Abstract
Alcohol-impaired driving continues to be a major public health problem in the United States. During 2000, alcohol was involved in 40% of all traffic fatalities (1). One promising countermeasure to alcohol-impaired driving is the ignition interlock license restriction program. Ignition interlock devices are designed to prevent an alcohol-impaired driver from starting and operating a motor vehicle. License restriction means that drivers are approved for license reinstatement on the condition that they agree to a license restriction prohibiting them from operating a vehicle without an ignition interlock device. The conditional interlock license restriction is prominently displayed on the driver’s license of each program participant. Ignition interlock license restrictions have shown potential for reducing recidivism among drivers with multiple alcohol-related traffic offenses (2). Later analyses of this same cohort examined recidivism rates 3 and 4 years after study entry (3, 4). In the current paper, new recidivism rates for the one year interlock license restriction program and second (i.e., first year post-interlock) through fifth year (i.e., fourth year post-interlock) of follow-up are presented using newly developed electronic data abstraction methods. There was no statistically significant difference in the recidivism rates for the interlock license restriction (4.0%) and control groups (4.8%) in the fifth year after study entry.

Introduction
A statewide-randomized trial of ignition interlock license restrictions was performed in Maryland and the results of that program evaluation were reported in the American Journal of Public Health (2). Participants were 1,387 drivers with multiple alcohol-related traffic offenses whose driver’s licenses were either suspended or revoked for multiple alcohol offenses and who were eligible for license reinstatement after undergoing a variety of treatment programs. Drivers were randomly assigned to participate in an ignition interlock license restriction program or the usual post-licensure treatment program (control group) lasting 12 months (2-4). Figure 1 shows the geographic distribution of participants by zip code. Participants in the interlock program had a restriction on their drivers’ licenses indicating they could drive only a vehicle equipped with an ignition interlock. Drivers who owned a car had to have the device installed within 45 days; those
who did not own a car had to sign a waiver that they would not drive a car unless it was equipped with an interlock. The interlock license restriction and customary treatment programs were administered by the MVA rather than the courts. This approach ensured greater consistency of case management and handling of license restrictions and allowed the MVA to monitor and enforce compliance with the license restrictions.

Figure 1:  Sample Distribution by Zip Code

The initial results in this cohort (2) were reproduced using a more standardized data abstraction method (3, 4). Although the recidivism rates for both the interlock and control groups were higher than those in the initial report, the analysis confirmed the earlier results. The current study differs from the previous analyses by using a standardized electronic data abstraction method, counting alcohol-related “violations” rather than “arrests,” and including all alcohol-related recidivism events by a repeat offender (i.e., not just the first event) in the analysis. All data reported in this paper uses the revised methodology.

The purpose of the current study was to determine the effectiveness of the ignition interlock license restriction program in reducing alcohol-related traffic recidivism 5 years after program implementation (i.e., in the fourth year after the ignition interlock license restriction program ended). In particular, we were interested in determining whether the convergence in alcohol-related traffic recidivism between the interlock and control groups, observed during the second, third and fourth years, would be maintained during the fifth year. We were also interested in determining whether the recidivism rates of interlock and control group participants would increase significantly beyond the levels observed during the first 4 years.

Methods
Data for this study were provided electronically by the Maryland Motor Vehicle Administration (MVA) after personal identifying information had been deleted from drivers’ records. Data from this file were matched to our earlier data file, an Access database into which data had been manually abstracted and double key-entered. We then compared the recidivism rates calculated
using the electronic and manual abstraction methods. The differences were minor and did not change any of the conclusions previously reported. An additional manual comparison of violation codes revealed no systematic biases. We also used alcohol-related “violations” rather than “arrests,” and included all alcohol-related recidivism events by a repeat offender (i.e., not just the first event) in the analysis. Given the randomized nature of the design, all participants assigned to the interlock condition were included in the analysis whether or not they had the device installed, as appropriate under the intention-to-treat design.

Thirty-one drivers died and 43 moved out of state during the study period. There were no statistically significant differences between the interlock and control groups in the proportions of drivers who died (Chi-Square = 0.90, d.f. = 4, p = 0.92) or moved out of state (Chi-Square = 7.37, d.f. = 4, p = 0.12). The analysis did not control for drivers who died or moved out of state during the study period, which may result in a slight overestimation of survival rates.

**Results**

During the first year of the study, 26 of 693 offenders in the interlock license restriction program (3.8%) and 62 of 692 offenders in the control group (9.0%) committed an alcohol-related traffic violation. This difference was statistically significant, with a relative risk of 0.40 (95% CI 0.25, 0.63). Being in the interlock program reduced a driver’s risk of committing an alcohol-related traffic violation by about 60 percent. During the second year, when the ignition interlock license restrictions were removed, the alcohol-related traffic recidivism rates for anyone recidivating in year 2 in the two groups converged and were not statistically significantly different. During the second year, the ignition interlock group had a slightly lower recidivism rate than the control group (6.9% vs. 8.1%), although the recidivism rates of the two groups were not statistically significantly different. During year 3, the rates were higher for the interlock group (7.8%) than for the control group (6.5%) but the difference was not statistically significant. In year 4, the rates were also higher for the interlock group (8.8%) than for the control group (7.1%) but the difference was not statistically significant. Thus, the reduction in alcohol-related traffic recidivism for the interlock group was limited to the first year of the program, when the interlock license restriction program was in effect, and there was no evidence that the first-year benefits extended into subsequent years.

Being in the interlock license restriction program significantly reduced a driver’s risk of committing an alcohol-related traffic violation by about 60 percent during the first year when the program was in effect (Chi-Square = 15.78, d.f. = 1, p < 0.0001). Contrary to first year findings, second, third, fourth, and fifth year recidivism rates of drivers in the interlock program and standard treatment (control) group converged and were not statistically significantly different (Table 1).
Table 1: Recidivism Rates in the Interlock (n = 693) and Control Groups (n = 692) by Year of Follow-Up, Using Electronic Abstraction and Replacement

<table>
<thead>
<tr>
<th>Year</th>
<th>Interlock</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1*</td>
<td>0.038</td>
<td>0.090</td>
</tr>
<tr>
<td>Year 2++</td>
<td>0.069</td>
<td>0.081</td>
</tr>
<tr>
<td>Year 3++</td>
<td>0.078</td>
<td>0.065</td>
</tr>
<tr>
<td>Year 4++</td>
<td>0.088</td>
<td>0.071</td>
</tr>
<tr>
<td>Year 5++</td>
<td>0.040</td>
<td>0.048</td>
</tr>
</tbody>
</table>

*Chi-Square = 15.78, d.f. = 1, p < 0.0001
++Not statistically significant (95% Confidence)

During year 5, 4.0% of the 693 drivers in the interlock group (n = 28) and 4.8% of the 692 drivers in the control group (n = 33) recidivated (Table 2). This difference was not statistically significant (Chi-Square = 0.44, d.f. = 1, p = 0.51). After 4 years of increasing recidivism rates in the interlock group, the rates for year 5 are much lower for both the interlock and control groups.

Table 2: Recidivism Among Drivers in the Interlock and Control Groups at the Fifth-Year Follow-up

<table>
<thead>
<tr>
<th>Group</th>
<th>Drivers (N)</th>
<th>Drivers with Violation in Year 5</th>
<th>% of N^+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interlock</td>
<td>693</td>
<td>28</td>
<td>4.0</td>
</tr>
<tr>
<td>Control</td>
<td>692</td>
<td>33</td>
<td>4.8</td>
</tr>
<tr>
<td>Total</td>
<td>1,385</td>
<td>61</td>
<td>4.4</td>
</tr>
</tbody>
</table>

^Chi-Square = 0.44, d.f. = 1, p = 0.51; not statistically significant

Figure 2 displays cumulative survival curves for the 5-year study period for all drivers who committed an alcohol-related traffic violation, including drivers with a prior alcohol-related traffic offense during years 1, 2, 3, and/or 4. It should be noted that at the time of randomization there were no statistically significant differences in the number of previous alcohol-related traffic violations between the interlock group (mean = 3.66, SD = 1.45) and the control group (mean = 3.65, SD = 1.28). Five year survival effect of the interlock license restriction program was also analyzed using an Anderson-Gill Multiplicative Hazards Model, stratified on year. The interlock license restriction program was found to reduce the hazard ratio by about 12 percent. However, this reduction was not statistically significant (Chi-Square = 2.24, d.f. = 1, p = 0.135).

In addition to overall recidivism rates, we also examined first-time recidivism (i.e., drivers who did not recidivate in years 1, 2, 3 and 4) among drivers in the interlock and control groups during year 5. Four percent of drivers in the interlock group (n = 21) and 4.5% of drivers in the control group (n = 23) recidivated for the first time since study enrollment during year 5 (Table 3). There were no statistically significant differences between interlock and control group drivers who...
recidivated for the first time during year five (Chi-Square = 0.15, d.f. = 1, p = 0.70). The positive effects of the interlock program do not extend over the 5-year period of study. At the end of 5 years, the overall effects of the interlock license restriction program are not statistically significant (Chi-Square = 0.63, d.f. = 1, p = 0.43).

**Figure 2:** Survival Until Recidivism, Years 1-5

![Graph showing survival until recidivism, years 1-5](image)

**Table 3:** First-Time Recidivism Among Drivers in the Interlock and Control Groups During the Fifth-Year of Follow-up

<table>
<thead>
<tr>
<th>Group</th>
<th>Drivers (N)</th>
<th>Drivers Without Violation in Years 1-4 (N)</th>
<th>% of N</th>
<th>Drivers with 1st Offense in Year 5</th>
<th>% of N⁺</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interlock</td>
<td>693</td>
<td>528</td>
<td>76.2</td>
<td>21</td>
<td>4.0</td>
</tr>
<tr>
<td>Control</td>
<td>692</td>
<td>516</td>
<td>74.6</td>
<td>23</td>
<td>4.5</td>
</tr>
<tr>
<td>Total</td>
<td>1,385</td>
<td>1,044</td>
<td>75.4</td>
<td>44</td>
<td>4.2</td>
</tr>
</tbody>
</table>

*Chi-Square = 0.15, d.f. = 1, p = 0.70; not statistically significant

**Discussion**

The positive effects of the ignition interlock license restriction program were limited to the first year, when the program was in effect. There is no evidence that the benefits of this program extended into years 2, 3, 4, and 5 (i.e., 4 years post-interlock), when the rate of alcohol-related traffic violations is essentially the same in both the interlock and control groups. The interlock license restriction program clearly reduced recidivism among this cohort of persistent drinking drivers during the one-year program. It is also equally clear that a one-year interlock license restriction program is not sufficient to alter drinking driving behavior once the program has ended. For persistent drinking drivers, interlock license restriction programs need to be maintained for longer than 12 months. Research suggests that having a high number of failed breath tests as recorded by the interlock datalogger is a predictor of recidivism in the first year.
after the interlock is removed from the vehicle (5, 6). Individuals who have a high number of failed breath tests during an interlock program may need to remain in an interlock license restriction program until they learn to separate drinking from driving.

The lower recidivism rates in both the interlock (4.0%) and control (4.8%) groups during year 5 may be explained by the fact that violations (not arrests) were used for this analysis. It can take more than a year before a defendant even appears in court, and there is an additional lag time before the final judicial outcomes appear on the driver record. Further research is needed to investigate why recidivism rates declined in year 5.

Ignition interlock license restrictions, like license revocation, are not a foolproof system for preventing alcohol-impaired driving. They do not prevent a driver from operating a vehicle that is not equipped with an ignition interlock, just as a license revocation cannot prevent a driver from driving with a revoked license. However, like license revocation, an interlock license restriction program may lead restricted drivers in unequipped vehicles to drive fewer miles and to drive more conservatively as a result of the interlock license restriction.

This study provides evidence regarding the long-term convergence of alcohol-related traffic recidivism in the two groups of interest. It is encouraging that the risk of an alcohol-related traffic violation was substantially lower (60%) for multiple offenders assigned to the interlock license restriction program during the 12 months the program was in effect. Once the interlock license restriction was removed, recidivism rates converged. This suggests that for certain chronic alcohol-related traffic offenders, interlock license restrictions may have to be maintained longer than 12 months—and perhaps indefinitely.

Acknowledgement
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References