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TWO N.C. PROGRAMS FOR ASSURING THE SAFE MOBILITY OF OLDER DRIVERS: ALTERNATIVE TRANSPORTATION AND DRIVER MEDICAL EVALUATION

FINAL REPORT

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Developing Local Resources for the Safe Transportation of the Elderly

A. Background

The proportion of North Carolina drivers over age sixty-four has increased rapidly during the past decade (see Figures 1 and 2) with unusually high increases in the proportion of females and non-whites (Stutts, et al., 1990). By 2020 it is anticipated that the older driver will comprise 17% of the driving population (TRB, 1988). Furthermore, approximately half of these drivers will be over the age of 74.

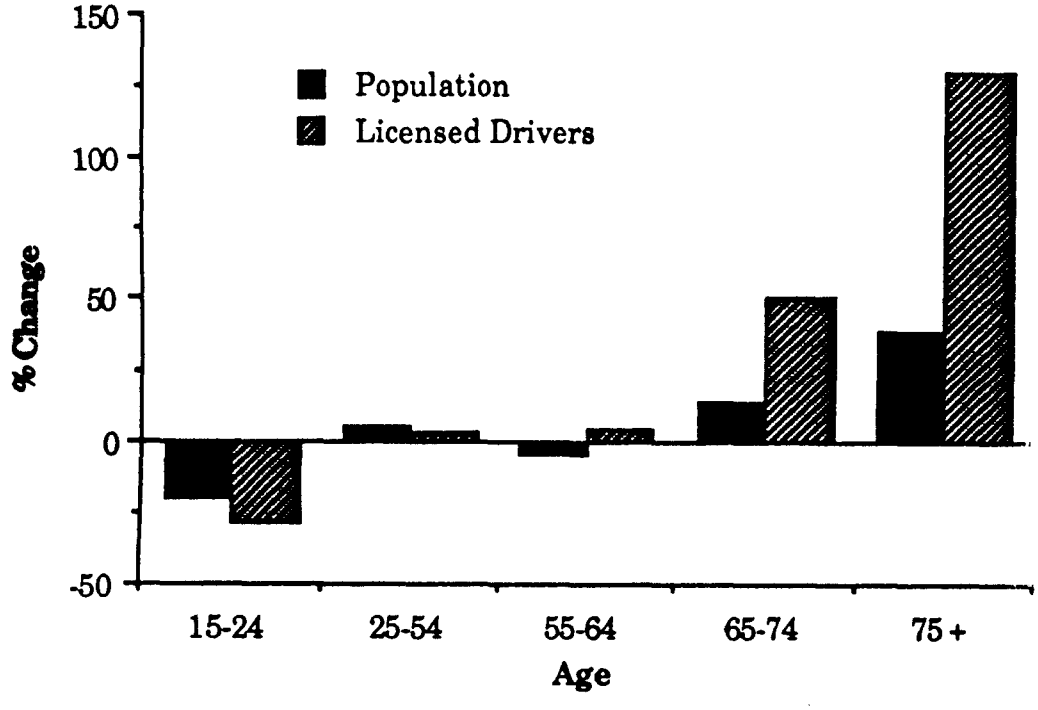

Figure 1. Percentage change in proportion of N.C. census population and licensed driver population by age, 1974-1988. (Stutts, et al. 1990)

While the number of crashes per licensed driver indicates that the older driver seems to have fewer crashes than his younger

counterpart in the general driving population, studies based on driving exposure (miles driven) reveal a heightened risk of crash involvement among those drivers over 74 years of age (see Figure 3).

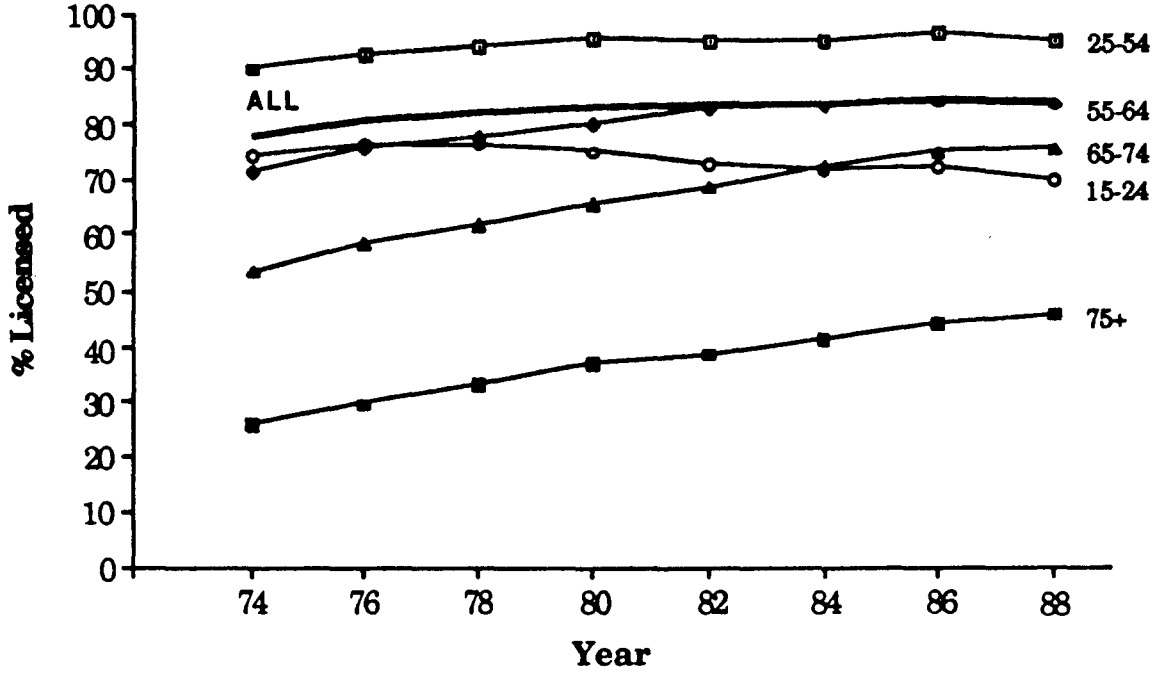

Figure 2. Percentage of N.C. census population licensed by age, 1974-1988. (Stutts, et. al, 1990)

The crash risk of older drivers based on driving exposure might be further heightened if information were available about the quality of their driving. Since at the present time older drivers are self-restricting in their driving, they are choosing to drive at 'low risk' times which place them in the least demanding situations. For example, they are less likely to drive at night when declining visual ability has its most pronounced effect. Thus, while we are able, at some level, to evaluate their crash risk based on number of licensed drivers and miles driven, we have little information to evaluate how elevated their crash risk is, given the fact that they are driving in what constitutes 'lower risk' situations. Thus, we know almost nothing about the quality of their driving.

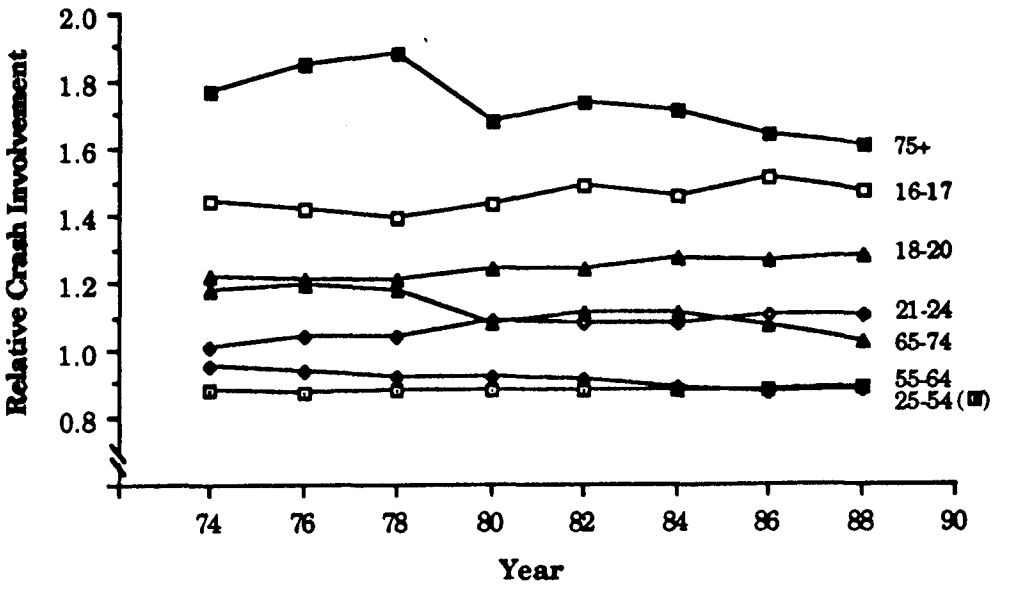

Figure 3. Relative crash involvement by driver age, 1974-1988. (Stutts, et al., 1990)

These factors may be of increasing concern in the future because, in addition to projections suggesting that a greater proportion of our driver population will be older, many of these older people will have different driving patterns than today's older drivers. For example, there is an increased probability that the retirement age may be raised to seventy which will mean that many more older drivers will be driving to and from work during rush hour. As our population ages and a substantial number of older people remain in the work force, many older drivers will no longer be able to select the time of the day during which they may drive. Furthermore, a generation of drivers have never functioned without an automobile and will be more reluctant than ever to give up their licenses. A trend has already been observed where in older people who have experienced the decline of income on the family farm turn to commercial driving as a means of supplementing their incomes. This will mean that a substantial portion of older drivers will be on the roads at high risk times and perhaps driving potentially more hazardous vehicles. This may result in a larger number of older people being involved in motor vehicle crashes.

Any heightened crash risk is of importance because many older people are more fragile than their younger counterparts (see Figure 4), are more incapacitated by injuries, and have a disproportionately high fatality rate when involved in crashes. Older people involved in crashes are more than three times as likely as a 20 year old person to die from serious injuries of equal severity (TRB, 1988).

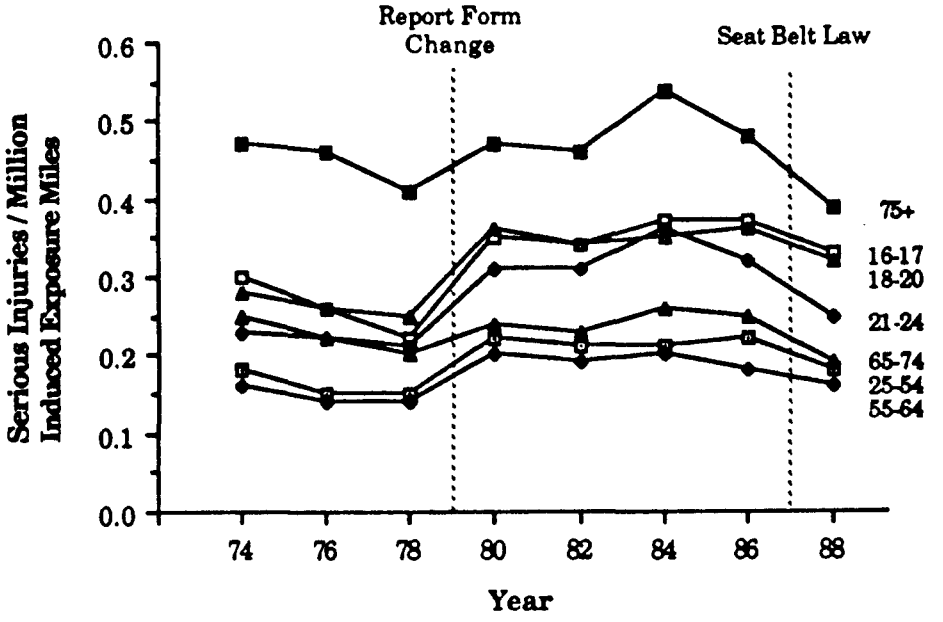

Figure 4. Serious injuries per million induced exposure miles by driver age, 1974-1988. (Stutts, et al., 1990)

Although the cohort of older drivers in 2020 will probably be healthier than today's older driver population, it will experience many of the declines often associated with the aging process, particularly with regard to visual acuity. It may also be anticipated that the variance in driving ability between older people will increase. A larger proportion of drivers who have the declines in abilities often associated with the aging process will mean that a larger number of people with physical or mental conditions that may impair the ability to drive will be referred to the Division of Motor Vehicle Driver Medical Evaluation Program. The increasing liability to the state with regard to the determination of driver risk and the associated need to restrict high risk drivers will result in a very large number of people being screened by the DME

program. Therefore, it may be anticipated that the number of persons encountering license restriction and license revocation will increase substantially.

Figure 5 shows that older drivers have the largest percentage of crashes in which they are found 'at fault'. The increasing number of cases coupled with the potential liability to the State of North Carolina will place more pressure on licensing authorities to improve the screening and regulation of older drivers, especially those with medical conditions that may impair their driving.

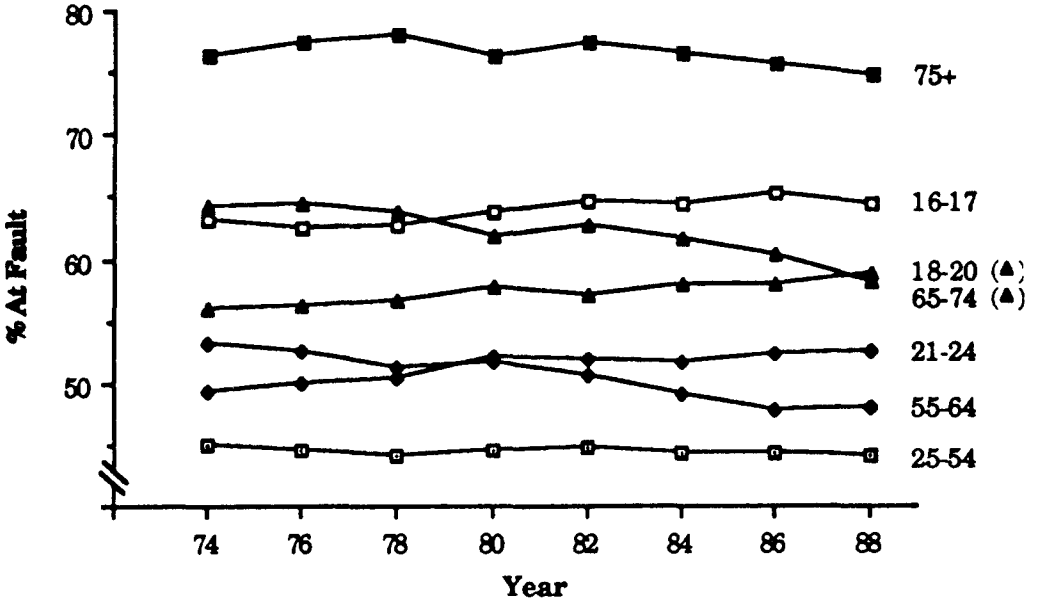

Figure 5. Percentage of crashes in which the driver is judged to be at fault, by driver age, 1974-1988. (Stutts, et al., 1990)

Determining who should be removed from this population of older drivers will be a difficult task for the license examiner who routinely screens all drivers because at the present time there is little epidemiological research available to assist licensing authorities regarding the driver crash risk associated with various conditions. Given

limited empirical data, most decisions are based on clinical impressions made in accordance with the AMA Guidelines. DMV clearly needs to have better information with which to screen drivers and upon which to make well-founded restrictions on drivers. In order to increase the likelihood of appropriate licensing restrictions being assigned, the state must have a better understanding of which drivers are at greatest risk of crash involvement.

In summary, the anticipated increase in the proportion of older drivers in North Carolina may cause two problems, namely increased numbers of drivers who must be screened for potential impairments that may affect their driving ability and a corresponding increase in the number of people who will experience license removal and restriction. Just as North Carolina began to plan for a different vehicle mix on the highways when the smaller car became popular, so must it prepare for a change in the driver mix. This project focuses on both these problems.

B. Project Objectives

The focus of this three year project, sponsored by the Governor's Highway Safety Program, has been the development of local resources for safe transportation for older people. During the first two years, a pilot alternative transportation project was begun in two counties in North Carolina - Surry and Forsyth . The Highway Safety Research Center served as a resource for these projects and members of the HSRC staff served on the Task Forces in each county. HSRC organized an Advisory Board and developed a network of individuals around the state who were interested in the issue of mobility of older people. In addition, we developed a collection of reports, articles and books on the subject of transportation needs of the older person.

In year two of the project we surveyed all of the states to identify programs that might have applicability for North Carolina. The results of these efforts are summarized in HSRC report Number PR 178.

The goals of the final year's work were:

- To develop a manual to be used by any counties seeking to implement a 'Transportation Needs Assessment for Older People.'

- To develop a brochure that might be distributed within each county that would have county specific information on alternative transportation resources available to older people.

- To disseminate information about the project to make counties aware of the availability of manuals and brochure covers.

- The final goal of the project was to examine the crash risk of older drivers in the medical evaluation program to determine if the presence of a secondary or comorbid condition increases crash risk and the extent to which restrictions that are placed by DMV on older drivers have resulted in reductions in their crash and violation involvement.

C. Development of a Manual

An important task of this project was the development of a manual for use by any county or group interested in conducting a needs assessment and implementing some of the ideas developed by the pilot counties that conducted the needs assessment and implemented individualized approaches to helping older people meet their transportation needs.

The manual appears in Appendix A. It contains summary information on the procedures used in both pilot counties. The pilot counties differed in their approaches for identifying the needs of their older residents. Since one county was predominantly rural, this was to

be expected. The dichotomy between the two is was useful because it provided some insight into the different problems presented to older people in each setting.

D. Development of a Brochure

Each of the pilot counties developed its own brochure for disseminating information to older people. An extensive list of alternative transportation resources was included in the brochure. This brochure was an appropriate tool for license examiners to give to any person about to undergo license restriction or removal. They were also placed in locations believed to be frequented by older people, e.g., drug stores, doctors' offices and senior citizen centers.

In order to encourage as many counties as possible to conduct a needs assessment and provide information to their older residents, HSRC, through the sponsorship of GHSP, developed a brochure cover that could be used by any county wishing to participate. It was patterned after the brochures developed in the pilot counties. The cover contains driving tips for older people such as a reminder to be certain to check with your doctor about the effects of your medications on your driving ability. It also contains information for older people using public transportation. A copy of the brochure cover appears in Appendix B. These brochures are available through the Governor's Highway Safety Program.

To make certain that all counties in the state were aware of the availability of the manual and covers, letters were sent to all Councils on Aging and County Health Departments. In addition, the North Carolina Council on Aging was contacted and asked to let HSRC know about any regional meetings that might be held around North Carolina so that we could make presentations at these meetings.

E. Evaluating the Crash Risk of Older Drivers in the Medical Evaluation Program

Background. As mentioned earlier, many older drivers curtail their own driving when they perceive that their driving skills and/or health are declining. However, some older drivers with declining driving competencies appear to be unaware of their decreased driving skill and continue to drive as before. Those with potential physical or mental impairments that may affect their driving abilities are made known to the Division of Motor Vehicles (DMV) through self-reporting, identification by the license examiner, report of law enforcement officers, family members or the family physician.

When identified, these people are required to have a medical evaluation completed by their physician. This medical evaluation form is then reviewed by the DMV Medical Advisor who may refer the case to a board of physicians with specialization in the area. The Medical Advisor makes a recommendation to DMV, who makes the final licensing decision. Those with confirmed problems are reviewed periodically. Many in the program receive driving restrictions or are not permitted to drive (Popkin, 1983).

Since older adults have a high prevalence of chronic disease that may functionally interfere with driving skills, a disproportionate number of those people in the MEP are older. While younger people often participate in the program with only one disability, many older people experience several comorbid conditions that may interact with one another to affect driving.

At the present time the Medical Evaluation Program is working at capacity to review these cases and to make decisions regarding the most appropriate restrictions to place upon these drivers so as to bring their crash risk to an acceptable level. To date most decisions have been based on a careful medical review and a very limited amount of empirical

data regarding the crash risk for people with certain conditions. Only a handful of studies have examined the crash risk of persons with certain medical conditions. These studies were limited by several factors including the failure to consider the possible effect of comorbid conditions on driver crash risk or to examine, in depth, the possibility that certain restrictions are more effective than others.

This difficulty in determining the crash risk of older drivers makes the job of the driver license examiner a particularly difficult one. On the one hand, it is believed that many of the crashes and violations that occur among older people may be the result of loss of function in the areas of visual perception, cognition and psychomotor functioning (Retchin, 1989). There is further concern over the influence of chronic disease on driving ability. On the other hand, there is little information available regarding the measurement of functional driving ability and about the types of restrictions which may be used to allow the older driver some mobility without endangering himself or the public. Almost nothing is known about the contribution made by comorbid conditions to crash risk. A severity of illness model that considers medication regimen, stabilization of regimen, presence of comorbid conditions as well as the potential driving implications for each individual is the ideal.

Two important studies have been conducted in North Carolina (Popkin, et al, 1981 and 1983) using information available on the DMV Driver History File (see Table 1). This table indicates that drivers in the North Carolina Medical Evaluation Program with certain medical conditions have crash rates that are comparable with those of the general driving population matched for age race and sex, while other groups have higher rates. The beneficial effectiveness of the Medical Evaluation Program for people in certain disability groups is evident when one examines the crash rates of these individuals before and after medical evaluation. Some improvement in driving performance is observed for every group with the exception of those in the alcohol/drug group.

Table 1. Annual Crash Rates Before and After Initial Medical Review[1,2]

Primary Disability	N	Crash Rate Before	Crash Rate After	t	Expected Crash Rate[3]	Difference Between Crash Rate After and Expected Crash Rate (t)
Cardiovascular	1274	0.069	0.048	2.87**	0.044	0.70
Stroke	219	0.073	0.062	0.60	0.050	0.89
Diabetes/ Endocrine	206	0.182	0.071	4.22**	0.055	1.06
Blackout	229	0.446	0.099	13.13**	0.057	2.61**
Seizure/ Narcolepsy	458	0.185	0.092	4.96**	0.063	2.60**
Neurological	129	0.117	0.109	0.12	0.058	2.21*
Musculo/ Skeletal	52	0.135	0.087	1.03	0.053	0.93
Visual	263	0.090	0.038	3.31**	0.052	
Mental	265	0.119	0.072	2.44**	0.062	0.75
Alcohol/Drug	3649	0.027	0.111		0.064	9.48**
Miscellaneous	31	0.113	0.081	0.47	0.046	0.73
No Disability	47	0.277	0.022	4.21**	0.063	

[1]Persons receiving initial medical review in 1978 or 1979.

[2]Based on two years crash experience both before and after medical review.

[3]Expected crash rate based on 1980-81 crash experience of the general driving population matched for age, race, and sex.

*Significant at .05.

**Significant at .01.

While participating in the medical evaluation program appears to be effective from a highway safety standpoint in terms of crash involvement, it does not seem to have as consistent a positive effect on violations. As may be seen in Table 2, the drivers with cardiovascular disabilities had significantly higher violation rates than their

counterparts in the general driving population, as did those with neurological, blackout, seizure/narcolepsy, mental and alcohol/drug disabilities. Individuals with stroke had an increase in violations after entering the program, but had lower rates than their counterparts in the general driving population--perhaps indicating a reduction in driving exposure.

Table 2. Annual Violation Rates Before and After Initial Medical[1,2] Review (Mean Number of Violations)

Primary Disability	N	Violation Rate Before	Violation Rate After	t	Expected Violation Rate	t
Cardiovascular	1274	.083	.077	.67676	.063	1.9645*
Stroke	219	.057	.064		.073	
Diabetes/ Endocrine	206	.175	.109	.2386	.093	.8131
Blackout	229	.205	.205	0	.101	3.7014**
Seizure/ Narcolepsy	458	.162	.156	.246	.128	1.6474*
Neurological	129	.151	.174		.111	1.4971
Musculo/ Skeletal	52	.192	.192	0	.087	1.2559
Visual	263	.095	.076	1.034	.087	
Mental	265	.294	.243	1.003	.133	3.3469**
Alcohol/Drug	3649	.064	.377		.143	23.4250**
Miscellaneous	31	.177	.145	0.4939	.068	1.4565
No Disability	47	.223	.245		.128	1.9804*

[1]Persons receiving initial medical review in 1978 or 1979.

[2]Based on two years crash experience both before and after medical review.

*Significant at .05.

**Significant at .01.

In order to enhance the likelihood that as many older persons as possible be permitted to drive for as long as possible, it is important that better criteria be established for restricting and removing the driving privilege, and that these criteria be more uniformly applied. This study evaluates our current methods for restricting older drivers who are members of the medical evaluation system and considers comorbid conditions.

Study Objectives

This study focuses primarily on gaining a better understanding of the crash and violation experience of older drivers with various disabilities by considering the presence of comorbid conditions and by controlling for the restrictions which they receive.

Methodology and Results

The data used for this study were obtained from the North Carolina Driver History File. This file includes crash and violation information and, for those persons participating in the Medical Evaluation Program, in a separate confidential area, information such as suggestions of the medical consultant panel and actions taken by the Medical Advisor.

For any person who has been required to have a medical evaluation, a permanent record of that and subsequent evaluations is retained in the computer file. Furthermore, each such person receives at least an initial primary disability code. Those persons found to have no disability receive a code called "no disability." Many persons with more than one medical condition are assigned additional disability codes, with the most potentially impairing problem listed as the primary disability code. There are forty-seven possible codes, the most frequently occurring disability being alcohol-related. In order to make the analysis of the data more manageable, these categories were

collapsed into twelve groups of similar or related disabilities.

The study population contained all drivers aged 55 and above who were members of the Medical Evaluation Program with a medical review date between 1/1/83 and 12/31/87. A single review was chosen for each person. For those people having multiple reviews, the most recent in the date range was chosen. This population of 16,293 was grouped by their primary and secondary disability codes.

All people having a primary disability and a code of 'none' for secondary disability were retained. The remaining cases were chosen to comprise disability combination groups of at least 200. For example, if 130 people had a primary code of diabetes and a secondary code of seizure and 75 people had a primary code of seizure and a secondary code of diabetes, the 205 people had the combination disability (regardless of order) of seizure/diabetes and were retained. Had the total fallen below 200, they would not be retained.

These disabilities and combinations of disabilities were reviewed in terms of both their frequency or occurrence and their association with crash involvement. Table 3 presents the distribution of drivers having crashes for each disability and disability combination. Of the 16,293 older people in our study population, 9 percent had had one crash within the two year period; and 1 percent had experienced two or more crashes. The Blackout alone group and the Alcohol/drug and Mental group had the largest percentage of crashes, followed closely by the Alcohol/drug and Visual and Mental alone groups.

Other features which seem to stand out in Table 3 are the fact that the crash rates for many of the disability combinations are quite similar (e.g., cardiovascular in combination with all but alcohol/drugs), and the very small population sizes of some of the disability combination groups. Thus, for more detailed analyses it seemed reasonable to combine certain disability groups and to drop others from further

Table 3. Distribution of Drivers having Crashes for Each Disability Combination

Combination No.	No Crashes %	1 Crash %	2 Crashes %	Population n
1. Alcohol/Drug and Cardiovascular	86	13	1	1110
2. Alcohol/Drug and Diabetes	87	11	2	202
3. Alcohol/Drug and Musculosk.	85	13	3	313
4. Alcohol/Drug and Mental	84	14	2	257
5. Alcohol/Drug and Miscellaneous	92	8	0	262
6. Alcohol/Drug Alone	87	11	1	1363
7. Alcohol/Drug and Visual	85	13	1	1164
8. Blackout and Cardiovascular	91	7	2	202
9. Blackout Alone	71	19	10	21
10. Cardiovascular and Cardiovascular	92	7	1	2309
11. Cardiovascular Alone	93	7	0	268
12. Diabetes and Cardiovascular	92	7	1	548
13. Diabetes Alone	88	12	0	26
14. Musculoskelatal Alone	88	8	4	24
15. Mental Alone	86	7	7	59
16. Miscellaneous and Cardiovascular	90	8	2	260
17. Miscellanous Alone	92	8	0	24
18. Neurological Alone	97	3	0	29
19. Seizure Alone	92	8	0	66
20. Stroke and Cardiovascular	91	8	0	625
21. Stroke Alone	100	0	0	42
22. Vision and Diabetes	89	10	1	464
23. Vision and Miscellaneous	91	7	1	798
24. Vision Alone	90	9	1	1479
25. Vision and Vision	92	7	1	4378
All	90	9	1	16293

consideration. Inspection of Table 3 led to the formation of four groups for further consideration and excluded the smaller groups (9, 13, 14, 17, 19, and 21). The final four groups were:

Alcohol/Drugs consisting of combinations 1,2,3,5,6,7;
Mental: combinations 4, 15;
C-V: combinations 8,10,11,12,16,20; and
Vision: combinations 22, 23, 24, 25

As a further justification of this selection process, a logistic regression model was fit to the proportions of crash-free and crash-involved drivers over the original 25 disability combination groups. The basic model contained a constant term and four group effects that specified equal crash proportions within each of the four composite groups. It was necessary to add three more effects to the model to adequately account for the variation in crash rates. Two of these added effects represented aggregates of the seven remaining disability combination groups. Namely, a Diab/None, Musk/None, Misc/None, and Seiz/None group. These two groups contained 140 and 71 subjects, respectively. The final model parameter was an additional effect for the AL/D-Misc group, which allowed this group to have a lower crash rate than the overall AL/D group.

Overall the model showed crash rates to be essentially homogeneous within the four basic disability groups with the exception of AL/D- Misc. as mentioned above. While there was some significant variation in crash rates among the remaining seven categories, the sample sizes involved made further consideration of these categories impractical. Hypothesis tests also showed that crash rates for the AL/D and MENT groups did not differ significantly, nor did crash rates for the C-V and VIS groups. It should be noted that at this point, however, no adjustments had been made for differences in age, race, and sex between groups.

The next phase of analysis involved comparing crash and violation rates for drivers in the four basic disability groups with those of older drivers in the general driving population. For this purpose a control group of 9,687 drivers aged 55 or older and having no medical trailer was systematically selected from the general driving population. Table 4 compares the proportion of crashes in the study group with that of the comparison group. The study group had significantly more crashes than the random sample of older drivers.

Table 4. The Crash Experience of the Study and Comparison Group.

Group	Crash Experience			
	0	1	2+	Total
Study	9125	665	50	9840
Comparison	14689	1439	165	16293
Total	23814	2104	215	26133

$X^2 + 49.520$ $P < .000$

Initially six age categories 55-59, 60-64, 65-69, 70-74, 75-79, and 80 and over were considered. Preliminary analyses showed that the driving records of drivers in the 60-64 and 65-69 age groups did not differ significantly; nor did those in the 70-74 and 75-79 age groups. Thus, in subsequent analyses only four age groupings were used, namely, 55-59, 60-69, 70-79, and eighty and over.

Table 5 depicts the crash experience of the combined population of cases in the older driver population by age. It is interesting to note that those in the youngest and oldest group had the highest proportion of crashes.

Table 5. The Crash Experience of the Combined Study and Control Populations by Age Group				
	Number of Crashes (In percentages)			
Age	0	1	2+	Total
55-59	90.8	8.3	1.0	5491
60-64	91.0	8.2	0.8	5350
65-69	91.4	7.8	0.8	4634
70-74	91.7	7.4	0.8	4025
75-79	91.4	8.0	0.6	3583
80+	90.4	8.7	1.0	2850
Total	23814	2104	215	26133

Non whites had a statistically higher proportion of crashes than their white counterparts (14 percent versus 8 percent in whites). Similarly, females had proportionally fewer crashes than males with 7 percent of females and 10 percent of males having one or more crashes during the two year period.

Table 6 depicts the violation experience of the study and comparison group during the follow-up period and shows that the study group had statistically more violations than members of the control group -- 6 % compared to 4%. Our examination of the violation experience of the groups by age showed that the number of violations went down with age. Non-whites had more violations that whites (12 percent compared to 4 percent). Men had more violations (6 percent as compared to women's 3 percent).

The subsequent analyses consisted of partitioning the data into eighty subpopulations corresponding to all combinations of the four age categories, two race categories, two sexes, and five groups consisting of

Table 6. The Two Year Violation Experience of the Study and Comparison Group

Group	Number of Violations			
	0	1	2+	Total
Comparison Group	9433	384	23	9840
Study Group	15297	872	124	16293
Total	24730	1256	147	26133

X^2=59.682, p.<.0000

the four basic disability groups and the general population sample, and fitting a categorical logistic model to the proportions of drivers having no crashes and one or more crashes within each subpopulation. A separate model was fit for violation rates. Models containing only main effects fit well to the data. Table 7 is the analysis of variable table for such a model fit to crash rates. The model was also used to

Table 7. Crash rate model ANOVA table.

Source	DF	X^2	Prob.
Intercept	1	1898.12	.0000
Race	1	73.10	.0000
Sex	1	17.73	.0000
Age	3	20.76	.0001
Group	4	90.31	.0000
Lack-of-Fit	65	56.37	.7685

compare the crash rates of drivers in each of the four disability groups with the crash rate of drivers in the control group. The results of these

comparisons are listed below:

AL/D group vs. control	X2 = 65.23,	p = .0000
MENT group vs. control	X2 = 27.13,	p = .0000
C-V group vs. control	X2 = 0.32,	p = .5718
VIS group vs control	X2 = 0.16,	p = .6859

Thus, after controlling for differences in age, race, and sex, neither the C-V-group nor the VIS-group differed significantly from the control group with respect to crash rates over a one-year period. Crash rates for the AL/D and MENT groups were higher than those of the controls and differed significantly from the controls. The MENT group had the highest crash rates.

Figure 6 presents the percentage of violations by disability combinations and shows that 94 percent of the study group had no violations. It also shows that the mental disability group alone, the alcohol/drug group with no other disabilities and the alcohol drug with musculoskelatal disabilities had a higher proportion of violations. The cardiovascular group had fewer violations.

Table 8 shows the ANOVA table and group comparisons for a similar model fit to violation rates. The primary difference with respect to violation rates was that the age effect was not statistically significant. As with crash rates, violation rates for the C-V and VIS groups did not differ significantly from the control group, while those for the AL/D group and the MENT group did. Both of these groups had higher violation rates than did the controls, with the MENT group having the highest violation rates.

Both of these two analyses were repeated after removing from the data the records of all subjects who were issued a Medical Stop at some point during the observation period. This reduced the total

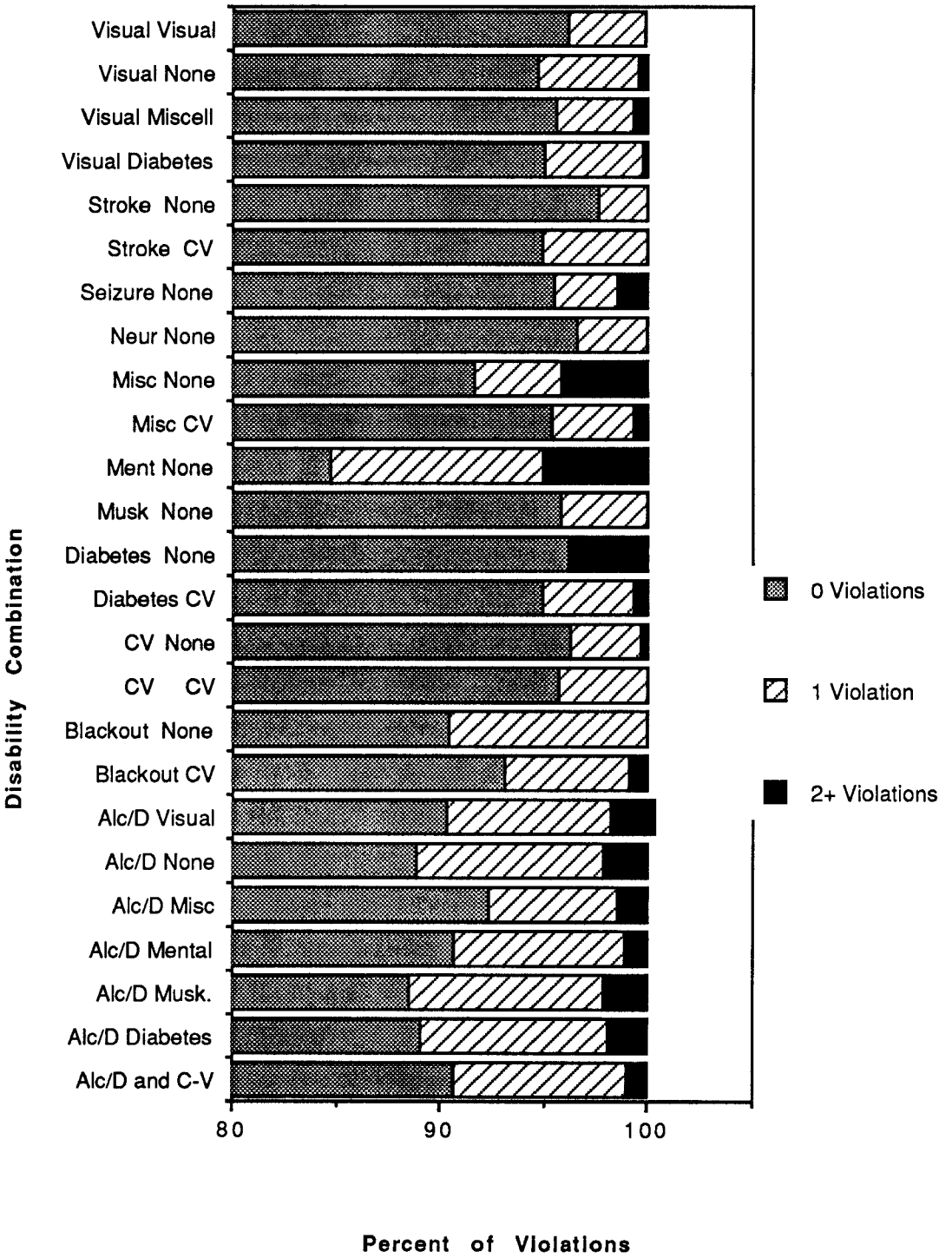

Figure 6. Percentage of Violations by Disability Combinations

Table 8. ANOVA for violation rate model.

Source	DF	X^2	Prob.
Intercept	1	1999.31	.0000
Race	1	167.61	.0000
Sex	1	45.39	.0000
Age	3	5.95	.1142
Group	4	66.95	.0000
Lack-of-Fit	65	61.89	.5866

Source	DF	X^2	Prob.
AL/D vs Control	1	50.52	.0000
MENT vs Control	1	17.79	.0000
C-V vs Control	1	0.13	.7211
VIS vs Control	1	1.56	.2118

size from 25,200 to 23,686, but model parameters and significance tests remained virtually the same. As before, crash and violation rates for the C-V and VIS groups did not differ significantly from those of the control group, while the AL/D and MENT groups had significantly higher crash and violation rates.

License Restrictions

From a potentially very large number of combinations of restrictions, three basic restriction groups were considered. By far the most frequent restriction was that of corrective lenses. Group 1 consisted of drivers restricted only for corrective lenses. Drivers in Group 2 were restricted in terms of where and when they could drive, (i.e., daylight only, 45 MPH, no interstate driving). Drivers in Group 2 were also often restricted for corrective lenses and for more than one of the where and when restrictions. Group 3 was comprised of drivers

with other, "as shown on the face of license" restrictions. A breakdown of disability group by type of restriction is presented in Table 9. That certain types of restrictions were more strongly associated with certain disability groups is apparent from the table.

Relationships between restrictions and crash rates were investigated by analyzing a contingency table of restriction type by crash occurrence within each disability group. Only within the C-V group was a significant difference in crash rates found between drivers having different types of restrictions. These results are shown in Table 10.

Table 9. Disability Group by Type of Restriction.

Disability	Restriction				
	None	Corrective Lenses	Where & When	Other	
AL/D	1383	1896	183	935	4397
	(31.4)	**(43.1)**	**(4.2)**	**(21.3)**	
MENT	121	102	33	57	313
	(38.7)	**(32.6)**	**(10.5)**	**(18.2)**	
C-V	1198	2016	702	285	4201
	(28.5)	**(48.0)**	**(16.7)**	**(6.8)**	
VIS	255	3161	3596	87	7099
	(3.6)	**(44.5)**	**(50.7)**	**(1.2)**	
Control	3453	6245	59	70	9827
	(35.1)	**(63.6)**	**(0.6)**	**(0.7)**	
Total	6410	13420	4573	1434	25837

Where it can be seen that the drivers with restrictions on where and when they drive have higher crash rates than those having no restriction or some other restriction. An examination of the age

distributions of drivers in the C-V disability group by type of restriction showed those with the where and when restrictions to be older than those with no restrictions or some other restriction. In particular, 25% of those having where and when restrictions were 80 years or older, compared with 8% for the C-V group as a whole.

Table 10. Crash Rates by Restriction Type for C-V Group.

Restriction Type	Number of Crashes		
	0	1 or more	Total
None	1114	84	1198
	(93.0)	**(7.0)**	
Corrective Lenses	1861	155	2016
	(92.3)	**(7.7)**	
Where & When	624	78	702
	(88.9)	**(11.1)**	
Other	261	24	285
	(91.6)	**(8.4)**	

Limitations of the data. Evaluated in this report is the population of older drivers with certain disabilities who are known to DMV. It in no way constitutes a true picture of the driving performance of all people with these conditions. It is not known whether or not the crash performance of an individual was responsible for his entrance into the program. Most of the information provided to the Medical Advisor was obtained from the individual's physician. Since there is no uniform individual screening and evaluating these drivers, DMV is dependent on the veracity of the medical forms completed by the physician. In many cases, the individual may not have seen the physician who completes

the form prior to the evaluation visit.

Summary. Although we do not show pair wise comparisons between disability groups, and only show comparisons with the control group, the implications are that the Al/D and Ment groups were worse than the C-V and Vis groups. (Raw rates confirmed this.) Our evaluation revealed that older drivers in the medical evaluation program did not differ from one another as a group. When compared with the control group, those with cardiovascular and visual problems appeared to drive similarly. One the other hand, those with mental disabilities and alcohol/drug disabilities fared worse than their counterparts, indicating that better procedures for dealing with individuals in these disability groups are needed.

With regard to restrictions placed on individuals, it is apparent that those drivers with restrictions on where and when they drive have higher crash rates than those having no restriction or some other restriction. The fact that they have restrictions is an indication that they were identified by the medical evaluation process and felt to present a higher risk. We suggest that the individual medical records of these individuals might be reviewed so as to determine what factors may assist licensing in discriminating between those at highest risk. When we examined those in the C-V group by type of restriction, we saw that those with restrictions appeared to be older. Unfortunately our computerized files did not provide enough information to enable easy identification of those at highest risk.

CONCLUSIONS

If predicted future population trends are correct, a substantial proportion of our driving population will be 55 years of age or older. This will mean that there will be a much larger number of older people to screen and that there will be larger numbers of people who will require periodic review by the Medical Evaluation Program. In the

absence of criteria on which to differentiate those high risk drivers from low risk drivers, DMV may place more severe restrictions on older drivers than necessary. Therefore, we need better criteria with which to screen and restrict them; and when their licenses are severely restricted or removed, North Carolina needs to assist them in finding alternative transportation to meet their daily needs.

This project addressed how effective current methods were for restricting drivers in the medical evaluation program in terms of bringing their driving risk to a level that was close to that of their peers in the general driving population. It evaluated the contribution made by co-morbid conditions to the crash and violation experience of older people in the current medical evaluation program and considered the effectiveness of current licensing restrictions placed on this population. It also served as a resource to pilot programs in two North Carolina Counties where the transportation needs of older people were assessed and access to alternative transportation was enhanced. It developed a needs assessment manual for use by any county in North Carolina desirous of conducting a transportation needs assessment for older people and produced a brochure cover for these counties to use if they wanted to distribute information about alternative public and private transportation available to older people within their counties.

The evaluation of the driving performance of older drivers in the medical evaluation program revealed that the program appears to be working. The crash and violation risk of most of the older drivers in the program is not significantly different than that of their peers in the general driving population with the exception of those with alcohol-drug disabilities and those who have mental disabilities.

With regard to restrictions imposed on older drivers in the program, it appears that the program is identifying and restricting the drivers at greatest risk, but also indicates that this group would benefit by even more stringent license restriction or removal.

It is known that many older persons, particularly those who are participants in the Medical Evaluation Program, are likely to self-restrict their driving to the environment that they perceive to be safest for them. Yet, in spite of these modifications and in spite of the decrease in driving at high risk times, many older drivers are still encountering difficulties in driving. To what extent this increase is attributable to an increase in the frequency and severity of medical conditions, and to what extent it is the effect of normal age-related changes of which the person might not even be aware is not known.

Questions remain to be answered. Is it possible to limit or reverse the deterioration of driving ability through retraining drivers so as to improve their driving skills? Can changes to vehicles and the highway environment mitigate the effects of impairment? Can a severity of illness model which considers medication regimen, stabilization of regimen, presence of comorbid conditions as well as the potential driving implications for each individual predict driving outcome? (Our study did not permit us to develop more than a very rudimentary severity of illness model, i.e., consideration of one additional comorbid condition.) This are questions which should be addressed if we are to enable the safe mobility of older North Carolinians.

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Appendix A

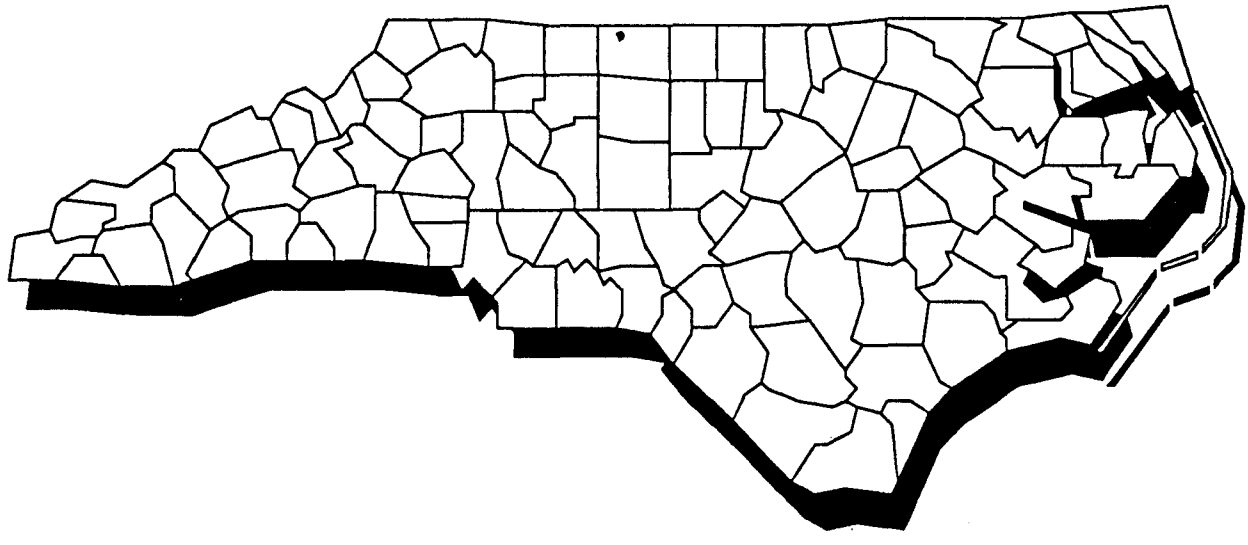
Manual entitled

"A Scheme for Providing Alternative Transportation to Older People in Your County"

Providing

Alternative Transportation to Older Adults

in Your County



University of North Carolina Highway Safety Research Center
N.C. Governor's Highway Safety Program

Providing Alternative Transportation for Older People

Mobility is very important to the overall well-being of older citizens. Many older people are good drivers and can provide for their transportation needs through the automobile. Age, however, does increase the likelihood that driving must be limited or discontinued. When older persons do reach this stage, whether through license removal or restriction, or self-limitation of driving, they must consider alternative ways to effectively meet their transportation needs. Often, the older person can depend on family or friends for transportation. However, many older North Carolinians do not have these options available or are reluctant to use them. These older non-drivers are forced to depend on other forms of transportation to remain mobile. Is there a way to assist them?

A study to examine ways to assist older people after they have experienced license restriction or removal was undertaken by the Highway Safety Research Center with the interest, cooperation, and support of the Governor's Highway Safety Program. The primary objectives of the study were to determine what the needs of these people were; and, if and how local resources could be utilized to assist to remain mobile. One important task of this project was to encourage North Carolina counties to participate in a pilot project to address local transportation needs of older people.

The Pilot Study

Two counties, Forsyth and Surry, participated in the pilot program. While both counties have a large proportion of older people, they are relatively dichotomous groups. Forsyth county contains a very large urban center, Winston-Salem, and has a substantial amount of public transportation available to meet the needs of its older population. Surry County, adjacent to Forsyth, is a rural county with small municipalities scattered in the corners of the county and a more limited number of existing transportation resources.

There are many similarities in the ways in which these two counties chose to

address the problem of developing local resources for safe transportation of the elderly. They include 1) establishing a group of advisors who are familiar with the problem and the resources available and who will be able to help in establishing solutions; 2) conducting a needs assessment; 3) conducting an assessment of existing transportation resources; 4) advising and encouraging area churches who might be able to provide transportation services where such does not already exist 5) developing a brochure that contains useful information about transportation and local transportation resources (see attached) and distributing the brochure to license stations and other locations frequented by older people.

Identifying If a Problem Exists in Your County

Does your county or municipality have a problem addressing the transportation needs of older people? Are these issues already being addressed? Is more transportation needed? To answer these questions, your county might:

1. Conduct a transportation needs assessment to determine what needs exist.
2. Conduct a resource assessment to determine how these needs are currently being met.
3. Determine if most needs can be met through existing resources. If they cannot, determine if existing systems can be modified or if additional transportation providers required.

Transportation Needs Assessment. The purpose of a transportation needs assessment is to determine what needs exist or are perceived to exist among the older population as well as among the professionals who provide services for them. A well designed and administered questionnaire will provide the specific information needed. Information needs to be obtained from both older citizens and professionals interested in older people.

Data Collection Methods. There are several ways to obtain the kind of information needed for an assessment of the transportation services available to the elderly.

Both user and interested professional needs assessments can be accomplished by the following methods, alone or in combination:

- personal interview
- telephone interview
- focus groups
- written questionnaire.

If using interviews or focus groups, you must determine where to conduct them. Possible locations include nursing homes, nutrition sites, homemaker clubs, senior citizen clubs, civic or religious organizations, in grocery stores and pharmacies, and while riding public transportation or Section VII-funded transportation. Avenues of distribution of written questionnaires also must be identified. Mailing lists can be obtained from many of the same sources listed previously. Short questionnaires may be distributed with the cooperation of local business such as pharmacies or restaurants.

In Forsyth county, a needs assessment was carried out through interviews with older people using public transportation and through interviews in local driver's license examiners' office. In addition, focus groups were conducted in various retirement homes and meal provision sites. Questions about availability of transportation alternatives and about driving ability and license revocation were included in the interviewing and focus group discussions.

In Surry county, a transportation questionnaire was developed and distributed to participants of Senior Citizens clubs and Elderly Nutrition Programs. In order to reach those older adults who do not participate in senior activities, an abbreviated survey was provided to 20 pharmacies, where the older person could complete the questionnaire while waiting for prescriptions to be filled. In addition, a random mailing of the questionnaire was conducted with limited results.

Data Collection Instrument for Older Persons. The methods of data collection you plan to employ will determine what the data collection instrument looks like. For instance, if the data is to be collected in personal interviews or over the telephone,

questions can be less specific and less formally worded than if written questionnaires are used. A list of topics of discussion for focus groups can be even less specific. If you are using several different methods of collecting the data, you might want first to list the topics about which you hope to obtain information, then break each of the topics down into specific questions for interviewing or a written questionnaire. Some questions you might want to include are:

- Do you ride the bus? Why? How often?
- Do you have a car? If yes, do you use it to get around?
- If you don't have a car or if you don't use your car, how do you get around?
- Are you having transportation problems?
- Are there things you want to do in the evenings but can't do because there is no transportation available?
- Do you feel transportation is a problem for you or others?
- What transportation problems do your friends complain about?
- Do you feel you are taking a "handout" when someone offers you transportation from a government agency?

Data Collection Instrument for Interested Professionals. Professionals who provide services to the elderly should also be interviewed to obtain their perspective(s) of the transportation needs of the elderly. It is useful to establish a group of advisors who are familiar with the problem and the resources available and who will be able to help in establishing solutions. Both the county projects in the pilot program began by forming a local advisory group consisting of individuals and agency representatives in the local community who work with the older adult population. County social services and health agencies, transportation providers (bus and taxicab companies) and churches were represented. These advisory groups were then able to help the projects in the needs and resource assessment processes.

Resource Assessment. The resource assessment is the next step in this process and can be accomplished in much the same way as the needs assessment. Existing

transportation resources should be identified. This can be accomplished by personal and telephone interviews of all transportation providers, social service agencies, health centers, civic organizations and churches. Begin by contacting the DOT county transportation coordinator. List all transportation systems available, the area served, schedule, cost to the user and funding sources.

You might want to make this list available to agencies that serve the older person or to the population in general. In both pilot counties brochures were developed for distribution at driver's license stations and at other areas around the county. These brochures provide some tips for helping older persons drive better and contain useful information about alternative transportation resources available, including cost per ride and eligibility requirements. In order to make ideas from these pilot counties available to other areas in North Carolina, HSRC has developed the cover for such a transportation resources brochure that is available through the Governor's Highway Safety Program (a copy is attached). Your transportation list can be incorporated into a brochure to be distributed at the driver's license examiners offices, at nutrition sites, among senior groups, health department offices, pharmacies and restaurants and at churches.

Are Needs Being Met? The final step is to determine if the needs identified are being met by existing resources. If they are not, you must decide if changes realistically can be made and how to accomplish these changes, working with county commissioners, social service and health agencies, and volunteer groups and churches.

If you have questions about the process described here, contact Chris Little at the UNC Highway Safety Research Center at (919) 962-2202, Katrina Hamilton or Dallice Joyner at the Forsyth County Health Department at (919) 727-8172, or Marti Loftis or Ronald Boyles at the Surry County Health Department at (919) 386-9431.

Appendix B

Brochure Cover

Older adults are driving and keeping their driver's licenses longer. They are the fastest growing category of licensed drivers in North Carolina. Their improved standard of living has resulted in their being healthier, more alert, and better skilled drivers as a group.

As long as older people remain alert and healthy, they should continue to drive. Unfortunately aging brings slower reaction times, medical problems, and less proficient eyesight and hearing. Sometimes these problems become so severe that they affect driving skills, and can put the driver, and others, at risk of being involved in a crash.

Many older adults have health problems that cause them to limit or lose their driving licenses. This leaves the older adult and often his/her family with the struggle of finding another means for needed transportation.

This pamphlet has been developed to help you find other sources of transportation. We realize that this is a difficult problem for all concerned. Our goal is to ease the burden and assist you in finding safe, alternative transportation.

Travel Tips for Older Drivers

- Always wear your seat belt
- Try to avoid heavy traffic areas
- Avoid traveling at night
- Be careful in making left turns
- Always stop at stop signs
- Have regular physical checkups
- Be aware that medications you take may affect your driving
- Have your eyes checked regularly
- Don't drink and drive
- Consider taking a safe driving course like AARP's 55 Alive

Facts for Older Drivers

- Owning a car may cost up to $4000 a year, including purchase, gas, maintenance, and insurance.
- Driving in heavy traffic can be tiring.
- Public transportation or ride-sharing can help you make new friends and help you feel more independent.

Transportation Alternatives For Older Adults