Mandating Treatment Based on Interlock Performance: Evidence for Effectiveness

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Background: Vehicle alcohol ignition interlocks reduce alcohol-impaired driving recidivism while installed, but recidivism reduction does not continue after removal. It has been suggested that integrating alcohol use disorder (AUD) treatment with interlock programs might extend the effectiveness of interlocks in reducing recidivism beyond their removal. This study evaluated the first implementation of a Florida policy mandating AUD treatment for driving under the influence (DUI) offenders on interlocks. Treatment was required when the offender accumulated 3 violations (defined as 2 "lockouts" within 4 hours; a lockout occurs when the device prevents a drinking driver from starting the vehicle).

Methods: Cox regression was used to compare alcohol-impaired driving recidivism during the 48 months following the interlock removal between 2 groups: (i) 640 multiple DUI offenders who received AUD treatment while interlocks were installed; and (ii) 806 matched offenders not mandated to treatment while interlocks were installed.

Results: The ignition interlock plus treatment group experienced 32% lower recidivism, 95% confidence interval [9, 49], following the removal of the interlock during the 12 to 48 months in which they were compared with the nontreatment group. We estimated that this decline in recidivism would have prevented 41 rearrests, 13 crashes, and almost 9 injuries in crashes involving the 640 treated offenders over the period following interlock removal.

Conclusions: This study provides strong support for the inclusion of AUD treatment for offenders in interlock programs based on the number of times they are "locked out." The offenders required to attend treatment demonstrated a one-third lower DUI recidivism following their time on the interlock compared to similar untreated offenders.

Key Words: Impaired Driving, AUD Treatment, Interlocks, Multiple DUI Offenders, DUI Recidivism.

THERE IS EXTENSIVE evidence that vehicle ignition interlock devices, which are designed to prevent an impaired driver from starting the vehicle, reduce recidivism of motorists convicted of driving under the influence (DUI) by approximately two-thirds while on their vehicles (Elder et al., 2011; Willis et al., 2004). This has resulted in most states making interlock use mandatory for all or selected groups of convicted DUI offenders (e.g., multiple offenders, offenders with high blood alcohol concentration [BAC] on arrest). The few states without mandatory provisions provide for discretionary use of interlocks by the courts (Mayer, 2014; National Highway Traffic Safety Administration, 2013). The enactment of these laws has produced a rapid growth in the use of interlocks with over 300,000 installed in the United States in 2014 (Roth, 2014). A significant limit in the potential benefit of interlocks is that they function primarily as an incapacitation mechanism by preventing impaired driving while installed, but once removed alcohol-impaired driving recidivism increases (Elder et al., 2011; Voas, 2015; Willis et al., 2004).

There is reason to believe that state ignition interlock programs can provide the opportunity to implement educational and treatment interventions that could reduce recidivism after the interlock is removed. Studies have shown that offenders adapt to the interlock over the period of use (Marques et al., 1999, 2010; Vanlaar et al., 2013). The Vanlaar and colleagues (2013) study of 7,433 DUI offenders on interlocks found that during the first 3 months on the device 54% produced lockouts (breath tests with BACs over the state limit, which prevented their starting their cars), whereas during the last 3 months of their 2-year term on the device only 22% experienced lockouts. This adaptation is achieved without significantly reducing the offender's total driving (Marques et al., 2010) or total drinking (Marques, 2012). Importantly, the extent of the adaptation as indicated by the number of lockouts is predictive of future recidivism, with less adaptation related to higher recidivism (Marques et al., 2003b). Despite this ability to adapt without major

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reductions in either drinking or driving, once the interlock is removed, recidivism returns to pre-installation levels (Marques et al., 2010).

This suggests that an opportunity exists to provide intensified monitoring, treatment, and educational programs to support the behavioral adaptation that occurs while the interlock is installed with an aim to extend the impact of the interlock after it is removed. Two studies have demonstrated that intensified monitoring through more frequent contacts with the offender can reduce lockouts while the interlock is installed. An early study in Alberta, Canada, compared a standard interlock program with another program that provided additional information on how the interlock functions and counseled the offender on methods for avoiding lockouts. The authors found that the added support (information and counseling) resulted in a statistically significant reduction ($F = 19.79$, $p = 0.001$) in lockouts during the program (Marques et al., 1999). More recently in Maryland, Zador and colleagues (2011) demonstrated that an intensive monitoring program involving supportive messages for good behavior and additional sanctions for failures to meet program rules improved performance while on the interlock. While these enhanced monitoring efforts indicate that adaptation to the interlock can be enhanced while the interlock is in place, to date, no treatment program specifically designed for use in conjunction with an interlock program has been shown to reduce recidivism following removal of the interlock.

This study takes advantage of the implementation in 2008 of legislation in Florida mandating treatment for DUI offenders in interlock programs, based on the lockouts reported in their interlock records. In Florida, the licenses of DUI offenders are administratively revoked at the time of their arrest. To restore their licenses, offenders must qualify for reinstatement by paying fines, entering mandated education/treatment programs, and satisfying any other sanctions imposed by the court. Offenders who qualify for reinstatement have their licenses restored but with a limitation that they may only drive a vehicle with an interlock for a period of 6 months to several years, depending on the number of prior offenses and the seriousness of their DUI offense. Interlock installation for the required time period is the sole path to license reinstatement for DUI offenders who are subject to the Florida interlock law, which include those receiving administrative license revocation and DUI convictions (see Florida Statute 322.2715 Ignition Interlock Device).

During the period on the interlock, offenders who commit 4 or more interlock violations (defined as 2 lockouts within 4 hours when attempting to start their cars with a BAC > 0.05)[1] are mandated to attend treatment. Failure to comply results in the termination of the interlock permit and return to revoked license status. The offender receives a notice from the Florida Department of Highway Safety and Motor Vehicles (DHSMV) with a list of the State Department of Children and Family (DCF) certified substance abuse counselors and treatment programs. The DCF programs have a memorandum of understanding agreement with the Florida DHSMV to provide the treatment services required. The DCF counselor assesses the problem status of the offender and develops an individualized treatment plan for the client that can include individual or group therapy and generally lasts 8 to 12 weeks. The counselors have access to violation reports and complaints about the interlock device. These may be discussed in individual and group sessions, but they are not the central theme of the therapy program. Time on the interlock is extended to accommodate the treatment program, and the therapist must certify completion of that plan before the interlock can be removed from the offender's vehicle. There is no standard definition for successful completion of treatment, as the treatment plans are tailored to the offender. This referral to treatment appears to be the first example in which an objective measure of performance on the interlock is being used as a basis for requiring treatment and where treatment results are used to determine the offender's readiness for interlock removal as well as license reinstatement.

Our study objectives were to (i) determine whether the mandated alcohol use disorder (AUD) treatment program imposed on interlock offenders with 3 or more interlock violations reduced their recidivism following interlock removal, (ii) describe the characteristics of DUI offenders on interlocks who are associated with postinterlock removal recidivism, and (iii) estimate the cost effectiveness of the mandated treatment program.

RESEARCH PLAN

Establishing the Treatment and Comparison Groups

The legislation that instituted the mandatory treatment requirement was accompanied by a lowering of the threshold arrest BAC from >0.20 to >0.15 for mandating first offenders to install the interlock. This caused the characteristics of first offenders to change over the period of our study, so we limited our analysis to multiple DUI offenders. From the DHSMV data file, we drew the records of all Florida multiple DUI offenders who installed interlocks between October 2008, when the mandatory treatment policy was implemented, and December 30, 2012. During that period, there were 27,736 multiple offenders who could have been referred to treatment if they committed 3 violations (Fig. 1). Of these, 13,458 (48%) had completed their interlock sentence, had the interlock removed, and had a minimum of 12 months—and up to 48 months—of postinterlock driving exposure (mean = 28.63 months, standard deviation [SD] = 10.66) within which we could assess their recidivism. Of the 13,458

[1]Two independent attempts that were locked out within 4 hours were required. The second failure validated the first lockout and prevented violations based on mouth alcohol.

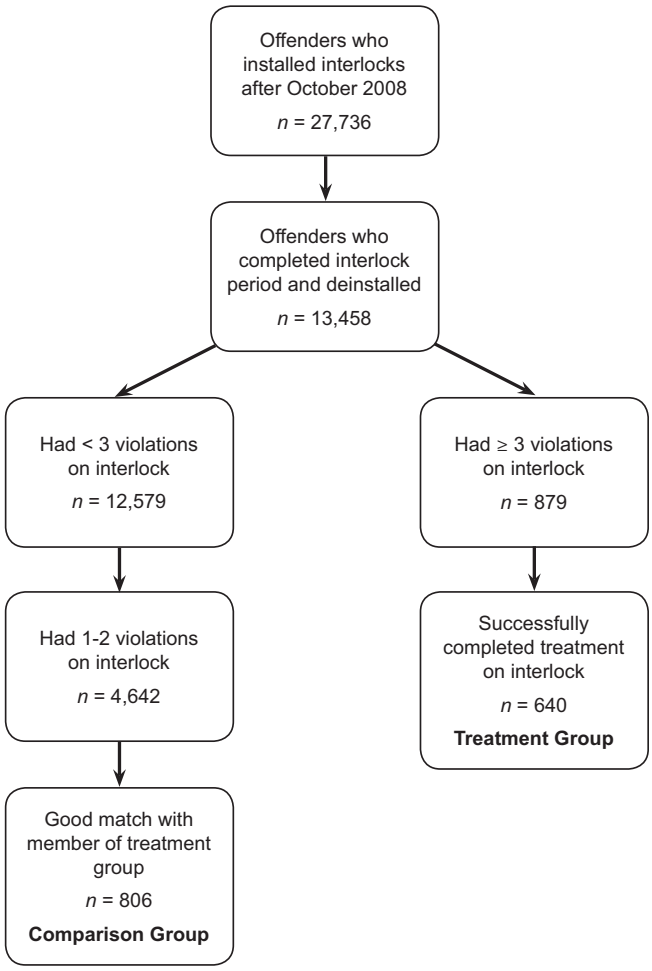


Fig. 1. Sample definitions involved in the construction of a group of multiple offenders in the Florida Ignition Interlock Program (2008 to 2012) for comparison with the 640 treated offenders. Violations are based on 2 lockouts within 4 hours. Offenders with 3 violations were mandated to attend alcohol use disorder treatment. Propensity analysis was employed to match 806 offenders with 1 or 2 violations with the 640 three-violation treated group.

who had completed their time on the interlock, 879 (7%) had 3 or more violations and of those 640 (72%) had received DHSMV notices ordering them to enter treatment, which was our criterion for inclusion in our treatment group. We deleted the 239 (28%) of the 3+ violators, who had fulfilled their time on the interlock and had their licenses reinstated but for whom we could not verify that they had been ordered to treatment by the DHSMV. Among the 12,579 multiple offenders who did not have 3 or more violations, there were 4,642 (37%) with 1 or 2 violations who, while not mandated to treatment, had completed their time on the interlock and had their interlock removed and their licenses fully restored. It was from that group that we constructed a comparison group of 806 offenders who were similar in demographic characteristics, prior DUI record, and performance on the interlock to compare with the 640 who had 3 violations and were ordered by the DHSMV to attend treatment.

MATERIALS AND METHODS

This study made use of 2 key data sources: (i) Florida DHSMV interlock program records; and (ii) interlock data recorder records supplied by the 2 Florida interlock providers—Alcohol Countermeasure Systems (ACS), Ontario, Canada, and LifeSafer, Blue Ash, Ohio. A confidentiality agreement between the Pacific Institute for Research and Evaluation (PIRE) and the DHSMV was established, and procedures for the use of these data were reviewed and approved by PIRE's Institutional Review Board. Using these 2 sources, we were able to derive the following measures.

Measures

Demographic Measures. Sex, age group (<25, 25 to 34, 35 to 44, 45 to 54, 55+), and race/ethnicity (White, Black, Hispanic, unknown) were drawn for this study file from the DHSMV interlock program file, a subfile of the state driver record system. While the court interlock sanction was included in the DHSMV interlock record, the court record system was not available to us; therefore, we were not able to include court sanctions and monitoring programs in this study.

Recidivism Risk Measures. From the DHSMV program file, we also drew measures designed to capture the recidivism risk factors associated with the individual's prior impaired driving and postdriving environment. Individual impaired driving risk measures included the number of prior DUI offenses, arrest BAC, and the length of the interlock sentence. Interlock sentence length is a function of the number of prior offenses but also captures the seriousness of the offense as judges can extend the interlock requirement specified by the law based on their assessment of the seriousness of the offense and the risk presented by the offender. Also, despite some question about the significance of arrest BAC to recidivism (National Conference of State Legislatures, 2014), we used arrest BAC as a measure of recidivism risk because it is used in many states as a criterion for requiring the installation of an interlock or determining the length of time the interlock must be on the vehicle. As the individual risk of recidivism is moderated by the probability of being detected if driving impaired, we included a DUI enforcement measure based on the population arrest rate in the county in which the offender resided.

Interlock Performance Measures. Prior research has demonstrated that offenders who fail to adapt to the interlock and to control the number of lockouts they experience have higher recidivism rates following interlock removal (Marques et al., 2003a). From the ACS and LifeSafer provider records, we derived 4 performance measures: (i) total number of lockouts while on the interlock; (ii) number of violations, defined as 2 lockouts within 4 hours; (iii) number of early morning lockouts (7:00 to 9:00 AM), which largely reflect heavy drinking the prior night (Marques et al., 2003b); and (iv) the highest BAC test recorded by the interlock, which is also an indication of a lack of ability to control drinking (Marques, 2012).

Time on the Interlock. The total time that the interlock is on the offender's vehicle is a protective factor for recidivism. As noted above, it is a function of offender DUI risk as reflected in sentence length, but it is moderated by the offender's performance on the interlock as the occurrence of lockouts can lead to extension of time on the interlock. (Offenders cannot exit the program in a month in which they have a lockout or while in the treatment program.) To control for this factor, we used total time on the interlock as a covariate in our recidivism analysis.

Table 1. Principal Component Analysis (PCA) of 27,736 Multiple DUI Offenders in the Florida Ignition Interlock Program who Installed Interlocks Between October 2008 and December 30, 2012

Component 1: Prior Record Prior drinking and driving behavior		Component 2: Interlock Record on interlock drinking and driving behavior	
Variable	Loading	Variable	Loading
Prior DUIs	0.764	All lockouts	0.925
Interlock sentence	0.784	Morning lockouts	0.842
Arrest BAC[a]	0.300[a]	Violations	0.710
County arrest rates (SES)	0.254	Max BAC (Interlock)	0.723

BAC, blood alcohol concentration; DUI, driving under the influence; SES, socioeconomic status.
[a]Subjects missing arrest BACs were imputed as having the population average BAC (using mean-substitution) while using the other measures for computing their component factor scores.

Postinterlock Recidivism. Recidivism for this study was defined as the occurrence, after the removal of the interlock from the offender's vehicle, of one of the following entries on the participant's driving record: (i) a DUI arrest or conviction; or (ii) an indication that an arrest had occurred but had not resulted in a DUI conviction based on an implied consent citation for failure to provide a breath test or an administrative license revocation resulting from an arrest BAC above the legal limit. Recidivism data were supplied by the DHSMV interlock record system, which is matched each month with the state driver record system to update DUI offense data.

Identifying an Appropriate Matched-Risk Comparison Group. Because those offenders who never incurred 2 lockouts within a 4-hour period—and thus had no violations—are behaviorally different from those who produced 1 or more violations, our first step in selecting the matched-risk comparison group was to eliminate all those with zero violations, leaving us with 4,642 potential comparisons with 1 or 2 violations (Fig. 1). While as a group these 4,642 can be viewed as not comparable to the treated group because they performed somewhat more adequately by avoiding a third violation, there is substantial variation within group with some accumulating larger numbers of lockouts without meeting the 2 lockouts in 4 hours criterion for a violation. Thus, it is possible to match them more closely with the treated group on their risk of recidivating using prior DUI offenses and interlock performance measures.

Measures Used to Match Comparison Group. To reduce the many intercorrelated driver record and interlock performance measures that have been shown to be predictive of recidivism to a few basic (and largely uncorrelated) underlying factors for use in matching the offenders, we performed a principal component analysis (PCA) (Jolliffe, 2002; Pearson, 1901) on the total group of 27,736 multiple offenders in Fig. 1. The results indicated that there were 2 unique and useful underlying dimensions, or components (Table 1). The primary PCA component, *Prior Record* (eigenvalue of 3.31), represents the recidivism risk as measured by the number of prior offenses, arrest BAC, interlock sentence length, and the probability of detection if driving impaired as indicated by the intensity of DUI arrest rate in the offender's county. A secondary PCA component, *Interlock Record* (eigenvalue of 1.97), represents drinking and driving behavior while on the interlock (total lockouts, total violations, morning lockouts, and the highest BAC lockout while on the interlock). These 2 PCA components were intercorrelated at $r = 0.132$. Thus, while not completely orthogonal, the 2 components share only 1.74% of their variance and can be considered essentially independent behavioral dimensions.

Table 2. Demographics and Risk Factors for the Comparison and Treatment Groups of Multiple Offenders in the Florida Ignition Interlock Program (2008 to 2012)

		Group	
		Comparison (n = 806) percent (n)	Treatment (n = 640) percent (n)
Age category	Unknown	5.5% (44)	8.3% (53)
	<25	4.2% (34)	3.0% (19)
	25 to 34	21.3% (172)	21.4% (309)
	35 to 44	28.8% (232)	27.2% (406)
	45 to 54	30.1% (243)	31.6% (445)
	55+	10.0% (81)	8.6% (136)
Sex	Male	82.1% (662)	78.1% (500)
	Female	17.9% (144)	21.9% (140)
Race/ethnicity	White	74.7% (602)	76.4% (489)
	Black	7.8% (63)	8.9% (57)
	Hispanic	9.2% (74)	5.6% (36)
	Other/unknown	8.3% (67)	9.1% (58)
Risk factors	Interlock sentence length (square root)	3.83	3.95
	Post-deinstall exposure (number of months)	28.33	31.08
	Composite risk factor score[a]	2.27	2.34
	Lockouts on interlock (log transform)	2.16	2.38
	Max BAC registered on interlock	0.111	0.104
	Proportion with 3+ prior offenses	57.9%	45.3%

BAC, blood alcohol concentration.
[a]Composite score from both Prior Record and Interlock Record principal analysis components in Table 1.

After these 2 PCA measures of recidivism risk had been computed for all 27,736 subjects, we undertook the selection of a comparison group from the 4,642 multiple offenders with 1 or 2 violations (Fig. 1) matching them with the 640 treated offenders on the 2 PCA components and the total time on the interlock using a propensity analysis procedure (Cummings and McKnight, 2004; Greenland, 1998; Mandrekar and Mandrekar, 2004; Mantel and Haenszel, 1959). In this procedure, we distributed the candidate control cases and the treated cases into a 30-cell matrix produced by the 2 PCA component scores and the time on the interlock drawing from each cell the same proportion of comparison to treated offenders to ensure a close relationship between the 2 groups on 3 factors (Prior Record and Interlock Record PCA components and time on the interlock). We found we could take advantage of the larger number of candidates for the comparison group by selecting 5 comparison cases for each 4 treated cases in every cell,[2] which increases the size of the comparison group by 25% to 806, while still maintaining the proportionality of the comparison group with the treated cases. All other subjects from the potential comparison pool (i.e., poor matches) were discarded. The extent to which this produced a control group that matches the treated group is shown in Table 2. The 2 groups are highly similar in demographic characteristics. While the proportion of the comparison group with 3 or more prior DUIs was greater than the treated group, the treated group had a slightly higher ($p = 0.327$) composite risk score based on combining the PCA Prior Record and Interlock Record recidivism risk scores.

[2]In cells with odd numbers of comparison cases, we rounded up to permit the use of 5:4 ratio in every cell.

However, to ensure that any differences we found between the 2 groups were not due to the comparison group having more prior DUIs, this factor was included as a covariate in the recidivism analytic models.

Recidivism Analysis

Using postinterlock removal recidivism events, we performed a survival analysis of DUI recidivism using Cox regression proportional hazards model. Recidivism events were treated as the "death" or terminal event, with exposure accounted for as time from installation date until the recidivism event. Subjects who recidivated more than once were allowed to accumulate multiple "death" dates and thus be counted again, adversely impacting their respective group's recidivism rate.

Various predictive and demographic factors were assessed for inclusion in the recidivism analysis using stepwise selection. Age, time on interlock, and Prior Record PCA component were significant and included in the model. The Interlock Record PCA component was on the cusp of significance and was also included.

A unique feature of the treated group is that members of this group each committed a third violation, an experience that no member of the comparison group had. The question arises as to whether any difference in recidivism between treated and comparison offenders could be due to inherent behavioral differences reflected by having a third violation (i.e., possibly self-selection into a biased group), rather than due to having participated in the treatment program. A standard procedure for dealing with this issue is to conduct a Heckman selectivity analysis (Heckman, 1979) to estimate the extent of such a bias. If that estimate of bias is significant, then it must be applied in the recidivism analysis to correct for self-selection in the measurement of the treatment effect. Our Heckman analysis indicated that self-selection bias was not significant in this study. However, to be conservative, we tested the sensitivity of our Cox regression recidivism analysis to the inclusion versus exclusion of the Heckman estimate and found that its inclusion did not meaningfully alter the results or significantly affect any of the other predictors in our model.

Estimating Crash Reduction Benefits

To gauge the health benefits of the reduction in arrests, it was necessary to estimate the relationship of arrests to crash involvements. Lacking individual crash information on our participants, we employed data from the Florida State Crash Record System, which provided statewide summary data on DUI arrests and alcohol-related crashes over the period of our study. From 2009 to 2012, the Florida annual total of DUI arrests averaged 57,645 with a standard error of 3,489, and state annual alcohol-related crashes averaged 18,040 per year with a standard error of 1,207. Over the past 2 decades, the correlation of the 2 measures was 0.386 ($p = 0.103$), but the correspondence rate has remained consistently stable between 3.11 and 3.28 arrests per alcohol-related crash during our study period. Based on this relationship, we estimated that 3.13 crashes are prevented for each 10 DUI arrests prevented.

Similarly, injuries in alcohol-related crashes in Florida averaged 12,545 per year from 2009 to 2012, with an SD of 924. Over the past 2 decades, injuries in alcohol-related crashes correlate even better with DUI arrests ($r = 0.702$; $p = 0.001$) with about 1 injury per every 5 DUI arrests. Using this relationship, we fixed the relationship at a correspondence of 2.18 injuries prevented for every 10 DUI arrests prevented.

RESULTS

The impact of the treatment on postinterlock recidivism was sizable, showing a proportional hazard of recidivism 32% lower, 95% confidence interval (CI) [9.2, 48.7], than the matched-risk comparison group in the Cox regression model (Table 3). Using the oldest age group (55+) as the reference group, those younger than 45 years were significantly more likely to recidivate, with those younger than 25 years being 503% as likely to recidivate, 95% CI [274, 926]; those 25 to 34 years 81% more likely to recidivate, 95% CI [6, 210]; and those 35 to 44 years 70% more likely to recidivate, 95% CI [1, 185].

Greater time on the interlock was related to *lower risk* of postinterlock recidivism; however, this relationship is partially confounded by the limitation in the follow-up period since longer periods on the interlock reduced the length of the available postinterlock exposure periods. Both the Prior Record and the Interlock Record PCA components were associated with *increased* postinterlock recidivism. However,

Table 3. Relationship of Treatment to Recidivism Based on Cox Regression Comparison of 640 DUI Offenders in the Florida Ignition Interlock Program who Received Treatment with a Comparison Group of 806 Offenders who did not Receive Treatment While on the Interlock (2008 to 2012)

	B	SE (*B*)	Wald	df	Significant	Exp (*b*)	Effect size
Treatment	−0.382	0.146	6.85	1	0.009	0.682	−31.8%
Age [baseline = 55+]			45.80	5	<0.001		
<25	1.616	0.311	26.93	1	<0.001	5.034	5.0× versus 55+
25 to 34	0.593	0.274	4.69	1	0.030	1.81	1.8× versus 55+
35 to 44	0.529	0.265	3.98	1	0.046	1.696	1.7× versus 55+
45 to 54	0.198	0.274	0.52	1	0.471	1.219	[same as 55+]
Unknown	0.029	0.420	0.01	1	0.946	1.029	[same as 55+]
Component 1: Prior drinking and driving behavior	0.740	0.038	370.17	1	<0.001	2.096	
Component 2: On interlock drinking and driving behavior	0.146	0.076	3.69	1	0.055	1.157	
Time on interlock (SqRt)	−0.458	0.056	67.69	1	<0.001	0.632	
Inverse Mill's ratio (from Heckman analysis)	0.299	0.528	0.32	1	0.571	1.349	
Variables not in model (not significant)			**Wald**	**df**	**Significant**	**Exp (*b*)**	**Effect size**
Males (vs. females)			1.20	1	0.274	0.828	−17.2% *n/s*
Race/ethnicity: Black			1.17	1	0.279	1.272	+27.2% *n/s*
Race/ethnicity: Hispanic			1.07	1	0.301	1.260	+26.0% *n/s*

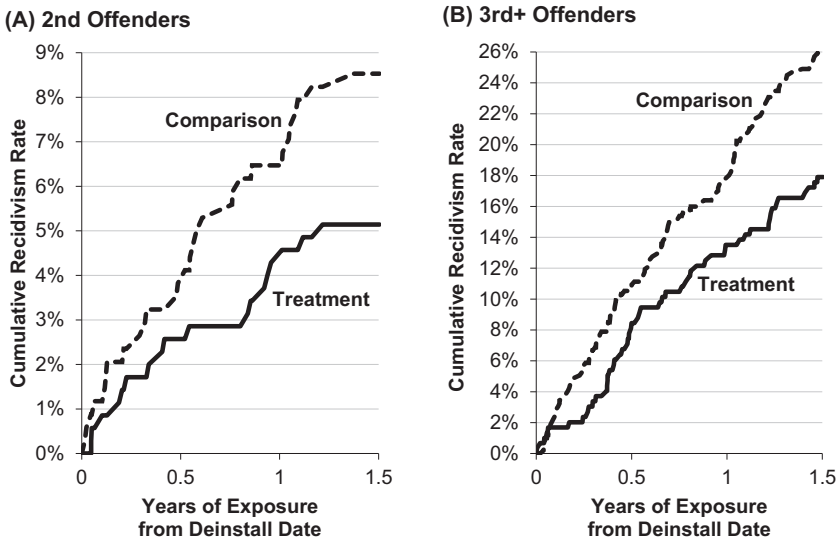
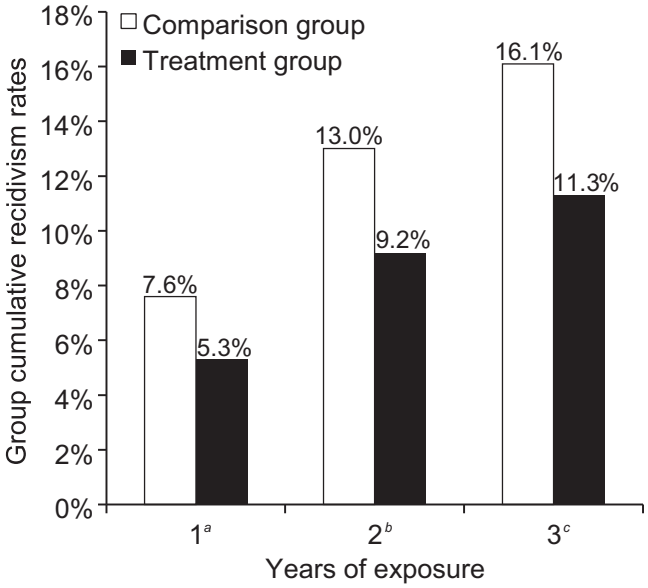


Fig. 2. Kaplan–Meier cumulative survival analyses curves comparing treated and untreated driving under the influence offenders with (**A**) 2 violations and those with (**B**) 3 or more violations in the Florida Ignition Interlock Program (2008 to 2012) for the 18 months following interlock removal.



[a] Year 1: Treatment n = 640; Comparison n = 806
[b] Year 2: Treatment n = 392; Comparison n = 485
[c] Year 3: Treatment n = 165; Comparison n = 237

Fig. 3. Postinterlock group total recidivism over 1, 2, and 3 years of exposure for multiple driving under the influence offenders in the Florida Ignition Interlock Program (2008 to 2012).

the relationship of Prior Record was much stronger. It was associated with a 5 times greater increase in recidivism rate than that produced by the Interlock Record (B = 0.740 vs. 0.146), which was not quite significant (Table 3). As indicated above, Table 3 shows that the Heckman correction was not significantly related to the recidivism outcome measure, 95% CI [0.48, 3.79].

Given the strong relationship between the Prior Record PCA component and postinterlock recidivism, we conducted a separate analysis to focus on the relationship of prior offenses to recidivism by analyzing second offenders separately from third or more offenders. The results of these separate Tarone–Ware survival analyses are shown in Fig. 2 and are consistent with the results from the overall Cox regression model. For second offenders, the treatment impact is a savings of approximately 40% in recidivism over 3 years of postinterlock exposure (Tarone–Ware = 4.70; p = 0.030), and for 3rd+ offenders, the treatment effect after 3 years of exposure is approximately 35% (Tarone–Ware = 10.72; p = 0.001). The recidivism exposure time following deinstallation of the interlock depended on the date at which the case entered our data file and varied from a minimum of 10 to 48 months. The cumulative recidivism during the first 18 months of all offenders in both the treated and experimental group is shown in Fig. 2.

Figure 3 provides separate recidivism rates for the treatment and matched control groups for years 1, 2, and 3, derived from the Cox regression model fit, adjusted for all significant predictors in the model. The treatment group had 88 total DUI recidivism events within that group's 1,658 person-years of exposure, and the Cox regression estimates that without treatment they would have had 133 recidivism events (based on comparison group as the expected "baseline"). This implies a predicted savings of 40.9 DUI arrests prevented for this group, 95% CI [8.9, 83.6].

Based on the estimates calculated for this study of 3.13 crashes and 2.18 injuries prevented for each 10 DUI arrests, the estimated 40.9 prevented arrests were associated with 12.8 crashes prevented, 95% CI [2.8, 26.2], within which an expected 8.9 injuries were prevented, 95% CI [1.9, 18.2]. Zaloshnja and colleagues (2013) estimated that the national mean cost per alcohol-related crash is $64,125. If we apply that estimate to Florida, we obtain a total crash benefit of $821,561, 95% CI [177,906, 1,678,281]. In this study, this

benefit was achieved by treating 640 DUI offenders at an approximate cost of $300 each for a total cost of $192,000 producing a net benefit of $629,561, 95% CI [−14,094, 1,486,281] over a mean follow-up period of 28.63 months (SD = 10.66).

DISCUSSION

The results provide substantial evidence that AUD treatment of multiple DUI offenders who show evidence of not being able to adapt to the interlock can reduce postremoval recidivism by one-third. This reduction is estimated to have saved 3.13 crashes and 2.18 injuries per 10 arrests prevented producing $822,000 in societal savings at a cost of $192,000 for treating 640 offenders producing a benefit of $632,000. The recidivism rate was not significantly different for women than for men, or for Hispanics and Blacks than for Whites, but was elevated for drivers under 25 suggesting that the treatment program was substantially less effective for young drivers.

The state of Florida has provided a unique example of the integration of treatment into an interlock program. Its comprehensive data system has provided the necessary data to analyze the effectiveness of AUD treatment embedded within an interlock program. The study also provides auxiliary information on the factors that are associated with recidivism. The PCA identified 2 components that inform current procedures for managing interlock programs and predicting postinterlock recidivism: (i) Prior Record, including number of DUI offenses, the length of time the offender is sentenced to be on the interlock, the arrest BAC, and the intensity of DUI enforcement in the offender's county of residence; and (ii) Interlock Record, based on 4 measures of interlock performance. Both components were shown to predict recidivism, which confirms earlier studies by Marques and colleagues (2003a) and supports the use of those measures for managing interlock programs (Mayer, 2014). The Prior Record measure is available when the offender installs the interlock and can be used in tailoring monitoring and education support efforts while the offender is on the interlock. The 4 interlock measures (total lockouts, total violations, morning lockouts, and the highest BAC lockout while on the interlock) were related to postremoval recidivism in this study. This supports their use by a number of states (Arizona, Illinois, and Florida, among others) in their Compliance Based Removal programs, to extend or reduce the time on the interlock based on the offender's performance.

This study has limitations. First, its generalizability is confined by the exclusion of first offenders and the inclusion of only 1 state over a relatively short time period. Second, records from treatment providers were not available due to privacy considerations. Therefore, all our data are based on archival administrative records and do not include treatment protocols or data from treatment providers or tests or interviews with treated offenders. Thus this should be viewed as an "intent to treat" study. The characteristics of the members of the constructed comparison group appear to be very similar to those in the treated group (Table 2), but there are other potentially significant factors related to recidivism that we could not measure in this study. We did not have a comparison group of noninterlock-treated offenders to compare with our 640 treated offenders who were on the interlock to determine the extent to which being on the interlock impacts the response to treatment. Finally, lacking direct information on the crash involvement of the participants in our study, we were forced to estimate crash savings by reference to statewide crash data.

This is the first study of the integration of AUD treatment into an interlock program. It demonstrated that such programs can produce substantial benefits in reduced recidivism in the period following interlock removal for those who are treated. The Florida program has several features that can be applied to other state programs. First, the candidates for treatment are selected based on their performance on the interlock. This provides a method for standardizing assignment and ensuring that it is efficient in that it is provided to those most in need of assistance. Next, treatment is provided by existing state licensed providers, which can help ensure the quality of treatment and assist in developing special statewide protocols for interlock users. Finally, the requirement that the offender must complete the treatment plan before being allowed to remove the interlock increases the motivation of the offender to attend and complete treatment and strengthens the role of the therapist in the management of the interlock program.

The 32% reduction in recidivism experienced is impressive, but there is reason to believe that this result might be improved with a treatment protocol that makes more direct use of interlock performance data in group therapy classes (Marques et al., 2004; Timken et al., 2012). This is the first demonstration of the utility of the interlock record for identifying offenders who can potentially benefit from treatment. Our results suggest that combining the 2 PCA recidivism risk measures identified in this study, Prior Record and Interlock Record, might provide a strengthened predictor mechanism that identifies candidates for treatment more accurately and earlier in their time on the interlock. The utility of combining these objective record measures with current clinical screening devices also merits study.

The impact of the program could probably also be enhanced by increasing the numbers of offenders treated. In Florida, the proportion of DUI offenders treated is small relative to the number of DUI offenders installing interlocks. The threshold established for mandating treatment was quite high and resulted in recruiting only 4.8% (of 13,219 installing/deinstalling within the selection parameters) of the offenders into the treatment program. The identification in this study of the comparison cohort (n = 806) with risk levels similar to the treatment group suggests that there were other offenders who could have benefited from treatment. There appears to be an opportunity to develop new performance standards that would at least double the 2.3% (640/27,736;

Fig. 1) who met the 3-violation criterion in this study. Among the interlock recorder criteria that might be used to expand the number treated are 6 or more lockouts (14.5% of interlock subjects), 4 or more morning lockouts (6.4% of interlock subjects), and any BAC $\geq$ 0.15 (9.5% of interlock subjects).

This study provides strong support for the inclusion of AUD treatment for offenders in interlock programs based on their ability to control their drinking in relation to their driving while on the interlocks. Implementation of such treatment could lower recidivism and reduce death and injury from alcohol-impaired driving.

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