Seniors face serious driving safety and mobility issues.

Keeping Seniors Safe and Mobile

An Evaluation of a Local Drive Test Option

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Summary

This study builds on an earlier AAAFTS-sponsored project to develop a database of state driver licensing policies and practices pertaining to older and/or medically-at-risk drivers. As part of the earlier project, information was gathered on 40 "noteworthy initiatives" being undertaken by the states. The current study evaluated the safety and mobility consequences of one of these initiatives: the offering of local drive tests. Local drive tests (LDTs) are an alternative to standard road tests typically offered by state driver licensing agencies. LDTs allow some drivers who otherwise might not qualify to renew their licenses the option of taking a road test near their homes, on familiar roadways, and/or to specific destinations they want or need to access. Drivers who pass this more limited road test are then restricted to driving only within the specific area or radius where they were tested, and often have additional restrictions placed on their licenses.

This study evaluated LDTs using data provided by the Iowa Office of Driver Services. ODS staff identified 239 drivers who took LDTs between January 2005 and August 2008 inclusive. Of these, 236 were age 65 or older and 205 went on to hold an LDT license. The median age for these 205 case drivers was 85, and almost two-thirds were female. Although 43% of the LDT license recipients lived in rural areas or small towns with populations less than 2,500, this was not dissimilar from the overall population of Iowa residents. In addition to their area restrictions (most often either 5 or 10 miles of their homes, or within the city limits of their communities), 44% of LDT license recipients were also restricted to no nighttime driving, 35% to operating their vehicle below a certain speed (or only on roadways with speed limits not exceeding a certain level), and 15% to no Interstate or freeway driving. The average period of time the 205 LDT drivers held their licenses was 2.3 years; however, this number does not take into account some drivers who held LDT licenses prior to the January 2005 beginning of the study, and others who were still holding a valid LDT license at the end of the study period.

Each case driver's period of driving exposure was determined based on the issue date for their LDT license (start date for exposure) and the date of license expiration, surrender, suspension or cancellation, or the death of the driver (end date of exposure). Drivers who were alive and still held a valid license at the end of the study period were assigned an exposure end date of December 31, 2010, allowing for at least two full years of follow-up for each LDT driver. A 4:1 control sample of non-LDT drivers was identified matched on age (plus or minus one year), gender, and residential city/town population (5 categories). Control drivers were also required to possess a valid driver's license during their corresponding case driver's period of exposure.

Eleven case drivers were involved in 13 crashes during the study period, and were judged to be either solely (10) or jointly (1) at fault in 11 of these crashes. This translates to an overall annual crash involvement rate of 0.0284, and an at-fault annual crash involvement rate of 0.0240. Corresponding rates for the control drivers were 0.0196 (all crashes) and 0.0087 (at-fault crashes). Risk ratios and 95% confidence intervals comparing the two were 1.44 (0.77-2.72) for total crashes, and 2.75 (1.28-5.93) for at-fault crashes. Similarly, the

relative risk of conviction for a moving violation for LDT vs. non-LDT drivers was 0.55 (0.16 – 1.82). Although these results show LDT drivers to have a modestly elevated risk of at-fault crash involvement, their overall crash rate of 0.0284 is only slightly higher than that for all Iowa drivers ages 65+, and lower than that for other groups of drivers, including younger drivers and males. Taken together, findings from this study suggest that local drive test licenses, at least as offered in Iowa, are a viable option for extending mobility to some older drivers, without posing undue safety risks to either the drivers themselves or to others sharing the roadway.

Introduction

Project Rationale and Background

By the year 2030, 19 percent of the U.S. population, and 22 percent of its licensed drivers, will be age 65 or older (Vincent and Velcoff, 2010; Lyman, Ferguson, Braver and Williams, 2002). Contrary to initial expectations, this increase in the proportion of older drivers seems unlikely to lead to large increases in the numbers of traffic crashes and associated injuries and fatalities. Recent research by the Insurance Institute for Highway Safety shows that older drivers have a lower overall crash involvement rate, and lower rates of both serious and moderate/minor injury crashes per 100,000 licensed drivers, than do middle-aged drivers. In addition, older drivers' rate of fatal crash involvement per licensed driver has declined steeply over the past decade, so that it is now only slightly higher than that for middle-aged drivers, despite older drivers' increased fragility once involved in a crash (Cheung and McCartt, 2011).

This is not to say that the aging of the driving population does not present challenges. Increased age is associated with a decline in many functional abilities identified as important for driving including vision, reaction time, and the ability to divide attention between tasks. With age there is also an increase in the occurrence of chronic medical conditions, and in the use of medications for their treatment. But persons age differently, so that not everyone's driving ability will be affected in the same way and to the same extent. The challenge becomes one of identifying those drivers whose functional impairments place them at increased risk of crashing, and intervening to lower their crash risks. The overall goal is to assist older adults in continuing to drive as long as they can do so safely; in other words, to improve safety as well as mobility for future older drivers.

In 2008, the AAA Foundation for Traffic Safety sponsored the North American License Policies Workshop (Eby and Molnar, 2008). The Workshop had three primary objectives: to synthesize current knowledge, develop consensus-based recommendations, and inform a robust research agenda aimed at improving older driver safety. Since the Workshop the Foundation has continued to make older driver safety a cornerstone of its research mission.

The current project was a follow-on to an earlier Foundation-funded project to create a national database of state driver licensing policies and practices pertaining to older and/or medically-at-risk drivers (see Stutts and Wilkins, 2009: also, the online database available at http://lpp.seniordrivers.org/lpp/).[1] As part of this earlier project, information was gathered on 40 "noteworthy initiatives" being undertaken by the states. A listing of these initiatives appears in *Appendix A.*

The overall goal of the current project was to encourage more widespread adoption by state driver licensing agencies of some of the most promising noteworthy initiatives. In some cases, however, it was felt that the safety and mobility consequences of an initiative should be evaluated prior to promoting it to other states. A decision was made to focus the current project on an evaluation of one of these initiatives, local drive tests (LDTs).

[1] The database has since been expanded to include Canada, and was recently updated by AAA National.

A local drive test is an alternative to the standard road test typically offered by state driver licensing agencies. It allows some drivers who otherwise might not qualify for a regular operator's license the option of taking a road test near their homes, on familiar roadways, and/or to specific destinations they want or need to access. The exam is sometimes referred to as a "tailored drive test," since it is specifically tailored to an individual's driving needs and abilities. Drivers who pass this more limited road test are then restricted to driving only within the specific area or radius where they were tested, and often have other restrictions placed on their licenses including speed limit and time of day restrictions.

In many respects, such local drive tests, and resulting licensing restrictions, represent a form of Graduated Driving Reduction, or GDR, for medically at-risk drivers (see Waller, 1988; Langford and Koppel, 2011). Like GDL for young beginning drivers, it attempts to better match a driver's abilities to the environment in which he or she drives. By reducing the demands of the driving environment—for example, by only including familiar low-speed roadways during daytime hours—the goal is to reduce the likelihood of crashing. While most often made available to older adults with declining functional abilities who are approaching the end of their driving lifespans, LDTs can benefit drivers of any age with functional impairments that disqualify them from full licensure.[2]

It is not known how many states offer restricted licenses based on local drive testing. The LPP noteworthy initiatives database identifies three states – Iowa, Kansas and Minnesota – that have offered the option for many years. Other states that also appear to offer a version of LDTs include Wisconsin, California, and New Hampshire. The tests go by different names in the different states, e.g., tailored drive tests in Iowa, limited area special exams in Minnesota, local drive tests in Kansas, and area driving performance evaluations in California. And while some states, such as Minnesota, utilize them only sparsely, other states may license several hundred drivers a year through the program.

When contacted, driver licensing staff in Iowa, Kansas, Minnesota, and Wisconsin all expressed strong support for their local drive test programs, crediting them with allowing thousands of individuals over the years to maintain their driver's licenses and, with them, their independence and mobility. Ultimately, a decision was made to focus the evaluation in Iowa. Minnesota's reported number of annual cases was small (only about 25), and neither Kansas nor Wisconsin maintains a centralized database with a unique identifier for drivers who have taken a local drive test. Thus, while it might have been possible to carry out an evaluation in one or both of these states, the process would have been much more labor intensive for DMV staff personnel, would have resulted in delays to the overall project, and might not have successfully identified all LDT license recipients, potentially biasing the sample. In addition, Wisconsin's eight-year license renewal cycle was less advantageous for determining accurate periods of driving exposure deemed critical for the evaluation.

[2] Local drive tests are not recommended for individuals with moderate to severe cognitive impairment, since they cannot be expected to adhere to the conditions of their license.

In Iowa, licenses are required to be renewed in-person every five years, and every two years starting at age 70. Any driver, regardless of age, can be required to take a road test in order to renew their license. While other states also allow for such impromptu road testing, Iowa license examiners are trained to be proactive in requesting such "line drives" if their observation and questioning of a driver raises any concerns about fitness to drive. In addition, a reexamination consisting of vision, knowledge, and road testing can be triggered by recent crash involvement (if the investigating officer's or the driver's own report of the crash indicates the need for reexamination) or if a driver's competence is otherwise brought into question (for example, by a law enforcement or physician referral). Road tests are handled at local DMV offices by experienced license examiners. Each case is considered individually, and just because a driver is asked to take a road test or is called in for reexamination does not necessarily mean that he or she is required to undergo Medical Review or submit a medical report. And although some drivers may be required to come in for more frequent testing and/or submit periodic medical or vision reports, the most common renewal period for those who pass the drive test is the standard two-year cycle.

In the past, only drivers who had attempted and failed a standard road test three times could appeal to an Iowa DOT hearing officer for permission to be tested in their own communities on roads they would typically drive. However, Iowa's license examiners are now able to directly offer this option to drivers who are unable to pass a standard road test or who simply have no need or desire to drive except under the more limited conditions allowed by a local drive test license. Drivers familiar with the option can also make a direct request to the DMV to schedule a road test specifically tailored to their driving abilities and needs.

Review of Relevant Literature

Perhaps the most relevant study to the current investigation is a 1998 evaluation of Washington State's Department of Licensing Special Exam Program (Salzburg and Moffat, 1998). The special exams are given to drivers who have failed the standard renewal reexamination, do not meet visual or medical standards, and/or have been referred by a law enforcement officer, physician, or driver licensing service representative. The exam process includes an in-depth interview along with an extended on-road drive test, typically conducted near the driver's residence. Drivers who take or request the special exam do so with the understanding that if they pass, their driving will be subject to certain restrictions. The Salzburg and Moffat study compared the crash rates of drivers who underwent the special exam in 1994 to those of a control sample of drivers matched on age, sex and city. Of the 449 drivers taking the exam, 380 passed. Of these:

- 6.3% had no restrictions placed on their license;
- 9.7% were given an area/time[3] restriction;
- 16.6% were given an equipment restriction (usually corrective lenses); and
- 67.4% were given some combination of area/time/equipment restrictions.

[3] No further breakdown of area/time restrictions was provided. Examples offered included driving with an "X" miles radius of the residence, driving only between the hours of 10AM and 3PM, daylight driving only, no freeway driving, and driving within the city limits only.

Drivers were followed for 3.5 years after their exam date, at which time 84 percent still held a valid license. Special drive test drivers' pre-exam crash rate was 7.07 crashes per 100 licensed drivers, compared to 3.82 for the control drivers. Their post-exam crash rate was 3.24, compared to a post-exam crash rate for the controls of 1.17. Although both differences are statistically significant, the authors note that the special exam drivers' post-exam crash rate was lower than the 3.47 crash rate for all licensed drivers in Washington State. They also noted that of the 65 post-exam violations committed by the special exam group, only 2 (3%) occurred outside of a driver's area and/or time restriction, and of 40 total post-exam crashes, again only 2 (5%) were outside of a driver's restrictions. The exam group drivers, were, however, much more likely to be at-fault in their crashes: 68 percent of the exam group drivers were deemed at fault, compared to only 6% (1 of 17) of control group drivers in crashes (Salzburg and Moffat, 1998).

A number of other studies have examined safety outcomes associated with restricted licensing, both within the general licensed driver population and for the subset of drivers referred for medical review. But while some of the studies have included area or radius restrictions in their evaluations, none has reported specifically on the crash and violation records of individuals who have taken and passed a local area road test.

For example, a recent Australian study by Langford and Koppel (2011) compared crash rates for nearly 33,000 Victorian drivers receiving restrictions on their licenses during 1996-2005 with those of 377,000 unrestricted drivers. Results showed that, overall, casualty (i.e., injury producing) crash rates for the restricted drivers dropped from 49.0 to 37.2 crashes per 10,000 driver-years following imposition of their restrictions. However, the vast majority of the restrictions imposed were for corrective lenses. Of the 32,000 restricted drivers, only 180 were restricted to driving within a specified distance from home and 74 to driving in specific areas only. During the "after" period, these two groups of drivers experienced only one crash between them, illustrating the difficulty of trying to evaluate their safety. Nevertheless, the authors reported that when the two groups above were combined with drivers not allowed to drive at night, their relative risk of crashing compared to control drivers was 0.24 (95% CI = 0.03-1.73), compared to 1.14 (95% CI = 1.00-1.29) for drivers with any license restriction (Langford and Koppel, 2011).

Another study following a large cohort of drivers pre and post restriction was carried out in Saskatchewan, Canada (Marshall et al., 2002). The researchers used multivariate Poisson regression models to compare at-fault crash and violation rates of restricted (n=23,185) and unrestricted (n=680,573) drivers adjusted for age, gender, and urban/rural residence. Although specific licensing restrictions were not examined, the study did differentiate between *driving* restrictions (e.g., driving during daylight hours only or driving within a certain number of kilometers from home only) and *licensing* restrictions (e.g., physical examination or periodic eye examination required for licensing). Both types of restrictions are offered to drivers with medical impairments that may affect driving ability. (A requirement to wear corrective lenses is not considered a medical restriction.) Results showed that restricted drivers (those with either driving or licensing restrictions) had a significantly higher rate of crashes than unrestricted drivers (IRR=1.14), but a lower rate of convictions for traffic violations (IRR=0.93). The authors point out, however, that the restricted drivers' crash rate was still lower than that associated with being male (IRR=2.01) or living in an urban area (IRR=1.38). Time series modeling also revealed that,

especially for those with driving rather than licensing restrictions, crash rates declined following imposition of the restriction (Marshall et al., 2002).
Another more recent Canadian study used survival analysis to examine whether restricted licenses lower crash risk and extend the period of crash-free driving for British Columbia drivers ages 66 and above (Nasvadi and Wister, 2009). The specific driving restrictions examined included those related to speed (not to exceed 80 km/h, no highway driving, etc.); restricted geographical radius; and time of day (daylight hours only, no rush hour). Results showed that, after adjusting for age and gender, the 7,032 restricted drivers had a significantly lower rate of crashes per 100 days licensed than did unrestricted drivers (odds ratio=0.89). Results for drivers with only a daylight driving restriction (n=237) were also significant (odds ratio=0.49), while those for drivers with only speed-related restrictions (n=1,761) were lower but not statistically significant. Results for drivers with only area restrictions were not presented (Nasvadi and Wister, 2009).

Several studies have examined restricted licensing specifically within the context of a state's driver medical review program. However, these studies have generally not examined specific licensing restrictions. Vernon and colleagues at the University of Utah School of Medicine evaluated the crash and citation rates of Utah drivers licensed with various medical conditions during the period 1992-1996 (Vernon, Diller et al., 2002). Of the total 54,938 drivers reporting single medical conditions during this time, 51,083 were allowed to drive without restriction, and 1,643 were allowed to drive with a restriction. Findings showed that overall, both restricted and unrestricted drivers with (single) medical conditions had higher crash rates (RR=1.37, RR=1.44), and higher at-fault crash rates (RR=1.55, RR=2.04) than did an age, gender, and county matched control sample of drivers not known to the state's medical review program. Citation rates, however, were only slightly higher for drivers identified with medical conditions (Vernon et al., 2002).

Similar results were reported in an earlier North Carolina study evaluating that state's driver medical review program (Popkin and Stewart, 1992). The total sample size for this study was 6,953 drivers, of whom 600 (8.6%) had special restrictions placed on their licenses. Results from this study were mixed, with restricted drivers having higher crash rates for some medical conditions, and lower for others. Similar mixed results were found when comparing crash rates for drivers in the medical review program (regardless of restriction) to drivers in the general driving population, adjusting for age, gender and race.

These and other studies (e.g., Braitman, Chaudhary and McCartt, 2010; Stutts, Stewart and Van Heusen-Causey, 2000) also provide information on the characteristics of drivers licensed with restrictions, drivers' compliance with their restrictions, and further information on the various types of restrictions offered by states. In general, they show that restricted drivers are more likely to be older, male, and living in a rural location. Other than the Washington State study, however, there is no information available specifically characterizing drivers taking and/or passing a local area road test.

In summary, findings from this review of the literature generally show that licensing restrictions can improve safety for older and/or medically at-risk drivers. And although crash rates for restricted drivers have generally been shown to be higher than those for non-restricted drivers, the difference is relatively small. Perhaps more importantly, the crash rate for restricted drivers has generally been shown to be lower than that for the

population as a whole, or for certain subgroups such as male drivers or drivers living in more urban areas. Little information is available for the subset of drivers who receive radius and other area/destination restrictions based on a limited area road test. However, the limited available results suggest that these drivers also do not pose significant threats to safety.

Study Objectives

The study was carried out to address the following research questions:

- What are the characteristics of LDT recipients (e.g., age, gender, residential locale)?
- How are the licenses of LDT drivers restricted?
- How long do LDT recipients continue to drive, i.e., what are the mobility benefits to offering this type of license?
- What is the crash/violation experience of LDT recipients?
- How does the crash/violation experience of LDT drivers compare to that of non-LDT drivers?

All data were provided by the Iowa DOT Office of Driver Services. Researchers prepared a Memorandum of Understanding that was signed and agreed to by both parties and also submitted a signed Privacy Act Agreement for Request of Motor Vehicle Records. Both documents specified that the data would be used only for approved research purposes and that the researchers would maintain its confidentiality.

Methods

Study Design

The study employed a matched case-control study design, where cases were a census of all Iowa drivers aged 65 and older who had passed a local drive test (LDT) conducted on familiar roadways near their homes, and controls were an age, gender, and residential population sample of individually matched drivers who held standard licenses. Study data were provided by the Iowa DOT Office of Driver Services (ODS). The data were obtained and processed in a number of steps, as described below.

Data Acquisition and Processing

Identifying Case Drivers with LDT Licenses

Iowa's Office of Driver Services (ODS) adds a unique identifier to the license files of drivers who take a local drive test. This identifier allowed ODS to pull up the files of all drivers who attempted LDTs between January 2005 and August 2008 inclusive. August 2008 was chosen as the final month to ensure that at least 24 months of subsequent driving history could be examined for all case drivers.

While initial informal estimates had put the number of potential case drivers somewhat higher, the true number of unique individuals who underwent an LDT during this 44-month period was 239. All but three drivers were age 65 or older at the time they took their LDT. Of the 236 drivers aged 65 and older who attempted an LDT, 27 were unable to pass, and two additional drivers who passed did not follow through with obtaining a license. As these drivers did not accrue driving exposure, they were dropped from the pool of case drivers. In addition, two drivers passed standard road tests and obtained standard driver's licenses within a month of trying to obtain their LDT licenses, and they were also dropped from the case pool. The project then focused on the subsequent driving safety of those drivers aged 65 and older who *received* licenses as a result of taking and passing an LDT.

With these exclusions, **205 LDT drivers** remained as case drivers for the study. Information made available for these drivers included the following:

- Driver license number
- Driver full name and address, including city and county of residence
- Date of birth and gender
- Dates and outcomes of initial and any subsequent drive tests
- LDT license issue dates and expiration dates
- License restrictions (text field)
- Driver history subsequent to LDT, including dates and events, e.g., license renewed, expired, surrendered, suspended or denied; driver involved in crash (text fields)
- Current license status or date of death (if known)

Iowa's standard renewal period is two years for drivers aged 70 and older, and the renewal period may be shorter and/or supplemented by a requirement for an annual medical or vision report. Thus, the files available for the case drivers included relatively frequent entries (see example Microsoft Access records in *Appendix B*).

Specifying the Driving Exposure Period for Each Case Driver

For each case driver, the date on which LDT driving exposure began was defined as the issue date for the license obtained by passing the exam. This date could correspond to the road test date, but could also be some days later since the drivers had to travel to their ODS branch offices to obtain their licenses. A case driver's driving exposure period was deemed to end when the earliest of any of the following events occurred:

- Death of the driver
- Voluntary surrender of the driver's license
- Expiration of the license without an attempt to renew
- Suspension or denial of the license for any reason (e.g., failure to provide medical or vision report, failure to report for re-examination after a crash, inability to pass license renewal tests)
- Conversion to a standard driver's license after passing a standard road test.

Dates of death were abstracted from ODS files and also verified using *Tributes.com*, an online searchable obituary database that collects data from the Social Security Administration's Death Index. For those drivers who were alive and still holding active LDT licenses at the conclusion of the project's study period, December 31, 2010 was used as their end of exposure date.

Identification of Matched Control Drivers

Each case driver was matched to four control drivers based on gender, date of birth plus or minus 12 months, and residential city/town population. For the residential matching, Iowa cities and towns were grouped into the following five population categories based on their July 1, 2007 Census Population estimates[4]. July 2007 represented the midpoint in the overall exposure period for the study.

- <2,500 population
- 2,500 – 9,999
- 10,000 – 49,999
- 50,000 – 99,999
- 100,000+

Initially, a list of 20 randomly selected control candidates for each case driver was generated and made available to the researchers in an Excel spreadsheet. For each control candidate, the spreadsheet displayed whether the driver's license had been successfully renewed each year from 2003 through 2010, the current status of the license, and any death date if known. No information about violations or crashes was included. Potential matches were first narrowed by ruling out those who were not actively licensed during their corresponding case driver's exposure period. This initial step was again facilitated by Iowa's standard license renewal period of two years for drivers aged 70 and older, and by the typical correspondence of license renewal dates to driver birthdays. In any ambiguous situations, exact dates of license expiration, denial, and suspension were obtained from ODS.

[4] See http://iowa.hometownlocator.com/census/estimates/cities2.cfm .

As a second step, within the remaining candidate matches for each case, the "best" matches were deemed to be those whose birth dates were closest to their case driver's birth date; i.e., while all were matched to their case driver's age plus or minus 12 months, the candidates were further narrowed to the closest age matches. As a final step, the online death database *Tributes.com* was used to confirm that the selected matched controls did not include drivers who had died during their case driver's key period of driving exposure.

For 11 cases, the initial request did not yield four valid controls. These were typically the oldest case drivers, where most of the potential matches of the same age had stopped driving prior to the specified driving exposure period. An additional pool of candidates was randomly drawn, with the successful identification of more controls. Still, some difficult-to-match cases remained. In particular, six case drivers had excellent matches for two or three, but not all four, of their needed controls. For each case driver, an otherwise qualified control did not continue to hold a valid license through the final portion of the case driver's exposure period. In order not to further decrease the sample size, these controls were used, but their exposure periods were extended at the front end to give them the same number of driving days as their case drivers. For example, a case driver who held an LDT license from March 1, 2006 to March 1, 2008 could be otherwise well matched to a control driver whose license expired on January 1, 2008. The exposure days for that control would be shifted from 3/1/06 – 3/1/08 to 1/1/06 – 1/1/08. This type of exposure shift was used for 7 out of the total 800+ matched controls. The time shifts were most often four months or less, but in two instances were ten to fifteen months.

Despite these efforts, adequate matched controls could not be found for three 98-year-old case drivers. Therefore, they were not included in the case-control portion of the analysis, reducing the number of case drivers to 202. Interestingly, the three 98-year-old unmatched Case drivers lost to analysis had no crashes or citations during their study exposure periods while driving on their LDT licenses.

Matched control candidates were randomly pulled by ODS staff without replacement, i.e., drivers whose names had been generated as potential matches for one case were not excluded from being selected as a potential control for another case. Once the final list of four matched controls per case had been assembled, it was checked for duplicates. Four drivers out of the final total of 808 control drivers were found to have been selected as matched controls for two cases each.

<u>Identifying Crashes for Cases and Controls During Cases' LDT Licensing Periods</u>
Information on any crashes and traffic convictions appearing on our case drivers' records was pulled as part of our initial request to the Iowa ODS. All case driver crashes were carefully checked to identify only those that occurred while driving on a LDT license. The question arose as to how to handle a driver who had continued to drive and who had crashed after his LDT license was no longer valid. This was not counted as a crash that occurred while driving on his LDT license, though it will be addressed descriptively in *Appendix C.*

Once the control sample of drivers had been identified, the file was returned to ODS staff to pull dates for any crashes (as well as convictions) appearing on these drivers' records. Each driver's crash dates, if any, were then compared to the key driving exposure period for that driver's matched case. Crashes occurring during the exposure period were identified, and ODS staff supplied photocopies of the original crash reports.

Identifying Traffic Convictions for Cases and Controls During Cases' LDT Exposure Periods

Iowa law does not allow drivers to expunge traffic citations from their driving records by attending traffic school, requesting "prayer for judgment continued," etc., so the state's citation records are relatively comprehensive. Two approaches were used to identify traffic violations. First, ODS staff abstracted citation report numbers and dates from case and control drivers' computerized driving records. Only citations resulting in convictions appear on an individual's driving record. In addition, older and less serious citations may be purged after five years. Since this time frame had the potential to overlap with the very earliest portions of our study period, every driver was also searched in Iowa Courts Online, a database that includes past traffic court records back to the 1990s. The name of each case driver was searched to identify all traffic convictions that occurred while driving on an LDT license. Similarly, each matched control driver's record was searched for all traffic convictions that occurred during the key driving exposure period for his or her matched case driver.

Results from the ODS driver record search and Iowa Courts Online search were then merged and compared. ODS identified two out-of-state tickets that were not found in Iowa Courts Online, and both were added to the database. The search of Iowa Courts Online found four tickets within targeted exposure periods that had "aged out" and were purged from the ODS records. These were confirmed by ODS staff inspection of the individuals' driver history records, and all four were added to the database.

Descriptive Crash Data

Hard copies of police crash reports were reviewed. Variables abstracted were crash synopsis, crash type (e.g., single vehicle, two vehicle), light condition, roadway speed limit, injury to the driver of interest, injury to other parties involved in the crash, and fault (solely at fault, not at fault, jointly at fault, unknown, and other). All variables except driver fault were pulled directly from crash report entries.

Apportioning fault required additional analysis, but Iowa's law enforcement crash reports include several relevant fields. The Citation Charge field beside each driver's name is completed if the driver is cited for a violation. In addition the officer completes a Driver Contributing Circumstances field for each driver, inserting specific codes for improper actions (e.g., failure to yield) or Code 28 indicating no improper action for that driver. Comparing the officer's entries in the Driver Contributing Circumstances fields typically clarifies fault even when the officer does not formally charge anyone with a violation. The officer's narrative description and diagram often further address responsibility.

For this study the following conventions were applied in apportioning fault:

- A driver who is cited for a violation is at fault.
- If Driver Contributing Circumstances includes an improper action or driving error for one driver and a code of no improper action for another driver, the first driver is at fault.
- If Driver Contributing Circumstances includes an improper action or driving error for both drivers, then both drivers are at fault.
- A single vehicle crash is presumed to be the fault of that driver, with the exception of deer crashes, which were coded as "other."

All crash reports were reviewed by both authors, who found that these conventions allowed for straightforward classification of most of the crashes. Five crashes that required more subjective "judgment calls" were submitted to an independent reviewer who was blind to whether the crash involved a case or control driver. He concurred with the authors' judgment of fault in four cases but recommended reclassifying one crash from "control driver at fault" to "unknown," and his recommendation was followed.

Data Analysis

Data were provided to the researchers in both Miscrosoft Access and Excel spreadsheets, along with paper copies of the police crash reports. The data were first examined descriptively and then uploaded to statistical software Stata version 10.1 (StataCorp LP, 2009) for additional analyses and significance testing. Confidence intervals for the calculated relative risk ratios were produced using conditional Poisson regression models.

Results

The Local Drive Test Process

Of the 236 Iowa drivers over the age of 65 who attempted a local drive test, 174 (73.7%) passed on their first attempt. An additional 26 (11.0%) passed on a second attempt or appeal, and nine (3.8%) on subsequent attempts or appeals. The remaining 27 drivers (11.4% of the original pool) who did not succeed in obtaining a LDT license included 21 who attempted the test one time, four who attempted it two times, and two who attempted it three or more times. Compared to those who eventually passed their LDT, those unable to pass were similar with respect to age and gender.

The average time required by examiners to administer the local drive test, including traveling to and from drivers' residences, was 1.4 hours for the initial testing, and 1.2 hours for subsequent testings.

Demographic Characteristics of LDT Drivers

The average age of all 239 Iowa residents attempting a local drive test during the January 2005 – August 2008 time period for the study was 84.7 years; for the 208 individuals who eventually passed and received a LDT license, it was 84.5 years. If one excludes the three individuals who were under the age of 65 from the latter group, the average age increased slightly, to 85.1 (range 65.1-99.0, median 86.1).

Table 1 summarizes basic demographics for these LDT license recipients. The largest single age group taking and passing local drive tests were 85-89 year-olds, followed by 80-84 year-olds. Together, these drivers in their 80s comprised 63% of LDT recipients. The program serves very few drivers under the age of 70, or older than 95. Almost two-thirds of recipients were women, and the average age of the women was comparable to that for men (85.5 years vs. 84.3 years).

Table 1. Demographic characteristics of LDT license recipients.

Demographic Characteristic	N	%
Age		
65-69	4	2.0
70-74	11	5.4
75-79	19	9.3
80-84	56	27.3
85-89	74	36.1
90-94	33	16.1
95+	8	3.9
Gender		
Female	133	64.9
Male	72	35.1
Residential Population		
<2,500	88	42.9
2,500 – 9,999	38	18.5
10,000 – 49,999	21	10.2
50,000 – 99,999	41	20.0
100,000+	17	8.3
Total N	205	100.0

The largest share of LDT license recipients resided in rural areas or small towns with populations under 2,500. Only 17 (8.3%) lived in either Des Moines or Cedar Rapids, Iowa's two largest cities with estimated 2007 populations of 195,000 and 127,000, respectively. There were no significant differences in residential population of LDT license recipients by either age or gender.

Drive test license recipients resided in all parts of the state, with highest concentrations in Black Hawk County (Waterloo, population 66,000, and surrounding towns) and Linn County (Cedar Rapids and surrounding towns) in the east central portion of the state, and Woodbury County (including Sioux City, population 82,000) in the far western portion of the state (see Figure 1). Polk County, which includes Iowa's largest city of Des Moines, had only nine LDT license recipients, even though that county has the highest number of residents aged 65 and older.[5]

[5] State Data Center of Iowa and the Iowa Department of Aging (2011). Older Iowans 2010. Available: http://www.aging.iowa.gov/Documents/Statistics/OlderIowans2010.pdf

Compared to those who passed their local drive tests, the 27 drivers who failed (11.3% of the original sample of 239), included 10 males and 17 females. Their average age was just over one year higher than those aged 65+ who passed (86.4 years versus 85.1 years). The biggest difference in these "failures" was that they were much less likely to live in the smallest sized communities and towns: 41% lived in one of the ten cities with populations over 50,000, while only 15% lived in small towns and rural areas with populations less than 2,500 ($X^2 = 16.34$, df=2, $p<.001$). Thus, Iowa drivers who live in smaller towns and more rural areas are more likely to succeed in their attempts to attain an LDT license.

Characteristics of Restrictions Placed on LDT Licenses

Radius or Geographic Restrictions. In requesting a LDT, individuals are agreeing to restrict their driving to the very limited areas and circumstances under which they have been tested. By definition, a LDT almost always entails some type of area or geographic restriction on one's license. Figure 2 shows the range of area restrictions placed on the licenses of the 205 drivers taking and passing a LDT in Iowa.

Five of the drivers were restricted to driving only within 1-1½ miles of their homes, and seven to driving within 2-2½ miles of their homes. The largest numbers of drivers were restricted to driving either five (n=39) or 10 (n=40) miles from their homes. As might be expected, drivers living in rural areas and smaller towns (<10,000 population) were more likely to receive 10 mile or greater radius restrictions than were drivers living in the larger towns and cities ($X^2 = 18.18$, df=2, $p<.001$).

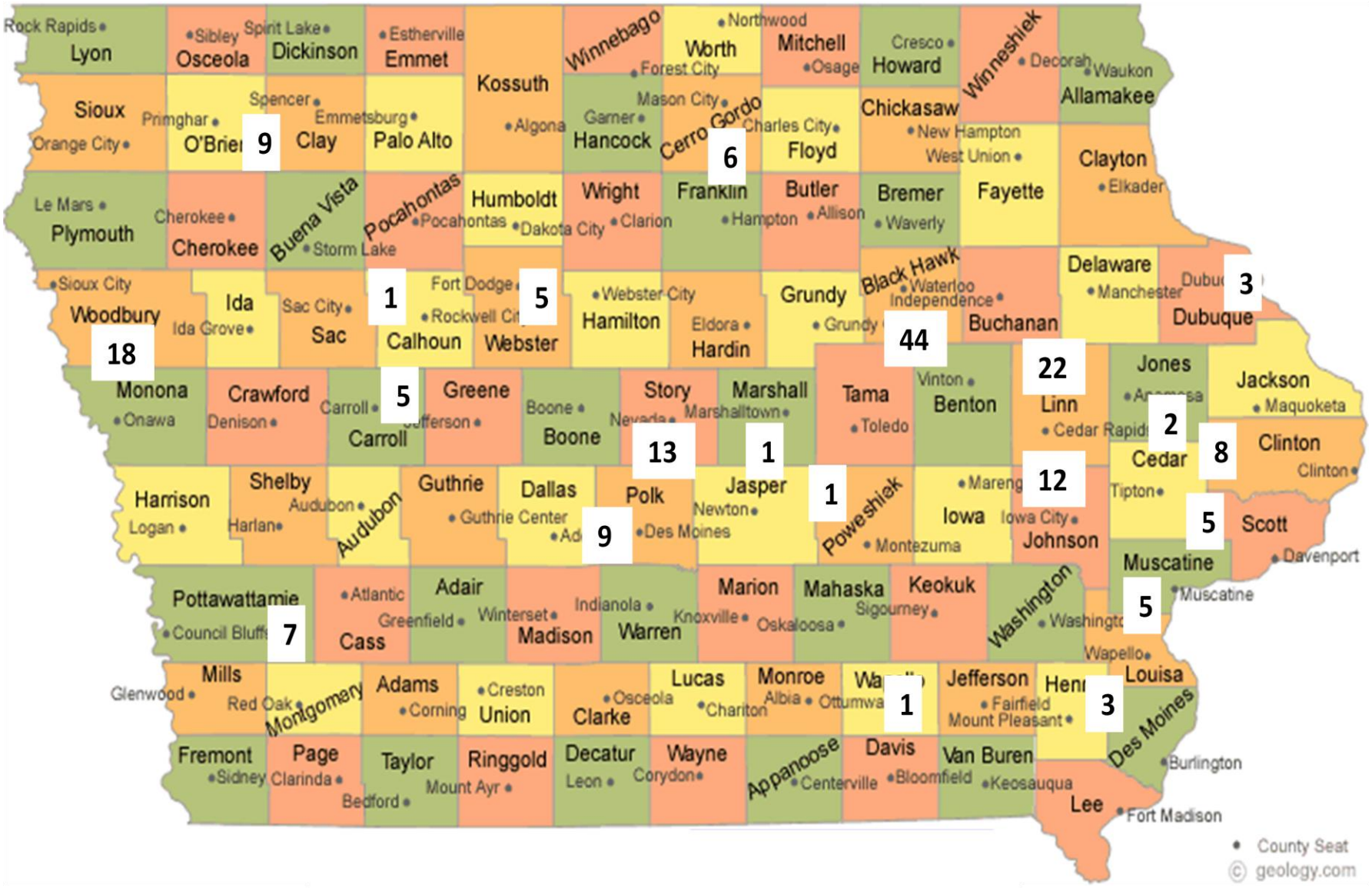

Figure 1. Distribution of Iowa local drive test license recipients ages 65+ by county. (Map source: http://geology.com/county-map/iowa.shtml)

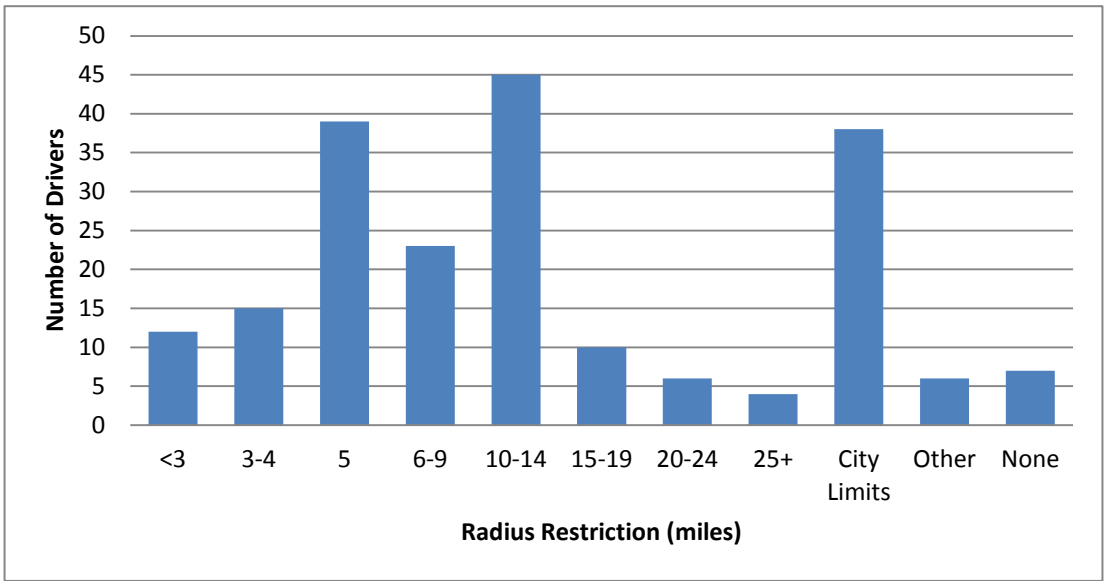

Figure 2. Area restrictions placed on licenses of LDT drivers (n-205).

Instead of a specific radius restriction, drivers were also frequently restricted to driving only within the city limits of their towns. In this case, two-thirds of the drivers were living in very small communities with populations under 2,500, and just under a third were living in slightly larger communities with populations of 2,500-4,999. Only one driver with a city limit restriction was living in a larger city.

The six drivers with "other" area restrictions included three who were restricted to driving a certain number of blocks from their home, one required to only drive on the Southside of town, one who was NOT to drive within the city limits, and a final driver who could only travel to a particular grocery store. There were also seven drivers with no radius restriction specified. Two of the seven had a 30 mph speed zone restriction on their licenses, limiting where they could drive, while the others had various other restrictions but no explicit area restrictions.

Other Restrictions. The vast majority (91.2%) of drivers with LDT licenses had other restrictions on their licenses in addition to their radius or area restrictions. Other than wearing corrective lenses (78.1% of drivers), the most frequently imposed restrictions were:

- A requirement for left-side (35.6%) or both left- and right-side (9.3%) mirrors[6];
- No nighttime driving (44.4%);
- Speed restriction, either for the roadway or for the driver's own travel speed (34.6%);
- No Interstate/freeway driving (14.6%);
- Other (automatic transmission, seat cushion, no 4-lane, no multi-lane, etc.) (4.9%)

[6] Iowa Administrative Rules currently require a left-side mirror restriction on drivers with less than 20/100 visual acuity in their left eye; the ruling is in the process of being amended to require both left and right-side mirrors.

Two of the 71 speed restrictions (both noted earlier) were speed zone restrictions, specifying the maximum speed limit roadway (30 mph) on which the drivers could travel. The remaining were all travel speed restrictions, specifying the maximum speed at which the drivers should operate their vehicles. Of the 69 drivers given a travel speed restriction, 64 were restricted to driving at speeds of 35 mph or less; one to driving at 30 mph or less, two to 45 mph or less, and two to 55 mph or less.

In addition to these driving or vehicle equipment restrictions, the licenses of 56 drivers (27.3%) were made contingent on submitting medical and/or vision reports, generally annually.

Length of Licensure

One goal of the study had been to determine the average length of time that individuals hold an LDT license; however, two factors intervened. First, at least some of the drivers who were identified as obtaining an LDT license in 2005 and 2006, the first two years of the study period, were later found to be renewing an earlier-obtained LDT license. Secondly, the sample included 45 drivers who were still holding an active LDT license at the December 31, 2010 end date for the study. Thus the January 2005-August 2008 study period represents a snapshot in time of all drivers holding LDT licenses, but not a longitudinal study of newly licensed LDT recipients for the duration of their LDT driving careers.

The average length of time that this "snapshot" sample of 205 drivers held their LDT license was 831 days, or 2.3 years. The median period of licensure was 713 days, or just shy of two years. As noted above, however, both numbers clearly underestimate the true period of time drivers typically drive under a LDT license, since they do not account for the fact that some of these drivers received their initial LDT license prior to the start of the study period, and others were still holding an LDT license at the end of the study period.

Of the 160 drivers whose LDT licenses terminated during the study period, five had been able to successfully convert back to a standard driver's license. Of the remaining 155 drivers, 33 (21%) died while still holding a valid LDT license. Ninety-four drivers (61%) either let their licenses expire or voluntarily turned in their licenses around renewal time. Nine more drivers (6%) voluntarily turned in their licenses early (i.e., prior to their next renewal dates), over half of whom may have been responding to an impending annual vision report due date. Twelve drivers (8%) had their licenses suspended for reasons explicitly related to annual vision or annual medical reports. (Six failed to provide a vision report, and three submitted a vision report that did not support renewal; one failed to provide a medical report, and two provided a medical report that did not support renewal.) Four drivers (3%) had their licenses suspended when they were no longer able to pass a renewal requirement—two could no longer pass the local drive road test, and two could no longer pass the DL vision screen. Finally, three drivers (2%) lost their driving privileges when they were called in for reexamination after being cited for a violation related to a crash, either because they did not appear or because they could no longer pass the

knowledge and/or road tests. (A fourth driver who crashed just before the study ended later joined this group.)

Crash and Conviction Experience of LDT Drivers and Comparison to Controls

Case Driver Crash Involvement

The results presented thus far have included all 205 case drivers who accrued driving exposure on their LDT licenses. As noted in the Methods section of the report, an adequate number of matching control drivers could not be found for three 98-year-old case drivers. These three case drivers will not be included in the remainder of the analyses, reducing the number of case drivers to 202. As previously noted, these three unmatched case drivers lost to analysis had no crashes or citations during the study period while driving on their LDT licenses.

The remaining 202 case drivers accumulated 167,251 days of exposure while driving on their LDT licenses during the study period. They were involved in 13 crashes distributed over 11 drivers. Nine of the drivers were involved in one crash each, and two drivers were involved in two crashes each. The occurrence of 13 crashes in 167,251 days of driving translates to an annual crash rate of **0.0284**. None of the case drivers who crashed appeared to be driving outside their area restrictions, nor did they appear to be in violation of other restrictions (e.g., time of day), based on available information from their crash reports.

The case drivers who crashed were deemed either solely (n=10) or jointly (n=1) at fault in 11 of the 13 crashes, and not at fault in only two crashes, translating into an annualized at-fault crash rate of **0.0240**. (One driver who crashed twice was judged to be not at fault in both instances.) The 11 at-fault crashes included four instances of striking parked or otherwise stationary vehicles and one instance of striking a building. None of these resulted in injuries to other people, though two resulted in possible or non-incapacitating injuries to the case drivers, one of whom was transported. The 11 at-fault crashes also included two sideswipes of other moving vehicles, both without injuries. There were also two instances of failure to yield while attempting a left turn, and one instance of running a red light, all without apparent reported injury. The final at-fault incident was a driver who parked and exited her car, which then began to roll downhill. She tried to reenter the vehicle and was dragged until the car stopped without striking anything. Her injury level was not coded on the police report, but she was transported by ambulance. No further medical details are known, but the driver is known to have renewed her license four months later. In sum, while the LDT licensed drivers were often at fault when they crashed, there were no injuries to other people, and only two case driver injuries required transport—one to the driver who struck a building and the other to a driver who attempted to re-enter a parked car.

Ten case drivers were responsible for the 11 at-fault crashes (i.e., one driver was at fault twice). Four of the ten at-fault drivers (including the driver involved in two at-fault crashes) subsequently lost their licenses when their crashes triggered a license reexamination, and a fifth lost his license a few months later due to an unfavorable medical report. Two other at-fault case drivers were called in for reexamination and were able to

pass the required tests and retain their licenses. The three remaining case drivers who had been deemed at-fault in their crashes were not called in for re-examination; none had been cited for violations in their crashes. *Appendix C* contains a more detailed synopsis of the crashes of each of the case drivers, along with one additional crash not included in the study because it occurred outside of the driver's designated exposure period under a LDT license.

Control Driver Crash Involvement

The non-LDT control drivers experienced a total of 36 crashes over 669,004 (4 X 167,251) days of driving exposure, for an annualized crash rate of **0.0196**. They were judged to be at fault in 16 (15 solely, 1 jointly) of their 36 crashes, for an annualized at-fault crash rate of **0.0087**.

The at-fault control drivers were similar to the case drivers with regard to low levels of serious injury. The 16 at-fault control crashes resulted in no injury (10 crashes), a possible injury (3 crashes), and a non-incapacitating injury (1 crash). Only two at-fault control crashes resulted in incapacitating injury requiring transport, and both injuries were to the driver himself. One involved failure to yield at a stop sign, and the other was a driver who was dragged by his own unoccupied parked vehicle, quite similar to the case driver described above.

Convictions for Moving Violations

The 202 case drivers had only three convictions for moving violations during the study period, and all three were linked to the crashes described above. Following the same approach as above, this translates to an annualized rate of convictions for moving violations of **0.0065**. Similarly, the 808 control drivers had 22 moving violations during the same driving exposure periods, six of which were linked to crashes and 16 of which were not. Their annualized rate of convictions for moving violations was thus **0.0120**, nearly two times higher than that for the case drivers.

Relative Crash Involvement and Conviction Risks

Table 2 summarizes the above descriptive results with respect to crashes and convictions, with their associated risk ratios and 95% confidence intervals based on univariate Poisson regression models. Although LDT drivers have a higher overall crash rate, and a lower overall conviction rate, only their **at-fault crash involvement** rate is significantly elevated (RR=2.75, 95% CI 1.28 – 5.93).

Table 2. Crash and conviction experience of Local Drive Test drivers compared to a sample of non-LDT drivers matched on age, gender, and residential population.

	Local Drive Test (LDT) (N=202 drivers) (Exposure=458.222 driver·years)		Comparison Group (N=808 drivers) (Exposure=1832.888 driver·years)		
Outcome	N	Rate (Outcomes/year)	N	Rate (Outcomes/year)	Risk Ratio (95% CI)[a] (LDT vs. Comparison)
Total crashes	13	0.0284	36	0.0196	1.44 (0.77 – 2.72)
At-fault crashes	11	0.0240	16	0.0087	2.75 (1.28 – 5.93)
Moving-violation convictions	3	0.0065	22	0.0120	0.55 (0.16 – 1.82)

[a.] 95% confidence intervals were estimated using univariate conditional Poisson regression.

Comparisons to the General Iowa Driving Population

Appendix D contains information on age and gender-specific driver crash involvements in Iowa for the year 2010, along with corresponding licensed driver data. The overall driver crash involvement rate in Iowa in 2010 was 0.038 (82,967 crash-involved drivers / 2,181,534 licensed drivers). This compares with 0.023 for drivers ages 65+, 0.047 for drivers in their 20s, and 0.030 for drivers in their 50s. It also compares with an annual crash involvement rate of 0.043 for males, and 0.033 for females. With the exception of the general population of licensed drivers ages 65+, all of these rates are higher than the overall crash rate of 0.028 reported above for LDT license recipients.

Discussion

The current study was carried out to determine the safety consequences of offering a "local drive test" option to older adults who otherwise might not qualify to renew their licenses. While the specifics vary from state to state, a LDT option typically involves road testing individuals on roadways near their homes. Drivers who demonstrate that they can safely operate their vehicles in this familiar and generally less demanding environment receive licenses restricting them to driving only within a certain radius of their homes. LDT license recipients are also often restricted in other ways, such as driving only during daylight hours or only below certain speeds, and they may be required to renew their licenses more frequently or to submit regular vision or medical reports from their doctors.

That local drive tests offer mobility benefits to a certain at-risk segment of the driving population seems indisputable, since by definition the licenses are offered only to drivers who otherwise would be faced with surrendering their licenses. Even if one were to argue that these at-risk individuals would be better served by helping them transition to alternative forms of transportation, an area-restricted license allows for a more gradual transition to non-driving. The majority of drivers in the current study were able to continue driving for at least an additional two years, and many much longer.

Both with respect to easing the transition to non-driving status, and with respect to decreasing exposure to higher risk driving situations while continuing to drive, a LDT license appears to function as a graduated driving reduction—or GDR—system for older at-risk drivers approaching the ends of their driving lifespans (Waller, 1988; Langford and Koppel, 2011). And while the results of the current study based on available data from Iowa have shown LDT license recipients to be less safe than their non-LDT peers, LDT drivers' risk of crashing was still relatively small, and there was no evidence that they posed a threat to public safety.

These findings are in line with other published literature directed more generally at drivers holding restricted licenses and/or those referred to DMV medical review programs. Like the current study, these studies have generally shown only modest differences in the crash rates of restricted versus unrestricted, or medically-reviewed versus non-medically-reviewed, drivers. For example, Salzburg and Moffat's (1998) data evaluating Washington State's Special Exam Program yielded a relative crash risk of 2.77 for drivers required to take the special exam compared to a matched sample of control drivers (0.0324 total crash involvements per year for special exam drivers versus 0.0117 for controls). This number compares to the current study's overall relative crash risk of 1.45, and an at-fault relative crash risk of 2.76. Other comparative findings from the literature include:

- A lower risk (OR=0.89) of crashing for daylight only, no highway, maximum speed, and area-restricted drivers in British Columbia (Nasvadi and Wister, 2009);
- A relative crash risk of 1.37 for restricted drivers with single medical conditions identified to Utah's driver medical review program (Vernon et al, 2002);
- A relative crash risk of 1.14 for medically restricted drivers in Saskatchewan, Canada, coupled with a lower 0.93 risk of being cited for a traffic violation (Marshall et al., 2002);

- A relative crash risk of 1.14 for drivers ages 65+ with any restrictions (including corrective lenses) compared to drivers with no restrictions in Victoria, Australia (Langford and Koppel, 2011).

The Australian study also reported a *lower* 0.38 relative risk of crashing for drivers with radius restrictions; however, these results were not significant (95% CI = 0.05-2.79) and also were not adjusted for potential age and gender differences in the case and control populations (Langford and Koppel, 2011).

Unlike several of these studies, the current study did not investigate changes in crash and conviction rates before and after licensing restrictions were imposed on our case drivers. Doing so would have required access to more "before" data than was available to the study (i.e., the researchers needed to go back to 2005 to capture a sufficient number of case drivers, and crash and conviction data prior to this was at risk of being purged from drivers' files). In general, other studies have shown a decrease in crash and/or violation rates post-restriction, or post-entry into a driver medical review program (Salzburg and Moffat, 1998; Nasvadi and Wister, 2009; Popkin and Stewart, 1992).

In support of restricted licensing, and especially restricted licensing for older medically at-risk drivers, it can be argued that even if these drivers' crash rates are higher than those of their unrestricted peers, they remain at levels that are generally accepted by society. Thus, while the annual crash rate of the LDT drivers in our Iowa sample was slightly higher than that for all drivers ages 65+ in Iowa, it was considerably lower than that for Iowa drivers in their 20s and very comparable to that for drivers in their 50s. It was also lower than the crash rate for Iowa males. Similarly, in Washington State, the annual crash rate for special exam drivers when that study was carried out was reported to be 0.0324, compared to 0.0347 for the population as a whole (Salzburg and Moffat,1998).

This is not to say that Iowa's LDT licensees are as capable behind the wheel as their non-LDT peers: the fact that most were unable to pass a standard road test suggests that LDT license recipients fall into a pool of higher risk drivers. And indeed, their higher at-fault crash rate, even with the added licensing restrictions in place, bears this out. What the study findings do suggest is that the approach taken to *managing* any increased crash risk among this particular subset of drivers has generally been successful, i.e., Iowa's LDT initiative appears to be allowing individual drivers to continue to provide for their most important transportation needs, without posing undue risk to others sharing the roadway. Even if any decrease in crashes is primarily due to a reduction in driving exposure, the bottom line is the same: only slightly more crashes over the course of a year than same-age peers, and far fewer crashes than other large subpopulations of licensed drivers, including young drivers and male drivers.

If a driver with a restricted LDT license crashes, Iowa has additional procedures in place to manage crash risk. By law[7], the Iowa DOT Office of Driver Services may request a special reexamination whenever a driver has been involved in a fatal crash; has had two at-fault crashes within a three-year period; is 65 or older, has been involved in a crash, and the investigating officer or their own report indicates the need for a reexamination; or at the

[7] See http://www.legis.state.ia.us/ACO/IAChtml/761.htm#rule_761_604_50 for a copy of the legislation.

request of a peace officer, a court, or a properly documented citizen's request. The special reexamination process includes a vision screening, knowledge test, and driving test. This legislation was consistently reflected in the experience of the current study's case drivers: all who crashed and who were cited by the investigating officer for a violation in conjunction with their crash were called in for re-evaluation.

In addition to evaluating the safety and mobility outcomes associated with offering a local drive test option, the current study has also offered insights into the population that most stands to benefit from the program. At least in Iowa, the program was found to primarily serve drivers in their 80s, with the 85-89 year-old age group constituting over a third of its beneficiaries. Also, women were more likely than men to participate in the program: nearly two-thirds of LDT license recipients aged 65+ were women, compared to just over half (53.5% based on available 2010 data) of Iowa's licensed drivers.

Perhaps somewhat surprisingly, the population of LDT license recipients does not appear to be heavily weighted towards drivers living in rural areas and smaller sized communities. Of course, as a whole Iowa is a very rural state: it ranks 36th in population density among U.S. states. It only has two cities (Cedar Rapids and Des Moines) with populations over 100,000, and seven with populations between 50,000 and 100,000. Based on 2010 U.S Census data, just over one-fourth (27%) of Iowa's residents live in one of these larger-sized cities, and about the same percentage (28%) of LDT license recipients also resided in these cities. At the other extreme, 43% of LDT recipients were identified as living in cities and towns with populations less than 2,500. This is a considerably higher percentage than the 16% identified in the 2010 U.S. Census population estimates, but if one also adds in the 23% of Iowa's population that were not identified by the Census as living in *any* city or town, the small town overrepresentation is not nearly as pronounced. The above statistics also do not take into account the fact that, in general, older adults are overrepresented in rural areas. All in all, Iowa's LDT license recipients live in rural areas, towns and cities of various sizes, suburbs, and even in Iowa's two largest cities.

A more important issue may be whether some of the LDT license recipients identified as living in a "small" town actually resided in a suburb of one of the larger cities, and if so, whether their radius and/or speed restrictions were appropriate for the more congested driving environment of a larger city. While a detailed geographical analysis of the residential areas of LDT drivers was beyond the scope of the current project, the authors did use available mapping websites to examine whether the city size group classifications accurately portrayed how built up a particular area actually was. We were most concerned with whether some small towns (those in population categories 1 (<2,500) or 2 (2,500-9,999)) might actually be "satellite communities" to much larger cities. While this did occasionally occur, it was not possible to judge the appropriateness of the radius restrictions imposed, especially given that there were LDT drivers living in the larger cities who sometimes also had large radius restrictions. And while two of the 11 drivers who crashed lived in Cedar Rapids and Des Moines, Iowa's two largest cities, the sample size was too small to conclude that LDT drivers residing in larger cities are at greater risk of crashing.

On a related matter, we found no evidence that any of the 11 case drivers who crashed were operating their vehicles outside of their imposed radius restrictions. There was also no evidence that they were violating any other restrictions with respect to time of day or speed

limit (although Iowa crash reports only contain information on a roadway's posted speed limit, and not the actual estimated travel speed of the vehicle).

Clearly care must be taken with respect to imposing appropriate restrictions on the licenses of individuals with functional impairments that otherwise would disqualify them from driving, and this is particularly true for drivers living in or near larger cities. Although they may be very familiar with their surroundings, the complexity of the driving environment is generally much greater, and even a very limited radius restriction of just a few miles can expose the driver to busy intersections and higher speed, multi-lane roadways. In such situations, additional restrictions including travel speed and time of day can be used to further reduce demands on the driver. However, the current study does not allow any conclusions to be drawn about whether a more conservative approach to licensing and restricting drivers living in urban areas would be beneficial.

To our knowledge, this is the first study to specifically examine the safety consequences of issuing restricted licenses to older adults based upon a road test conducted on familiar roadways near their homes. The study has a number of important strengths, including strong 4:1 matching on factors known to be associated with older drivers' crashes; comprehensive case identification over a period of nearly five years; selection of controls while remaining blind to crash histories; very close follow-up with both case and control drivers to determine the duration of their valid exposure; and detailed information on crash occurrence from a review of official crash reports. On the negative side, the study still suffered from inadequate sample sizes to produce precise estimates of relative risks, and also lacked data on miles driven or other more specific measures of driving exposure.

The latter weakness is not deemed critical, given that the goal of restricted licenses is to maintain safety, and not necessarily to improve driving performance. As noted earlier, Iowa's LDT program has many similarities with GDL programs for young beginning drivers, where reductions in crash risk are sought (and achieved) by regulating when and where drivers operate their vehicles. Thus, a high risk driver of any age who is only allowed to operate a vehicle under more limited exposure conditions can theoretically have fewer crashes, and be less of a threat to public safety, than a low risk driver who accumulates many more miles under much more varied driving conditions.

A final limitation to the current study relates to the potential generalizability of its findings to other states. A constellation of favorable features likely contributes to Iowa's ability to offer LDT licenses without undue risk both to the drivers themselves and to other road users. Iowa requires drivers aged 70 and above to renew their licenses in person every two years. Even more frequent medical and/or vision reports may be required, as was the case for over a fourth of the LDT drivers. Iowa examiners are trained to observe drivers for functional limitations, and to be proactive in requiring "line drives" if they perceive a potential problem. And as has already been noted, Iowa statutes allow for reexamination of any older driver who is cited for a traffic violation in conjunction with a crash. Finally, Iowa is a very rural state, so fewer of its drivers are faced with demanding urban driving situations. Even though the current study attempted to control for driving environment, LDT drivers in more urbanized states may have higher crash rates in comparison to their non-LDT counterparts.

Future research should focus on developing specific guidelines or criteria to help guide examiners in conducting local drive tests and setting appropriate restrictions. Feedback might also be gathered from LDT license recipients on ways the program might be improved, or ways they might be better assisted in making a positive transition to alternative forms of transportation. Approaches to local drive testing taken in other states could also be examined. For example, in Kansas, a state that has offered the program for decades, budget cuts have led to offering the local drive tests at county government offices, when an examiner is already visiting for other business, rather than traveling to individuals' residences. The result has been a savings in time, but the effects on safety and mobility are not known. Finally, research needs to be carried out to more directly examine the effects of offering restricted licenses based on local drive tests to older adults residing in more urban areas.

Local drive testing is not appropriate for all at-risk drivers. Drivers with moderate to severe dementia, for example, cannot be expected to comply with the imposed restrictions, and some drivers' functional impairments are so severe or unpredictable that they are not safe to drive in *any* environment. Other drivers' functional limitations may not be as severe, but their immediate driving environments may pose so many demands that a local drive license cannot meaningfully reduce their crash risks.

Most senior drivers, however, take personal responsibility for their driving and, after serious thought and consideration, self-restrict themselves from driving in unfamiliar and high- traffic areas and when headlights are required. To require a senior driver to demonstrate driving skills in a traffic environment they have already determined to be beyond their comfort and skill level places undue stress on the driver and could ultimately place both the driver and examiner in a dangerous traffic situation. Having a local drive test option does consume valuable examiner time and resources, but can result in less time and resources at the appeals level. The results of the current research also suggest that it can afford valuable time to ease seniors' transitions to non-driving status, without unreasonably endangering the lives of others on the roadway.

Conclusion

This study is the first to examine the safety of issuing restricted licenses to older drivers based on road testing on familiar roadways near their homes. The results demonstrate that, at least as practiced in Iowa, this option can work. LDT based licenses allow some Iowa drivers to continue to provide for their most important transportation needs without posing undue risks. Other Iowa licensing practices may contribute to the program's success, including shortened licensing intervals for older drivers, local examiner discretion to require annual medical or vision reports, local examiner discretion to impose other tailored restrictions, and Iowa's reexamination triggers for older drivers who cause crashes. States that wish to learn from Iowa's experience should consider Iowa's policies in their entirety. With that caveat, the authors encourage more states to consider the local drive test option.

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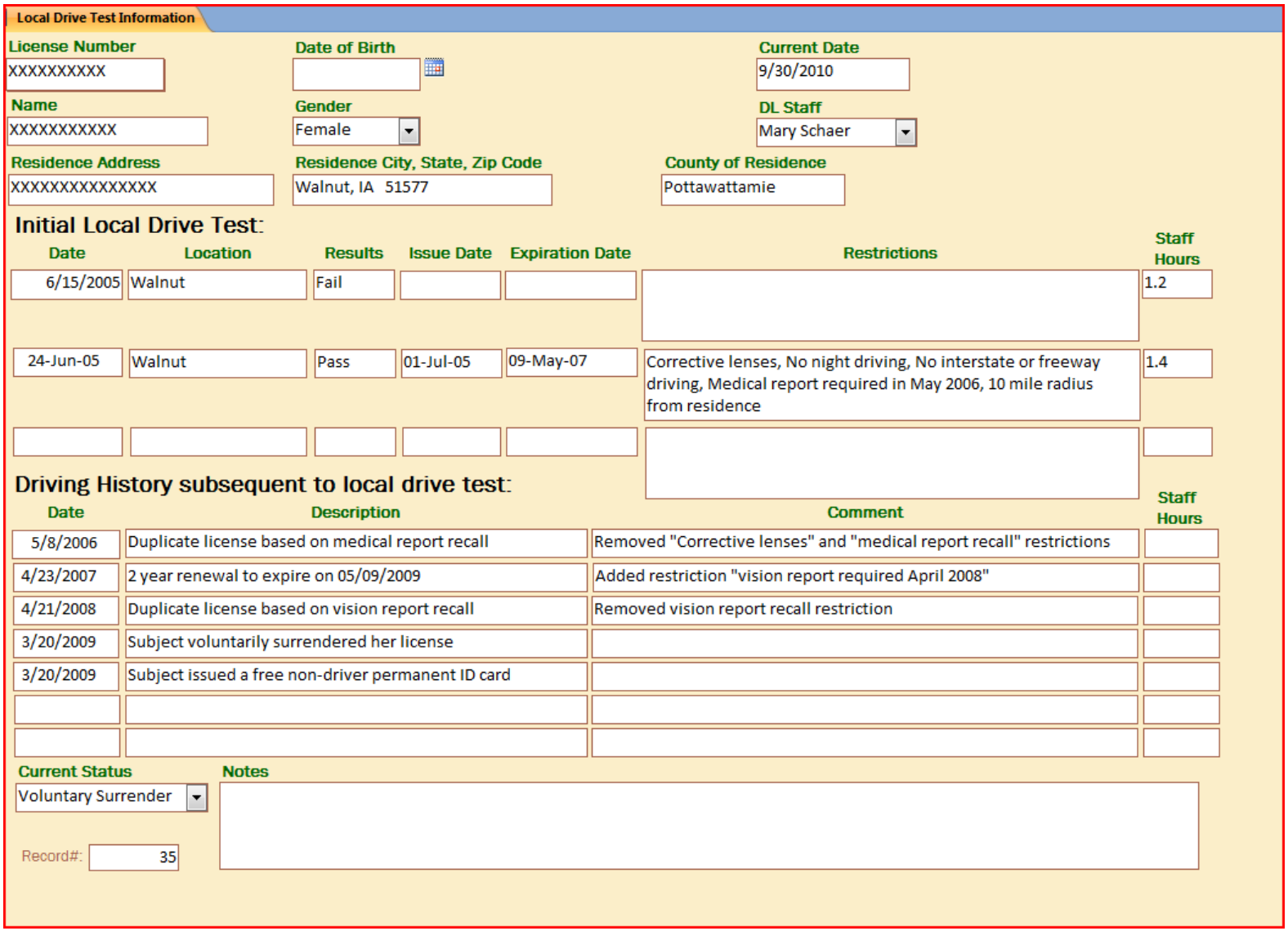
APPENDIX A
State DMV Noteworthy Initiatives Appearing in the Licensing Policies and Practices Database and Considered for Evaluation

State	Initiative Title
Alaska	Mature Driver Information (flyer & web page)
Arizona	Driver License Prohibition for Persons Adjudged Incapacitated
California	California 3-Tier Pilot Driver Assessment Program
California	Senior Driver Ombudsman Program
California	Older Californian Traffic Safety Task Force
California	Web Resources for California's Older Drivers
Hawaii	Hawaii Driver Licensing Training Video (copyrighted)
Illinois	Super Seniors Program and Rules of the Road
Iowa	Choices, Not Chances Public Awareness Campaign
Iowa	Department-wide Sensitivity Training
Iowa	Tailored Drive Tests
Iowa	"CarFit" Training for License Examiners
Kansas	"Local Drive" Road Test Program
Kansas	Driver Review Outreach
Maine	Maine Functional Ability Profile Booklet
Maryland	Tiered Driver Functional Assessment
Maryland	Maryland Research Consortium
Massachusetts	Shifting Gears – Safe Driving for Elders
Minnesota	Local Drive Option for On-Road Test
Minnesota	Interface Between Driver Evaluation & Driver Rehabilitation Specialists
Nebraska	"How Safe is Your Driving" (included with all driver license renewal notices)
New Jersey	New Case Management Procedures for Driver Medical Review
New Jersey	AMA Guide Physician Training
New York	New York DMV Office for the Older Driver
North Carolina	NC Senior Driver Safety Coalition
North Carolina	NC Coordinator for Older Driver Initiatives
Oklahoma	Handicapped Parking Permits Linked to Driver Medical Review
Oregon	Oregon Medically At-risk Driver Program
Oregon	Oregon Safe Mobility Outreach
Pennsylvania	Revisions to Medical Regulations

Pennsylvania	Driver Medical Re-examination Program
South Dakota	Local Law Enforcement Training to Assist Families Concerned about an At-Risk Driver
Utah	Medical Standards Based on Functional Ability
Utah	Guidelines for Placing Restrictions on Driver's Licenses
Virginia	Training for Driver License Quality Assurance Staff
Virginia	Law Enforcement Training to Increase reporting of Medically At-Risk Drivers
Washington	Court and Law Enforcement Liaison from Department of Licensing
Wisconsin	Law Enforcement Training for Reporting of Medically At-risk Drivers
Wisconsin	Encouraging Physician Reporting of Medically At-risk Drivers
Wisconsin	Promoting Awareness of Aging Driver Issues

APPENDIX B
Sample Microsoft Access Data Forms



Local Drive Test Information

License Number: XXXXXXXXXX
Date of Birth:
Current Date: 9/30/2010
Name: XXXXXXXXXXX
Gender: Female
DL Staff: Mary Schaer
Residence Address: XXXXXXXXXXXXXX
Residence City, State, Zip Code: Walnut, IA 51577
County of Residence: Pottawattamie

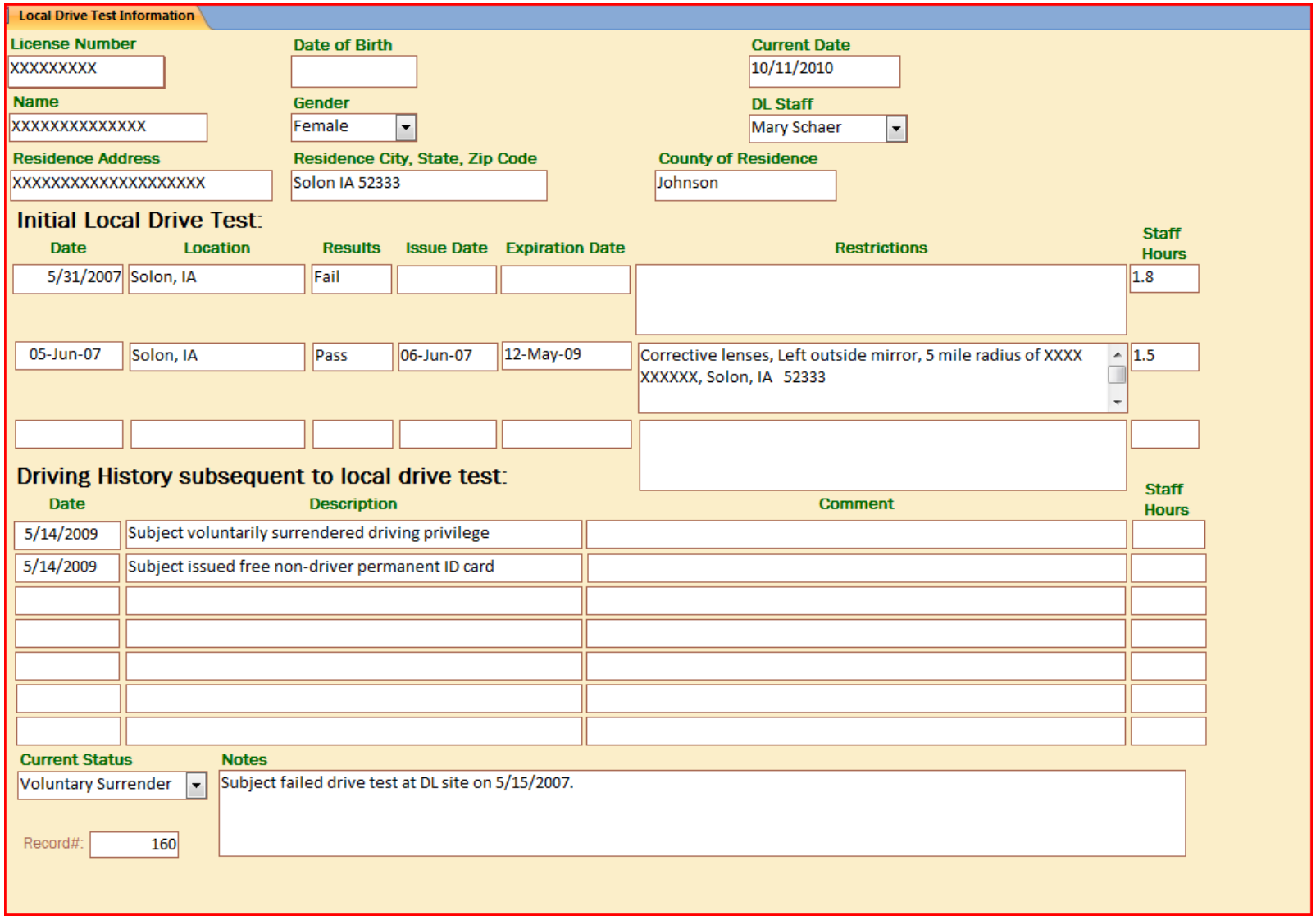
Initial Local Drive Test:

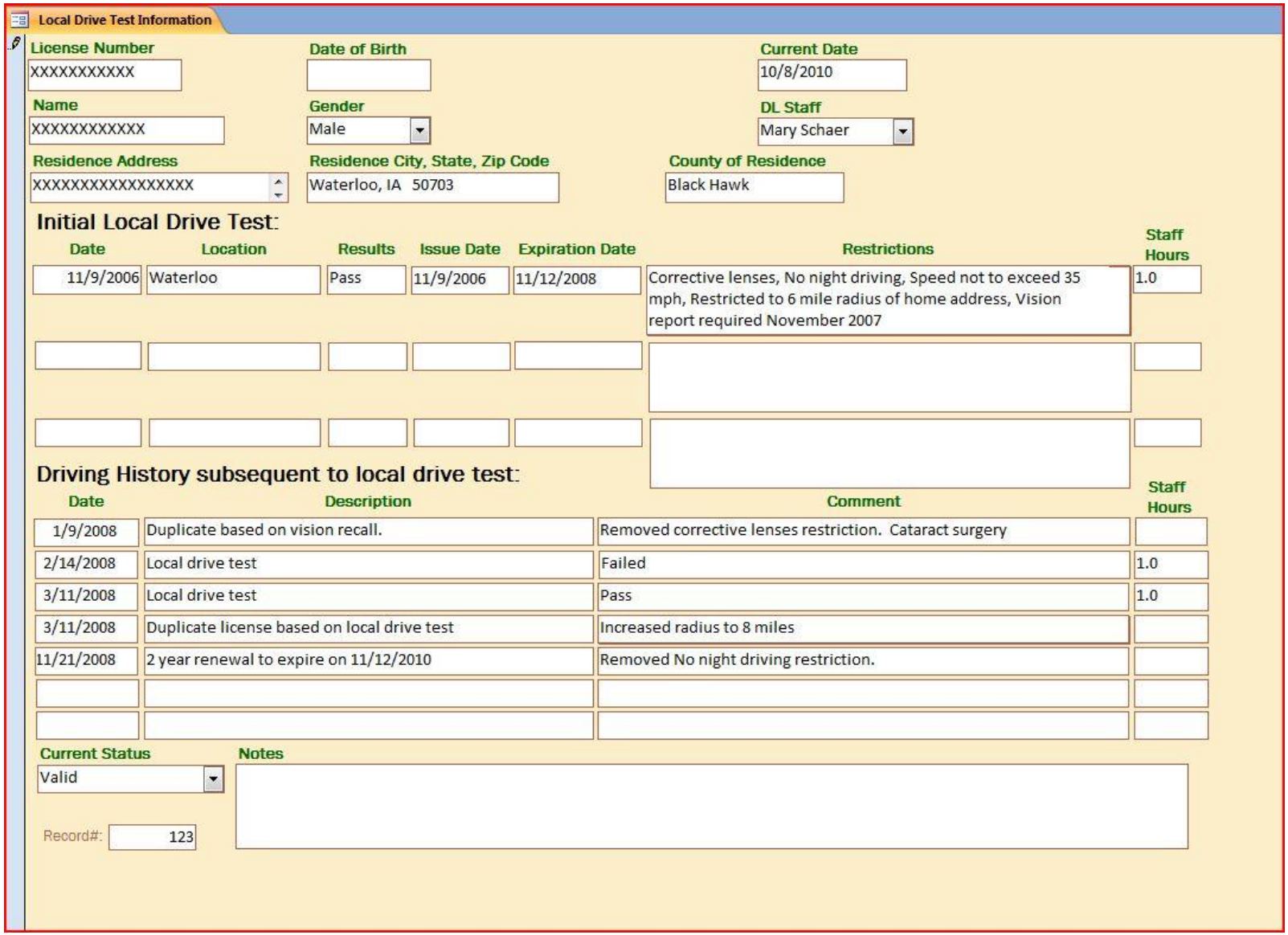
Date	Location	Results	Issue Date	Expiration Date	Restrictions	Staff Hours
6/15/2005	Walnut	Fail				1.2
24-Jun-05	Walnut	Pass	01-Jul-05	09-May-07	Corrective lenses, No night driving, No interstate or freeway driving, Medical report required in May 2006, 10 mile radius from residence	1.4

Driving History subsequent to local drive test:

Date	Description	Comment	Staff Hours
5/8/2006	Duplicate license based on medical report recall	Removed "Corrective lenses" and "medical report recall" restrictions	
4/23/2007	2 year renewal to expire on 05/09/2009	Added restriction "vision report required April 2008"	
4/21/2008	Duplicate license based on vision report recall	Removed vision report recall restriction	
3/20/2009	Subject voluntarily surrendered her license		
3/20/2009	Subject issued a free non-driver permanent ID card		

Current Status: Voluntary Surrender
Notes:
Record#: 35


Local Drive Test Information
License Number
XXXXXXXXX
Date of Birth
Current Date
10/11/2010
Name
XXXXXXXXXXXXX
Gender
Female
DL Staff
Mary Schaer
Residence Address
XXXXXXXXXXXXXXXXXXX
Residence City, State, Zip Code
Solon IA 52333
County of Residence
Johnson
Initial Local Drive Test:
Date
Location
Results
Issue Date
Expiration Date
Restrictions
Staff Hours
5/31/2007
Solon, IA
Fail
1.8
05-Jun-07
Solon, IA
Pass
06-Jun-07
12-May-09
Corrective lenses, Left outside mirror, 5 mile radius of XXXX XXXXXX, Solon, IA 52333
1.5
Driving History subsequent to local drive test:
Date
Description
Comment
Staff Hours
5/14/2009
Subject voluntarily surrendered driving privilege
5/14/2009
Subject issued free non-driver permanent ID card
Current Status
Voluntary Surrender
Notes
Subject failed drive test at DL site on 5/15/2007.
Record#:
160


Local Drive Test Information
License Number
XXXXXXXXXX
Date of Birth
Current Date
10/8/2010
Name
XXXXXXXXXXX
Gender
Male
DL Staff
Mary Schaer
Residence Address
XXXXXXXXXXXXXXXX
Residence City, State, Zip Code
Waterloo, IA 50703
County of Residence
Black Hawk
Initial Local Drive Test:
Date
Location
Results
Issue Date
Expiration Date
Restrictions
Staff Hours
11/9/2006
Waterloo
Pass
11/9/2006
11/12/2008
Corrective lenses, No night driving, Speed not to exceed 35 mph, Restricted to 6 mile radius of home address, Vision report required November 2007
1.0
Driving History subsequent to local drive test:
Date
Description
Comment
Staff Hours
1/9/2008
Duplicate based on vision recall.
Removed corrective lenses restriction. Cataract surgery
2/14/2008
Local drive test
Failed
1.0
3/11/2008
Local drive test
Pass
1.0
3/11/2008
Duplicate license based on local drive test
Increased radius to 8 miles
11/21/2008
2 year renewal to expire on 11/12/2010
Removed No night driving restriction.
Current Status
Valid
Notes
Record#:
123

APPENDIX C
Synopsis of Case Drivers who Crashed

Case #8
At the time of her accident, this 84 year-old woman had held her LDT license for about 18 months. She was limited to a ten mile radius of her town, whose population was under 1,000 people, and her accident occurred within a mile of her home. Her other restrictions were corrective lenses, left outside mirror, and no interstate/freeway driving. This case driver parked and exited her car, which began rolling downhill. She tried to reenter the car and was dragged until the car came to a stop without striking anything. She was taken to a hospital by ambulance but is known to have renewed her license four months later. At the end of that two year licensure period, she did not attempt to renew.

Case #11
This 78 year-old man was involved in two at-fault crashes within an eight month span while driving on his LDT license. His area restriction was a ten mile radius of his residence, which was in a city of over 100,000 people. His other restrictions were left outside mirror and vehicle speed not to exceed 35 mph. He had held an LDT license for over four years (with renewals) at the time of his first at-fault crash. He sideswiped another car while turning left in one of two parallel left turn lanes; no one was injured. In his second at-fault crash, he failed to yield right-of-way while turning left in front of an oncoming car; again no one was injured. He was called in for reexamination, passed the vision and knowledge tests, but was unable to pass the local drive test despite three attempts from his residence. His license was then suspended.

Case #29
This 82 year-old man had held an LDT license for six months at the time of his at-fault crash. His area restriction was a ten mile radius of his residence, which was in a town of fewer than 500 people, in a rural area. His other restriction was corrective lenses. He ran a red light in a nearby town (of under 5000 residents) and struck another vehicle; there were no injuries. He was called in for reexamination but did not appear, whereupon his license was suspended.

Case #32
This 77 year-old man was involved in two crashes within twenty months while driving on an LDT license, but was judged not at fault in either. His area restriction was a seven mile radius of his residence, which was in a town of fewer than 1,000 people. His other restrictions were corrective lenses, no night driving, and vehicle speed not to exceed 35 mph. He had held an LDT license for over five years (with renewals) at the time of the first crash. In the first crash, the case driver's vehicle was struck by another vehicle that failed to yield right-of-way at a stop sign. No one was injured, and the other driver was cited. In the second crash, the case driver was turning left when the car behind pulled out to pass and struck him; the other driver was cited, and a passenger in the other driver's vehicle had a non-incapacitating injury. The case driver continued to hold an active license when the research project ended.

Case #46
This 89 year-old man had held an LDT license for only two months at the time of his at-fault crash. His area restriction was a 3 mile radius of his residence, which was in a city of over 50,000 people. His other restriction was a left outside mirror. He was attempting to turn left from a stop sign in the city when he pulled out in front of another vehicle. Injuries were coded as "none" and "unknown," and no one was transported. He was called in for re-examination and was able to pass and retain his license. He was also able to renew approximately eighteen months later, and he held an active LDT license until his death.

Case # 47
This 83 year-old man had held an LDT license for seven years (with renewals) at the time of his at-fault crash. His area restriction was the city limits of his town, which had a population of about 1000 people. His other restrictions were corrective lenses, a prosthetic device, and a medical report at each renewal. His crash occurred within a block of his home when he struck an unoccupied legally parked car. There were no injuries. He was called in for reexamination, and his license was suspended after he failed the knowledge test three times.

Case #61
This 89 year-old woman had held an LDT license for 20 months at the time of her at-fault crash. Her area restriction was a four mile radius of her residence, which was in a city of over 50,000 people. Her other restriction was corrective lenses. Her at-fault crash occurred in her city and within a mile of home, when she sideswiped one car while turning into a parking lot, then "panicked" and drove into a second parked car. There were no injuries. She was called in for reexamination, and her license was suspended when she failed to appear.

Case #126
This 81 year-old man had held an LDT license for about six months at the time of his at-fault crash. His area restriction was a ten mile radius of his hometown of over 5,000 people. His other restrictions were corrective lenses, no night driving, vehicle speed not to exceed 35 mph, left and right outside mirrors, and an annual vision report. His crash occurred when he "blacked out", striking a parked dump truck, then an unoccupied parked car. He was coded as a "possible" injury, and there were no injuries to others. He was called in for reexamination and was able to pass all requirements. He retained an active license for two more years, after which his driving privilege was suspended based on unsatisfactory vision.

Case #128
This 65 year-old man had held an LDT license for less than three months at the time of his at-fault crash. His area restriction was a ten mile radius of his residence, which was in a city of over 100,000 people. His other restrictions were corrective lenses, no night driving, no interstate or freeway driving, left and right outside mirrors, and an annual medical report. His crash occurred in the city when he was attempting to park, "pushed the wrong pedal", and backed into an unoccupied legally parked car. There were no injuries. When this driver's annual medical report arrived some months later, it indicated that he was no longer able to drive safely, and his license was suspended.

Case #146
This 87 year-old woman had held an LDT license for seven months at the time of her at-fault crash. Her area restriction was the city limits of her hometown of under 5,000 people. Her other restrictions were corrective lenses, no night driving, left and right outside mirrors, and a medical report at renewal. Her crash occurred in town, when she accelerated while attempting to park, jumping the curb and striking a building. She was coded as having a non-incapacitating injury and was transported by ambulance; there were no injuries to others. Her license expired fifteen months later, and she did not attempt to renew it.

Case #188
This 90 year-old woman had held an LDT license for only a month at the time of her crash, in which both drivers were judged to share fault. Her area restriction was a 35 mile radius of her residence in a town of less than 1,500 people. Her other restrictions were corrective lenses, left outside mirror, no night driving, and no interstate or freeway driving. Her crash occurred just beyond her town, when she met and sideswiped an oversized farm implement which was being towed by a tractor. The crash report showed the farm implement slightly over the centerline but with room for oncoming vehicles to avoid it, and this was judged by the researchers to be a shared fault crash. There were no injuries. When the case driver's license expired eighteen months later, she did not attempt to renew it.

Case #79
(Case driver who crashed after his LDT license had expired)
When this 92 year-old man ran into a tree that was down in the roadway, he was found to be driving with an LDT license that had expired three months earlier. He was alone in the car and uninjured. The license had included an area restriction for a seven mile radius around his residence in a town of under 500 people, as well as requirements for a left outside mirror and no interstate or freeway driving. Several months after his conviction for driving on the expired license, he tried but failed to pass a local drive test. He at first elected to appeal the decision, but then his wife contacted driver licensing to say he would no longer drive.

APPENDIX D. 2010 Iowa Crash and Driver License Data by Age and Gender

	All Crashes							Male Crashes							Female Crashes							Licensed Drivers (As of August 2010)	
Driver Age	Fatal	Major	Minor	Possible/ Unk.	Property Damage Only	All Crashes		Fatal	Major	Minor	Possible/ Unk.	Property Damage Only	All Crashes		Fatal	Major	Minor	Possible/ Unk.	Property Damage Only	All Crashes		Males	Females
13 and younger	0	1	4	0	4	9		0	1	1	0	3	5		0	0	3	0	1	4			
14	0	5	25	25	70	125		0	4	16	16	39	75		0	1	9	9	32	51		8,707	8,135
15	5	7	78	94	350	534		3	4	47	49	186	289		2	3	31	45	167	248		13,762	13,214
16	4	47	258	495	1,839	2,643		1	24	121	211	959	1,316		3	23	138	288	901	1,353		16,066	15,753
17	13	56	260	478	2,114	2,921		9	37	136	234	1,138	1,554		4	19	125	251	1,012	1,411		17,119	16,686
18	14	78	295	583	2,228	3,198		9	44	141	259	1,241	1,694		5	33	153	324	1,003	1,518		17,660	17,760
19	17	60	249	494	2,011	2,831		11	39	127	245	1,083	1,505		5	21	121	247	927	1,321		18,290	18,286
20	9	57	268	437	1,904	2,675		6	29	134	210	1,014	1,393		3	29	133	226	876	1,267		18,872	19,047
21 to 24	39	172	739	1,456	6,160	8,566		31	115	439	730	3,322	4,637		9	59	298	735	2,885	3,986		72,173	73,423
25 to 29	42	182	738	1,367	6,129	8,458		35	118	416	677	3,355	4,601		7	64	323	690	2,779	3,863		89,666	90,642
30 to 34	39	187	656	1,229	5,025	7,136		29	128	376	636	2,802	3,971		10	61	287	604	2,215	3,177		83,240	84,825
35 to 39	46	156	577	1,078	4,448	6,305		37	88	342	566	2,495	3,528		9	65	235	517	1,967	2,793		79,174	80,085
40 to 44	39	164	532	1,036	4,496	6,267		33	114	319	520	2,577	3,563		6	52	210	518	1,952	2,738		85,966	85,902
45 to 49	43	150	575	1,094	4,845	6,707		36	106	367	586	2,842	3,937		9	48	215	524	2,047	2,843		97,351	100,313
50 to 54	47	183	541	1,015	4,563	6,349		39	127	353	534	2,736	3,789		10	58	193	491	1,848	2,600		102,717	104,952
55 to 59	52	139	451	916	3,977	5,535		44	96	286	509	2,347	3,282		11	42	175	417	1,643	2,288		96,891	96,939
60 to 64	41	107	358	739	2,967	4,212		31	73	235	416	1,772	2,527		11	33	121	331	1,210	1,706		80,393	81,335
65 to 69	23	64	225	458	1,863	2,633		13	42	127	263	1,138	1,583		10	22	98	204	728	1,062		57,347	60,079
70 to 74	17	52	167	316	1,540	2,092		13	33	98	169	936	1,249		4	19	66	149	602	840		43,860	48,789
75 and older	41	113	364	629	2,624	3,771		30	60	209	355	1,451	2,105		11	56	158	288	1,211	1,724		73,901	92,214
Total Driver Cras	**531**	**1,980**	**7,360**	**13,939**	**59,157**	**82,967**		**410**	**1,282**	**4,290**	**7,185**	**33,436**	**46,603**		**129**	**708**	**3,092**	**6,858**	**26,006**	**36,793**		**1,073,155**	**1,108,379**
Total Crashes	348	1,343	4,839	8,404	39,412	54,346		307	1,021	3,449	5,679	26,899	37,355		112	590	2,560	5,365	21,343	29,970			