% of drivers were involved in a collision. Driver involvement by age group is graphically presented in Exhibit 4.7.

Exhibit 4.5: Collision Involvement by Age Group (Ontario, 1994)

Age Group	Total Licensed Drivers			Drivers Involved in Collisions		
	Male	Female	Total	Male	Female	Total
Under 16	--	--	--	338	116	454
16	29,073	23,683	52,756	3,306	1,990	5,296
17	49,668	43,010	92,678	5,977	3,420	9,397
18	54,734	47,635	102,369	6,461	3,533	9,994
19	59,358	51,656	111,014	6,612	3,310	9,922
20	61,577	53,051	114,628	6,481	3,200	9,681
21-24	270,048	238,028	508,076	27,014	13,113	40,127
25-34	868,172	777,790	1,645,962	73,145	33,264	106,409
35-44	840,740	771,232	1,611,972	54,323	27,783	82,106
45-54	637,952	552,490	1,190,442	35,555	16,616	52,171
55-64	437,235	333,647	770,882	20,762	7,763	28,525
65-74	320,988	241,337	562,325	11,808	5,097	16,905
75 and Over	131,487	89,369	220,856	5,035	2,229	7,264

Unknown	--	--	--	32,053	4	32,057
Total	3,761,032	3,222,928	6,983,960	288,870	121,438	410,308

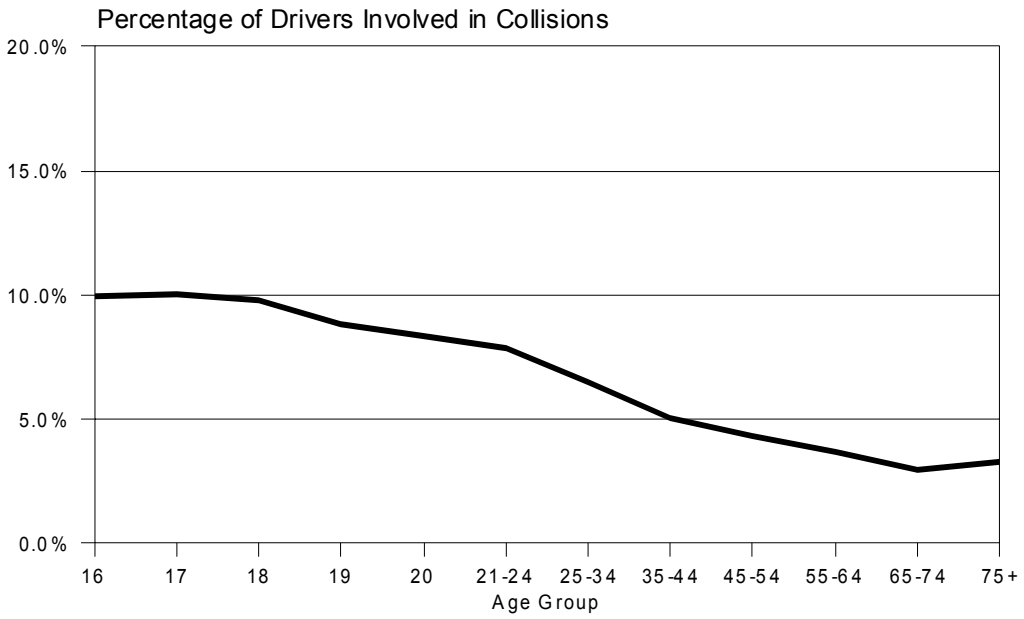
Source: *Ontario Road Safety Annual Report*, Ontario Ministry of Transportation, 1994.

Exhibit 4.6: Collision Involvement as a Percentage of Total Drivers, by Age Group (Ontario, 1994)

Age Group	Drivers Involved in Collisions As a Percentage of Total Drivers in Each Age Group		
	Male	Female	Total
Under 16	--	--	--
16	11.4%	8.4%	10.0%
17	12.0%	8.0%	10.1%
18	11.8%	7.4%	9.8%
19	11.1%	6.4%	8.9%
20	10.5%	6.0%	8.4%
21-24	10.0%	5.5%	7.9%
25-34	8.4%	4.3%	6.5%
35-44	6.5%	3.6%	5.1%
45-54	5.6%	3.0%	4.4%
55-64	4.7%	2.3%	3.7%
65-74	3.7%	2.1%	3.0%
75 and Over	3.8%	2.5%	3.3%
Unknown	--	--	--
Total	7.7%	3.8%	5.9%

Source: *Ontario Road Safety Annual Report*, Ontario Ministry of Transportation, 1994.

Exhibit 4.7: Collision Involvement Rate by Age Group (Ontario, 1994)



Source: *Ontario Road Safety Annual Report*, Ontario Ministry of Transportation, 1994.

4.1.2 Fatalities and Injuries

Exhibits 4.8 and 4.9, profile population growth rates, and fatalities and injuries related to motor vehicle collisions, by age group, for the period of 1979 to 1995. The following observations can be made from these tables:

- the severity of collisions (as measured by fatalities as a percentage of total fatalities and injuries) declined between 1979 and 1995. In particular, in 1979, fatalities accounted for 2.2% of total fatalities and injuries, and declined to 1.4% in 1995. For the elderly, fatalities accounted for 5.1% of all total fatalities and injuries in 1979, and declined to 3.4% in 1995.

- between 1979 and 1995, Canada's population (all ages) increased by over 24%. In comparison, fatalities due to motor vehicle collisions decreased almost 43% and injuries decreased 6.5%.

- in Canada's elderly population, the number of persons ages 65 and over increased approximately 61% between 1979 and 1995. Over the same time period, the number of fatalities involving the elderly decreased 1.8%, while the number of injuries involving the elderly increased almost 50%. Although there was an increase in the number of injuries, this increase was still below the growth in the elderly population.

- the elderly's share of total fatalities increased from 9.4% in 1979 to 16.3% in 1995 (an increase of approximately 73%). Meanwhile, the elderly's share of total injuries increased from 4.1% in 1979 to 6.4% in 1995 (an increase of almost 59%).

Factors which may account for the gradual increase in the elderly's percentage share of total fatalities and injuries between 1979 and 1995 include:

- the frailty of elderly drivers and passengers;

- the elderly age group's population growth in general and the growth in the number of elderly licensed drivers;

- the over-representation of elderly drivers in multiple-vehicle collisions and collisions at intersections, and the fact that the elderly are more frequently the struck vehicle than the striking vehicle. The elderly's higher than average share of impacts involving angled impacts at junctions, in addition to the fact that vehicles provide relatively less occupant protection against side impacts, may also contribute to the higher proportion of fatalities.

It has also been suggested that there has been less benefit accrued to the elderly road user from road safety measures that have focused on driving under the influence and speeding, two issues more common among younger drivers. (Federal Office of Road Safety, Australia, 1996)

Exhibit 4.8: Analysis of Population by Age Group, and Fatalities and Injuries due to Motor Vehicle Collisions (Canada, 1979 to 1995)

Variable and Age Group	1979	1995	% Change between 1979 and 1995
Population*			
Under 65	21,537,100	25,973,700	+20.6%
Ages 65 and Over	2,210,200	3,565,700	+61.3%
All Ages	23,747,300	29,539,400	+24.4%
Fatalities			
Under 65	5,309	2,803	-47.2%
Ages 65 and Over	554	544	-1.8%
All Ages	5,863	3,347	-42.9%
Injuries			
Under 65	245,832	226,227	-8.0%
Ages 65 and Over	10,393	15,573	+49.8%
All Ages	256,225	241,800	-5.6%
Fatalities and Injuries			
Under 65	251,141	229,030	-8.8%
Ages 65 and Over	10,947	16,117	+47.2%
All Ages	262,088	245,147	-6.5%

Sources: *Canadian Motor Vehicle Traffic Collision Statistics*, Transport Canada, 1979 to 1995; *Intercensal Estimates of Population by Sex and Age, Canada, Provinces and Territories, 1981 to 1986*, Statistics Canada; *Projected Population by Age Group and Sex, Canada, Provinces and Territories, 1994 to 2016*, Statistics Canada.
*Population figures are estimates based on above noted sources. Figures may not add up to totals due to rounding.

Exhibit 4.9: Fatalities and Injuries due to Motor Vehicle Collisions (Canada, 1979 to 1995)

Year	Fatalities			Injuries			Fatalities & Injuries		
	Total	Elderly	Elderly as a % of Total	Total	Elderly	Elderly as a % of Total	Total	Elderly	Elderly as a % of Total
1979	5,863	554	9.4%	256,225	10,393	4.1%	262,088	10,947	4.2%
1980	5,461	542	9.9%	262,977	11,126	4.2%	268,438	11,668	4.3%
1981	5,383	503	9.3%	260,658	11,110	4.3%	266,041	11,613	4.4%
1982	4,169	480	11.5%	225,717	9,828	4.4%	229,886	10,308	4.5%
1983	4,209	428	10.2%	224,304	10,291	4.6%	228,513	10,719	4.7%
1984	4,120	471	11.4%	237,455	11,113	4.7%	241,575	11,584	4.8%
1985	4,360	489	11.2%	258,808	12,111	4.7%	263,168	12,600	4.8%
1986	4,071	473	11.6%	264,481	12,626	4.8%	268,552	13,099	4.9%
1987	4,285	552	12.9%	280,575	13,918	5.0%	284,860	14,470	5.1%
1988	4,151	559	13.5%	273,491	13,933	5.1%	277,642	14,492	5.2%
1989	4,221	591	14.0%	284,234	15,003	5.3%	288,455	15,594	5.4%
1990	3,961	582	14.7%	262,604	14,390	5.5%	266,565	14,972	5.6%
1991	3,685	542	14.7%	249,198	14,397	5.8%	252,883	14,939	5.9%
1992	3,486	543	15.6%	249,729	14,786	5.9%	253,215	15,329	6.1%
1993	3,615	521	14.4%	247,500	15,133	6.1%	251,115	15,654	6.2%
1994	3,260	528	16.2%	244,975	15,513	6.3%	248,235	16,041	6.5%
1995	3,347	544	16.3%	241,800	15,573	6.4%	245,147	16,117	6.6%
Change between 1979 and 1995	-2,516 or -42.9%	-10 or -1.8%	6.8% or 72.0%	-14,425 or -5.6%	5,180 or 49.8%	2.4% or 58.8%	-16,941 or -6.5%	5,170 or 47.2%	2.4% or 57.4%

Source: *Canadian Motor Vehicle Traffic Collision Statistics*, Transport Canada, 1979 to 1995.

The *nature* of fatalities and injuries related to motor vehicle collisions (for 1993) is presented in Exhibit 4.10. As this exhibit indicates, in 1993, with respect to motor vehicle collisions:

- collisions involving the elderly as a driver or passenger accounted for approximately 73% of all elderly fatalities and almost 88% of elderly injuries;
- collisions involving elderly pedestrians accounted for approximately 23% of all elderly fatalities and almost 11% of elderly injuries;
- the elderly accounted for over 26% of all pedestrian fatalities; and
- collisions involving bicycles and motorcycles accounted for 1.5% of all elderly fatalities and 1.3% of elderly injuries.

Exhibit 4.10: Nature of Fatalities and Injuries related to Motor Vehicle Collisions (Canada, 1993)

Age	Driver	Pass-enger	Ped-estrian	Bicyclist	Motor Cyclist	Not Stated	Total
Fatalities							
All Ages	1,804	959	473	81	212	86	3,615
As a % of Total	49.9%	26.5%	13.1%	2.2%	5.9%	2.4%	100.0%
65 and Over	238	140	125	7	1	10	521
65+ As a % of Total	13.2%	14.6%	26.4%	8.6%	0.5%	11.6%	14.4%
As a % of 65+	45.7%	26.9%	23.4%	1.3%	0.2%	2.0%	100.0%
Injuries							
All Ages	134,329	79,253	14,723	10,341	7,038	1,816	247,500
As a % of Total	53.3%	32.0%	5.9%	4.2%	2.8%	0.7%	100.0%
65 and Over	7,893	5,357	1,612	152	50	69	15,133
65+ As a % of Total	5.9%	6.8%	11.0%	1.5%	0.7%	3.8%	6.1%
As a % of 65+	52.2%	35.4%	10.7%	1.0%	0.3%	0.5%	100.0%
Fatalities and Injuries							
All Ages	136,133	80,212	15,196	10,422	7,250	1,902	251,115
As a % of Total	54.2%	31.9%	6.1%	4.2%	2.9%	0.8%	100.0%
65 and Over	8,131	5,497	1,737	159	51	79	15,654
65+ As a % of Total	6.0%	6.9%	11.4%	1.5%	0.7%	4.2%	6.2%
As a % of 65+	51.9%	35.1%	11.1%	1.0%	0.3%	0.5%	100.0%

Source: *Traffic Collision Statistics in Canada,* Transport Canada, 1993.

4.1.3 Fatalities per Vehicle Kilometres, or Miles Travelled (VKT, VMT)

An additional measure of the risk associated with driving a motor vehicle is fatalities per vehicle kilometres or miles travelled (VKT, VMT). In a report released by the Ontario Ministry of Transportation, based on an exposure survey conducted in the autumn of 1988, accident rates per million kilometres driven per year, for males, were 7.58 for 16- to 19-year-olds, 4.07 for 20- to 24-year-olds, 3.49 for 25- to 59-year-olds, 2.64 for 60- to 69-year-olds, 3.87 for 70- to 79-year-olds, and 6.67 male drivers 80 years of age and over (somewhat lower than that for 16- to 19-year-old males). (Ontario Ministry of Transportation, 1991)

For females, the rates were lower than those for men in comparable are groups, except for women drivers over 70. In particular, for women drivers, accident rates per million kilometres driven per year, were 4.93 for 16- to 19-year-olds, 4.01 for 20- to 24-year-olds, 2.96 for 25- to 59-year-olds, 2.09 for 60- to 69-year-olds, 5.63 for 70- to 79-year-olds, and 12.13 for female drivers 80 years of age and over (the highest level amongst all drivers, regardless of age and gender).

The report notes however, that for both male and female drivers in the 80-year-old and over age group, the 95% confidence intervals for accident rates per kilometre are very wide, meaning that the estimates are not very reliable, and must be used with caution.

Figures from NHTSA in the United States (U.S. Department of Transportation, 1993), indicate that in 1990, drivers 85 years of age and over have the second highest crash involvement rate of U.S. drivers (in terms of collisions per VMT), next to the 15- to 19-year-old age group (see Exhibit 4.2). In particular, the 85 and over age group has a rate of approximately 1,500 crashes per 100 million vehicle miles travelled. For the 15- to 19-year-old age group, the crash involvement rate was approximately 2,000 per 100 million VMT. For all other age groups, the rate was less than 1,000 crashes per 100 million VMT.

The U.S. DOT's NHTSA provides valuable insights into the pattern illustrated in Exhibit 4.2:

> *This curve [in Exhibit 4.2] ... indicates that the highest **per-mile** crash rates occur among the youngest and the oldest age groups. This demonstrates that an "average mile" driven by a member of one of these two groups is more dangerous than an "average mile" driven by a member of an intermediate age group.*
>
> *However, since drivers at either end of the age range drive far fewer miles than those in between, researchers have questioned the equality of those "average miles" across age groups. Unlike younger and older drivers, drivers in the intermediate age groups travel a sizeable proportion of their annual miles on expressways and other inter-city roadways. These types of roads typically offer fewer hazards than do roads in urban areas. Most of the miles driven by younger and older drivers involve congested areas and heavy concentrations of intersections that offer relatively more opportunities for conflict with pedestrians and other vehicles.*

In Australia, the Federal Office of Road Safety (FORS) reports that the relative risk of death per million kilometres driven is high for those aged 17 to 20 and 75 to 79, and highest among those 80 years of age and over. In addition to their data, FORS also raises the issue of "how old is an older driver?" As they state:

> *Drivers aged 60 to 64 are statistically safer for every kilometre driven than those aged 30 to 34. Similarly, those aged 65 to 69 are safer than drivers aged 21 to 25; and 70 to 74 year olds are much safer than drivers younger than 21.* (Federal Office of Road Safety, 1996)

4.2 Driver Actions

To develop measures aimed at improving the safety of the motor vehicle environment for the elderly, it is important to consider elderly driver actions in relation to collisions. In this regard, research (NHTSA, 1996; FHWA, 1992, 1994; TRB, 1993) has indicated that elderly drivers:

- exhibit less aggressive driving behaviour (e.g., speeding, following too closely, and drinking and driving) as compared to younger adults;
- are more likely to be involved in collisions involving comprehension errors (e.g., confusion in congested situations, misunderstanding of signage);
- have more problems at intersections than younger drivers and in situations involving turns and merges (where complex manoeuvres and interactions must take place with opposing traffic);
- are over-represented in collisions at stop signs where the driver has stopped at the sign and then proceeded to pull out in front of another vehicle;
- are over-represented in collisions involving lane changing on two-lane rural highways.

Over-representation of the elderly in incidents involving intersections and complex situations may be due to the fact that "*older drivers have more difficulty perceiving and judging the dynamics of traffic movement and performing cognitive tasks with time constraints".* (U.S. Department of Transportation, 1997)

In addition, elderly drivers are over-represented in multiple vehicle collisions at non-highway junctions, are more frequently the struck vehicle than the striking vehicle, and are increasingly likely to be at fault as they age. This conclusion is reflected in the research results presented by the U.S. Federal Highway Administration (FHWA):

> *It appears that the problem experienced by elderly drivers involved in crashes either relate to the difficulties in distinguishing target vehicles from surrounding clutter, judging closing speeds of target vehicles, and/or an inability to use the acceleration capabilities of the cars they are driving in order to utilize what would be considered to be "safe gaps" for younger drivers.* (FHWA, 1994)

Two factors which may also affect elderly drivers (and all drivers in general), but are not necessarily related to driver actions include the presence of variable message signs (which can distract drivers), and the apparent decline in civility and courtesy, and increase in "road rage" and aggressive driving.

4.3 Physiological Conditions and Elderly Drivers

> *Perceptual, Cognitive and Motor are the three basic skills required to successfully complete the complex task of driving a car. Perceptual input comes to the driver primarily through the sensory process such as vision and hearing. The stimulus must be registered and recognized at the cognitive level. Again at the cognitive level, the driver must decide how to respond to the stimuli. Physical and motor skills are then used to carry out the task maneuver*. (Struthers, 1997)

Many of the skills noted above, which are needed to operate a motor vehicle safely, may be compromised by physiological changes and various medical conditions that often accompany aging. (Stutts et al., 1996)

Due to the relationship between age-related declines in physiological functions and their affect on driving performance, this area has received a considerable amount of research. Exhibit 4.11 summarizes physiological conditions affected by aging, that are of importance to driving performance. Research related to two of the key functions, cognitive and visual, are briefly summarized below. Recent research results related to medication use and elderly drivers are also presented.

For reference purposes, current licensing requirements of Canada's provinces and territories are provided in Exhibit 4.12.

Exhibit 4.11: Physiological Functions affected by Aging, of Importance to Driving Performance

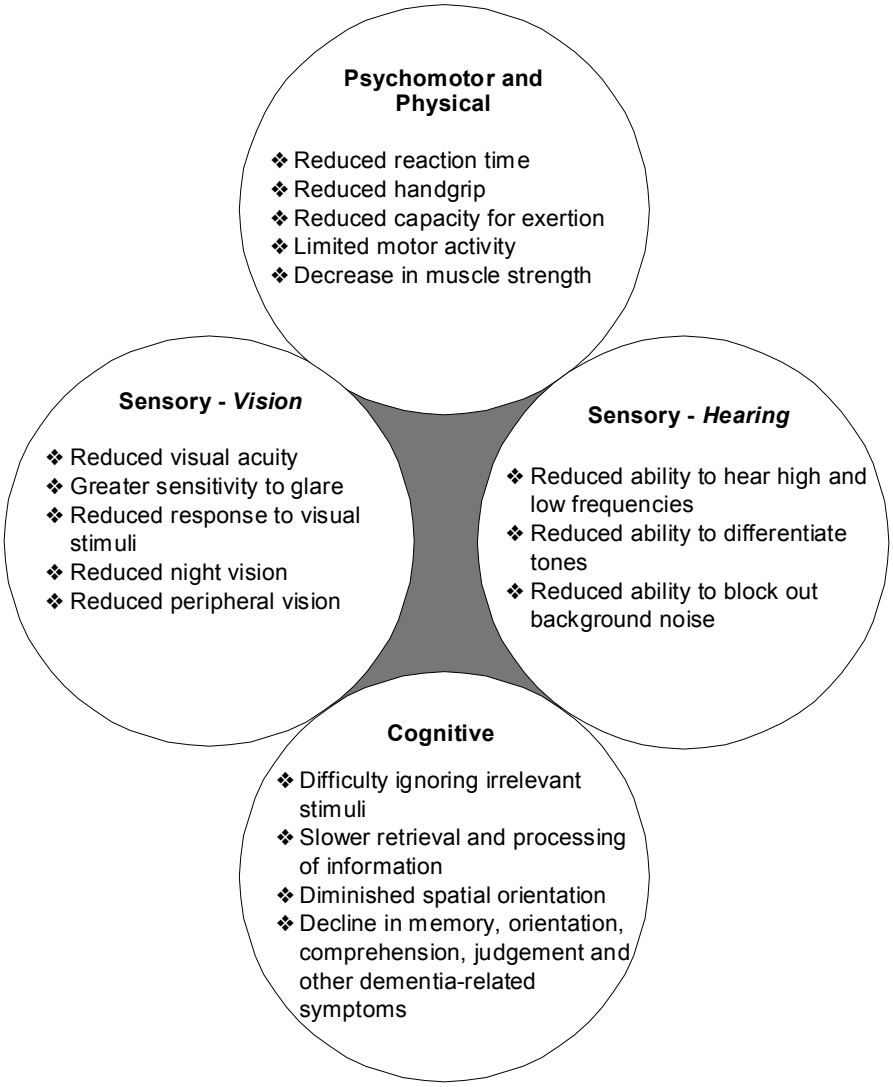


Exhibit 4.12: Provincial and Territorial Driver Licensing Requirements

Province/Territory	Comments
Newfoundland	• no age at which drivers must be re-examined • medical required at age 70 and every two years thereafter until age 80 when a medical is required annually
PEI	• no age at which drivers must be re-examined
Nova Scotia	• no age at which drivers must be re-examined • need for a medical is discretionary with individuals responsible for reporting any changes in their ability to drive
New Brunswick	• no age at which drivers must be re-examined • need for a medical is discretionary
Quebec	• medical and vision test required at age 70 and every two years thereafter; driver evaluation may be required based on results
Ontario	• driver evaluation required at age 80; also required for individuals 70 years of age and over who are involved in a motor vehicle accident and are at fault
Manitoba	• need for a medical is discretionary with individuals responsible for reporting any changes in their ability to drive • licences need not be renewed in person except when photo update required (every four years)
Saskatchewan	• need for a medical is discretionary with individuals responsible for reporting any changes in their ability to drive
Alberta	• medical report required for individuals 75 and over when renewing license; vision test also required
British Columbia	• medical required at age 80. A driver's re-examination consists of a vision screening; an oral examination on traffic signs and signals; and a road test.
Northwest Territories	• medical required at age 70 and every two years thereafter until age 80 when a medical is required annually
Yukon	• medical required at age 70 and every two years thereafter

Sources: Provincial Ministries of Transportation and U. Rutenberg, *Elderly and Disabled Drivers: Licensing Procedures*, Transportation Development Centre, TP10212E, 1990.

4.3.1 Cognitive Functions

Research has indicated that declines in cognitive abilities appear to be a high risk factor in relation to motor vehicle collisions involving elderly drivers. A summary of research related to driving and cognitive abilities is provided below.

- A study recently completed in Sweden (Johansson, 1997) revealed that a decrease in cognitive abilities appears to be a very important risk factor for older drivers' involvement in traffic collisions. However, the cognitive impairment is often not great enough to be recognized or detected by examinations commonly performed by physicians. In addition, blood samples from 23% of the male drivers 75 years of age and over involved in fatal crashes, revealed that at the time of the fatal crash, the drivers had in their blood drugs, known to affect cognitive functions. The study concluded that:

- *... a detailed test of cognitive function should be included in the examination of older driver licence applicants. The physician, and the older driver on medication, must also be made aware of the importance of drug influence on cognitive functions and the subsequent increase in accident risk when using such drugs*.

- In a review of studies involving accident rates and drivers with dementia, Tallman reports that elderly drivers with dementia had accident rates 2.25 to 4.5 times greater than did control groups. A review of performance-based tests (e.g., road tests and attentional and visuospatial tests of Alzheimer patients) revealed that drivers with dementia performed less well than control groups. (Tallman, 1995)

- In a study comparing driving records of persons diagnosed as probable sufferers of Alzheimer's and comparison drivers (Waller et al., 1993), no differences were found for crash rates and few differences in crash characteristics. In related research, Janke concluded that "*from a strictly public health standpoint, the findings did not support the contention that drivers in the early stages of Alzheimer's disease pose a significant public risk"*. (Janke, 1994)

- In relation to driving, Messinger reported that in mild stages of cognitive impairment due to Alzheimer's disease, driving can be done on the basis of automatic, overlearned functions, but there is diminishing ability to respond to novel situations, with the possibility that the patient may become lost while driving. Among the driving skills affected by dementia are the following functions:

    - perception and recognition
    - selective attention and the ability to focus attention on a particular stimulus in a complex display, and (especially) in disengaging attention from that stimulus in order to focus on another
    - the ability to divide attention between more than one stimuli at a time
    - judgement and decision making (which can play a role in deciding which driver has the right of way at an intersection)
    - impulse control (anxiety) and inappropriate reaction

In moderate and severe stages of dementia, impairments and their impact on driving are correspondingly more severe.

4.3.2 Visual Functions

Given that driving is a highly visual task, a person's visual capability is an important factor in safely operating a motor vehicle. In their research related to visual impairment, Wood et al. (1994) compared the driving of elderly persons (with and without cataracts) against a group of younger drivers. All of the elderly drivers had levels of visual acuity that enabled them to be eligible to drive. Their research, based on driver tests in a closed-circuit driving course, concluded that elderly drivers have:

- greater susceptibility to glare;
- more problems detecting low-contrast signs and images;
- greater difficulties locating objects in crowded or cluttered areas;
- a need for greater time to register a stimulus in the periphery; and
- generally, a more pronounced visual impairment, for elderly drivers with cataracts.

With respect to requiring greater time to register stimulus in the periphery, the authors state that these differences "*might mean the difference between seeing or not seeing a child or another car at an intersection*".

While these reduced visual abilities imply a greater risk when driving, both Wood et al., and Magg et al. (1996), state that elderly drivers do compensate for their reduced visual abilities by among other things, driving during the day, driving slower, driving in familiar surroundings, and avoiding peak congested driving times.

4.3.3 Medication Use

A recent study, released by a team of researchers at McGill University and Montreal's Royal Victoria Hospital, (The Gazette, 1997) indicates a link between elderly drivers who use benzodiazepines and motor vehicle collisions. Studying Quebec driver licence files of about 225,000 persons between the ages of 67 and 84, police reports, and health insurance records, the researchers found that that there is a 45% increase in the rate of motor vehicle collisions among elderly patients during the first seven days of taking a form of benzodiazepines. The researchers found a 26% increase in the rate of motor vehicle collisions after continuous use of the drug for one year.

The side effects of the medication, which is prescribed to deal with symptoms such as anxiety and insomnia, include drowsiness, sedation, confusion, and impaired motor function.

4.4 Measures for Improving Safety

A review of current research and literature related to the safety and security of elderly persons reveals a wide variety of measures that have been, or could be implemented to provide a safe and secure transportation environment. These range from:

- design considerations (regarding terminals, public vehicles, the traffic engineering environment, and motor vehicles);

- technology applications;
- public education/awareness; and
- licensing regulations, including operator testing.

The following is a list of measures aimed at enhancing the safety and security of elderly persons in relation to motor vehicles. The measures are presented under the following headings:

- traffic engineering environment;
- driver-related;
- motor vehicle-related;
- communications and education/public outreach; and
- addressing issues related to physiological conditions and driver performance.

Traffic Engineering Environment

- clear display of traffic signage;
- reduction of irrelevant stimuli;
- appropriate street lighting, particularly for both controlled and un-controlled intersections;
- standardized left-turn signals at controlled intersections;
- clear lane demarcation;
- adequate road maintenance; and
- intersection design (e.g., walk-time intervals) that recognize the reduced walking speed of many elderly pedestrians (measures aimed at improving the safety of elderly pedestrian are discussed in more detail in Section 5.2).

In response to the U.S. Federal Highway Administration's (FHWA) "Action Plan for Older Persons" (1989), the Florida Department of Transportation (FDOT) implemented an initiative to improve the safety of elderly road users through traffic engineering enhancement. Examples of design improvements aimed at benefiting the older road user as recommended by the FDOT (1997) include:

- improved signage through the use of increased letter size, retroreflectivity, better placement, multiple and mid-block signing, trailblazing and use of symbols.
- improved pavement marking and delineation - size of markings, use of edge and centerlines on low volume roads, improved maintenance and inspection, more pavement arrows and words.

- improvements to traffic signals - larger signal faces, better located within field of view, longer walk phase for pedestrian signals, improved maintenance.

- improved sight distance - for stopping, decision making, intersections, and clear sight line.

- improved intersection configurations - simplify designs, provide protected left turns, grade separations for very high volumes with confusing movements.

- improved roadway designs - for better channelization, increase use of medians, minimize hazards and unexpected obstacles, eliminate grade crossings.
- improved pedestrian crossings - provide refuge islands, utilize high visibility crossing pavement markings, re-evaluate pedestrian walk speeds.

- improved roadway lighting - reduce headlight glare with glare screens and open graded asphalt at pedestrian crossings, interchanges, intersections and mainlines.

The Florida Department of Transportation also recommends that the Department of Highway Safety and Motor Vehicles periodically test all road users on traffic control devices since technology and regulations can and do change.

Driver-Related

- extended driver testing for assessing disabilities prevalent in older adults, particularly those which (may) play an important factor in motor vehicle collisions involving elderly drivers (e.g., vision disabilities, dementia);

- use of driving simulators in testing routines;

- licence restrictions versus revocation;

- elderly driver (re)training and education;

- elderly driver self-assessments and self-awareness; and

- provision of low-cost alternative modes of transportation (e.g., car pooling and sharing involving local community groups, co-operative or voluntary local transportation services).

Motor Vehicle-Related

- user-friendly vehicle controls and displays;

- new in-vehicle safety features such as seat belt improvements and “smart” airbags; and

- Intelligent Transportation System (ITS) applications such as:
  - collision warning/avoidance systems
  - in-vehicle signing (providing advance notice in the vehicle of caution, speed change, and contour signs that will be encountered)

- incident identification and location systems (combining Mayday rescue communication systems and vehicle location systems).

Exhibit 4.13 presents an overview of the relationship between selected difficulties and barriers to safe driving, their impact on driving and potentially applicable ITS equipment/technologies.

There is, however, an apparent lack of research related to the elderly's acceptance and use of ITS applications for personal vehicles. In addition, the elderly are often not considered in ITS designs. However, based on a review of a selected number of ergonomic studies of ITS and elderly drivers, C.G.B. Mitchell notes that:

> *... it does appear that ITS technologies can mitigate some of the difficulties encountered by elderly drivers. Indeed, there is a remarkable match between the capabilities of ITS systems for car drivers and the driving tasks which become more difficult as people age.* (Mitchell, 1997)

In terms of new in-vehicle safety features, the Canadian Motor Vehicle Manufacturers' Association notes that seat belt improvements and "smart" airbags are being pursued by North America's major motor vehicle manufacturers.

Also, in anticipation of an aging population, General Motors is in the process of designing vehicles which are easier for everyone to use, including the elderly and persons with disabilities. Involving a team of persons with disabilities working directly with designers and engineers, GM's Paragon Project is focusing on vehicle designs(s) which take into consideration factors such as diminished hearing, vision, and physical capabilities. Established four years ago, the Paragon team consists of GM employees and retirees representing a variety of groups, including persons with arthritis, replacement knees and/or hips, hearing loss, vision loss, users of wheelchairs, and the elderly. (Akre, 1997)

Communications and Education/Public Outreach

Increased public awareness and education campaigns could be introduced which address traffic safety issues related to elderly drivers (e.g., awareness of elderly driver abilities, elimination of negative stereotypes).

Exhibit 4.13: Potential ITS Applications for Reducing Difficulties and Barriers Experienced by Drivers with Cognitive and Visual Disabilities

Disability and Difficulties/Barriers to Safe Driving	Impact on Driving and Potential Results	Applicable ITS Equipment
Cognitive ➢ increased reaction time ➢ difficulty dividing attention between tasks ➢ difficulty judging speed and distance ➢ difficulty perceiving/analyzing situations	*Impact on Driving* ➢ difficulty driving in unfamiliar or congested areas ➢ failure to perceive conflicting vehicles ➢ failure to comply with traffic signals and rail crossings *Potential Results/Impacts* ➢ increased risk of accidents ➢ increased anxiety while driving ➢ avoidance of stressful situations (e.g., unfamiliar areas, congestion)	➢ navigation/route guidance systems ➢ in-vehicle sign display and warning devices ➢ collision warning and avoidance systems ➢ automated lane changing ➢ traffic information systems, including variable message signs
Visual ➢ increased sensitivity to glare ➢ reduced dusk/night vision ➢ reduced peripheral vision ➢ reduced ability to focus	*Impact on Driving* ➢ difficulty seeing/failure to see pedestrians, other vehicles, and traffic signals ➢ difficulty seeing/failure to see pedestrians, other vehicles, and traffic signals while maneuvering *Potential Results/Impacts* ➢ increased risk of accidents ➢ increased anxiety while driving ➢ avoidance of stressful situations (e.g., night driving)	➢ night vision enhancement ➢ navigation/route guidance systems ➢ in-vehicle sign display and warning devices ➢ collision warning and avoidance systems ➢ automated lane changing ➢ blind spot/obstacle detection ➢ traffic information systems, including variable message signs

Source: Based on "Directions for ITS Research and Development on Safety and Security for Elderly and Disabled Travelers in Canada", Suen, Mitchell, and Rutenberg (1997).

Issues Related to Physiological Conditions and Driving Performance

Counselling, graded licensing (i.e., gradual relinquishment of driving), and driver self-assessments have been suggested as methods of identifying and assisting elderly drivers who have suffered a decline in physiological functions.

Given the broad range of physiological conditions that may be affected by aging (some of which may not be easily recognizable either by the driver, his/her physician, or a licensing agency), it has been suggested by the U.S. Department of Transportation that more research be conducted on identifying and assisting elderly drivers who have suffered a decline in physiological functions. (See Section 4.2 for additional areas of research prioritized by the U.S. Department of Transportation.) In particular, the following areas have been identified as being key priority research areas:

- the role of medical conditions and functional ability on crash involvement and driver performance, including the relative risk between various conditions, functions and crash involvement;

- the development of standard guidelines on who should or should not be driving, based on performance/capabilities; and

- testing, evaluating, and establishing systems for assessing drivers, and identifying problem drivers.

With respect to the first area of research (medical conditions, functional ability, and driving performance), Janke (1994) suggests that the following functional capabilities be considered when assessing elderly drivers:

- visual functions (in addition to typical tests of static visual acuity under normal illumination):
  - static visual acuity under low illumination
  - contrast sensitivity or low-contrast acuity
  - acuity under glare and low-luminance acuity
  - visual fields

- cognitive functions (in addition to knowledge of driving-related rules and laws):
  - short-term memory
  - visual spatial reasoning
  - attentional visual field or useful field of view
  - ability to focus attention under conditions of distraction
  - vigilance (i.e., sustained attention)
  - hazard perception
  - judgement, including self-judgement

- psychomotor and physical functions:
  - visual tracking
  - flexibility
  - stability (balance)
  - strength (at some minimal level)
  - reaction force and speed sufficient for driving

To make such an assessment scheme feasible, elderly drivers could first be screened by initially testing for:

- knowledge of traffic laws and rules, including safe driving habits;
- static visual acuity under high and low illumination conditions;
- low-contrast acuity or contrast sensitivity;
- visual attentional fields; and
- informal observation by trained agency staff for frailty or confusion.

Overall, when designing a driver assessment program, Janke suggests the following questions be considered:

- What functions would be measured?
- How should these functions be measured?
- Who should measure them (e.g., driver licensing personnel or trained medical staff)?
- Are candidate tests reliable and valid for assessment of driver skill and/or safety?
- If administered in preliminary screening, are they also inexpensive and brief?
- If administered by licensing agency staff, can proper administration and scoring (if not automated) be readily learned?
- If administered by licensing agency staff, can proper interpretation of results be readily learned?
- Is administration of the tests to elderly, possibly frail or cognitively impaired persons, feasible, simple and non-threatening?
- Are the tests sensitive to changes of normal aging?
- Are the tests sensitive to driving-related functional impairments of dementia and frailty within an unselected group, of say, elderly license renewal applicants? Are they specific enough not to yield too high a rate of false positives?
- Are the tests sensitive to the kinds and severity of functional impairments that would prevent safe driving, within a group of elderly subjects already identified as having dementia or being frail? Are they specific enough not to falsely categorize functionally adequate drivers as inadequate?

Competence-Based Driver Evaluations

To address the issue of testing elderly drivers, the University of Alberta's Department of Psychology conducted research into methods of evaluating driver competency. The research was based on the conclusion that current testing procedures (including road tests, neuropsychological tests, and psychological tests), and/or the presence of medical conditions or drug treatments are not, on their own, sufficient for identifying at-risk drivers. To address these issues, the researchers concluded that a competence-based driving evaluation process was

needed that enabled evidence-based decisions about continued driving of individuals to be made.

Among the issues addressed by the researchers in the development of the competence-based driving evaluation were: What constitutes an appropriate road course? Which driving errors are associated with declines in driving competency and which are associated with bad driving habits? How should relevant errors be weighted? How can an empirically defined criterion for Pass/Fail be determined? In addition, the cost and safety of road tests were also concerns for the researchers.

Results of the research has led to the development of a competence-based driver evaluation program which includes two components: a computer-based test and a road test. The computer-based test consists of a highly accurate and short computerized competency test that can identify up to two-thirds of the drivers who pass or fail the road test, without the safety risk and cost of the actual road testing. The road test is needed to assess the competency of the remaining drivers found to be "indeterminate" with the computerized competency test.

The driver evaluation was developed through research testing of over 500 driving dementia patients and over 200 healthy volunteer drivers, and is available through a company named DriveAble Testing Ltd.

Reporting Medically Unfit Drivers

As illustrated in Exhibit 4.14, most provinces and territories have regulations which require physicians to report medically unfit drivers to the provincial licensing authority. However, the Canadian Medical Association (CMA) strongly urges physicians to report unfit drivers regardless of whether they are legally bound to do so, particularly if a physician feels that the patient will continue to drive in defiance of medical advice. As the CMA notes, failure to report could leave the physician vulnerable in the event that litigation occurs.

Exhibit 4.14: Regulations Pertaining to the Reporting of Medically Unfit Drivers

Province or Territory	Regulation	Obligation to Report	Physician Protected from Liability?
Newfoundland	Not applicable.	No specific regulatory obligation, although there are many ways by which the Registrar learns of unfit drivers.	Not addressed.
Nova Scotia	Motor Vehicle Act, Section 279.	Discretionary for physician.	Yes, explicitly stated.
PEI	Highway Traffic Act, Section 218.	Mandatory for physician.	Yes, explicitly stated.
New Brunswick	Not applicable.	No specific regulatory obligation, although there are many ways by which the Registrar learns of unfit drivers.	Not addressed.
Quebec	Highway Safety Code C-24.2, Section 603.	Discretionary for physician.	Implied, but not explicitly stated.
Ontario	Highway Traffic Act, Section 177.	Mandatory for physician.	Yes, explicitly stated.
Manitoba	Highway Traffic Act, Section 157	Mandatory for physician.	Yes, explicitly stated.
Saskatchewan	Vehicle Administration Act, Section 94.	Discretionary for physician.	Yes, explicitly stated.
Alberta	Motor Vehicle Administration Act, Section 14.	Discretionary for physician; mandatory for patient.	Yes, explicitly stated.
British Columbia	Motor Vehicle Act, Section 221	Mandatory for physician to report a persons whose medical condition renders driving dangerous or who continues to drive after having been warned not to by the physician.	Not addressed.
Northwest Territories	Motor Vehicle Act, Section 118	Mandatory for physician.	Yes, explicitly stated.
Yukon	Motor Vehicle Act, Section 17.	Mandatory for physician and patient.	Yes, explicitly stated.

Source: *Physicians' Guide to Driver Examination*, Canadian Medical Association, Fifth Edition, 1991.

5. Pedestrian Safety

After motor vehicle collisions, pedestrian safety is the next major transportation-related safety issue involving the elderly in Canada (1993). As presented in Exhibit 4.10:

- over 1,700 elderly persons were either killed or injured as a pedestrian (125 fatalities and 1,612 injuries); and
- elderly persons accounted for over 26% of all pedestrian-related fatalities in 1993 (yet accounted for approximately 12% of the total population).

Similar statistics are reported in the United States (Environmental Working Group, 1997) and Australia (McFadden, 1996). During 1995 in the United States, there were approximately 1,400 fatalities involving persons 65 years of age and over. In terms of proportional share, persons 65 years of age and over accounted for approximately 13% of the population, but accounted for 23% of all pedestrian fatalities. In Australia, persons 60 years of age and over accounted for 40% of all pedestrian fatalities.

In the United Kingdom (1989), the Department of Transport reported that a pedestrian aged 60 to 69 was twice as likely to be killed than a younger adult pedestrian. People aged 70 to 79 were three times as likely to be killed than a younger adult pedestrian, and for those aged 80 and over, the risk was four times greater for males and eleven times greater for females. In addition, in 1989, almost half of all pedestrians killed on roads were over 60 years of age.

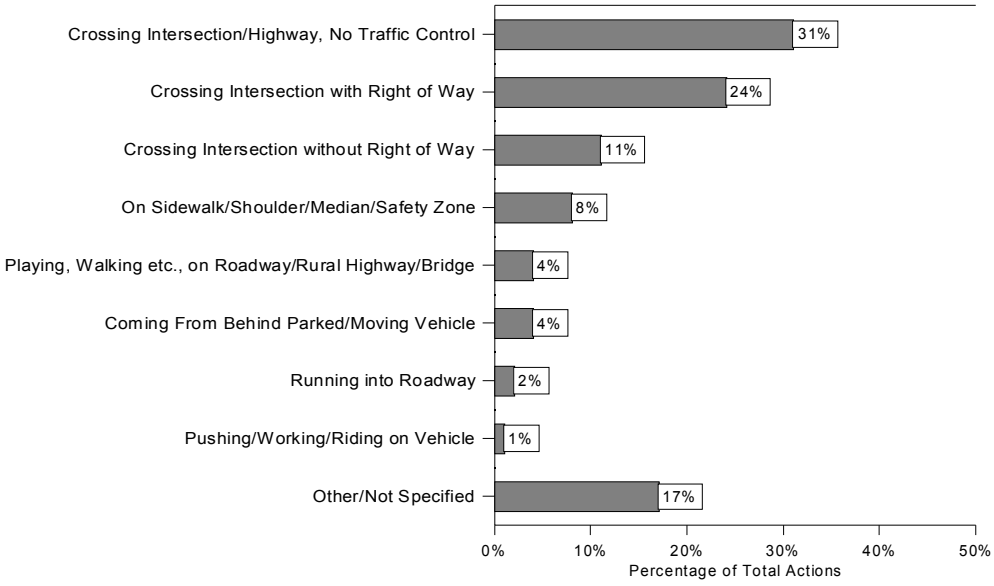
5.1 Pedestrian Actions

To better understand incidents involving pedestrians, and assist in designing appropriate countermeasures, police reports in Canada capture information on the action being taken by the pedestrian when the collision took place. Exhibit 5.1 presents a profile of the actions taken by elderly pedestrians in motor vehicle collisions.

As this exhibit indicates, the primary action reported was crossing an intersection or highway (with no traffic control device present). This was followed by elderly pedestrians crossing intersections with the right of way, and crossing intersections without the right of way. Overall, intersections were involved in 66% of all elderly pedestrian collisions.

It should be noted that these figures do not include falls which may occur to the elderly while walking to, or within, public transportation environments, such as bus or rail terminals, airports, or public transit stations. Also, the figures do not specify incidents which may have involved a bicyclist, and can potentially pose a hazard to elderly pedestrians.

Exhibit 5.1: Actions related to Pedestrian Fatalities and Injuries Involving the Elderly in Motor Vehicle Collisions (1993)
(Total Fatalities and Injuries: 1,738)



Source: *Traffic Collision Statistics in Canada,* Transport Canada, 1993. Note: Figures add up to more than 100% due to rounding.

A study of pedestrian fatalities in the United States (Zegeer et al., 1993) concluded that pedestrians, 65 years of age or over, are over-represented in fatal incidents:

- during daylight hours;
- on weekdays; and
- in winter.

Older pedestrians in the United States are also over-represented in intersection crashes (particularly involving turning vehicles) and in crashes involving wide street crossings. Alcohol involvement was less likely a factor for older pedestrians than for most younger age groups.

A study conducted by the U.S. Federal Highway Administration (1993) concluded that, in relation to younger pedestrians, elderly pedestrians displayed:

- crossing start-up times that were approximately 25% greater;
- walking speeds that were significantly slower; and
- stride lengths that were approximately 86% of younger pedestrians.

In Australia, a study conducted in Victoria (Oxley, et al., 1996), developed similar conclusions regarding elderly pedestrians. In particular, the study concluded that elderly pedestrians:

- tended to take longer to leave the curb when crossing a street (although differences in curb delay may not be as apparent in less complex traffic environments);

- left longer gaps between themselves and oncoming traffic; and
- crossed the street at slower speeds than younger pedestrians.

Overall, the study concluded that:

> *... the ability to cross the road efficiently becomes more difficult as age increases, and this is particularly so as the complexity of the task increases. A combination of a complex traffic environment, fast speeds, and declining abilities to make appropriate judgements along with a failure to accommodate or modify behaviour quickly to avoid a potentially dangerous situation are several interacting sources of threat to older pedestrians.*

Additional research conducted in Australia (McFadden, 1996) concluded that for all age groups, 74% of pedestrians involved in fatal crashes were primarily responsible for the crash and a further 8% were partially responsible.

5.1.2 Frailty of Elderly Pedestrians

The fact that the elderly represent high proportions of pedestrian fatalities in Canada, the U.S. and Australia (relative to their share of total population in general), suggests that the elderly are less able to survive being struck by a vehicle. One explanation for the elderly's reduced ability to survive such incidents is the increased frailty associated with health problems among the elderly. As a result, an accident is likely to cause greater injury to an older person, and an older person is more likely to die from an injury.

As discussed in Section 2.3, it should be noted that frailty is not necessarily a result of aging but is often a result of an illness, disease, and/or lack of physical activity which can result in reduced muscle tone, decreased bone strength and mass, decreased flexibility, and gait and balance disorders. Each of these can increase an elderly person's susceptibility to injury in situations such as accidents and falls.

5.2 Measures for Improving Safety

The following measures have been or could be implemented to provide a safe pedestrian environment. Many of these measures are aimed at compensating for the reduced mobility and agility of elderly pedestrians, as discussed in the above section.

- clear demarcation at all intersections where a material pedestrian-vehicle conflict exists;
- audible crosswalk signals (some organizations providing services to the blind are against audible signals, as such signals may cause pedestrians to pay less attention to other traffic cues (including visual clues and other audible signals) (Zegeer et al., 1993);
- pedestrian push-button devices (including pole-buttons and sensor mats) for lengthening pedestrian crossing times;

- sensors (e.g., infrared, video imaging) for detecting the presence of pedestrians on the crosswalk area, triggering increased signal time;

- increased implementation of conflict-free pedestrian crossings (e.g., restricted crossing privileges at red lights);

- installation of pedestrian islands/refuges;

- easily visible and interpreted guide-signs for directing pedestrians to sidewalks, walkways, transit stops, overpasses, or other facilities;

- adequate snow and ice removal and maintenance of sidewalks and pathways;

- proper placement of street furniture (e.g., paper racks, telephone booths, benches, poles and signs) to avoid obstruction or screening of pedestrians, especially at intersections; and

- increased public awareness and education regarding:
  - correct interpretation of pedestrian signals
  - appropriate/correct pedestrian actions (e.g., proper search behaviour such as checking for turning vehicles and continual checking for oncoming traffic, avoidance of visual screens such as parked vehicles, telephone booths).

A summary of best practices for developing pedestrian-friendly facilities has been developed by the Driver Information & Traffic Management Division of the U.K. Department of Transport. These include:

- use of lighting (improved lighting reduces crime and fear of crime);

- closed circuit television (CCTV) cameras (reduced crime and fear of crime);

- traffic calming measures (reduced vehicle speeds and increased pedestrian safety);

- minor engineering schemes (pedestrian phases at traffic signals, footway widening, etc);

- appropriate use of street furniture (wall-mounted lights and the removal of unnecessary street furniture);

- use of public art and planting (improving the environment to make walking more pleasurable);

- provision of seating; and

- provision of toilets (walking may take longer than journeys using the car).

The University of Victoria's School of Nursing has also conducted research into the prevention of falls. The STEPS Project (Seniors and Persons with Disabilities Task Force for Environments which Promote Safety), launched in 1994, involved surveying almost 800 individuals who had experienced a fall, with the objective of identifying and addressing the factors (both human and environmental) which contribute to falls.

The STEPS Project has resulted in two reports (the STEPS Project, which details the results and recommendations of the survey, and Taking STEPS, a comprehensive manual on how to make streets, buildings and sidewalks safer for people who are at risk of falling), and a video which explores the environmental risks and challenges that the elderly and persons with disabilities face in carrying out their everyday activities. One-day workshops, entitled "Reducing Risks which Contribute to Falls in Public Places," are also offered by the STEPS project team.

Designing communities that are beneficial to elderly pedestrians can also be a boost for local economic development. As an example, Camrose, Alberta, has made a strong effort to ensure that community planning initiatives meet the needs of its elderly population. (Gold, 1997) Angled parking, wheelchair accessible sidewalks, and lighted pedestrian crossings are common in the city's downtown area. From a recreational perspective, 10 km of walking paths have been established which are paved and lit for safety. A large seniors' centre has been developed (offering recreational facilities and a travel agency), while services such as Meals on Wheels and alternative transportation services for elderly persons who are frail and disabled are available.

In return, Camrose has seen the number of elderly in the community double in the last ten years, with elderly persons accounting for approximately 20% of its population of 14,000, with an additional 19% between the ages of 45 and 64. As a result, this elderly population has provided employment opportunities for younger individuals (particularly in service jobs related to the elderly), contributes to the city's tax base, and represents a significant source of revenue for retailers.

6. Safety and Security and Public Modes of Transportation

This section profiles safety of the elderly and public modes of transportation, including specific causes of death in using public modes of transportation other than motor vehicles (i.e., air, rail, marine, and bus), and personal security issues in using public modes of transportation.

6.1 Deaths Related to Public Modes of Transportation

In Canada (1994), there were 237 fatalities involving modes of transportation other than private motor vehicles, of which 18 (8%) involved elderly persons. In comparison, there were approximately 3,050 fatalities resulting from motor vehicle collisions, of which 510 (almost 17%) involved the elderly. With respect to the 18 fatalities of the elderly involving modes of transportation other than motor vehicles, eight were related to water transport, six were related to rail transport, and four were related to air transport.

All eight fatalities related to water transport involved a small boat. No commercial vessels (i.e., ferries) were involved.

Of the six rail deaths involving the elderly, five involved elderly pedestrians being struck by rolling stock, while the sixth involved an elderly employee who died during a railway accident involving a collision with another (unspecified) object.

Regarding the four air transport-related fatalities involving elderly persons, only one was identified as involving a commercial aircraft. In particular, of the four air-related fatalities:

- one involved an occupant of a commercial aircraft in surface-to-surface transport;
- one involved an accident to a powered aircraft (unspecified) at takeoff or landing; and
- two involved elderly persons as occupants in powered aircraft (type and situation unspecified).

In 1994, there were no deaths classified as being related to bus travel (intercity or local transit). There have, however, been incidents where a pedestrian is struck and killed or injured by a bus, or where an individual may have fallen from a bus and later died in hospital. In these situations, causes of death may have been classified under pedestrian-related deaths or falls. These incidents are not however specific to the elderly. While industry representatives believe that the number of incidents such as this occurring is very low (e.g., between zero and five per year), there are no systematically collected national statistics available to analyze the issue.

In the United Kingdom (1989), six persons over the age of 60 were killed due to incidents involving bus transportation (both local transit and intercity bus), while over 400 were seriously injured. Total fatalities involving bus transportation fluctuate between 20 and 35 per year in the U.K.

6.2 Personal Security Issues and Public Modes of Transportation

Feeling safe or unsafe while walking alone at night can be a barrier to mobility, which can consequently affect the quality of life of an elderly individual. From a modal perspective, this feeling of safety is especially a factor in using public transit, where the perception of safety (or lack thereof) can influence an elderly person's decision to use public transit (especially at night, which can also influence day trips) versus alternative modes (particularly the automobile). For persons without personal vehicles, such a perception may prevent them from travelling at night altogether.

As reported by CUTA, increasing perceptions of risk to personal security have been related to ridership losses in both Montreal and Toronto. As CUTA notes:

> *When the concern is about crime on transit, there is clearly pressure to shift to those modes which are perceived to be safer when those choices are affordable and available ... Reluctance to make an evening trip may deter a person from taking transit earlier in the day to go shopping, work, to a leisure activity, etc. Concerns about safety also encourage transit dependent riders to seriously consider purchasing their own car.* (CUTA, 1991)

A national review of transport-related crime, passengers' perceptions of safety, and current crime prevention initiatives was sponsored by the Mobility Unit of the U.K. Department of Transport. The results of the study reflect concerns raised by organizations such as CUTA. In particular, the review (U.K. Department of Transport, 1996) concluded that:

- despite low levels of recorded crime, passengers on public transport are exposed to a range of behaviour from other passengers which makes them feel vulnerable;
- cars are considered fairly safe;
- people are most afraid after dark;
- for both the public transport passenger and the private motorist, the time spent in vehicle is felt to be safer than the beginning and end of the journey;
- staff are seen as crucial in providing reassurance;
- the behaviour of children and young people in groups is seen as threatening; and
- only a few crime prevention initiatives have been properly evaluated.

6.3 Falls in Transit Terminals

In the United States, the incidence of falls occurring in public transit terminals has been concluded as being lower than that experienced in industrial settings and in the home. This is in part due to the design and maintenance standards adopted by the public transit industry. Typically, falls involving public transit facilities are classified as those involving escalators, stairs, and level walking surfaces.

In their analysis of 1,000 transit-related falls, the U.S. Urban Mass Transportation

Administration (1985) identified that the elderly (in this instance, persons ages 62 and over) had higher proportional rates of falling accidents. In particular:

- elderly men, who accounted for approximately 3.5% of passengers, accounted for almost 10% of all falls, and approximately 14% of falls requiring an ambulance; and

- elderly women, who accounted for approximately 1.5% of passengers, accounted for almost 8% of all falls, and approximately 7% of falls requiring an ambulance.

Overall, persons ages 62 and over accounted for approximately 5% of passengers, 18% of falls, and approximately 20% of falls requiring an ambulance.

In the United Kingdom, fear of falling is the largest single reason why elderly persons stop using public transportation (particularly buses).

6.4 Measures to Improve Safety[7]

The following is a discussion of measures that have been, or could be, implemented to facilitate safety and security in relation to public modes of transportation. The measures, based on information from various sources, are presented under the following headings:

- environment external to public facilities and terminals;
- environment inside public facilities and terminals; and
- in-vehicle.

It should be noted that many of the accessibility and universal design measures being implemented in areas such as public transportation and building design, which benefit persons with disabilities, will also benefit the elderly and the public in general.

Environment External to Public Facilities and Terminals

- accessible and well-lit route from the parking lot, street, sidewalk and passenger loading zone

- sufficient and well positioned lighting (e.g., to prevent glare)

- accessible walks with reduced/minimized slope

- visible and colour contrasted handrails on both sides of ramps or staircases

- adequate snow and ice removal

- non-slip surfaces

Inside Public Facilities and Terminals

[7] An excellent source of information for safety and accessibility design considerations for public modes of transportation is *Improving Transportation Information: Design Guidelines for Making Travel More Accessible*, TransVision Consultants Ltd., 1996.

- door design which meets minimum requirements for operating force and manoeuvring clearances
- glass doors and glazing marked at 0.8 m and 1.6 m above floor level
- sufficient and well positioned lighting (e.g., to prevent glare)
- slip-resistant flooring
- elevators
- emergency communications system for elevators
- accessible moving sidewalks
- handrails which meet requirements on all stairs
- appropriate handrails/grab bars in elevators
- boarding assistance for elderly passengers (feasible for all modes)
- staff training both in terms of sensitization with respect to the needs and concerns of the elderly, and in first aid
- clearly audible announcement systems, complemented by visual communication systems for persons who are deaf or hard of hearing
- self-identification by elderly persons with a disability, when communicating with terminal staff (which can facilitate the provision of appropriate services which meet their needs)

In-Vehicle

- smooth riding, including decreased levels of accelerations and jerks applied to the moving vehicle (primarily for public transit buses and streetcars)
- maximized clear view of outside available to bus riders to allow them to prepare against the risk of falls by monitoring outside events
- provision of vertically oriented visual cues to optimize the role of vision in the control of posture and stability
- use of low-floor and kneeling buses
- appropriately positioned and colour contrasted grab bars/handrails
- colour-based visual cues for steps
- emergency communications
- pre-boarding assistance for elderly passengers

- appropriately trained staff in terms of first aid

6.5 Air Safety

To mitigate safety risks in cases where emergency evacuations of aircraft are required, Transport Canada (in 1994) proposed an amendment to Air Navigation Order Series VII which stated that *"an air carrier shall ensure that, prior to take-off, every passenger seated next to a window emergency exit is informed by a crew member that the window is an emergency exit and how the exit operates"*. (Transportation Safety Board, 1995) This is particularly important given that some exit doors are in excess of 60 lb.

The proposed amendment does not state which passengers are prohibited from sitting next to a window emergency exit. However, operating procedures specifying restrictions regarding exit row seating are normally found in air carriers' Flight Attendant Manuals which must be approved by Transport Canada before an air carrier can obtain an operating certificate.

In addition, for commercial aircraft in the United States and Europe, it is common practice to screen and brief passengers sitting next to emergency exists.

In the United States, the Federal Aviation Administration amended regulations so that certain air carriers must screen and brief passengers seated in exit row seats. In addition, a crew member must verify that no unqualified person occupies an exit seat. Air carriers "*may not seat a passenger in an exit row seat who is not able (as defined by the amendment) and willing, without assistance, to activate an emergency exit and to take certain additional actions needed to ensure safe use of the exit in an emergency in which a crew member is not available* ...." (Transportation Safety Board, 1995) A similar approach has been taken by the United Kingdom.

6.6 Security of Public Transit

As noted in Section 3, increasing perceptions of risk to personal security is seen as an important issue for Canadian transit operators. While security concerns relate primarily to the portion of the transit trip that takes place before and after the patron leaves the vehicle, CUTA recognizes that transit must maximize security by choosing bus stop locations in secure, well-lit areas, and by reducing walking distances between transit and destinations. Among the initiatives encouraged by CUTA (1991), are:

- allowing off-peak patrons to exit the bus closer to their destinations, rather than at designated stops;
- providing two-way communications between dispatchers and bus drivers;
- enhancing security at waiting areas through design considerations such as well-lit shelters, emergency phones, and/or surveillance cameras; and
- on-site personnel deployment, especially for larger urban areas.

In their report, *Perspectives on Transit Security in the 1990s: Strategies for Success*, the U.S.

Federal Transit Administration (1996) provides advice for managers and transit security personnel on how to implement appropriate security strategies to reduce all incidents of crime and improve patron perceptions of security. Aimed at all age groups, the strategies identified and discussed by the FTA include:

- security personnel deployment (ways in which security personnel secure transit systems while on patrol or on fixed post assignments. Methods include responses to calls for service, random patrol, directed patrol, and apprehension-oriented control);
- system design and technology strategies (including crime countermeasures such as movement control, surveillance and space utilization, and physical environment design features such as increased lighting, monitoring and communication systems, alarms, signage, and access control);
- security-related data collection and analysis; and
- operating practice strategies (such as route design and scheduling, and system policies and personnel training).

As a result of the national review of transport-related crime, sponsored by the Mobility Unit of the U.K. Department of Transport (1996), four key recommendations were made for improving safety and security of public transit, including:

- that operators should review their organizational structures to reflect the importance of personal security;
- that the Department should develop a model policy on personal security for operators and issue guidelines;
- that the Department should prepare guidance notes for use by public transport operators to facilitate the setting up of recording and monitoring systems;
- that the Department should run a series of seminars for operators, local authorities, and the police, to encourage greater involvement in security initiatives.

In addition, a series of guidelines for public transport operators was published by the Mobility Unit. These guidelines cover different security aspects such as: design and maintenance of infrastructure and vehicles, developing the role of staff, making best use of physical security measures, providing information to passengers, working with young people and other organizations, setting up recording and monitoring systems and monitoring and evaluation.

7. Commercial Operators

7.1 Labour Force Participation

In 1994, 11% of the male work force was 65 years of age or over, while 3.5% of the female work force was 65 years of age or over. As illustrated in Exhibit 7.1, the United States and Japan both had higher labour force participation rates among the elderly, while Australia had a slightly lower labour force participation rate among the elderly.

Exhibit 7.1: Labour Force Participation Rates, by Age and Gender (Canada and Selected Countries, 1994)

Age Group and Gender	Canada	U.S.*	Japan	Australia
Men				
15 to 24	65.2%	70.3%	48.0%	70.7%
25 to 54	91.4%	91.7%	97.5%	91.4%
55 to 64	60.3%	65.5%	85.0%	60.7%
65 and Over	11.0%	16.8%	37.6%	9.0%
All Ages	83.7%	87.0%	90.6%	84.1%
Women				
15 to 24	60.6%	62.5%	47.1%	65.9%
25 to 54	75.7%	75.3%	65.3%	67.4%
55 to 64	37.4%	48.9%	48.1%	26.5%
65 and Over	3.5%	9.2%	15.9%	2.3%
All Ages	68.5%	71.4%	62.1%	62.4%

Source: *Labour Force Statistics*, Organization for Economic Co-Operation and Development, 1995, as profiled by Statistics Canada.
*Estimates for persons 16 and over.

7.2 The Elderly and Commercial Operator Occupations

There are several commercial operator occupations identified in the National Occupational Classification (NOC) system relevant to this study. (Developed by Human Resources Development Canada (HRDC), the NOC is a systematic categorization of occupations in the Canadian labour market, and is intended for use in compiling, analyzing and communicating information about occupations.)

The commercial operator occupations, and the total number of persons (all ages) employed in each occupation (based on the 1991 Census) are listed below. Overall, these occupations employed 458,610 persons in 1991. The four largest occupational groups involve operators of

commercial vehicles, and accounted for over 86% of the total commercial operator work force.

- truck drivers (204,195);
- delivery drivers (90,315);
- bus drivers and subway and other transit operators (69,410);
- taxi and limousine drivers and chauffeurs (31,510);
- fishing vessel skippers and fishermen/women (30,305);
- air pilots, flight engineers, and flying instructors (10,830);
- railway and yard locomotive engineers (6,620);
- railway conductors and brakemen/women (6,525);
- deck officers, water transport (4,560);
- fishing masters and officers (3,125); and
- boat operators (1,215).

Persons aged 65 and over account for a small percentage of the total work force related to these occupations. For example, with respect to truck drivers, 1991 Census data from selected provinces indicates that 1.4% of the truck driver work force was 65 years of age or over. In particular, 2,220 of 164,705 truck drivers (representing approximately 81% of the total truck driver labour force), in P.E.I., Nova Scotia, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, the Yukon, and the Northwest Territories, were 65 years of age or over.

With respect to bus drivers, and subway and other transit operators, data from HRDC's Ontario and Quebec Regions indicate that 3.5% of this work force was 65 years of age or over. In 1991, these two provinces accounted for 63% of this occupation's total work force (all ages).

With respect to the remaining occupational groups, the proportion of operators who are elderly is also small. Based on data from the 1986 Census, the elderly represented slightly less than 2.5% of taxi drivers, and less than 1% of marine vessel operators, railway conductors, and air pilots. (Statistics Canada, 1989)

Several factors contribute to the relatively small numbers of elderly persons in commercial operating occupations, including:

- company-specific mandatory retirement policies at age 65;
- pension plan agreements based on 65 as the year of retirement; and
- existence of Old Age Security which ensures income for persons ages 65 and over (which can reduce economic pressures to extend work life and to postpone retirement).

In addition, there are relatively more stringent licensing procedures for commercial operators than for the population in general. Commercial driver's licences (e.g., for tractor trailers, buses), typically involve a medical examination, visual test, knowledge test, and a skills test (i.e., road test).

For example, in Ontario, an individual who applies for a commercial driver's licence must submit a medical report, and pass a knowledge and road test. Licences must be renewed every five years, with a medical examination required every three years. When drivers reach the age of 65, they are required to renew their licence every year (which includes a knowledge test and a road test). The three-year medical examination requirement does not change at age 65.

With respect to taxi operators, in Ontario, commercial drivers' licences are not required for operating a taxi. However, taxi operators must complete a four-week classroom-based training course prior to operating a taxi. In Quebec, taxi licensing is more rigorous, with drivers required to complete a medical exam every two years, in addition to an expanded written test.

Licensing requirements, can and in some cases, do restrict operation of a commercial motor vehicle based on an individual's age, medical and performance requirements. Moreover, factors such as mandatory retirement policies, can limit the number of individuals who continue to work in these occupations once they reach the age of 65.

For commercial air pilots, medical examinations are performed on an annual basis. In Canada, there are no age-related restrictions regarding who can fly a commercial aircraft (except that they must be 21 years of age or over). Specific companies may have policies which prevent pilots from flying large commercial aircraft once they reach the age of 60. These company polices reflect the "Age 60 Rule", which is a regulation of the International Civil Aviation Organization (ICAO). The "Age 60 Rule" prohibits individuals over the age of 60 from flying large commercial aircraft due to increased safety risks. This does not however, prevent pilots ages 60 or over from flying smaller aircraft, cargo planes, or recreational aircraft. Additional information on the "Age 60 Rule" can be found in the U.S. Federal Aviation Administration's *"Notice on the Age 60 Rule*", available through the Career Pilot Association's web site, at http://cgibin1.erols.com/burnside/age60.htm.

In regards to rail transportation, all railway employees must meet minimum qualification standards, as per the Railway Act of Canada. (Government of Canada, 1987-3) These standards include on-the-job training and a knowledge test (the content of which varies by occupation). The Act also states that a railway company shall, at intervals of not more than three years, have each employee re-examined on the required subjects. In addition, depending on the occupational category, employees must meet minimum vision and hearing standards (regardless of age). Tests of visual acuity, color perception, and hearing, are performed at two year intervals. Employees with vision or hearing impairments are required to be re-examined every year. In addition, age 65 is the typical retirement age for railway employees.

In the marine sector, minimum physical (or fitness for duty) and competence/knowledge standards are required, again varying on the occupation and type of marine vessel to be operated. These standards are discussed in the Canada Shipping Act. (See, for example, Masters and Mates Examination Regulations, and Medical Examination of Seafarers Regulations.)

7.3 Safety Issues

Given the fact that the elderly represent relatively small proportions of total commercial transportation operators (i.e., operators of trucks, taxis, buses, aviation aircraft, and marine vessels), in conjunction with stringent licensing requirements, the elderly do not appear to present a significant safety problem. However, there is little information on collisions involving elderly operators to substantiate this conclusion.

With respect to the four largest occupational groups (i.e., those involving operators of commercial vehicles), national collision data, stratified by age and type of vehicle involved in collisions, would be useful in analyzing the safety situation related to these occupations.

8. Current Research and Initiatives

The following is an overview of current research and initiatives related to safety and security of transportation and elderly persons. The research initiatives are categorized into activities related to all modes in general, and motor vehicles in particular.

8.1 Canada

8.1.1 Recently Completed Research

In 1988, the National Advisory Council on Aging (NACA) released a study entitled, *Transportation ... Options for the Future*, which focused on transportation issues related to elderly drivers and elderly pedestrians. The Council also released a position paper on Canada's oldest seniors, which included a focus on the transportation needs of this population group and the importance of mobility to their independence and quality of life.

The Transportation Development Centre (TDC) has hosted three national workshops on elderly and disabled drivers. Proceedings of the first two workshops, have been published (*Keep on Rolling '95: Proceedings of the Second National Workshop for Driver Educators of Elderly and Disabled Persons*, TP 11489E, and *On the Road Again '92: Proceedings of the First Canadian Workshop on Assistance for Drivers with Disabilities*, TP 11489E). The third workshop was recently held in Halifax, Nova Scotia, in May 1997.

TDC has also published a report entitled *Elderly and Disabled Drivers: Licensing Procedures*, TP 10212E, in 1990, covering provincial and territorial licensing requirements related to the elderly.

As discussed in Section 4.4, the University of Alberta's Department of Psychology conducted research into methods of evaluating driver competency. Results of the research led to the development of a competence-based driver evaluation program, which includes two components: a computer-based test and a road test. The driver evaluation was developed through research testing of over 500 driving dementia patients and over 200 healthy volunteer drivers, and is available through a company named DriveAble Testing Ltd.

8.1.2 Ongoing Research

Transport Canada is in the process of developing a fact sheet on elderly persons and motor vehicle collisions, which would include an analysis of fatalities and injuries by age-related sub-groups of the age 65 and over population. In addition, Transport Canada, in conjunction with Statistics Canada, is assessing the feasibility of a national travel survey for 1998, will should provide valuable information on the travel patterns of elderly persons in Canada.

In Alberta, the Alberta Mental Health Research Fund and the Alberta Heritage Fund for Medical Research are currently funding a study on driving and dementia. With principal research being undertaken and coordinated by the University of Alberta, the study is one of the largest current studies addressing this issue in North America. The study is investigating the consequences that a driving evaluation and resulting recommendations about continued driving (and/or cessation) have for adults with dementia and their caregivers. Research is expected to be completed by March 1998.

In Ontario, the Ministry of Transportation is conducting research in a variety of areas related to elderly drivers. Projects include:

- the development and validation of a Senior Driver Research Inventory (SDRI) consisting of 62 self-reported factors aimed at assessing elderly driver capabilities. The 62 factors address perception of functional deficits and the risks associated with them, older driver willingness to acknowledge their functional deficits, and compensatory tactics used by older drivers to minimize perceived risks and functional deficits. Final results are expected to be published in the late 1997.

- assessment of a 1994 exposure survey, assessing trip patterns and crash exposure for Ontario drivers ages 16 and above. Final results are expected to be published in late 1997.

- development of a diagnostic benchmark for Useful Field of View (UFOV) scores, based on estimating the range of UFOVs found in healthy individuals. Research is ongoing.

- assessment of medical fitness and crash risk. This project includes: a review of the organization, content and function of medical review programs in North America and Europe; review of landmark legal decisions or impending court challenges related to physician reporting requirements; literature review on driving performance and medical fitness. Final results are expected to be published in late 1997.

- an analysis of crash involvement and injury outcomes (for incidents between 1992 and 1994) by age and gender. Three elderly driver age groups will be assessed (60 to 69, 70 to 79, and 80 and over) and compared to each other and drivers aged 16 -19, 20-24, 25-44, and 45-59. Final results are expected by the end of 1997.

Public awareness campaigns related to elderly drivers include the *55 Alive/Mature Drivers' Course* and the *National Seniors Safety Week*, both sponsored by the Canada Safety Council.

8.2 United States

In the United States, a wide variety of activities have taken place, or are currently taking place, regarding the elderly and transportation. For example, in the spring of 1995, a White House Mini Conference on Mobility and Transportation for Seniors was undertaken, which developed policy recommendations to guide the Administration's efforts in providing transportation to senior citizens. Results of the conference were presented at the White House Conference on Aging in May of 1995. Participants at the conference included individuals, agencies, and organizations who are concerned about accessible transportation for seniors and others. Conference sponsors included:

- American Public Transit Association
- International Taxicab and Livery Association

- International Taxicab Foundation
- American Automobile Association
- American Automobile Association Foundation for Traffic Safety

The recommendations from the conference fell into five categories, including:

1. **Coordination of Federal, State, and Local Resources to Maximize Senior Mobility**

    - federal, state and locally funded programs which fund transportation for human services agency clientele coordinate their planning, funding and service delivery with public and other transportation providers to ensure maximum accessibility by older Americans.

2. **Economic Security Through Education**

    - the Department of Transportation (DOT) and Human and Health Services (HHS) provide a comprehensive education and training program designed to inform, promote, and encourage safe and independent use of all modes of transportation by older Americans and facilitate the transition from driver to consumer of alternative transportation.

3. **Research and Development**

    - the HHS and DOT fund research and development of innovative projects to promote the safe and independent use of a variety of transportation modes.

4. **Health Care, Economic Security and Quality of Life for Older Drivers**

    - the DOT increase support of research into safety of older drivers and improve highways, signs and vehicles based on that research.

    - older driver education programs be expanded through cooperation of the DOT, Administration on Aging and others. HHS aid the medical community in assuming a gatekeeping responsibility for identifying and/or providing transportation options for patients who are discharged from the hospital; and in identifying older drivers who can no longer drive safely and who do not take appropriate action themselves.

    - health insurance providers consider offering temporary alternative transportation in their benefits.

5. **Transportation Security Program**

    - additional dedicated gas taxes be established to provide an adequate level of public transportation services for those who cannot drive or use existing transportation services.

In January, 1997, the U.S. DOT released the report *Improving Transportation for a Maturing Society*, with the strategic goal of ensuring safe mobility, for life. The report, addressing all modes of transportation, focuses on safety, individual personal mobility, and facilitating the eventual transition to mobility alternatives. New initiatives recommended in the report include:

- added emphasis on mobility alternatives for older adults, including:
  - the development of an inventory of best practices to assure mobility alternatives for older adults; and
  - identification and evaluation of the most effective mobility services and systems to provide the means to stimulate replication;

- development of countermeasures to compensate for the frailty of older adults, recognizing the growing level of older adult injuries and fatalities expected over the next 25 years;

- development of medical practice parameters and guidelines (for use when conducting evaluations required for commercial licensure, as well as personal licences);

- initiation of studies to support public policy decisions in areas such as:
  - study of the impacts of reduced mobility on elderly persons
  - influence of mobility alternatives on driver cessation
  - security in transportation (including an emphasis on elderly-friendly terminals and elderly-friendly pedestrian facilities)
  - linkage of mobility to health care costs
  - improved understanding of the effects of certain medical conditions, functional disabilities, and behavioural limitations on operator performance and crash involvement.

Current programs recommended in the report for enhanced priority include:

- improving highway travel for an aging population, including the compilation and publication of research into a Preliminary Older Driver and Highway Safety handbook for distribution to highway engineers and community planners;

- improving identification and evaluation systems of problem older drivers and older commercial operators for all modes. This includes the National Highway Traffic Safety Administration's (NHTSA) development of identification techniques and tests focusing on disabilities prevalent in older adults; and

- support for emerging ITS technologies which show promise for improving safety and mobility of older travellers.

A wide variety of organizations are currently involved in research related to the elderly and safe transportation, including NHTSA, and the Federal Highway Administration (FHWA). Selected research of these organizations are listed below.

- NHTSA activities focus on the safety of older drivers, vehicle occupants, and pedestrians. The research activities reflect the research agenda prepared by NHTSA in

its 1993 report to the U.S. Congress, entitled *Addressing the Safety Issues Related to Younger and Older Drivers*. Selected ongoing research includes:

- Establishment of Crash Risks for Specified Medical/Functional Conditions (in association with the Oak Ridge National Laboratories)
- Development of a Model System to Improve Self and Institutional Regulation of Driving by Older People
- Analysis of Vehicle Crashworthiness for Older Occupants
- Investigation of Intersection Negotiation Problems of Older Drivers
- Family and Friends Reporting and Assisting Problem Older Drivers
- Older Driver Family Assistance
- Identification of Specific Vehicle Design Practices that Enhance Older Driver Crash Avoidance
- Update of National Medical Standards and Examiner Training Programs
- Development of Performance Assessment Techniques (for evaluating status of drivers with dementia or age related frailties)
- Health Community Involvement with Problem Older Drivers
- Identification and Evaluation of a Model Driver Screening and Evaluation Program
- Validation of Statistical models Relating Functional Limitations to Driving Cessation and Crash Involvement

- research activities of the FHWA focus on identifying, developing, and evaluating a variety of engineering enhancements to the highway system to meet the needs of older road users (including drivers and pedestrians). Selected research includes:
  - Pavement Marking and Delineation for Older Drivers
  - Traffic Operations Control for Older Drivers and Pedestrians
  - Intersection Geometric Design for Older Drivers and Pedestrians
  - Investigation of Older Driver Freeway Needs and Capabilities
  - Delineation of Hazards for Older Drivers
  - Computer-Aided Techniques for Optimizing Symbol Signs

The Transportation Research Board (TRB)'s Committee on the Safe Mobility of Older Persons is one of 180 committees and task forces that carries out technical activities for the TRB. The Committee addresses eight key issue areas, including:

- medical factors and elderly drivers;
- transportation alternatives;
- older driver research;
- vision and cognition;
- vehicle and environmental factors;
- public information;
- older driver programs; and
- older driver policy.

Among the subcommittee's activities are communications (through its twice annual newsletter), and sponsoring research and technical forums. One forum, held in the fall of 1996, focused on elderly driver licensing with topics on the identification, assessment procedures, and assistance of at-risk older drivers. A TRB Circular documenting the results of the research is expected in 1997.

The American Association of Motor Vehicle Administrators (AAMVA) recently formed an "Older Driver Working Group" with the goal of:

- determining state licensing requirements for older drivers (which would result in an update of their 1989 publication entitled *Licensing the Older Driver: A Summary of State Practices and Procedures*);
- encouraging interest in older driver licensing issues;
- educating professionals involved with older drivers (e.g., physicians, occupational therapists, police, caregivers) in the importance of understanding older driver behaviour; and
- facilitating public awareness through partnerships with organizations such as NHTSA, the American Association of Retired Persons, and the National Safety Council.

The Intelligent Transportation Association of America recently formed an Older Driver Subcommittee to address the opportunities and constraints of intelligent transportation systems in relation to older drivers. From a safety perspective, the subcommittee will assess ITS applications such as collision avoidance systems and advanced traveller information systems, to determine their impact on older drivers.

Other organizations involved in elderly driver research include the U.S. National Institute on Aging, the Centres for Disease Control, the National Institute on Alcohol Abuse and Alcoholism, and the Alzheimer's Association of America.

Public awareness/information materials related to elderly drivers include the *55 Alive/Mature Driving Program* and *Questions and Answers related to Older Drivers* (produced by the American Association of Retired Persons - AARP), the *Drivers 55 Plus: Self Rating Form* and *The Older Person's Guide to Safe Driving* (both published by the AAA Foundation for Traffic Safety), and *Tips for the Senior Driver* (published by Seniors-Site).

8.3 Japan

In Japan, traffic safety measures aimed at the elderly were first implemented around 1975. However, the emphasis of early measures was on educating the elderly as the possible victims of traffic accidents, "*not as drivers or riders who might cause traffic accidents that kill or injure themselves and others*". (Nishiyama, 1995)

In 1988, with the creation of the Traffic Countermeasures Headquarters, this emphasis shifted towards providing the elderly with traffic safety education consisting of actual training in real-life situations, with the goal of "*equipping the elderly with the knowledge and skills necessary to live an independent life in a society that depends on the automobile as a vital means of transportation, without causing accidents or inconveniencing others*". Education sessions (focusing both on drivers and pedestrians) consist of seminars and workshops, where issues such as safe practices, gaps in awareness, and traffic accidents involving aged persons, are addressed.

Part of this change in focus was due to the appreciation that the elderly are increasingly enjoying an active lifestyle, combined with the realization that the elderly will constitute a large segment of the Japanese population in the future. The Japanese government predicts that the elderly will account for slightly more than 25% of their population by 2020.

8.4 Germany

In Germany, a variety of specific measures to improve the safety of drivers, passengers, and pedestrians have been suggested and implemented. (Weinand, 1996) These include:

- **traffic engineering** (e.g., controlling traffic lights based on traffic volume, using left-turning signals, designing comprehensive, unambiguous and easily recognized traffic signs, improved lane demarcation especially at intersections, increased luminance of surroundings to reduce glare from oncoming traffic).

- **improved automotive engineering and information technology,** such as:
  - vehicle dimensions which are easy to assess from the driver's seat;
  - a driver's seat and steering wheel which are height adjustable;
  - left and right-hand rearview mirrors, adjustable from the driver's seat
  - clear and simple instruments and displays to reduce the amount of the driver's attention which is deflected from the traffic situation
  - supplements to audible controls
  - easily understood pictograms (if used)
  - power steering, automatic transmission, and ergonomic seating
  - multi-directional (power) seats
  - height adjustable seat belts which are easily reached

  Elderly-friendly vehicles developed through improved automotive design are described as "*the car which is good for the elderly is not a special vehicle for the elderly, rather it is a better vehicle for everyone*".

- **safety campaigns and training** (including the "Getting Older - Driving Safely" checklist and the "Active Elderly Drivers" training program, both developed by the German Council for Road Safety).

- **legal measures** (such as driving restrictions, licence suspensions, restrictions and withdrawals).

8.5 United Kingdom (U.K.)

Recognizing that the number of elderly drivers is likely to increase in the United Kingdom due to demographic trends and increased licence holding, particularly amongst women, the U.K. Department of Transportation Road and Vehicle Safety Division has research planned to determine how the safety of elderly drivers could be improved. An internal review is in progress to establish specific research requirements, with research anticipated to be completed in the 1998/99 fiscal year.

From the perspective of pedestrians, the Driver Information & Traffic Management Division of the U.K. Department of Transport released a discussion paper in late 1996 entitled *Developing a Strategy for Walking*. The purpose of the discussion paper is to "*seek contributions towards the development of a walking strategy and good practice guidance for highway authorities, developers and other practitioners involved in designing and managing the built environment*". The paper summarizes what is understood about walking as a mode of transport, identifies some factors believed to contribute to the decline in walking as a mode of transport, and suggests possible actions to reverse the trend. Views and suggestions from a wider constituency are invited to gain a wider base of knowledge and experience that is vested in highway authorities, planners, designers, pedestrian groups, and others.

9. Summary of Findings

The importance of mobility to an elderly person's quality of life has been clearly noted by many organizations. As the Canadian National Advisory Council on Aging (NACA) states, an elderly person's ability to get out to see friends, shop or visit a health professional, in winter as well as summer, is closely tied to life satisfaction and is vital to one's full participation in life.

Lack of safe and secure transportation can act as a barrier to elderly persons (and persons of all ages), negatively affecting their mobility, independence, and their quality of life. This report further explored the issues of safety and security, from the perspective of all modes (i.e., drivers and passengers of motor vehicles, pedestrians, and users of public modes of transportation, including air, rail, intercity bus, and public transit). An overview of measures for improving safety and security, and current research and initiatives was provided. In addition, demographic, health, and socio-economic aspects related to aging and the elderly were discussed.

This section summarizes the research presented in the report, under the following headings:

- Who are the Elderly?
- Travel Characteristics of the Elderly
- Motor Vehicle Safety
- Pedestrian Safety
- Safety and Security of Public Modes of Transportation
- Current Research

9.1 Who Are the Elderly?

Demographics of Aging: Canada's population, like most Western countries, will be aging over the next 50 years. In Canada, the number of persons 65 and over will increase from approximately 3.7 million in 1996 (approximately 12% of the total population) to almost 9.7 million in 2041 (approximately 23% of the total population).

Of the elderly population, those who are 90 years of age and over will experience the most rapid growth, increasing from approximately 125,000 in 1996, to 635,000 in 2041 (an increase of over 400%). The following list presents growth rates for selected age groups in Canada, between 1996 and 2041:

- less than 15 years of age - 9.7%
- 15 to 64 - 31.0%
- 65 to 69 - 106.6%
- 70 to 74 - 121.2%
- 75 to 79 - 187.5%
- 80 to 84 - 231.1%
- 85 to 89 - 283.3%
- 90 and over - 408.0%
- 65 and over - 164.4%
- all ages - 43.0%

Both today and in the future, females will represent more than 50% of persons 65 and over,

with their share increasing with age. For example, in 1996, females represented 53% of persons 65 to 69, 56% of persons 70 to 74, 59% of persons 75 to 79, 63% of persons 80 to 84, 68% of persons 85 to 89, and 75% of persons 90 and over.

Implications of Aging: Health is a significant issue in relation to the elderly. The aging process results in the decrease of physical, sensory, and cognitive capabilities due to various forms of normal deterioration and resulting from the onset of disease(s), which can include:

- deteriorating vision, particularly at night;
- increasing reaction time;
- decreasing ability to split attention between multiple tasks;
- deteriorating judgement of speeds and distances;
- reduced physical mobility, dexterity, and ability to balance; and
- greater fragility.

This aging process results in persons 65 and over having a greater incidence of disability as compared to younger age groups.

The use of medication increases with age. The use of medication, including multiple medications, can produce interacting effects and/or adverse drug reactions, with the potential for impairing physical, sensory, and cognitive functions, and can be an important factor when considering the safety and security of the elderly in transportation situations.

Frailty, associated with aging-related health problems, is also more common in the elderly. The results of the normal aging process and the presence of certain diseases combine both to decrease the older individual's ability to withstand trauma, and to increase the likelihood of post-traumatic complications that can result in death, extension of disability or a prolonged recuperative period.

Income: Over the last 25 to 30 years, the income circumstances of the elderly have improved considerably. However, seniors have lower average incomes than all age groups, with the exception of the 15- to 24-year-old age group. A disparity also exists between elderly men and elderly women. In 1994, elderly women had an average income of slightly less than $15,000, while elderly men had an average income of more than $24,500.

Primary sources of income for the elderly (1994) included Old Age Security (including Guaranteed Income Supplements) and C/QPP. Combined, these two sources accounted for slightly more than 50% of total income for elderly persons.

Housing: The likelihood of an elderly person living in an institution increases with age and is higher for elderly women than for elderly men. Overall, 8.1% of persons 65 years of age and over (in 1991) lived in an institution (such as special care homes, hospitals, religious institutions, etc.).

Geographical Location: Overall, 82.2% of the elderly live in urban areas while 17.8% live in rural areas. The impact of an elderly person relinquishing their driver's licence is likely less in urban areas as compared to rural areas, due to the absence of (or reduced choice in) alternative modes of transportation in rural areas.

Personal Security: Research indicates that the fear of violence and the threat to personal security are major public concerns. The fear of crime is higher among women than men, and

increases with age (although older people typically have lower victimization rates than younger age groups).

Perceptions regarding lack of safety can act as a barrier for elderly pedestrians and elderly users of public modes of transportation, especially for public transit and public facilities such as intercity bus and rail terminals.

9.2 Travel Characteristics of the Elderly

Local Trips: Overall, the elderly take less local vehicular trips than other age groups. For all age groups, the automobile was the most commonly used mode for local vehicular trips. Persons 75 years of age and over, however, relied less on the automobile for local trips, and relied relatively more on transit.

As the elderly take the majority of their transit trips during off-peak hours, the growth of the elderly population (persons ages 65 and over) can be expected to increase off-peak ridership. The projected growth of the elderly population is also expected to increase demand for "community bus" type services, connecting residential areas to shopping, healthcare facilities, and community centres.

Long-distance Trips: Between 1982 and 1994, persons over the age of 65 have steadily increased their share of domestic long distance trips. In 1982 persons over the age of 65 accounted for 5.2% of domestic long distance trips; by 1994 this same age group accounted for 7.2% of domestic long distance trips. With the projected increase in the number of people in this age group over time, one can expect this trend to continue.

Driver Licensure Patterns: Given the growth of the elderly population in absolute terms (for Canada and other industrialized countries), one can expect that the number of elderly persons with a driver licence will increase, together with usage of motor vehicles by elderly persons. This is evident in Ontario where the number of drivers in the 65 and over age group grew from 495,000 in 1985 to 783,000 in 1994, an increase of 58%. As a percentage of total drivers, the 65 and over age group increased from 8.8% of total licensed drivers in 1985 to 11.2% of licensed drivers in 1994.

Overall, licensure rates drop in older age groups as compared to younger age groups, particularly for women. However, licensure rates among the elderly have been increasing. For example, in Ontario, between 1985 and 1994, the percentage of persons over 65 with a driver's licence increased from 52% to 60%. Data from the U.S. also indicates that licensure rates in older age groups have been increasing. For example, licensure rates for the elderly were higher in the 1990 Nationwide Personal Transportation Survey (NPTS), versus the 1983 NPTS.

One interpretation of this trend is that the current lower rate of licensure among older people is partly a reflection of the proportion of this population group that never held a driver's license. Since current licensure rates (in Ontario) among the younger age groups range from almost 65% to over 90%, one would expect that most of these drivers will continue to renew their license, and that the licensure rate among the older age groups will continue to increase (as younger persons age), approaching current rates for the younger age groups.

Driving Characteristics: Elderly drivers show an increased effort of self-protection in their

driving habits compared to middle-aged drivers (persons between the ages of 25 and 64), and tend to compensate for any declines in their health which may affect their ability to drive.

Research has indicated that the elderly:

- reduce their daily driving exposure by reducing not the frequency of trips, but by driving fewer vehicle miles;
- are less likely to drive at night and during peak hours than the middle-aged, and avoid driving in ice and snow;
- are less likely to drive on limited-access highways than the middle-aged;
- drive at slower speeds than the middle-aged. This is either because the elderly are more likely to drive on roadways with lower speed limits, or because they drive slower on roadways with the same speed limits; and
- carry slightly fewer passengers than the middle-aged.

Transportation and Causes of Death: Transportation-related incidents (all modes) accounted for a small percentage (less than 0.5%) of all deaths of the elderly age group. Motor vehicle collisions accounted for approximately 97% of all transportation-related deaths.

9.3 Motor Vehicle Safety

Collision Involvement: The number of collisions per licensed driver declines with age, with a slight increase for those 85 years of age and over. However, this only provides a partial picture, as it does not account for the amount of driving done by drivers in each age group. When figures related to collisions per licensed driver are normalized for the amount driven, the collision involvement per amount driven (i.e., vehicle miles travelled - VMT) decreases rapidly until about age 25, continues to decline slowly until about age 60, increases slowly until age 80, and then increases rapidly for drivers over 80.

The fatality rate, normalized by the amount driven, indicates that the fatality rate for the elderly is disproportionately high relative to other age groups. By any other measure, younger drivers outnumber, travel more, are involved in more collisions and have higher fatalities, than older drivers. However, once an elderly person is involved in a collision, they are more than three times as likely to die as younger drivers.

Figures for Ontario indicate that approximately 10% of 16- and 17- year-old drivers were involved in collisions (1994). This rate gradually decreases with driver age, with a slight increase for the 75 and over age group, where 3.3% of drivers were involved in a collision.

Fatalities and Injuries: The severity of collisions (as measured by fatalities as a percentage of

total fatalities and injuries) declined between 1979 and 1995. In particular, in 1979, fatalities accounted for 2.2% of total fatalities and injuries, and declined to 1.4% in 1995. For the elderly, fatalities accounted for 5.1% of all total fatalities and injuries in 1979, and declined to 3.4% in 1995.

Between 1979 and 1995, Canada's population (all ages) increased over 24%. In comparison, fatalities due to motor vehicle collisions decreased almost 43% and injuries decreased 6.5%. The number of persons ages 65 and over increased approximately 61% between 1979 and 1995. Over the same time period, the number of fatalities involving the elderly decreased 1.8%, while the number of injuries involving the elderly increased almost 50%. Although there was an increase in the number of injuries, this increase was still below the growth in the elderly population.

However, the elderly's share of total fatalities increased from 9.4% in 1979 to 16.3% in 1995 (an increase of approximately 73%). Meanwhile, the elderly's share of total injuries increased from 4.1% in 1979 to 6.4% in 1995 (an increase of almost 59%). Factors which may account for this gradual increase in the elderly's percentage share of total fatalities and injuries between 1979 and 1995 include:

- the frailty of elderly drivers and passengers;
- the elderly age group's population growth in general and the growth in the number of elderly licensed drivers;
- the over-representation of elderly drivers in multiple-vehicle collisions and collisions at intersections, and the fact that the elderly are more frequently in the struck vehicle than in the striking vehicle. The elderly's higher than average share of impacts involving angled impacts at intersections, in addition to the fact that vehicles provide relatively less occupant protection against side impacts, may also contribute to the higher proportion of fatalities.

It has also been suggested that there has been less benefit accrued to the elderly road user from road safety measures which have focused on driving under the influence (of alcohol or drugs) and speeding, two issues more common among younger drivers.

With respect to the nature of fatalities *and* injuries related to motor vehicle collisions (for 1993):

- the elderly accounted for over 26% of all pedestrian fatalities;
- incidents involving the elderly as a driver or passenger accounted for approximately 73% of all elderly fatalities and almost 88% of elderly injuries;
- incidents involving the elderly as a pedestrian accounted for approximately 23% of all elderly fatalities and almost 11% of elderly injuries; and
- incidents involving bicycles and motorcycles accounted for 1.5% of all elderly fatalities and 1.3% of elderly injuries.

For 1993, elderly drivers were involved in more fatal collisions than collisions resulting in

injuries. Elderly drivers were involved in 8% of fatal collisions and 6% of collisions resulting in an injury.

Driver Actions: Research has indicated that elderly drivers

- exhibit less aggressive driving behaviour (e.g., speeding, following too closely, and drinking and driving) as compared to younger adults;
- are more likely to be involved in collisions involving comprehension errors (e.g., confusion in congested situations, misunderstanding of signage);
- have more problems at intersections than younger drivers and in situations involving turns and merges (where complex manoeuvres and interactions must take place with opposing traffic);
- are over-represented in collisions at stop signs where the driver has stopped at the sign and then proceeded to pull out in front of another vehicle;
- are over-represented in collisions involving lane changing on two-lane rural highways.

Cognitive Functions and Driving: Over-representation of the elderly in collisions involving intersections and complex situations may be due to the fact that older drivers have more difficulty perceiving and judging the dynamics of traffic movement and performing cognitive tasks with time constraints.

Research has tended to be inconclusive and/or contradictory with respect to the role dementia plays in collisions involving the elderly. While research continues, a study conducted in Sweden revealed that a decrease in cognitive abilities appears to be a very significant risk factor for older drivers' involvement in traffic collisions. However, the cognitive impairment is often not great enough to be recognized or detected by examinations commonly performed by physicians.

In addition, the Swedish study found that blood samples from 23% of the male drivers 75 years of age and over involved in fatal crashes, revealed that at the time of the fatal crash, the drivers had in their blood drugs known to affect cognitive functions.

These results led the author to conclude that a detailed test of an individual's cognitive functions should be included in the examination of older driver licence applicants. The physician, and the older driver on medication, must also be made aware of the importance of drug influence on cognitive functions and the subsequent increase in accident risk when using such drugs.

Visual Functions and Driving: Research has also indicated that the elderly have greater susceptibility to glare, more problems detecting low-contrast signs and images, have greater difficulties locating objects in crowded or cluttered areas, and required greater time to register a stimulus in the periphery.

Safety Measures for Drivers: A variety of measures aimed at enhancing the safety and

security of elderly persons in relation to motor vehicles have been, or could be, implemented in the areas of traffic engineering, the driver, motor vehicle-related and communications and education/public outreach.

Counselling, graded licensing (i.e., gradual relinquishment of driving), and driver self-assessments have been suggested as methods of identifying and assisting elderly drivers who have suffered a decline in physiological functions.

Given the broad range of physiological conditions that may be affected by aging (some of which may not be easily recognizable either by the driver, his/her physician, or a licensing agency), it has been suggested that more research be conducted on identifying and assisting elderly drivers who have suffered a decline in physiological functions. In particular, the following areas have been identified as being key priority research areas:

- the role of medical conditions and functional ability on crash involvement and driver performance, including the relative risk between various conditions, functions and crash involvement;
- the development of standard guidelines on who should or should not be driving, based on performance/capabilities; and
- testing, evaluating, and establishing systems for assessing drivers and identifying problem drivers.

9.4 Pedestrian Safety

After motor vehicle collisions, pedestrian safety is the next major transportation-related safety issue involving the elderly. Over 1,700 elderly persons were either killed or injured as a pedestrian (125 fatalities and 1,612 injuries). Elderly persons accounted for over 26% of all pedestrian-related fatalities in 1993 (yet accounted for approximately 12% of the total population). Similar pedestrian-related statistics are reported in the United States and Australia.

Pedestrian Actions: The primary reported action resulting in elderly pedestrian fatalities and injuries was crossing an intersection or highway (with no traffic control device present). This was followed by elderly pedestrians crossing intersections with the right of way, and crossing intersections without the right of way. Overall, intersections were involved in 66% of all pedestrian-related collisions involving the elderly.

9.5 Public Modes of Transportation

In Canada (1994), there were 237 fatalities involving modes of transportation other than private motor vehicles, of which 18 (8%) involved elderly persons. In comparison, there were approximately 3,050 fatalities resulting from motor vehicle collisions, of which 510 (almost 17%) involved the elderly.

With respect to the 18 fatalities involving modes of transportation other than motor vehicles,

eight were related to water transport, six were related to rail transport, and four were related to air transport.

In 1994, there were no deaths classified as being related to bus travel (intercity or local transit). There have, however, been incidents where a pedestrian is struck and killed or injured by a bus, or where an individual may have fallen from a bus and later died in hospital. In these situations, causes of death may have been classified under pedestrian-related deaths or falls. These incidents are not specific to the elderly. While industry representatives believe that the number of incidents such as this is very low (e.g., between zero and five per year), there are no systematically collected national statistics available.

In the United Kingdom (1989), six persons over the age of 60 were killed due to incidents involving bus transportation (both local transit and intercity bus), while over 400 were seriously injured. Total fatalities involving bus transportation fluctuate between 20 and 35 per year in the U.K.

Personal Security and Public Transportation: From a public transportation perspective, the feeling of being safe or unsafe is an important factor, especially for public transit, where the perception of safety (or lack thereof) can influence an elderly person's decision to use public transit (especially at night) in comparison to alternative modes (particularly the automobile). For persons without personal vehicles, such a perception may prevent them from travelling at night altogether.

Perceptions regarding personal security can have a negative implication for public modes of transportation, particularly public transit and for pedestrians. As reported by CUTA, increasing perceptions of risk to personal security have been related to ridership losses in both Montreal and Toronto.

Falls and Transit Terminals: Research in the United States on the incidence of falls occurring in public transit terminals, has indicated that the incidence is lower than that experienced in industrial settings and in the home. This is in part due to the design and maintenance standards adopted by the public transit industry. Of falls that were analyzed, the elderly (in this instance, persons over the age of 61) had higher rates of falling accidents.

Safety Measures for Public Modes of Transportation: A wide variety of measures have been, or could be implemented to facilitate safety and personal security in relation to public modes of transportation, including measures related to the environment external to public facilities and terminals, the environment inside public facilities and terminals, and inside the public transportation vehicles themselves.

9.6 Commercial Operators

Persons aged 65 and over account for a small percentage of the total work force related to these occupations. For example, with respect to truck drivers, 1991 Census data from selected provinces indicates that 1.4% of the truck driver work force was 65 years of age or over.

In particular, 2,220 of 164,705 truck drivers (representing approximately 81% of the total

truck driver labour force), in PEI, Nova Scotia, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, the Yukon, and the Northwest Territories, were 65 years of age or over.

With respect to bus drivers, and subway and other transit operators, data from HRDC's Ontario and Quebec Regions indicate that 3.5% of this work force was 65 years of age or over. In 1991, these two provinces accounted for 63% of this occupation's total work force (all ages).

With respect to the remaining occupational groups, the proportion of operators who are elderly is also small. Based on data from the 1986 Census, the elderly represented slightly less than 2.5% of taxi drivers, and less than 1% of marine vessel operators, railway conductors, and air pilots.

Several factors contribute to the relatively small numbers of elderly persons in commercial operating occupations, including:

- company-specific mandatory retirement policies at age 65;
- pension plan agreements based on 65 as the year of retirement; and
- existence of Old Age Security which ensures income for persons ages 65 and over (which can reduce economic pressures to extend work life and to postpone retirement).

In addition, there are relatively more stringent licensing procedures for commercial operators than for the general population. This may effectively limit the number of individuals who continue to work in these occupations past the age of 65 (based on performance as opposed to age). For example, commercial driver's licences (e.g., for tractor trailers, buses), typically involve a medical examination, visual test, knowledge test, and a skills test (i.e., road test).

Given the fact that the elderly represent relatively small proportions of commercial operators, in conjunction with stringent licensing requirements for older operators of trucks, buses, aviation aircraft, and marine vessels, the elderly do not appear to present a significant safety problem for these sectors. However, there is little information on collisions involving elderly operators to substantiate this conclusion. With respect to the four largest occupational groups (i.e., those involving operators of commercial vehicles), national collision data, stratified by age and type of vehicle involved in collisions, would be useful in analyzing the safety situation related to these occupations.

9.7 Current Research

A wide range of research activities is taking place regarding transportation and the elderly. In Canada, selected research includes:

- a study on driving and dementia, sponsored by the Alberta Mental Health Research Fund and the Alberta Heritage for Medical Research. With principal research being undertaken and coordinated by the University of Alberta, the study is one of the largest current studies addressing this issue in North America.

- the development and validation of a Senior Driver Research Inventory (SDRI) consisting of 62 self-reported factors aimed at assessing elderly driver capabilities (being undertaken by the Ontario Ministry of Transportation).

- assessment of a 1994 exposure survey, assessing trip patterns and crash exposure for Ontario drivers ages 16 and above (being undertaken by the Ontario Ministry of Transportation).

- development of a diagnostic benchmark for Useful Field of View (UFOV) scores, based on estimating the range of UFOVs found in healthy individuals (currently being undertaken by the Ontario Ministry of Transportation).

- assessment of medical fitness and crash risk. This project includes: a review of the organization, content and function of medical review programs in North America and Europe; review of landmark legal decisions or impending court challenges related to physician reporting requirements; literature review on driving performance and medical fitness (being undertaken by the Ontario Ministry of Transportation).

- an analysis of crash involvement and injury outcomes (for incidents between 1992 and 1994) by age and gender. Three elderly driver age groups will be assessed (60 to 69, 70 to 79, and 80 and over) and compared to each other and drivers aged 16 -19, 20-24, 25-44, and 45-59 (being undertaken by the Ontario Ministry of Transportation).

In the United States, a comprehensive research program is underway regarding transportation and the elderly. Current research is documented in the January, 1997 report *Improving Transportation for a Maturing Society* (published by the U.S. Department of Transportation), with the strategic goal of ensuring safe mobility, for life. The report, addressing all modes of transportation, focuses on safety, individual personal mobility, and facilitating the eventual transition to mobility alternatives. New initiatives recommended in the report include:

- added emphasis on mobility alternatives for older adults, including:
  - the development of an inventory of best practices to assure mobility alternatives for older adults; and
  - identification and evaluation of the most effective mobility services and systems, to provide the means to stimulate replication;

- development of countermeasures to compensate for the frailty of older adults, recognizing the growing level of older adult injuries and fatalities expected over the next 25 years;

- development of medical practice parameters and guidelines (for use when conducting evaluations required for commercial licensure, as well as personal licences);

- initiation of studies to support public policy decisions in areas such as:
  - study of the impacts of reduced mobility on elderly persons
  - influence of mobility alternatives on driver cessation
  - security in transportation (including an emphasis on elderly-friendly terminals and elderly-friendly pedestrian facilities)
  - linkage of mobility to health care costs

- improved understanding of the effects of certain medical conditions, functional disabilities, and behavioural limitations on operator performance and crash involvement.

Current programs recommended in the report for enhanced priority include:

- improving highway travel for an aging population, including the compilation and publication of research into a Preliminary Older Driver and Highway Safety handbook for distribution to highway engineers and community planners;

- improving identification and evaluation systems of problem older drivers and older commercial operators for all modes. This includes NHTSA's development of identification techniques and tests focusing on disabilities prevalent in older adults; and

- support for emerging ITS technologies which show promise for improving safety and mobility of older travellers.

10. Conclusions and Recommendations

The study explores the issues of safety and security of the elderly in all modes of transportation. (It considers elderly drivers and passengers of motor vehicles, pedestrians, and users of public modes of transportation, including air, rail, intercity bus, and public transit). It suggests measures for improving safety and security, and outlines current research and initiatives. The study also discusses demographic, health, and socio-economic aspects related to aging and the elderly.

Within the context of this study, personal safety has been defined as an individual's exposure to the risk of injury or death, resulting from their use of Canada's transportation system. This includes the use of personal and commercial motor vehicles, travelling as a pedestrian, and using public modes of transportation. Personal security is defined as an individual's exposure to the risk of being a victim of criminal activity while using Canada's transportation system.

Presented below is a summary of the key conclusions and recommendations resulting from the study.

10.1 The Elderly

10.1.1 Defining the Elderly - Descriptive Purposes

For descriptive purposes, the elderly are defined as persons ages 65 and over. Attempts have been made to further classify the elderly, based on age sub-groups. For example, the following sub-groups have been suggested as a way of further defining the elderly:

- young-old - referring to those between 65 and 74,
- middle-old - referring to those between 75 and 84; and
- old-old - referring to those over the age of 85.

Recommendation: *When describing the elderly, more than one age group (i.e., 65 and over), should be used when data permits. Depending on the nature of the analysis, this could require more defined age groups than those identified above (e.g., five-year rather than ten-year age groups). Different age groups for men and women could also be considered because women have a longer life expectancy.*

10.1.2 Defining the Elderly - Assessment/Policy Purposes

The aging process varies from individual to individual, due in part to the different genetic, environmental, cultural, lifestyle, and socio-economic factors which individuals experience, and categorization of the elderly by age groups ignores the fact that the aging process varies from one individual to another.

Recommendation: *The heterogeneity of elderly persons should be recognized and assessment programs should consider individual capabilities (including physical, sensory, and cognitive).*

10.2 Societal Trends

Population projections indicate that the number of elderly persons, particularly older age groups, will increase as a proportion of Canada's total population. The number of persons with a disability will also increase, given the higher incidence of disabilities among the elderly.

These trends will increase the number of elderly persons who will be unable to drive and who will therefore require alternatives to the personal vehicle for transportation. This growth in demand for alternative services, such as specialized (or parallel) transportation, will occur as provincial and local governments are curtailing funding for public and specialized transportation services. Home care for the elderly (to reduce health care costs associated with institutional care) will also create new demands for transportation services.

***Recommendation**: Measures aimed at ensuring the mobility of individuals no longer capable of driving should be encouraged by all levels of government. Examples of such measures include:*

- *community-based solutions (e.g., car pooling/sharing involving local community groups, co-operative or voluntary local transportation services, meals-on-wheels);*
- *community planning for the elderly (e.g., communities where residents can walk to most services); and*
- *a continuation of the shift towards low-floor and kneeling buses, which will help reduce the strain on specialized transit (leaving specialized transit to focus on users with more serious mobility impairments).*

10.3 Motor Vehicles

10.3.1 The Driver

The key policy challenge is to help elderly drivers continue driving safely as long as possible, thus controlling pressures for alternative transportation services.

***Recommendation:** Governments, particularly provincial governments, must identify those elderly individuals who are no longer "safe" drivers. It is recommended that the definition of a "safe" driver encompass physical, sensory, and cognitive capabilities and that the focus should be on driving capability rather than age.*

A definition of acceptable driving capabilities should consider time of day, nature of roadway, etc., leading to conditional licences. To ensure consistency across jurisdictions, national standardization would be necessary.

Extended testing for elderly drivers should be pursued for assessing all aspects of capability. In addition, the legal and ethical implications of such measures should be taken into consideration. To be viable, driver assessments must be straightforward, accurate, and low-cost. The use of simulators, successfully employed in training and testing pilots, should be examined as an approach to meeting this requirement.

Research, education, and information campaigns should be undertaken to help elderly drivers,

friends, and family identify and adjust to the reduced capabilities of elderly drivers. The elderly themselves should be directly involved in these projects. An incidental benefit would be increased awareness among the general public.

Given its role in promoting road safety, Transport Canada should take a leadership role in developing education and information campaigns.

10.3.2 The Vehicle

Further improvements could be made to private motor vehicles, to increase the safety for elderly road users. These include user-friendly vehicle controls and displays, new in-vehicle safety features such as seat belt improvements and "smart" airbags and Intelligent Transportation System (ITS) applications.

Recommendation: *The high incidence of fatalities among the elderly must be addressed. In developing new in-vehicle safety features such as seat belt improvements and "smart" airbags, auto manufacturers should be encouraged to consider the needs of elderly occupants.*

ITS opportunities should be evaluated and priority given those that show promise of reducing the likelihood of collisions. In addition, more participation by the elderly is required in the planning and decision-making related to the development and deployment of ITS. Given the wide range of organizations involved in ITS, these efforts should be pursued by Transport Canada in partnership with organizations such as the Transportation Association of Canada (TAC), the Canadian Council of Motor Transport Administrators (CCMTA), and provincial governments.

10.3.3 The Road Environment

In addition to the driver and the vehicle, the road environment is the third key element of road safety. Measures for enhancing the safety of elderly road users with regards to the road environment, include the clear display of traffic signage, the reduction of irrelevant stimuli, appropriate street lighting, particularly for both controlled and un-controlled intersections, standardized left-turn signals at controlled intersections, and clear lane demarcation.

Recommendation: *Efforts should be made to ensure consistent implementation of the safety measures noted above. To ease the implementation of road designs consistent with the safety needs of elderly road users, Canada should monitor U.S. Federal Highway Administration (FHWA) research on the identification, development, and evaluation of engineering enhancements to the highway system to meet the needs of older road users.*

Best practices suitable for Canada's environment should be considered for implementation, while promising measures requiring modification to suit the Canadian environment should also be pursued. Appropriate funding levels should be considered when implementing these measures. To facilitate the implementation, Transport Canada should consider a technology transfer program aimed at all levels of government across Canada responsible for maintaining the road environment.

10.4 Pedestrians

Motor vehicle collisions involving elderly pedestrians are the most serious transportation safety-related issue next to motor vehicle collisions in general. The physiological implications of aging (such as reduced mobility) play an important role in elderly pedestrian fatalities, and intersections are the primary problem locations.

Recommendation: *Current research into traffic engineering and elderly pedestrians being undertaken by the U.S. FHWA should be monitored and best practices applicable to Canadian situations should be disseminated and implemented. Transport Canada and the Transportation Development Centre should consider developing an information campaign aimed at local and regional governments on measures available for improving pedestrian safety.*

Pilot safety evaluations involving elderly pedestrians at site specific traffic-related settings (e.g., intersections, crosswalks) should be considered by local governments (possibly supported in part by Transport Canada). These evaluations would assess first-hand the benefits of measures aimed at improving the safety of elderly pedestrians. A list of safety measures could then be developed, including such features as intersection clearance intervals, no slip surfaces, and appropriate snow and ice removal procedures.

10.5 Public Modes of Transportation

10.5.1 Personal Safety

For elderly local transit passengers, the risks of falling while walking to and from transit stops, within transit stations, or standing in the vehicle are primary safety issues. For intercity modes, falls in terminals are the key safety concern.

Recommendation: *To mitigate the risk of falling, advances in terminal and transit station design and appropriate maintenance standards (including snow and ice removal) should be continued. In addition, in-vehicle features, such as no-slip surfaces, grab bars, and colour contrasting, should be implemented. For trips to and from transit stops and stations, measures aimed at improving the safety of elderly pedestrians should be considered (if they are not already in place).*

10.5.2 Personal Security

Personal security is the greatest concern of elderly users of local transit, particularly at night. In intercity travel, risks relate largely to terminals, with greater risk in intercity bus terminals than in airports.

Recommendation: *Appropriate lighting, emergency phones, surveillance cameras, and on-site personnel deployment (especially for larger urban areas) should be implemented if they are not already in place.*

In addition, for local transit, allowing off-peak patrons to exit the bus closer to their destinations, rather than at designated stops, and providing two-way communications between

dispatchers and bus drivers should be implemented (again, if they are not already in place).

10.6 Commercial Operators

The elderly do not appear to present a significant safety problem in this area because they represent relatively small proportions of total commercial transportation operators (i.e., operators of trucks, taxis, buses, aircraft, and marine vessels), and licensing requirements are stringent. However, there is little information on collisions involving elderly operators to substantiate this conclusion.

Recommendation: *If licensing requirements or mandatory retirement policies are eased, the collision experience of elderly operators should be carefully scrutinized.*

10.7 Information Dissemination and Additional Needs

Current information is not comprehensive in all areas; however, a number of initiatives designed to fill some of the gaps are under way.

Recommendation: *Current and ongoing research should be monitored and the results disseminated. Given the wide range of organizations involved in transportation safety, Transport Canada, in partnership with organizations such as TAC, the CCMTA, and provincial governments, should take on this responsibility. Dissemination and sharing of research results, lessons learned, and best practices could be generated through a conference or seminar sponsored by Transport Canada, or a web page/clearinghouse arrangement.*

In addition, it is recommended that elderly persons or their representatives be directly consulted about the advantages and disadvantages of specific measures aimed at improving their transportation safety and security.

10.8 Need for Continued Action

The information collected in this study indicates that many opportunities exist to help meet the safety and security needs of Canada's aging population. However, while many measures to benefit the elderly have been or are being implemented, sustained efforts are required at all levels of government and in the private sector to ensure that the transportation system is as safe and secure as possible for this group.

Recommendation: *Transportation policy should pay more attention to the transportation safety and security of Canada's aging population. All interested parties (in both the public and private sectors) should be proactive in identifying and implementing appropriate measures, and in undertaking research and development to address unmet needs.*

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Appendix A: Disability Definitions

For reference purposes, the following discussion is provided concerning the term disability and types of disabilities.

Disability - The Health and Activity Limitations Survey (HALS) uses the World Health Organization's definition of disability which is "*... any restriction or lack (resulting from impairment) of ability to perform any activity in the manner or within the range considered normal for a human being.*"

Adults are not considered to have a disability if they use a technical aid and that aid completely eliminates the limitation, e.g., an individual who uses a hearing aid and states that she or he has no limitation when using the aid would not be considered to have a disability. The concept of time has also been added as an additional parameter, the limitation has to be of a minimum six-month duration, i.e., has lasted or is expected to last six months or more.

Type of Disability - Disability type, referred to as "nature of disability" by Statistics Canada, categorizes an individual's type of disability(ies), and is based upon the respondent's answer to the Section A (Activities of Daily Living) questions of the 1991 HALS Questionnaire.

A person may have multiple disabilities, meaning that he or she has reported a limitation in more than one category of disability type. The categories used for the HALS survey were defined as follows:

Mobility: Limited ability to walk, move from room to room, carry an object for ten metres or stand for long periods.

Agility: Limited in ability to bend, dress or undress oneself, get in and out of bed, cut toenails, use fingers to grasp or handle objects, reach, or cut own food.

Seeing: Limited in ability to read ordinary newsprint or to see someone from four metres, even when wearing glasses.

Hearing: Limited in ability to hear what is being said in conversation with one other person or in a group conversation with at least three other people, even when wearing a hearing aid.

Speaking: Limited in the ability to speak and be understood.

Other: Limited in activities of daily living due to a learning disability, a mental health condition, a mental handicap, or because of labelling by others.