Seniors face serious driving safety and mobility issues.

2009 Older Adults' Knowledge About Medications That Can Impact Driving

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SUMMARY

A survey of community dwelling drivers, 55 years and older, was conducted to assess knowledge regarding prescription and over the counter (OTC) medication use and driving. Overall, 630 men and women were interviewed. The average age of participants was 70.4 years (SD 8.6), 87.5% were white race, and 11.2% were black race. The majority of respondents (92.1%) listed driving as their preferred mode of transportation. Sixty percent of respondents drove six or seven days per week. Men drove approximately twice as many miles per week as women.

Overall, 94.6% of respondents reported having one or more medical conditions. The number of medical conditions increased with age and men reported slightly fewer medical conditions compared to similarly aged women. Approximately 78% of respondents currently used one or more medications, 71.3% currently used one or more *prescription* medications, and 68.7% currently used one or more *prescription* medications that were potentially driver impairing (PDI). In addition, 19.1% of respondents currently used five or more medications, 12.1% currently used five or more *prescription* medications, and 10.2% currently used five or more *prescription* PDI medications

Awareness, experience and healthcare worker warning of PDI medications were low, especially among the oldest respondents and those with less educational attainment. Overall, 27.6% of respondents indicated some awareness of PDI medications; however, awareness decreased with increasing age for both women and men. Few respondents (17.6%) had received a warning about PDI medications from a healthcare professional. Among respondents currently taking five or more PDI prescription medications, 21.9% indicated some awareness, and 18.8% reported receiving a warning about PDI. Among respondents 75 years and older, approximately 77% reported no-AEW, even though these subjects had the greatest number of medical conditions and were currently taking the greatest number of prescription PDI medications.

A dichotomous (yes/no) summary measure was created for any driver awareness, experience, or healthcare worker warning of PDI medications. It is likely that driver awareness is influenced by a number of factors, including media exposure, experience of friends, family and self, communication by health professionals and friends and family, or simply reading the safety information provided on PDI medication labels. Rather than focus on all potential components of drivers' awareness, we were interested in

garnering information about drivers' overall awareness of PDI medications, experience with PDI medications, and the influence of healthcare worker warnings.

Respondents with no awareness, experience or warning from a healthcare professional were significantly older and had fewer years of education. Subject awareness, experience and warning were not associated with number of reported medical conditions, number of current medications, or number of current PDI medications. Further, respondents' awareness about PDI medications was not associated with use of multiple PDI medications. In addition, respondents with and without awareness, experience, or warning from a healthcare professional were similar in both their driving exposure (days and miles driven weekly) and their overall driving avoidance behavior. In other words, although respondents may have been aware, their driving exposure and overall driving avoidance was not different. However, there was a significant effect of AEW on health-related driving avoidance. Those reporting any-AEW were more likely to avoid driving due to health than those with no-AEW.

With the potential to affect safe decisions regarding health-related driving avoidance behaviors, clinicians (i.e., physicians, physician assistants, nurse practitioners and nurses) and pharmacists should put more emphasis on patient education regarding PDI medications, particularly among potential high risk groups. Such groups include those with multiple medical conditions or those taking multiple medications, or PDI medications. In addition, our results indicate that awareness, experience and warning is lower for older drivers and for those with less education. Therefore, particular emphasis on patient education should be focused on these people.

Previous research has reported that increased number of medical conditions is associated with increased risk of motor vehicle crashes (MVCs) among older adults. Other research has shown that increased use of multiple medications and of PDI medications is also associated with increased risk of MVCs. In this study, we found that driver awareness, experience, or healthcare worker warning of medication's side effects and their potential to impair driving are not significantly higher with increasing numbers of medications or with increasing numbers of medical conditions.

INTRODUCTION

Many older adults have chronic medical conditions, and consequently, they often consume multiple medications (Hayes et al. 2007). A recent survey of non-institutionalized adults reported that medication use rates increased with age and that 44% of men and 57% of women aged 65 and older used five or more medications weekly (Kaufman et al. 2002). Furthermore, over time the number of older adults using multiple medications has also increased; for example, the proportion using five or more medications increased from 54% in 1998 to 67% in 2003 (Jyrkkä et al. 2006). Medications commonly used by older drivers include anti-arthritics, muscle relaxants, analgesics (NSAIDS), anti-depressants, anti-anxiety agents, beta blockers, and anticonvulsants (Moxey et al. 2003; LeRoy and Morse 2008).

Many medications can cause adverse effects. Older people are more susceptible to side effects because they often use multiple medications, many have heightened sensitivity to medications, and they are more likely to have pre-existing conditions that can increase both the frequency and severity of adverse effects. Research has shown that for some medications (e.g., long half-life benzodiazepines) side-effects are more prevalent soon after patients begin taking new medications (Hemmelgarn et al. 1997). Adverse effects can include many problems beyond those related to driving, such as falls (French et al. 2005; Neutel et al. 2002; Schwab et al. 2000; Grisso et al. 1997; Leipzig et al. 1999). Research has reported that adverse drug events account for approximately 3.2% to 7.0% of all acute hospital admissions (Pouyanne et al. 2000; Wasserfallen et al. 2001). However, among older adults adverse drug events account for 10% to 17% of acute hospital admissions and approximately 10% of emergency department visits (Hanlon et al. 1997; Beard 1992; Hohl et al. 2001).

The increased number of medications that older adults take, coupled with sometimes complex administration regimens for doses and times, increases the risk of mismanaging medications (Edlund 2004). Common errors include mixing OTC medications and prescription medications, discontinuing prescriptions, taking the wrong dosages, using incorrect techniques, and consuming inappropriate foods with specific medications (Curry et al. 2005). Other medication-related issues among older drivers include compliance and adherence. Past research has reported increased risk of adverse drug events as a result of poor adherence to taking medications (Bero et al. 1991; van den Bemt et al. 2000).

Although older drivers are involved in a small proportion of total motor vehicle collisions (MVCs), they have the highest number of MVCs per mile traveled (Williams and Shabanova 2003), and because of the increased fragility of the body at older ages, older drivers are more likely to be injured or killed when involved in an MVC (Li et al. 2003; Griffin 2004). With the number of drivers 65 years of age and older expected to double by 2030 (Federal Interagency Forum on Aging Related Statistics 2008), reducing the risk of MVCs among these drivers will increase in importance. Therefore, the relationship between medication use and MVC risk is likely to grow increasingly important as the older population continues to grow.

Studies have also shown that certain prescription medications are known to be associated with motor vehicle collision involvement. For example, studies have reported that benzodiazepine use is associated with an elevated risk of MVC involvement of 1.3 to 2.4 times (Engeland et al. 2007; Barbone et al. 1998; Ray et al. 1992; Hemmelgarn et al. 1997). Benzodiazepines, commonly prescribed for the treatment of anxiety and insomnia in older adults (Ray 1993) are used in small amounts by between 9% and 20% of patients over age 65 (Leveille et al. 1994; Cowart and Kandela 1985). However, the risks posed by the wide array of medications commonly used by older adults have not fully been investigated (Betts et al. 1984; Colsher and Wallace 1993; Ellinwood and Heatherly 1985; O'Hanlon et al. 1998).

Additionally, many medications are associated with adverse effects whose underlying mechanisms are also suggestive of increased MVC risk. For example, increased risks of falls and hip fracture have been reported for older adults using sedatives or psychotropic drugs (French et al. 2005; Neutel et al. 2002; Schwab et al. 2000; Grisso et al. 1997) and increased risk of falls when taking multiple medications (Leipzig et al. 1999). It is likely that the underlying mechanisms of adverse effects that increase risk of falls would also increase risks for other traumatic injuries such as MVCs. In fact, a 2.6 fold increased risk of MVC has been reported among older adults who have a history of falling within two years (Sims et al. 1998). Furthermore, recent research has reported that 21% to 23% of community dwelling elderly patients are still prescribed medications that are potentially inappropriate (Fick et al. 2001; Liu and Christensen 2002).

To assist clinicians in their decision making when prescribing medications for older adults, a number of medications have been identified as being inappropriate because they are either ineffective or

because the potential for adverse effects outweighs potential benefits (Beers et al. 1991; Beers 1997). Because of the constant addition of new medications to the marketplace, these "Beers criteria" must be regularly updated if they are to remain useful (Fick et al. 2003). A recent report examining the role of Beers-criteria medications in emergency room visits for adverse effects indicates that a low proportion (3.6%) of all visits are related to these drugs (Budnitz et al. 2007). There are also a number of over-the-counter (OTC) medications that have side effects, e.g., dizziness or drowsiness, which could potentially impair driving.

To better educate clinicians and pharmacists about PDI medications, a number of professional resources have been developed (AMA 2003; Lococo et al. 2007; Lococo and Tyree 2007). These resources include information specific to classes of medications and medication types that have high potential to impair driving, as well as suggestions on how to assess function and counsel patients who can no longer drive safely.

One recent large case-control study, which relied on administrative claims data to identify respondents who had experienced an MVC, reported statistically elevated odds ratios (ORs) for respondents 50 years and older who had been prescribed one or two (OR=1.29) and 3 or more PDI medications (OR=1.87) within two months of their MVC (LeRoy and Morse 2008).

Past research has examined patients' knowledge of adverse drug effects for certain classes of medications, e.g., for NSAIDs (Wynne and Dorward 1999; Cullen et al. 2006). Generally, researchers have reported that respondents were more likely to be aware of adverse effects for some classes of medications and that patients tended to underestimate risks. Attempts to decrease the prevalence of older adults driving under the influence of PDI medications will likely involve patient education.

Research shows that many older drivers change their driving habits; many drive less and avoid what they believe are risky driving situations (e.g., driving at night, in bad weather) in response to diminished visual acuity and health (Tuokko et al. 2007; Unsworth et al. 2007). However, it is not clear how older drivers' knowledge of PDI medications relates to their medication consumption or their driving behaviors. This information is important in understanding whether drivers with potentially increased risks are aware of those risks and whether their perception of risks has resulted in increased safety, i.e., their level of concern is great enough to change their driving behaviors.

The objective of this study was to better understand older drivers' experiences with prescription and OTC medications and driving, whether they had been alerted by clinicians or pharmacists about potential impacts, and to assess overall knowledge about the potential impacts on driving. We were interested in knowing the extent to which driver characteristics (demographic, medical, driving exposure and avoidance, and activities of daily life) are associated with awareness of PDI medications. Research in this area will help focus future research and educational interventions.

METHODS

Study Population

Contact information on 5,000 Alabama residents 55 years and older was obtained from Pinpoint Technologies, a national list brokerage firm that specializes in providing information for direct marketing companies (http://www.pinpoint-tech.com). Information obtained included name, age, ethnicity, gender, education, marital status, home phone number, and home address. To ensure adequate representation within age and gender groups, approximately 100 participants in each of six age (55-64, 65-74, and 75+) and gender (male and female) groups were interviewed. Study interviews were conducted via telephone from September through December 2007. The Institutional Review Board of The University of Alabama at Birmingham approved the study.

Study interviewers attempted to contact 1,280 potential participants (Table 1). Six hundred and sixty nine respondents (52.3%) agreed to participate, 485 respondents either refused participation (276, 21.6%) or the limit of 10 call attempts (209, 16.3%) was met; 126 respondents were ineligible/unable to participate because of an invalid phone number (60, 4.7%) or because of current hospitalization or care in a non-ambulatory facility (66, 5.2%). Information regarding hospitalization and care in non-ambulatory facilities was provided by household members during one of the contact attempts. We were able to compare demographics by participation status based on data provided by the marketing list company. Within gender, subject participation differed significantly by age. For example, for both males and females the 55-64 age groups were the least likely age groups to participate. Participation did not differ according to race or education years attained.

Survey Conduct

All respondents who agreed to participate were asked if they were current drivers. Respondents who had never driven or were not current drivers were not included in the survey (N =39). All study participants provided demographic information (age, gender, race, marital status, current employment status, and highest level of education completed). Of the 630 current drivers included, 11 (1.8%) did not fully complete the survey, refusing to provide medical information; in addition, no survey took over 20 minutes to complete. The survey is included in Appendix A.

Current drivers were asked to provide detailed information about their medical history and current use of medications related the following health conditions: heart problems, circulation problems, high blood pressure, low blood pressure, diabetes, numbness of feet, arthritis, osteoporosis, cancer, lung/chest problems, urinary problems, kidney problems, hearing problems, glaucoma, macular degeneration, cataracts, eye disease due to diabetes, insomnia or sleep problems, depression, nervous system problems (e.g. Parkinson's Disease); and any other (not previously listed) medical conditions. Respondents provided the names of their current medications, which were later categorized as to whether they were prescription or OTC, as well as into general descriptive groups. For example, drug groups included angiotensin converting enzyme (ACE) inhibitors, antihistamines, benzodiazepines, beta blockers, calcium channel blockers, diuretics, hypnotics, non-steroidal anti-inflammatory drugs (NSAIDs), opioids, proton pump inhibitors, statins, synthetic opioids, etc.

In addition, each medication's most common side effects were reviewed via a public Internet site (http://www.drugs.com) and those with sedative (e.g. drowsiness, dizziness, fatigue, etc.), behavioral (anxiety), vision-impairing (blurring, dry/itchy eyes, tearing, etc.), or headache-related side effects were categorized as PDI medications. The number of medications (overall) and the number of PDI medications that respondents currently used were then categorized as 0, 1-2, 3-4, and 5+.

Respondents were also asked about their recent history of falls (including number and severity), ability to perform daily activities, and current driving habits. A modified Katz ADL scale was used to determine if respondents currently experienced any difficulty in performing daily activities including: moving outdoors, using stairs, walking at least ¼ mile, carrying heavy objects, walking between rooms,

feeding themselves, getting in and out of bed, using the lavatory, dressing and undressing, and washing and bathing.

Participants' orientation, concentration and memory (OCM) were assessed using the Short Orientation-Memory-Concentration Test of Cognitive Impairment (Katzman et al. 1983). For this instrument, respondents were asked: the current year, month, and time (within one hour), to count backward from 20 to 1, to say the months of the year in reverse order, and to repeat a "memory a phrase" given to them at the beginning of the OCM test. The OCM test was intended to identify respondents not fully capable of participating in the survey; however, given that few respondents were shown to have errors, all subjects were included in the analysis.

Driving habits were assessed using the Driving Habits Questionnaire (Owsley et al. 1999). Respondents were asked about their current driving habits, including their preferred mode of transportation (drive, someone else drive, public transportation); to self-rate the quality of their driving as excellent, good, average, or fair; their recent driving habits, including: average number of days driven weekly; average miles driven weekly; and longest driving trip in previous two years. They were also asked about driving avoidance in the previous three months (e.g., driving in the rain, driving alone, left hand turns across oncoming traffic, driving on interstates and expressways, driving on high traffic roads, driving during rush hour, and driving at night) whether or not avoidance was related to health, and in the event they were unable to drive, what alternate methods of transportation they would rely upon.

The main outcome of interest was respondents' awareness, experience and healthcare worker warning (AEW) of PDI medications. Respondents were asked:

- "Are you *aware* of any medications that may cause side effects when you drive?"
- "Have you noticed that any of your medications *affect your ability to drive* (i.e. causes drowsiness, blurs vision, causes headaches, etc.)?"
- "Has a *health care provider* (doctor, nurse, pharmacist) spoken with you about possible side effects of taking any medication and potential impacts on driving?"

Responses to each of these three questions were categorized as "yes" or "no" and an affirmative answer to any one of the three questions resulted in a "yes" on the composite AEW variable.

Driver awareness may be influenced by a number of factors, including media exposure, interactions with friends and family, or simply reading the safety information on medication labels. Rather than focus on all potential components of drivers' awareness, we were interested in garnering information about drivers' overall awareness of PDI medications, their experiences driving while on medications, and the influence of clinician or pharmacist's warnings. Creating a dichotomous (yes/no) summary measure (any-AEW) removes logical inconsistencies such as when respondents who'd received a warning or had felt the effects of medications while driving answered "no" to awareness. In these instances, it would be reasonable to conclude that respondents actually did have awareness.

Statistical Analysis

Participants with any-AEW were compared to those without AEW with respect to demographic characteristics (age, gender, racial group, marital status, employment, and education). Logistic regression was used to adjust for age and gender when examining the potential explanatory power of current health factors (numbers of OCM errors, medical conditions, medications, prescription medications, and prescription PDI medications); driving habits, exposure and avoidance; history of falls; and activities of daily living.

For the logistic regression models, any-AEW (yes/no) was the dependent variable and significant differences in categorical variables were tested using the Wald Chi-square statistic, which treats categorical variables as dichotomous variables. Alpha values of less than 0.05 were considered statistically significant. A similar procedure was used for continuous variables; however, in these instances a class statement was not necessary.

Logistic regression was also used for non-parametric techniques, modeling continuous variables based on their rank order and using the Wald Chi-square statistic to test significant differences. As a secondary analysis, we were interested in whether increasing numbers of current prescription PDI medications (0, 1-2, 3-4, 5+) were significantly associated with increase in AEW or in any of its components, demographic characteristics (age, gender, racial group, marital status, employment, education), current health (numbers of OCM errors, medical conditions, current medications, current prescription medications), driving habits, driving exposure, driving avoidance, history of falls and activities of daily life. For categorical variables, the Cochran-Armitage trend test was used; for categorical

variables of multiple levels, the Mantel-Haenszel-chi square for trend was used; for continuous variables, a linear trend test was used; for non-parametric comparisons (e.g., median values), a Mann-Kendall trend test was used. Results of the trend analyses are presented in Appendix B, tables B9-B11.

RESULTS

Of the 669 respondents who agreed to participate, 630 (94.2%) indicated that they were current drivers. The average age of the 630 participants was 70.4 years. Mean and median age values were similar overall as well as within males and females. Study participants self identified as being white race (87.5%), black race (11.2%), and other (1.3%).

Subject awareness, experience, and healthcare worker warning

Overall, 245 (38.9%) respondents reported any-AEW (Table 2). Demographic comparisons by AEW status were based on survey responses, not the sample information provided by Pinpoint Technologies. Compared to respondents reporting no-AEW, any-AEW respondents were significantly younger (67.5 versus 72.1, p=<0.0001), but similar in race, marital status, and employment status. There were fewer men with any-AEW but differences were not statistically significant. Respondents with any-AEW were more likely to have had some college (28.7% versus 23.1%), or earned a college degree or greater (38.7% versus 27.9%), (p=0.0042).

Respondents with any-AEW did not differ significantly from those with no-AEW by number of OCM errors, number of medical conditions, number of current medications (overall and prescription), or by number of prescription medications with potential to cause side-effects (Table 3). Respondents who had any-AEW were for the most part similar to others in their driving habits (Table 4). For example, the majority (> 90%) of respondents with and without AEW listed driving themselves as their preferred method of getting around. Any-AEW respondents were also similar to those with no-AEW in the percentages who had ever had anyone suggest that their driving be limited or stopped and what they would do if they could not drive. Any-AEW and no-AEW respondents were also similar in the percentages self-reporting their driving as excellent or good (92.7% versus 88.5%).

Driving exposure among any-AEW and no-AEW groups were also similar (Table 5). The average miles driven per week were not significantly different for respondents with any-AEW compared to no-AEW

(133 versus 139); however, median values were significantly greater for respondents reporting any-AEW (84 versus 70, p=0.0167).

Compared to no-AEW respondents, those reporting any-AEW did not significantly differ in overall driving avoidance or any of the specific types of driving avoidance in the three months prior to the interview (Table 6). However, among those reporting any driving avoidance, those with any-AEW were significantly more likely to attribute avoidance to health than were those with no-AEW (16.7% versus 12.2%, p = 0.0126). In addition, respondents reporting any-AEW did not significantly differ from no-AEW respondents in history of falls and activities of daily living (Table 7).

Any-AEW was greatest for women of age 55-64 (60.9%), followed by men of age 55-64 (46.4%). The lowest proportion of AEW was found in both women and men ages 75 and above, 21.4% and 25.8%, respectively (Table 8). As the number of current prescription PDI medications increased, there was no associated increase in AEW or in any of its components (Table 9). Among respondents currently taking prescription or OTC PDI medications (N=476), relatively few subjects reported having any-AEW (Table 10). For both women and men, the lowest AEW was reported among those 75 years and older, 21.8% and 24.6%, respectively. Among subjects 75 years and older, approximately 77% reported no-AEW, even though these subjects had the greatest number of medical conditions and were currently taking the greatest number of prescription PDI medications.

Additional tables

The appendix includes additional detailed tables showing percentages or means on demographics, numbers of OCM errors, medical conditions, medications, driving habits, self-rating of driving, driving exposure, specific medical conditions, medications associated with medical conditions, and specific medications within the six age/gender groups (Tables B1-B7). Tables B8 to B11 show percentages (or means) of each variable in the study by the number of PDI medications, along with the appropriate statistical test results.

DISCUSSION

The current study surveyed drivers 55 years and older to assess their awareness, experience, and healthcare worker warnings about the potential effects of prescription and OTC medications on

driving. To our knowledge, no previous studies have attempted to address these questions, so direct comparisons with other research are not possible. The results indicate that awareness, experience, and healthcare worker warnings about the potential effects of medications on driving is very low.

The proportion of all drivers who are actually impaired by medications is unknown, whether at a given time or over a period of time. Recent research suggests that the proportion of older drivers impaired at the time of a fatal MVC is lower than that of younger drivers (20.4% versus 56.5%) (CDC 2006). However, among impaired drivers, the prevalence of potentially impairing drugs (both illicit and licit) with no alcohol involvement at the time of MVC, was much greater among older drivers than younger drivers (56.9% versus 29.6%).

The current study indicates that with increasing age AEW decreases, a result supported by research reporting decreased health literacy with increasing age (Baker et al. 2000). In addition, AEW was low among widowed older adults and those with low educational attainment, the latter being statistically significant. These results suggest that drivers' baseline ability to understand PDI medications and perhaps the presence of a spouse play important roles in drivers' awareness. Spouses may reinforce health care worker warnings or seek out information regarding PDI medications and more educated respondents may be more likely to read medication labels or ask questions of their health professionals.

There were no differences between AEW and number of medical conditions, number of current PDI medications, or health status. Thus, among respondents, those at highest risk of being on PDI medications did not have appreciably more knowledge than those at lower risk. Drivers with five or more current prescription PDI medications did have significantly reduced driving exposure compared to drivers who took fewer PDI medications even though respondents on more PDI medications were no more aware of potential impacts. In addition, drivers with and without AEW did not significantly differ in their driving exposure or driving avoidance. It appears that increased AEW does not decrease driving exposure. This finding suggests that increased AEW on its own does not result in drivers markedly reducing their driving or changing their driving behaviors. It's possible that even though they are aware of potential risks, drivers may not consider these potential risks as an important threat to safety or they may simply not have alternatives to driving. In addition, many older drivers are likely restricting their exposure and already

operating in low-risk situations (Tuokko et al. 2007; Unsworth et al. 2007). Drivers with medical impairments curtail their driving due to their medical illness but not necessarily due to the medications they use.

Much of patients' knowledge regarding their medications comes from communications with clinicians. Thus, educating older patients about the risks medications pose to safe driving during physician-patient encounters and encouraging them to discuss medications with their physicians at each encounter should be beneficial. However, current research suggests that physician-patient communications are often incomplete with regard to potential risks of medications (Makoul et al. 1995; Sleath et al. 2001; Richard and Lussier 2006). For example, on average physicians spend approximately 4 minutes of each office visit discussing medications with their patients, and approximately half of all patients currently taking medications do not ask any questions of their physicians (Sleath et al. 1999). Coupled with this, communications with elderly drivers are often difficult due to physical limitations associated with advancing age such as hearing loss and visual impairment (Grue et al. 2008) in addition to slowing of cognitive processes that affect memory and learning (Langa et al. 2008; Plassman et al. 2008). Increased physician awareness of PDI medications and the potential interactions due to polypharmacy should help to motivate improved communications.

This study suggests that health professionals are not sufficiently informing their patients of the risks posed by PDI medications. Increased knowledge and awareness by health professionals will enable them to offer suggestions on how older drivers can modify their behavior to reduce risks, e.g., by reducing driving or increasing self-monitoring of PDI side effects. Increased patient education by pharmacists is also a key component to addressing PDI medications and has been shown to effectively increase patient knowledge of medications (Jameson et al. 1995; Lim et al. 2004; Simonson and Feinberg 2005). Recent educational interventions have been developed to help health professionals identify and counsel older drivers about PDI medications (Lococo et al. 2007; Lococo and Tyree 2007). One program, co-sponsored by Walgreens and the federal agency responsible for traffic safety, the National Highway Traffic Safety Administration (NHTSA), offers continuing education credits to pharmacy technicians (Lococo and Tyree 2007). Nursing staff may also be available to educate elderly patients about proper management of their medications (Curry et al. 2005).

Ultimately, the responsibility for knowing about PDI medications and acting accordingly rests on older drivers and their families. To assist in their decision making, a number of resources have been developed. For example, the US Food and Drug Administration has developed a number of pamphlets to educate patients to communicate with their health professionals, know their medications, read labels and follow directions, avoid interactions, and monitor medicine's effects (FDA 2009).

The Internet and advances in information technology offer the potential to educate patients and families regarding medication risks. Utilization of these resources has increased access to knowledge among younger individuals but effectiveness in older populations has not been studied (Assemi et al. 2002). For example, NHTSA has produced a pamphlet, "Driving When You Are Taking Medications", that should be informative for older drivers and their families (NHTSA 2004). In addition, NHTSA, has an in depth report on polypharmacy and older drivers (Lococo and Staplin 2006), which should help health care professionals identify at-risk patients. Efforts to make these resources available in the physician waiting rooms could increase awareness. Finally, increased use of electronic decision support systems and electronic medical records will likely improve prescription decisions and help clinicians counsel and monitor elderly patients (Terrell et al. 2006).

The results of the current study should be considered in light of several strengths and limitations. The study relied on self-reported medical conditions and medication information, in addition to driving characteristics. Some research indicates that among older adults, self-reported medication usage has high agreement with pharmacy prescription records (Caskie and Willis 2004). In addition, agreement is very high for self-reported medical history, even among the very old (Goebeler et al. 2007). Other recent research suggests that self-reporting of PDI medications has limited accuracy among drivers who participated in a roadside survey and submitted to biomarker testing for PDI medications (Lacey et al. 2007). The NHTSA-sponsored study measured alcohol and drug use among night time drivers who were randomly tested in six locations throughout the United States. Results indicated that 15.0% (N=94) of participants were positive for either licit and illicit drugs that could affect driving; however, only two of the 94 respondents reported having taken drugs that night that might affect driving. The authors speculated that some of the discrepancy between what drivers reported and the laboratory results may have been

due to a lack of awareness of their medications' potential to impair driving, an explanation that is consistent with the current study.

Another limitation of the current study is that it did not examine awareness specific to drug classes, medical conditions, or the potential interactions of the two. Therefore our results cannot be generalized to these potentially high risk groups of older drivers. Other research has addressed MVC risk among older adults and considered conditions, medications and interactions, reporting elevated risks for many (LeRoy and Morse 2008). Since our intent was to measure driver awareness and experience in a general sense, without attribution to specific PDI medications (class or drug), our definition of prescription PDI medications should be considered generous and is based on information that should be available to patients on medication labels.

Study participants were screened for mental status using standardized questions to access orientation, concentration and memory (OCM). We found that older respondents had more errors, but there was no relationship between the number of PDI medications and the number of OCM errors. Thus, for some participants, it is possible that they were informed or had experience of PDI risks but simply forgot. However, the proportion of participants who made two or more OCM errors, was relatively low, ranging from 6.1% to 10.8%, and no subject provided medical or drug information which indicated dementia. Currently, the prevalence of Alzheimer's disease and other dementias across the US is estimated to be approximately 14% (Plassman et al. 2007). Since none of the participants in the current study indicated dementia in their medical histories, it is unlikely that forgetfulness played a large role in their recall of awareness and experience. With regards to the current study, it is not known why the numbers of drivers with dementia are under represented with respect to the general population; however, given the stigma associated with dementia it is possible that under-reporting may have occurred.

Overall, the study was strengthened by good participation. We attempted to contact 1,280 people and 669 (52.3%) participated; of the respondents interviewers were able to contact (e.g., those who answered their phone within 10 call attempts, had valid phone numbers, and who were not institutionalized), 70.8% participated. Equivalent numbers of men and women participated and 94.2% were current drivers. It is likely that study participants have higher socio-economic status than the general Alabama population. For example, compared to recent census estimates of older Alabama

adults (60+ years), more study participants were White race (87.5% versus 80.0%), and fewer were Black race (11.2% versus 19.0%) (ADSS 2007). Furthermore, participants had higher education attainment; 92.6% had a high school diploma or greater, compared to 58.4% of older Alabama adults; similarly, 32.1% of study participants had a bachelors degree or greater compared to only 12.6% of older Alabama adults. Differences between study participants and the general population are likely due to the fact that the study sample was identified through a national list brokerage firm that obtained identifying information from consumer credit companies (Pinpoint Technologies). Since our results suggest that participants with low educational attainment are more likely to lack awareness and our sample under represents this group, it is likely that that lack of awareness is even more prevalent in the general population.

The current study provides insights into older adults' knowledge about PDI medications. Our results indicate a need for substantially more patient education regarding PDI medications and the need to pay more attention to PDI medications as a safety issue. Results support increased education efforts directed towards older drivers, their families, and healthcare professionals.

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Table 1. Demographic characteristics by survey participation status

Characteristic	Participated	Refused*	Ineligible†	Total	P-Value
N (%)	669 (52.3)	485 (37.9)	126 (9.8)	1,280 (100)	
Women					0.0042
55-64	51.5	45.4	3.1	227	
65-74	57.8	34.8	7.4	204	
75+	62.6	29.1	8.4	179	
Men					0.0174
55-64	43.0	44.9	12.2	263	
65-74	52.9	36.8	10.3	204	
75+	49.8	32.5	17.7	203	
Ethnicity (N, %)					0.5292
Caucasian	51.6	38.2	10.2	1,081	
African American	54.4	37.4	8.2	182	
Other	70.6	5.9	23.5	17	
Education (years, SD)	12.7 (1.57)	12.8 (1.58)	12.6 (1.31)	12.7 (1.55)	0.6607

* Directly refused or limit of 10 call attempts was met
† Invalid phone number or subject was hospitalized and unable to participate

Table 2. Demographic characteristics of survey respondents reporting any awareness, experience or healthcare worker warning of PDI compared to other respondents

Characteristics	Awareness, experience, or healthcare worker warning		P-value
	Any	None	
N (%)	245 (38.9)	385 (61.1)	
Mean age (SD)	67.5 (7.8)	72.1 (8.6)	<0.0001
Male (%)	45.3	52.0	0.1040
Racial group (%)			0.3243*
White	84.9	88.6	
Black	12.2	8.6	
Other	2.9	2.91	
Marital status (%)			0.5880*
Married	74.6	69.5	
Single	5.6	3.0	
Separated/divorced	7.8	7.0	
Widowed	12.1	20.5	
Employment (%)			0.0662*
Retired full time	60.6	68.6	
Retired/work part time	16.5	11.3	
Non-retired	22.9	20.2	
Education (%)			0.0042*
Less than 12^{th} grade	3.9	9.8	
High School	28.7	39.3	
Some college	28.7	23.1	
College degree and above	38.7	27.9	

* Adjusted for age and gender

Table 3. Orientation, concentration and memory (OCM); numbers of medical conditions, medications and prescription medications among survey respondents reporting awareness, experience and healthcare worker warning of PDI compared to other respondents

Characteristics	Awareness, experience, or healthcare worker warning: Any	None	P-value*
N (%)	245 (38.9)	385 (61.1)	
Number of OCM errors (%)			0.9737
0	60.0	58.2	
1	32.7	31.7	
2	6.1	7.5	
3	1.2	1.8	
4	0.0	0.8	
Medical conditions (%)			0.4456
0	5.3	5.4	
1-2	29.8	30.1	
3-4	30.6	30.9	
5+	34.3	33.5	
Medications (%)			0.7421
0	20.0	23.1	
1-2	35.9	33.8	
3-4	25.3	23.9	
5+	18.8	19.2	
Prescription medications (%)			0.5690
0	27.8	29.4	
1-2	38.4	38.4	
3-4	23.3	19.2	
5+	10.6	13.0	
Prescription medications with potential to cause side-effects (%)			0.6555
0	31.0	31.4	
1-2	38.4	40.5	
3-4	21.1	17.4	
5+	9.4	10.7	

* Adjusted for age and gender

Table 4. Driving habits among survey respondents reporting awareness, experience and healthcare worker warning of PDI compared to other respondents

Characteristics	Awareness, experience, or healthcare worker warning: Any	None	P-value*
N (%)	245 (38.9)	385 (61.1)	
Prefer to get around (%)			0.9148
Drive self	92.7	91.8	
Have someone else drive	6.5	8.2	
Public transportation/taxi	0.8	0.0	
Has anyone suggested driving be limited or stopped? (%)	3.3	3.2	0.4613
If yes, who? (%)			
Doctor	25.0	30.0	
Family	75.0	70.0	
How do you rate your driving? (%)			0.5370
Excellent	48.0	38.9	
Good	44.7	49.6	
Average, fair or poor	7.4	11.5	
If you could not drive, what would you do? (%)			0.6051
Ask a friend or family to drive	73.0	77.7	
Taxi or bus	2.9	1.6	
Drive self regardless	13.1	12.5	
Cancel/postpone plans	9.8	6.9	
Other	1.2	1.3	

* Adjusted for age and gender

Table 5. Driving exposure among survey respondents reporting awareness, experience and healthcare worker warning of PDI compared to other respondents

	Awareness, experience, or healthcare worker warning		
Exposure characteristics	Any	None	P-value*
Average days driving in a week (SD)	5.6 (1.92)	5.4 (1.95)	0.5596
Typical number of days/week driving (%)			0.4052
1-5	36.5	42.3	
6 - 7	63.5	57.7	
Miles normally drive in an average week			
Mean (SD)	133 (154)	139 (299)	0.1035
Median	84	70	0.0167

* Adjusted for age and gender

Table 6. Driving avoidance within 3 months before interview among survey respondents reporting awareness, experience and healthcare worker warning of PDI compared to other respondents

	Awareness, experience, or healthcare worker warning		
Avoidance due to:	Any	None	P-value*
Any driving avoidance	49.0	46.8	0.0983
Avoidance due to health	16.7	12.2	0.0126
Rain	15.9	15.4	0.3983
Avoidance due to health	17.5	8.8	0.1660
Driving alone	6.6	4.3	0.3334
Avoidance due to health	56.3	25.5	0.0532
Left-hand turns across traffic	6.5	8.2	0.9663
Avoidance due to health	25.0	6.7	0.0782
Interstates or expressways	13.5	12.5	0.2678
Avoidance due to health	21.2	11.4	0.1653
High-traffic road	12.7	14.4	0.7227
Avoidance due to health	16.1	7.7	0.3677
Rush-hour traffic	25.0	23.9	0.2552
Avoidance due to health	11.5	8.0	0.2424
Driving at night	30.2	28.1	0.1148
Avoidance due to health	48.0	40.0	0.2433

* Adjusted for age and gender

Table 7. History of falls and activities of daily life* among survey respondents reporting awareness, experience and healthcare worker warning of PDI compared to other respondents

	Awareness, experience, or healthcare worker warning		
Health status	Any	None	P-value[†]
Experienced fall in last year? (%)	16.9	14.0	0.1562
Among those, avg. number of falls (SD)?	2.2 (2.7)	1.6 (1.3)	0.6230
Proportion that have sought medical attention for falls (%)	61.5	58.8	0.8751
Difficulty in activities of daily life* (%)			
Washing and bathing self	1.7	0.5	0.5693
Dressing and undressing	0.8	0.3	0.3000
Using lavatory	0.8	0.3	0.3000
Getting in and out of bed	1.2	1.3	0.9878
Feeding self	0.4	0.3	0.9878
Walking between rooms	2.1	2.4	0.6135
One or more difficulties (%)	2.9	2.9	0.5974
Mobility difficulty (%)			
Moving outdoors	10.0	9.3	0.8912
Using stairs	16.6	14.9	0.8745
Walking at least ¼ mile	15.4	15.9	0.9795
Carrying heavy objects	25.4	24.3	0.6934
One or more difficulties (%)	67.8	70.4	0.6797

* Modified Katz ADL scale
[†] Adjusted for age and gender

Table 8. Awareness, experience, and healthcare provider warning of side effects among current drivers

Question	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
Awareness	27.6	48.3	26.3	14.1	32.4	25.2	13.0
Experience	8.4	16.7	7.9	4.7	10.0	4.9	4.4
Healthcare provider warning about medications and driving? (%)	17.6	23.9	16.7	8.2	21.8	14.7	17.8
If warned, by who? (%)							
Doctor	66.3	61.5	66.7	57.1	68.2	83.3	62.5
Nurse	3.0	7.7	5.6	0.0	0.0	0.0	0.0
Pharmacist	12.9	11.5	16.7	14.3	18.2	0.0	25.0
Other/unsure	17.8	19.2	11.1	28.6	13.6	16.7	25.0
Any awareness, experience, or warning	38.9	60.9	39.1	21.4	46.4	33.0	25.8

Table 9. Awareness, experience, and healthcare provider warning of side effects by number of current prescription PDI medications among current drivers

	Number of prescription medications with potential to cause side-effects				
Question	0	1-2	3-4	5+	P-trend*
N (%)	197 (31.3)	250 (39.7)	119 (18.9)	64 (10.2)	
Awareness	29.4	28.2	26.5	21.9	0.2484
Experience	7.4	8.1	10.3	9.4	0.4196
Healthcare provider warning about medications and driving? (%)	17.6	13.8	25.0	18.8	0.2578
Any awareness, experience, or warning	38.6	37.6	43.7	35.9	0.8259
If warned, by who? (%)					
Doctor	36.4	48.6	37.9	33.3	
Nurse	3.0	0.0	3.5	0.0	
Pharmacist	27.3	14.3	20.7	25.0	
Other (e.g., dentist, unsure)	33.3	37.1	37.9	41.7	

*Cochran-Armitage Trend Test

Table 10. Awareness, experience and healthcare worker warning, medical conditions, and prescription medications with potential to cause side-effects among current drivers taking any prescription or OTC PDI medications.

		Women			Men		
	Total (n=476)	55-64 (n=84)	65-74 (n=95)	75+ (n=78)	55-64 (n=72)	65-74 (n=78)	75+ (n=69)
Awareness, Experience, and Healthcare worker warning (%)							
Awareness	27.0	56.0	26.3	13.2	28.2	24.7	8.8
Experience	8.5	19.0	7.4	3.9	9.9	5.2	4.4
Healthcare provider warning about medications and driving?	16.9	22.9	13.7	9.2	23.9	14.5	17.9
Any-AEW	38.9	66.7	37.9	21.8	45.8	33.3	24.6
Medical conditions (%)							
0	1.5	4.8	1.1	0.0	2.8	0.0	0.0
1-2	22.5	32.1	18.9	9.0	41.7	19.2	14.5
3-4	34.5	36.9	40.0	30.8	31.9	35.9	29.0
5+	41.6	26.2	40.0	60.3	23.6	44.9	56.5
Prescription Medications with potential to cause side-effects* (%)							
0	9.0	13.1	7.4	3.8	9.7	12.8	7.2
1-2	52.5	50.0	49.5	57.7	58.3	51.3	49.3
3-4	25.0	25.0	28.4	20.5	20.8	28.2	26.1
5+	13.4	11.9	14.7	17.9	11.1	7.7	17.4

APPENDICES

Appendix A
AAA Foundation for Traffic Safety
Survey of Older Drivers

Name: _____
DL #: _____
Phone # _____

Hello, my name is _____, and I am calling from the Department of Ophthalmology at the University of Alabama at Birmingham.

May I please speak to _____?

1. *Yes*

Date Completed Survey	Comments	Interviewer
__ / __ / _____		

2. *No*
3. *Does not reside at this location.*

Hello. On behalf of the AAA (pronounced "Triple A") Foundation for Traffic Safety we are conducting a survey to learn more about the health of older drivers, their current medication use as well as their driving history. Would you allow me to ask you a few questions, this survey should last no more than 10-15 minutes.

1. *Yes _____ Great, thank you, let's get started.*
2. *No _____ When would be a better time to call you back?*

_____

3. *Refused* _____

Thank you for your honest responses to the following questions. Your responses are completely confidential and will not have any impact on your medical care or ability to continue driving

Current Driver
Do you currently drive?
(1) _____yes
(2) _____no

If NO, proceed with the next short section (a through e) about why stopped, when last drove, and knowledge and beliefs. Finally, ask Q1-Q6 Demographic information.

a. Why did you stop driving?

b. When was the last time your drove?

Record the date (MM/YY)_____

c. Are you aware of any medications that may cause side effects when you drive?

(1) _____ Yes
Please specify medication (s)_____
_____
_____
_____

(2) _____ No

d. Before you stopped driving, had you noticed that any medications you take affect your ability to drive (i.e. cause drowsiness, blurs vision, causes headaches, etc)?

(1) _____ Yes
Please specify medication (s)_____
_____
_____
_____
For each medication, please provide details about what the problems were?
_____
_____
_____
_____

(2) _____ No

e. Before you stopped driving, had a health care provider (doctor, nurse, pharmacist) spoken with you about possible side effects of taking any medication and driving?
(1)_____yes
Please tell us what each specific person told you?
_____
_____
_____

(2)_____no

Go to Q1-Q6, Demographics.

First / Now (if not currently driving), I'd like to get some general information.

Demographic Information

1. What is your date of birth? ____/____/_____
MM DD YYYY

2. What is your gender?
1. Male
2. Female

3. Are you of Hispanic origin (Yes/No)

4. What is your primary race?
1. White
2. Black
3. Asian
4. American Indian
5. Other, please specify: _____

5. What is your marital status?
1. Married
2. Single
3. Living separated

4. Divorced
5. Widowed
6. Living together/not married

6. What is your current employment status?
   1. Retired and not working at all
   2. Retired but working part time or more
   3. Non-retired

7. What is your highest level of education completed?
   1. Less that 9th grade
   2. 9th grade-11th grade
   3. 12th grade (High School)
   4. Some college
   5. College degree
   6. Graduate / professional degree

If subject has previously answered NO to Current Driver question, thank them for their participation and end the survey.

Now I am going to read a list of health conditions and ask if you have any of them. If you do, I will ask about your current prescription and over the counter medication use. You will not be asked any specific details about health conditions which you may have.

8. Has a doctor ever told you that you have any heart problems?
   1. Yes
   2. No

   If yes, are you taking medications for any heart problems?

   8a. If yes, what medications:

   _____

9. Has a doctor ever told you that you have any circulation problems?
   1. Yes
   2. No

   If yes, are you taking medications for any circulation problems?

   9a. If yes, what medications:

   _____

10. Has a doctor ever told you that you have high blood pressure?
    1. Yes
    2. No

    If yes, are you taking medications for high blood pressure?

    10a. If yes, what medications:

    _____

11. Has a doctor ever told you that you have low blood pressure?
    1. Yes
    2. No

    If yes, are you taking medications for low blood pressure?

    11a. If yes, what medications:

    _____

12. Has a doctor ever told you that you have diabetes?
    1. Yes
    2. No

If yes, are you taking medications for diabetes?

12a. If yes, what medications:

_____

13. Do you have numbness in your feet?

1. Yes
2. No

If yes, are you taking medications for numbness in your feet?

13a. If yes, what medications:

_____

14. Has a doctor ever told you that you have arthritis?

1. Yes
2. No

If yes, are you taking medications for arthritis?

14a. If yes, what medications:

_____

15. Has a doctor ever told you that you have weak bones (e.g., osteoporosis)?

1. Yes
2. No

If yes, are you taking medications for osteoporosis?

15a. If yes, what medications:

_____

16. Has a doctor ever told you that you have cancer?

1. Yes
2. No

If yes, are you taking medications for any form of cancer?

16a. If yes, what medications:

_____

17. Has a doctor ever told you that you have any lung or chest problems?

1.Yes
2. No

If yes, are you taking medications for any lung or chest problems?

17a. If yes, what medications:

_____

18. Has a doctor ever told you that you have any stomach or problems digesting?

1. Yes
2. No

If yes, are you taking medications for any stomach problems?

18a. If yes, what medications:

_____

19. Has a doctor ever told you that you have any urinary problems?

1. Yes
2. No

If yes, are you taking medications for any urinary problems?

19a. If yes, what medications:

_____

20. Has a doctor ever told you that you have any kidney problems?
    1. Yes
    2. No
    If yes, are you taking medications for kidney problems?
    20a. If yes, what medications:
    _____

21. Do you have any problems hearing?
    1. Yes
    2. No
    If yes, are you taking medications for hearing loss?
    21a. If yes, what medications:
    _____

22. Has a doctor ever told you that you have glaucoma?
    1. Yes
    2. No
    If yes, are you taking medications for glaucoma?
    22a. If yes, what medications:
    _____

23. Has a doctor ever told you that you have macular degeneration?
    1. Yes
    2. No
    If yes, are you taking medications for macular degeneration?
    23a. If yes, what medications:
    _____

24. Has a doctor ever told you that you have cataracts?
    1. Yes
    2. No
    If yes, are you taking medications for cataracts?
    24a. If yes, what medications:

---

25. Has a doctor ever told you that you have an eye disease because of diabetes? (such as diabetic retinopathy)?
    1. Yes
    2. No
    If yes, are you taking medications for an eye disease caused by diabetes (such as diabetic retinopathy)?
    25a. If yes, what medications:
    _____

26. Has a doctor ever told you that you have sleep problems, for example, insomnia?
    1. Yes
    2. No
    If yes, are you taking medication for sleep problems?
26a. If yes, what medications:
    _____

27. Has a doctor ever told you that you have depression?

1. Yes
2. No

If yes, are you taking medication for depression?

27a. If yes, what medications:

_____

28. Has a doctor ever told you that you have any neurological or nervous system problems?
(Ex: stroke, seizures or Parkinson's disease)
1. Yes
2.No

If yes, are you taking medications for neurological or nervous system problem ☐

28a. If yes, what medications

_____

29. Has a doctor ever told you that you have any other condition that was not previously mentioned?
1. Yes
2. No ☐

If yes, are you taking medications for any other conditions that were not previously mentioned?

29a. Condition #1: _____
What medications _____
_____

29b. Condition #2: _____

What medications _____
_____

29c. Condition #3: _____

What medications _____
_____

30. In the past year, did you ever fall to the floor or the ground?

1.	yes	
2.	no	Skip to ADL questions
3.	DK/NS	Skip to ADL questions
4.	Ref	Skip to ADL questions

31. How many times have you fallen in the last year?

1.	_____ Times	
2.	DK/NS	Skip to ADL questions
3.	Ref	Skip to ADL questions

32. How many of the falls that you mentioned required medical attention?

1.	_____ Falls	
2.	DK/NS	Skip to ADL questions
3.	Ref	Skip to ADL questions

33. I am now going to list several activities that you may do each day. I would like to know whether you need help or have difficulty with any of the following activities?

Do you need help or have difficulty:	Yes	No	DK/NS	REF
Moving outdoors?	1	2	8	9
Using stairs?	1	2	8	9
Walking at least ¼ mile?	1	2	8	9
Carrying heavy objects for 100 yards?	1	2	8	9
Walking between rooms?	1	2	8	9
Feeding yourself?	1	2	8	9
Getting in and out of bed?	1	2	8	9
Using the lavatory?	1	2	8	9
Dressing and undressing?	1	2	8	9
Washing and bathing yourself?	1	2	8	9

Now I am going to ask you questions about your driving habits. After each question I will read you a list of possible answers. Please choose the response that best describes your situation.

Driving Habits Questionnaire

Current Driving Questions

34. Which way do you prefer to get around? Would you say:

_____ (3) drive yourself
_____ (2) have someone drive you
_____ (1) use public transportation or a taxi

35. Has anyone suggested over the past year that you limit your driving or stop driving?
_____ (1) yes if yes, "who?" Please record and allow for multiple answers (e.g. spouse, children, family, doctor, other).

_____

_____ (0) no

36. How would you rate the quality of your driving? Would you say:
_____(5) Excellent
_____(4) Good
_____(3) Average
_____(2) Fair

_____(1) Poor

37. If you had to go somewhere and didn't want to drive yourself, what would you do? Would you:
_____(1) Ask a friend or relative to drive you
_____(2) Call a taxi or take the bus
_____(3) Drive yourself regardless of how you feel
_____(4) Cancel or postpone your plans and stay home
_____(5) Other (specify):

Exposure

38. In an average **week**, how many days per week do you normally drive?
_____ number of days per week

39. In an average week, how many miles do you normally drive?

40. What is the longest trip you've taken in the past two years? (one-way direction)

Interviewer may need to follow-up with mileage chart after the survey. For example if the answer is Macon Georgia; check mileage charts to approximate the miles.

Avoidance

41) During the past 3 months, did you avoid driving when it was raining?
_____Yes _____No

If YES, follow-up with the following question:
Was your avoidance due to your health?
_____Yes _____No

42) During the past 3 months, have you avoided driving alone?
_____Yes _____No

If YES, follow-up with the following question:

Was your avoidance due to your health?
_____Yes _____No

43) During the past 3 months, have you avoided making left-hand turns across oncoming traffic?
_____Yes _____No

If YES, follow-up with the following question:

Was your avoidance due to your health?
_____Yes _____No

44) During the past 3 months, have you avoided driving on interstates or expressways?
_____Yes _____No

If YES, follow-up with the following question:

Was your avoidance due to your health?

_____Yes _____No

45) During the past 3 months, have you avoided driving on high-traffic roads?
_____Yes _____No

If YES, follow-up with the following question:

Was your avoidance due to your health?
_____Yes _____No

46) During the past 3 months, have you avoided driving in rush-hour traffic?
_____Yes _____No

If YES, follow-up with the following question:

Was your avoidance due to your health?
_____Yes _____No

47) During the past 3 months, have you avoided driving at night?
_____Yes _____No

If YES, follow-up with the following question:

Was your avoidance due to your health?
_____Yes _____No

Now I am going to ask you questions about your knowledge of medication and possible side effects. Please choose the response that best describes your situation.

48. Are you aware of any medications that may cause side effects when you drive?

(1) _____ Yes
Please specify medication (s)_____
_____
_____

(2) _____ No

49. Have you noticed that any of your medications affect your ability to drive (i.e. cause drowsiness, blurs vision, causes headaches, etc)?

(1) _____ Yes
Please specify medication (s)_____
_____
For each medication, please provide details about what the problems were?
_____

(2) _____ No

50. Has a health care provider (doctor, nurse, pharmacist) spoken with you about possible side effects of taking any medication and potential impacts on driving?
(1)_____ Yes
Please tell us what each specific person told you?

_____

(2)_____ No

Now I would like to ask you some questions about your memory.

Orientation, memory and cognition (OMC)

51. What year is it now? _____
    1. Correct
    2. Incorrect
    3. Refused to answer

52. What month is it now? _____
    1. Correct
    2. Incorrect
    3. Refused

Memory phrase. Repeat this phrase after me: John Brown, 42 Market Street, Chicago

53. About what time is it? (within one hour) _____
    1. Correct
    2. Incorrect
    3. Refused to answer

54. Count backward from 20 to 1.
    1. Correct
    2. Incorrect
    3. Refused to answer

55. Say the months of the year in reverse order.
    1. Correct
    2. Incorrect
    3. Refused to answer

56. Repeat the memory phrase.
    1. Correct
    2. Incorrect
    3. Refused to answer

This concludes our survey. Thank you for your participation.

Appendix B

Table B1. Demographic characteristics of current drivers

Characteristic	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
Age							
Mean	70.4 (8.6)	60.4 (2.4)	69.9 (2.5)	80.8 (4.0)	60.3 (2.2)	70.3 (2.3)	80.6 (4.1)
Median	70.0	60.4	69.7	79.7	60.4	70.7	80.0
Racial group (%)							
White	87.5	82.0	87.5	87.5	88.1	86.3	94.6
Black	11.2	17.1	9.8	12.5	10.1	13.7	3.3
Other	1.3	0.9	2.7	0.0	1.8	0.0	2.2
Marital status (%l)							
Married	71.5	77.8	56.0	38.4	89.8	84.2	78.0
Single	4.0	8.3	5.5	3.5	1.9	2.0	2.2
Separated/divorced	7.3	9.3	8.3	12.8	6.5	6.9	0.0
Widowed	17.3	4.6	30.3	45.4	1.9	6.9	19.8
Employment (%)							
Retired full time	65.5	45.4	77.5	88.6	40.4	67.0	80.4
Retired/work part time	13.3	13.9	10.8	5.7	12.8	23.0	13.0
Non-retired	21.2	40.7	11.7	5.7	46.8	10.0	6.5
Education (%)							
Less than 12th grade	7.4	4.7	9.2	14.8	0.0	5.2	12.4
High School	35.4	37.7	51.4	37.5	24.1	34.4	25.8
Some college	25.2	20.8	24.8	26.1	30.6	21.9	27.0
College degree	19.8	20.8	11.9	18.2	30.6	18.8	18.0
Graduate or professional degree	12.3	16.0	2.8	3.4	14.8	19.8	16.9

Table B2. Among current drivers - Orientation, concentration and memory (OCM); numbers of medical conditions, medications and prescription medications.

		Women			Men		
	Total (n=630)	55-64 (n=115)	65-74 (n=115)	75+ (n=89)	55-64 (n=112)	65-74 (n=106)	75+ (n=93)
Number of OCM errors (%)							
0	58.9	58.3	59.1	57.3	66.1	59.4	51.6
1	32.1	33.0	34.8	32.6	25.0	30.2	37.6
2	7.0	7.0	5.2	7.9	8.0	8.5	5.4
3	1.6	1.7	0.9	2.3	0.9	1.9	2.2
4	0.5	0.0	0.0	0.0	0.0	0.0	3.2
Medical conditions (%)							
0	5.4	11.3	1.7	0.0	8.0	6.6	3.2
1-2	30.0	38.3	25.2	14.6	47.3	27.4	22.6
3-4	30.8	28.7	38.3	31.5	27.7	30.2	28.0
5+	33.8	21.7	34.8	53.9	17.0	35.9	46.2
Medications (%)							
0	21.9	24.4	16.5	10.1	31.3	24.5	22.6
1-2	34.6	38.3	28.7	33.7	37.5	39.6	29.0
3-4	24.4	21.7	31.3	27.0	20.5	22.6	23.7
5+	19.1	15.7	23.5	29.2	10.7	13.2	24.7
Prescription Medications (%)							
0	28.7	34.8	19.1	14.6	37.5	34.0	30.1
1-2	38.4	35.7	42.6	46.1	40.2	34.0	32.3
3-4	20.8	19.1	26.1	20.2	13.4	24.5	21.5
5+	12.1	10.4	12.2	19.1	8.9	7.6	16.1
Prescription Medications with potential to cause side-effects* (%)							
0	31.3	36.5	23.5	15.7	42.0	35.9	31.2
1-2	39.7	36.5	40.9	50.6	37.5	37.7	36.6
3-4	18.9	18.3	23.5	18.0	13.4	20.8	19.4
5+	10.2	8.7	12.2	15.7	7.1	5.7	12.9

Appendix B

Table B3. Driving habits by gender-age group

Driving habits characteristics	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
Prefer to get around (%)							
Drive self	92.1	88.7	88.6	90.7	95.5	94.2	95.7
Have someone else drive	7.6	10.4	10.5	9.3	4.5	5.8	4.4
Public transportation/taxi	0.3	0.9	0.9	0.0	0.0	0.0	0.0
Has anyone suggested driving be limited or stopped? (%)	3.2	2.6	0.0	4.7	4.5	0.0	8.8
Suggested by (%):							
Doctor	28.6	0.0	0.0	0.0	50.0	0.0	33.3
Family	71.4	100.0	0.0	100.0	50.0	0.0	66.7
How do you rate your driving? (%)							
Excellent	42.5	51.8	36.6	20.7	63.4	37.3	39.1
Good	47.7	43.9	55.4	65.5	30.4	50.0	44.6
Average, fair or poor	9.8	4.4	8.0	13.8	6.3	12.8	16.3
If you could not drive, what would you do? (%)							
Ask a friend or family to drive	75.9	84.4	78.1	83.9	72.3	68.0	67.8
Taxi or bus	2.1	1.7	1.8	1.2	3.6	1.9	2.2
Drive self regardless	12.7	6.1	10.5	6.9	13.4	20.4	20.0
Cancel/postpone plans	8.1	7.8	9.7	5.8	8.0	8.7	7.8
Other	1.3	0.0	0.0	2.3	2.7	1.0	2.2

Appendix B

Table B4. Driving exposure by gender-age group

Exposure characteristics	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
Average days driving in an average week (SD)	5.5 (1.9)	5.6 (1.8)	4.7 (2.1)	4.5 (2.0)	6.3 (1.4)	6.0 (1.8)	5.6 (1.9)
Typical number of days/week driving (%)							
1-5	40.0	40.4	49.8	62.8	20.6	26.5	33.0
6 - 7	60.0	59.6	50.2	37.2	79.4	73.5	67.0
Average miles driven per week							
Mean (SD)	137 (252)	140 (218)	73 (78)	54 (65)	267 (452)	142 (223)	115 (136)
Median	75	75	50	30	150	100	80
Longest trip (1 way) in past 2 years							
Mean (SD)	354 (418)	357 (410)	180 (313)	95 (129)	600 (466)	458 (465)	374 (382)
Median	250	258	85	40	500	328	250

Table B5. Prevalence of reported medical conditions among current drivers by gender-age group

Medical conditions (%)	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
Heart	31.2	16.5	27.4	39.3	25.2	33.0	52.7
Circulation	11.5	7.9	10.7	16.9	7.1	10.4	18.3
High BP	60.0	52.2	67.3	73.0	56.3	61.3	51.6
Low BP	2.2	4.4	0.0	1.1	3.6	2.9	1.1
Diabetes	18.7	14.8	19.3	13.5	14.4	31.1	18.5
Foot numbness	12.0	11.3	12.3	14.8	12.6	12.3	8.6
Arthritis	45.1	36.5	58.8	58.4	27.0	44.3	48.4
Osteoporosis	13.9	21.7	21.2	30.3	4.6	2.9	3.2
Cancer	18.5	13.9	15.0	23.6	10.0	21.7	30.1
Lung	11.2	7.8	11.5	13.5	6.4	10.5	19.4
Stomach	24.7	23.5	32.7	23.9	20.0	25.7	21.5
Urinary	12.0	7.0	4.4	13.6	8.3	19.1	22.6
Renal	6.1	6.1	0.9	9.1	3.7	9.5	8.6
Hearing	22.7	5.2	17.7	20.5	21.8	31.1	44.1
Glaucoma	5.5	2.6	6.2	8.1	4.6	2.9	9.7
Cataracts	38.4	18.3	52.2	74.4	9.8	27.4	58.1
Diabetic eye disease	1.3	0.0	0.9	0.0	0.9	3.9	2.2
Insomnia	21.9	31.3	20.4	18.2	23.6	20.4	15.1
Depression	12.1	18.3	15.9	10.3	10.9	7.8	7.6
Neurologic	6.8	7.0	11.9	19.1	8.2	3.9	8.6
Other	30.0	33.0	33.9	26.1	34.6	23.5	26.9

Table B6. Prevalence of reported medical conditions and current medication use among current drivers by gender-age group

Conditions (%)	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
Heart	31.2	16.5	27.4	39.3	25.2	33.0	52.7
Current med (Y)	60.9	57.9	58.1	60.0	60.7	54.3	69.4
Circulation	11.5	7.9	10.7	16.9	7.1	10.4	18.3
Current med (Y)	36.1	22.2	25.0	33.3	50.0	45.5	41.2
High BP	60.0	52.2	67.3	73.0	56.3	61.3	51.6
Current med (Y)	85.4	85.0	89.5	93.9	81.0	75.4	87.5
Low BP	2.2	4.4	0.0	1.1	3.6	2.9	1.1
Current med (Y)	21.4	20.0	0	0	0	33.3	100.0
Diabetes	18.7	14.8	19.3	13.5	14.4	31.1	18.5
Current med (Y)	76.1	88.2	86.4	66.7	75.0	75.8	58.8
Foot numbness	12.0	11.3	12.3	14.8	12.6	12.3	8.6
Current med (Y)	25.3	23.1	35.7	15.4	35.7	30.8	0
Arthritis	45.1	36.5	58.8	58.4	27.0	44.3	48.4
Current med (Y)	60.8	71.4	59.7	63.5	43.3	55.3	66.7
Osteoporosis	13.9	21.7	21.2	30.3	4.6	2.9	3.2
Current med (Y)	67.8	68.0	70.8	70.4	40.0	66.7	66.7
Cancer	18.5	13.9	15.0	23.6	10.0	21.7	30.1
Current med (Y)	13.8	25.0	35.3	9.5	0.0	4.4	10.7
Lung problems	11.2	7.8	11.5	13.5	6.4	10.5	19.4
Current med (Y)	40.0	33.3	46.2	50.0	14.3	27.3	50.0
Stomach	24.7	23.5	32.7	23.9	20.0	25.7	21.5
Current med (Y)	69.5	74.1	75.7	71.4	72.7	63.0	55.0
Urinary	12.0	7.0	4.4	13.6	8.3	19.1	22.6
Current med (Y)	48.0	8.3	20.0	41.7	66.7	55.0	47.6
Renal	6.1	6.1	0.9	9.1	3.7	9.5	8.6
Current med (Y)	26.3	14.3	100.0	37.5	0	40.0	12.5
Hearing	22.7	5.2	17.7	20.5	21.8	31.1	44.1
Current med (Y)	0	0	0	0	0	0	0
Glaucoma	5.5	2.6	6.2	8.1	4.6	2.9	9.7
Current med (Y)	58.8	66.7	57.1	57.1	60.0	66.7	55.6
Cataracts	38.4	18.3	52.2	74.4	9.8	27.4	58.1
Current med (Y)	1.2	0	0	0	9.1	3.5	1.9

Table B6. Prevalence of reported medical conditions and current medication use among current drivers by gender-age group

		Women			Men		
Conditions (%)	Total (n=630)	55-64 (n=115)	65-74 (n=115)	75+ (n=89)	55-64 (n=112)	65-74 (n=106)	75+ (n=93)
Diabetic eye disease	1.3	0.0	0.9	0.0	0.9	3.9	2.2
Current med (Y)	37.5	0	0	0	100.0	25.0	50.0
Insomnia	21.9	31.3	20.4	18.2	23.6	20.4	15.1
Current med (Y)	54.4	66.7	60.9	50.0	30.8	47.6	71.4
Depression	12.1	18.3	15.9	10.3	10.9	7.8	7.6
Current med (Y)	60.0	57.1	83.3	22.2	66.7	50.0	57.1
Neurologic	6.8	7.0	11.9	19.1	8.2	3.9	8.6
Current med (Y)	21.4	25.0	0	0	22.2	50.0	37.5
Other	30.0	33.0	33.9	26.1	34.6	23.5	26.9
Current med (Y)	84.4	94.7	84.2	91.3	73.7	91.7	72.0

Table B7. Prevalence of reported drug use among current drivers by gender-age group

Medicines (%)	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
ACE inhibitor	12.7	9.6	17.4	12.2	13.4	9.4	12.9
Angiotensin II receptor antagonist	14.7	13.9	16.5	20.0	13.4	14.2	8.6
Antiarrhythmic agent	1.3	0.0	1.7	1.1	0.0	1.9	3.2
Antibiotic	1.0	0.9	0.0	2.2	0.9	0.9	1.1
Anticoagulant	2.5	0.9	1.7	6.7	0.9	2.8	3.2
Anti cholesterol	2.2	1.7	1.7	5.6	0.0	1.9	3.2
Anti convulsion	2.7	1.7	2.6	1.1	6.3	3.8	0.0
Anti diabetic	2.5	0.9	3.5	2.2	3.6	1.9	2.2
Antihistamine	1.4	2.6	0.0	2.2	1.8	0.0	1.1
Anti hypertension	2.9	0.9	5.2	2.2	1.8	1.9	3.2
Benzodiazepines	3.3	6.1	3.5	2.2	2.7	1.9	2.2
Beta blocker	17.4	12.2	20.9	25.6	13.4	11.3	23.7
Calcium channel blocker	12.4	7.8	16.5	17.8	8.9	12.3	11.8
Cox 2 inhibitor	4.1	0.9	8.7	4.4	2.7	6.6	1.1
Digitalis	1.0	0.9	0.9	1.1	0.0	0.0	3.2
Diuretic	9.2	10.4	9.6	8.9	6.3	6.6	4.3
Dopamine reuptake inhibitor	0.3	0.0	0.9	0.0	0.9	0.0	0.0
Estrogen/hormone	2.2	3.5	6.1	1.1	0.0	0.9	1.1
Eye drops (prescription)	0.3	0.0	0.9	1.1	0.0	0.0	0.0
Histamine H2r antagonist	1.4	0.9	3.5	1.1	0.9	0.9	1.1
Sedative	4.4	7.8	7.0	4.4	1.8	2.8	2.2
Laxative	0.2	0.0	0.0	0.0	0.0	0.0	1.1
Inhaler	5.1	5.2	7.0	7.8	0.9	1.9	8.6
Melatonin agonist (for insomnia)	0.2	0.9	0.0	0.0	0.0	0.0	0.0
Muscle relaxant	0.2	0.0	0.0	0.0	0.0	0.9	0.0
Nitroglycerin	0.3	0.0	0.0	0.0	0.0	0.9	1.1
Non steroidal anti inflammatory	26.0	21.7	30.4	34.4	13.4	21.7	37.6
Opioid	1.0	1.7	0.9	1.1	0.9	0.9	0.0
Osteoporosis medication	7.8	0.9	0.0	1.1	0.0	0.0	0.0
OTC eye medication	0.6	0.0	0.9	1.1	0.0	0.0	2.2
Prokinetic (digestive aid)	0.2	0.0	0.9	0.0	0.0	0.0	0.0
Proton pump inhibitor	12.0	10.4	16.5	14.4	9.8	13.2	7.6
Prost_anlg	0.6	0.0	0.0	0.0	0.9	0.0	2.2
Prostamide	0.5	0.0	0.9	0.0	1.8	0.0	0.0
Restless legs	0.5	1.7	0.0	1.1	0.0	0.0	0.0
Robinul	0.2	0.9	0.0	0.0	0.0	0.0	0.0
Statin	13.6	7.8	13.9	16.7	15.2	10.4	19.4
Steroid	5.2	6.1	8.7	10.0	0.9	0.9	5.4
Supplement	8.1	7.0	9.6	11.1	6.3	5.7	9.7
SSRI	5.7	9.6	9.6	3.3	4.5	2.8	3.2

Table B7. Prevalence of reported drug use among current drivers by gender-age group

Medicines (%)	Total (n=630)	Women 55-64 (n=115)	Women 65-74 (n=115)	Women 75+ (n=89)	Men 55-64 (n=112)	Men 65-74 (n=106)	Men 75+ (n=93)
Synthetic opioid	1.6	2.6	0.9	0.0	3.6	0.9	1.1
Triptans	0.2	0.0	0.0	0.0	0.0	0.9	0.0
Tricyc_ad	1.3	2.6	2.6	0.0	0.9	0.9	0.0
Thyroid	4.0	8.7	6.1	3.3	1.8	0.9	2.2
Topical cream	0.5	0.9	0.0	1.1	0.0	0.0	1.1
Anti gout	0.8	0.0	2.6	2.2	0.0	0.0	0.0
Vasodilator	0.3	0.0	0.9	0.0	0.0	0.0	1.1
Xanthine	0.3	0.0	0.9	0.0	0.0	0.9	0.0

Table B8. Demographic characteristics by number of prescription PDI medications among current drivers

	Number of prescription medications with potential to cause side-effects				
Question	0	1-2	3-4	5+	P-trend*
N (%)	197 (31.3)	250 (39.7)	119 (18.9)	64 (10.2)	
Age					
Mean	69.0	70.7	71.0	71.5	0.0336
Median	69.2	70.1	70.2	71.7	0.0201
Racial group (%)					
White	81.7	87.2	94.1	90.6	0.0033
Black	13.7	10.0	4.2	9.4	0.0359
Other	4.6	2.8	1.7	0.0	0.0338
Male (%)	57.9	46.4	46.2	40.6	0.0078
Marital status (%l)					
Married	74.3	71.8	71.3	62.5	0.4589
Single	4.9	2.9	3.5	6.3	0.8103
Separated/divorced	4.9	7.9	11.3	4.7	0.2840
Widowed	15.9	17.4	13.9	26.6	0.1497
Employment (%)					
Retired full time	54.0	67.2	75.9	73.4	<.0001
Retired/work part time	15.5	14.1	8.6	12.5	0.2373
Non-retired	30.5	18.7	15.5	14.1	0.0012
Education (%)					
Less than 12th grade	7.0	5.6	10.7	10.0	0.2165
High School	32.4	38.8	31.3	33.7	0.0610
Some college	27.0	23.7	29.5	18.3	0.5004
College degree or greater	33.5	31.9	28.6	35.0	0.7836

*Cochran-Armitage Trend Test. For mean values, Linear trend test; for median values, Mann-Kendall trend test.

Table B9. Orientation, concentration and memory (OCM) errors and number of medical conditions, by current number prescription PDI medications among current drivers

	Number of prescription medications with potential to cause side-effects				
Question	0	1-2	3-4	5+	P-trend*
N (%)	197 (31.3)	250 (39.7)	119 (18.9)	64 (10.2)	
Number of OCM errors (%)					0.0239
0	67.0	58.4	51.3	50.0	
1	25.4	31.2	38.7	43.8	
2	6.1	7.6	8.4	4.7	
3	1.5	2.4	0.8	0.0	
4	0.0	0.4	0.8	1.6	
Medical conditions* (%)					<0.0001
0	14.2	2.4	0.0	0.0	
1-2	49.2	30.8	10.1	4.7	
3-4	24.4	38.4	33.6	15.6	
5+	12.2	28.4	56.3	79.7	

*MH Chi-Square for trend

Table B10. Driving habits by respondents' current number of prescription PDI medications

	Number of prescription medications with potential to cause side-effects				
Question	0	1-2	3-4	5+	P-trend*
N (%)	197 (31.3)	250 (39.7)	119 (18.9)	64 (10.2)	
Prefer to get around (%)					
Drive self	94.3	93.6	86.4	90.6	0.9727
Have someone else drive	5.2	6.1	13.6	9.4	0.0227
Public transportation or taxi	0.5	0.4	0.0	0.0	0.3874
Has anyone suggested driving be limited or stopped? (%)	2.1	3.3	5.1	3.2	0.3009
If yes, who? (%)					
Doctor	0.0	37.5	25.0	0.0	
Family	0.0	62.5	75.0	100.0	
How do you rate your driving? (%)					
Excellent	45.5	41.1	44.1	35.9	0.4503
Good	45.0	49.2	48.3	48.4	0.3733
Average, fair or poor	9.5	9.7	7.6	15.6	0.3822
If you could not drive, what would you do? (%)					
Ask a friend or family to drive	71.7	78.6	73.7	81.3	0.1084
Taxi or bus	3.1	2.0	0.9	1.6	0.2341
Drive self regardless	13.6	11.7	13.6	12.5	0.9727
Cancel/postpone plans	9.4	6.9	11.0	3.1	0.4406
Other	2.1	0.8	0.9	1.6	0.5401

*Cochran-Armitage Trend Test

Table B11. Driving exposure by respondents' current prescription PDI medications

	Number of prescription medications with potential to cause side-effects				
Exposure	0	1-2	3-4	5+	P-trend*
Average days driving in a week (SD)?	5.9 (1.7)	5.6 (1.9)	4.9 (2.2)	4.9 (2.0)	<0.0001
Typical number of days/week driving (%)					
1-5	29.4	38.4	48.7	54.7	<0.0001
6 - 7	67.0	59.6	50.4	45.3	0.0002
Average miles driven per week?					
Mean (SD)	199 (368)	113 (171)	121 (215)	77 (75)	0.0005
Median	100	70	60	50	<0.0001

*Cochran-Armitage Trend Test. For mean values, Linear trend test; for median values, Mann-Kendall trend test.