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Alcohol ignition interlock programmes for reducing drink driving recidivism (Review)

Willis C, Lybrand S, Bellamy N

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TABLE OF CONTENTS

[Intervention Review]

Alcohol ignition interlock programmes for reducing drink driving recidivism

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ABSTRACT

Background

An ignition interlock device is part of a multi-dimensional programme aimed at reducing recidivism in convicted drink drivers. To operate a vehicle equipped with an ignition interlock device, the driver must first provide a breath specimen. If the breath alcohol concentration of the specimen exceeds the predetermined level, the vehicle will not start. As a measure to reduce circumvention of the device (i.e. someone else blows into the mouthpiece), random retests are required while the vehicle is running. Other components of the drink driving programme include information seminars for the driver and downloading data from the device's data logger, which logs all test attempts and records all passes, warnings and failures.

Objectives

To systematically assess the effectiveness of ignition interlock programmes on recidivism rates of drink drivers, by examining rates of recidivism while the ignition interlock device was installed in the vehicle and after removal of the device.

Search methods

We searched The Cochrane Injuries Group's Specialised register (Sept 2002), MEDLINE (1966 to August 2002), PubMed (to Aug 2002), EMBASE (1980 to Sept 2002), TRANSPORT (1988 to 2002 issue 06), CENTRAL (*The Cochrane Library* 2002, Issue 3), The Science Citation Index (1980 to Sept 2002)
National Research Register (2002, issue 3). We also searched the Internet using various search engines.

Selection criteria

Controlled trials in which offenders have been charged with drink driving and have either been sentenced to participate in an ignition interlock programme or the usual punishment (either licence suspension or some form of treatment programme). This study was not restricted by language or status of publication.

Data collection and analysis

One randomised controlled trial (RCT) and ten controlled trials were identified, and also three ongoing trials. Data regarding recidivism while the interlock is installed in the vehicle; after the interlock has been removed from the vehicle and total recidivism during the study were extracted and entered into analyses using RevMan.

Main results

The RCT showed that the interlock programme was effective while the device was installed in the vehicle; relative risk 0.36 (95% confidence interval 0.21 to 0.63). Controlled trials support this conclusion, with a general trend − in both first-time and repeat offenders − towards lower recidivism rates when the interlock device is installed. Neither the RCT nor the controlled trials provide evidence for any effectiveness of the programmes continuing once the device has been removed.

Authors' conclusions

In order to eliminate potential selection bias, more RCTs need to be conducted in this area so that effectiveness, as well as efficacy, can be ascertained. The interlock programme appears to be effective while the device is installed in the vehicle of the offender. Studies need to address ways of improving recidivism rates in the long term, as the major challenges are participation rates, compliance and durability.

PLAIN LANGUAGE SUMMARY

Alcohol ignition interlocks may stop repeat drink driving offences, but only as long as they are still fitted

Convicted drink drivers are sometimes offered the choice of a standard punishment, or for an alcohol ignition interlock to be fitted to their car for a fixed period. To operate a vehicle equipped with an interlock, the driver must first give a breath specimen. If the breath alcohol concentration of the specimen is too high, the vehicle will not start. A number of studies have been conducted to see whether the interlock stops drink drivers from offending again. Most of these studies have not been of high quality. The interlock seems to reduce re-offending as long as it is still fitted to the vehicle, but there is no long-term benefit after it has been removed. However, more studies of good quality are needed to confirm these findings. The low percentage of offenders who choose to have an interlock fitted also makes it difficult to reach firm conclusions about their effectiveness.

BACKGROUND

Driving a car requires the interactions of a complex set of skills. Moskowitz 1990 reviewed data relating to alcohol intake and the impairment of psychomotor, perception, tracking, attention, vision and information processing skills. The conclusion of the review was that there was no absolute threshold below which impairment did not occur, with some impairment occurring at even very low blood alcohol concentrations (BAC) (0.01 and 0.02% BAC).

Statistics on drink driving, and the increase in risk of injury to drivers and the public, are readily available; for example, from the web sites of state or national traffic governing bodies. 'Drink drivers' are not a homogeneous group. It would appear that multiple offenders are relatively resistant to rehabilitation. There may also be a subset of drivers with no prior drink driving conviction who are, nevertheless, habitual drink drivers (Collier 1995; Morse 1992). Countermeasures available to dissuade persistent drink drivers include fines, incarceration, vehicle impoundment and licence revocation. Incarceration is costly, while the effect of vehicle impoundment is not limited to the drink driver (Beck 1999). Licence revocation has limitations, previous studies reporting that up to 75% of drivers with suspended licences continue to drive illegally (Hagen 1980; Kaestner 1974; Ross 1988; Staplin 1989). It has also been noted that the probability of arrest while driving with a blood alcohol level over 0.10% is very low (about one in 200) (Beitel 1975). Although the study is old, the figure is one of the more conservative estimates. However, it has been shown that violators who receive licence revocation do modify their driving habits and drive fewer miles (Ross 1988). Such countermeasures rely on drink drivers choosing not to drive if they believe they will be caught and punished.

Improvements in alcohol-sensing technology, microprocessors and the development of relevant legislation have led to the development of alcohol ignition interlocks, which are now another tool in the drink driving countermeasures arsenal (Marques 2001b). An ignition interlock device is part of a programme aimed to reduce recidivism in convicted drink drivers. To operate an ignition-interlocked vehicle, the driver must first provide a breath sample. The driver must present an alcohol concentration in the breath (BrAC) equivalent to the blood alcohol concentration (BAC) that is lower than a preset threshold level, for it to be possible to start the vehicle. Drivers are randomly retested while the vehicle is running, to reduce circumvention of the device. Breath test attempts are logged into a data recorder. As the device does not allow the operation of the vehicle if the driver has consumed sufficient amounts of alcohol, the decision-making process of whether to drive is removed from the person under the influence of alcohol (Baker 1991).

The compliant offender retains driving privileges and may, therefore, continue to earn a livelihood and travel, while sober. The ignition interlock system is designed to affect the driver's behaviour by requiring a change in their habits related to drinking and driving, as it provides immediate feedback on inappropriate alcohol consumption (Weinrath 1997). The complete programme often includes training in the use of the interlock and the return to an authorised service centre regularly for inspection, calibration checks, and downloading of the interlock data recorder. Usually the cost of installing and maintaining (including calibration of the machine) is borne by the driver.

Alcohol ignition interlocks are gaining acceptance, with legislation and programmes in countries such as America, Canada, Australia and feasibility studies currently under way in the European Union. Countries that offer an interlock programme have incentives such as reducing insurance premiums and reducing the time taken to get a licence reinstated. However, the literature suggests that less than 10% of convicted drink drivers choose to participate in the programme (Voas 2002). Those who opt for the interlock programme usually do so in exchange for shorter licence suspension time (Marques 2001a). The low participation rates reduce the contribution of the ignition interlock in reducing drink driving in the recidivist population overall (Marques 2001b).

OBJECTIVES

To assess the effectiveness of ignition interlock programmes on recidivism rates of drivers with prior convictions of drink driving:

- the primary outcome is the recidivism rate of drivers while the ignition interlock device is installed in the vehicle;
- the secondary outcome is the recidivism rate of drivers after the ignition interlock device has been removed from the vehicle.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials (RCTs), as per the definition below, and other controlled trials.

RCT: A study involving at least one test and one control treatment, concurrent enrolment and follow-up of the test and control-treated groups, and in which the treatments to be administered are selected by a random process, such as the use of a random numbers table (coin flips are also acceptable). If the author(s) state explicitly (usually by using some variant of the term 'random' to describe the allocation procedure used) that the groups compared in the trial were established by random allocation, then the trial is classified as 'RCT'. (Cochrane Effective Practice and Organisation of Care Group).

Types of participants

Drivers who have been convicted of drink driving. Drink driving convictions include, but are not limited to, the following:

- DUI – driving under the influence
- DWI – driving while impaired (intoxicated)
- OUI – operating under the influence
- OWI – operating while intoxicated
- OWVI – operating a motor vehicle while intoxicated
- DUIL – driving under the influence of liquor
- DUII – driving under the influence of an intoxicant
- DWAI – driving while ability impaired
- DWUI – driving while under the influence
- DUBAL/UBAL – driving with unlawful blood alcohol level.

Types of interventions

The alcohol ignition interlock programme.

Types of outcome measures

- Rates of recidivism while the driver is involved in an ignition interlock programme.
- Rates of recidivism after the ignition interlock device has been removed from the vehicle.
- Rates of recidivism during the entire study period.

Search methods for identification of studies

Electronic searches

We searched the following electronic databases;

- The Cochrane Injuries Group's Specialised register (Sept 2002),
- MEDLINE (1966 to August 2002),
- PubMed (to Aug 2002),
- EMBASE (1980 to Sept 2002),
- TRANSPORT (1988 to 2002 issue 06),
- CENTRAL (*The Cochrane Library* 2002, Issue 3),
- The Science Citation Index (1980 to Sept 2002),
- National Research Register (2002, issue 3).

The full search strategies can be found in Appendix 1.

Searching other resources

Reference lists in each potentially eligible study were scanned, and authors of published works were contacted regarding obtaining data from completed and unpublished studies. Conference articles were obtained by identifying relevant meetings;
The international conferences on Alcohol Drugs and Traffic Safety were searched online:http://www.icadts.org/ As were the contents of "Accident Analysis and Prevention": http://www.sciencedirect.com/science?_ob=JournalURL&_cdi=5794&_auth=y&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=d1d8a65244f691c2de0eed41e423bd52Alcc
Studies Database: Center of Alcohol Studies, Rutgers: The State University of New Jersey; http://www.scc.rutgers.edu/alcohol_studies/alcohol/Search.cfm (search term "interlock")

We searched the Internet and the following web sites were searched using the word "interlock" (Internet searching carried out on 23rd and 26th May 2003)

- AAA Foundation for Traffic Safety (USA) - www.aaafoundation.org
- ACRS - The Australian College of Road Safety - www.acrs.org.au
- ARRB - Australian Road Research Board - www.arrb.org.au
- Australian Transport Safety Bureau - www.atsb.gov.au
- CROW - Information and Technology Centres for Transport and Infrastructure (Netherlands) - www.crow.nl
- ETSC - European Transport Safety Council - www.etsc.be/index.html
- FINNRA - Finnish National Road Administration - www.tieh.fi
- INRETS - Institut National de Recherche sur les Transports et leur Securite (France) - www.inrets.fr
- NHTSA - National Highway Traffic Safety Administration (USA) - www.nhtsa.dot.gov
- NZLTSA - New Zealand Land Transport Safety Authority - www.ltsa.govt.nz
- Roads and Highway Department (Bangladesh) - www.rhdbangladesh.org
- ROSPA - The Royal Society for the Prevention of Accidents - www.rospa.com/cms
- SWOV - Institute for Road Safety Research (Netherlands) - www.swov.nl
- TC - Transport Canada - www.tc.gc.gov
- TRIPP - Transportation Research and Injury Prevention Programme (Delhi) - www.iitd.ac.in/tripp
- TRL - Transport Research Laboratory (UK) - www.trl.co.uk
- US Department of Transport - Federal Highway Administratio (USA) - www.fhwa.dot.gov
- US Department of Transportation - www.dot.gov
- VICROADS - www.vicroads.vic.gov.au
- VTI - Swedish National Road and Transport Research Institute - www.vti.se
- VTT - Finland - www.vtt.fi/indexe.htm
- VV - Swedish National Road Administration - www.vv.se

Data collection and analysis

One reviewer (CW) searched and located trials that were possibly relevant to the review. Two reviewers (CW and SL) independently applied the selection criteria. There was no disagreement regarding trials that were eligible for inclusion in this review. Two reviewers (CW and NB) then independently assessed the included trials for methodological quality. The RCT was assessed using Jadad's quality scale (Jadad 1996). There is no one best tool for assessing the quality of non-randomised controlled trials. For this review we needed a tool that was not based upon clinical trails (where a majority of the questions would be irrelevant). We decided that the tool would need to account for what we deemed were most important in the area of alcohol ignition interlocks;

- internal and external validity to be scored (i.e. the study is methodologically sound and the effects observed in the study are applicable outside of the study).
- selection bias; were the groups similar at baseline
- performance bias; is there a difference in care between the groups, other than that being evaluated
- attrition bias; Intent to treat, describe those who did not complete the programme
- level of study; RCT, cohort study, before-and-after
- length of follow-up; was it the same for both groups, was it sufficiently long enough to show effect.

We then evaluated nine quality assessment tools against these criteria. Tools which would give no score to non-randomised trials (such as Jadad's) were excluded, as they would not produce meaningful results in this review. The tool that fulfilled the most requirements was Downs 1998. We then modified the tool to account for some specific areas of ignition interlocks. A copy of this quality assessment tool may be obtained from the Cochrane Injuries Group (cochrane_injuries@lshtm.ac.uk). The tool gave a rating score out of 27. All studies, including the RCT, were assessed for quality using this tool.

The following information was extracted (by CW and SL): recidivism while the interlock device is installed on the offender's vehicle, recidivism after the interlock device has been removed from

the offender's vehicle, and total recidivism throughout the study period.

The primary analysis was based, for RCTs, on meta-analytic methods. Relative risk with random effects was calculated using RevMan 4.2.

Results from the non-RCTs have been considered in the discussion but have not formed a part of the meta-analysis, due to differences in methodology and potential biases. Results have been entered into RevMan Analyses only to aid in presenting the data; no totals are given.

RESULTS

Description of studies

Fifteen trials met the inclusion criteria. One of these trials (Alberta (Weinrath)) was conducted with overlapping time frames of another group (Voas et al, Alberta). Since the second group had a longer study duration, and also had split their results into first and repeat offenders, it was decided to exclude the first trial due to the possibility that the participants would not be independent. The Alberta group has published more than one study but the time frames for the studies were overlapping and it was not certain that the participants in each study were independent. Also all other studies from these investigators compare groups within the ignition interlock participation group. Therefore, only results from the study published in 1999 were incorporated into this review.

Of the remaining 14 studies, one is an RCT and 13 are controlled trials. Of the controlled trials, one is an effectiveness study and the remainder are efficacy studies. Of the efficacy studies, one was a before-and-after study, two were retrospective record reviews and six were longitudinal studies. The effectiveness study was a before-and after-design. The three remaining trials are ongoing, and have yet to be reported.

Completed programmes

Effectiveness studies

HANCOCK COUNTY, Indiana (Hancock County)
In 1992, legislation was passed in Hancock County that made ignition interlocks a part of sentencing for most multiple offenders. In 1997 this policy was expanded to include first-time offenders. This study uses the entire county as the treatment group and six similar counties with no interlock programme as the control. Hancock County had around a 62% success rate in recruiting offenders into the interlock programme.

MARYLAND (Maryland)
A study looking at the effectiveness of a statewide ignition interlock programme for drivers with multiple (two or more offences in the previous five years or three or more offences in the last ten years) alcohol-related traffic offences. Alcohol offenders who petitioned for, and were recommended for, relicensing and whose relicensing was approved were randomly assigned to the interlock or control programme. The interlock group were required to use the interlock for 12 months and were usually required to participate in mandatory treatment or support programmes. The control group were not allowed to drive after drinking any amount of alcohol and it was usually mandatory to participate in Maryland's Drinking Driving Monitoring programme. The control groups also had to report regularly to a court-approved probation monitor. Failure to comply for either group resulted in suspension of driving privileges. The arrest rates were compared between the two groups for one year, while the ignition interlock programme was in place, and for the year after unrestricted driving privileges were returned. The study design was intention-to-treat so that all participants randomised to the interlock programme were analysed as such, whether or not they had the device installed. If an interlock was not installed by 45 days after placement, the participant faced suspension for failure to comply.

Efficacy studies

ALBERTA, Canada (Alberta)
In Alberta, first-time offenders usually served three to six months of their suspension, then completed an eight-hour educational programme before being eligible for the interlock programme. Second-time offenders served at least two years of their suspension and completed a weekend intervention programme (IMPACT) before being eligible for the interlock programme. Participants had the interlock installed for six months, or until the end of their suspension. To be eligible for the interlock programme, drivers had to have no other DUI offences recorded against them (clean record) during their period of licence suspension. 8.9% of the offenders were eligible to participate in the interlock programme and of these, 6% were required to have the interlock installed.

CALIFORNIA (California)
This study was the first interlock intervention study conducted in the US. The design was quasi-experimental with non-random assignment. The variable of principal interest was recidivism for DUI offenders. There was no set policy as to who would receive an interlock sentence (the interlock could be used at the discretion of local judges as an additional condition of probation); controls were drawn from the pool of DUI probationers who were convicted of the same primary charge. Controls had to match interlock participants on: date of conviction, age, gender, race, number of prior DUIs, and BAC level at arrest. Four counties in California participated, each with distinct local criminal justice systems. Only Santa Clara county used a device that produced a hard copy of the data log. Responsibility for compliance feedback was left to the manufacturers as DUI probation was not supervised. The manufacturer had to notify the courts to trigger the issuance of warrants for failure to comply. 62% of the devices were still installed in vehicles when the study ended.

COLORADO (Colorado)
In 1995, a voluntary alcohol ignition interlock pilot programme was authorized. In 1999, legislation mandated a one-year interlock installation for drivers with two or more alcohol offences, within a five-year period, at the time of licence reinstatement. To participate in the voluntary programme, offenders must have applied for an Interlock-Probationary Licence (I-PDL). To do so, they must have provided proof of insurance and have attended a hearing. The groups used in this trial were participants who had the interlock installed , applicants who went through the application procedure but decided not to install an interlock (who were followed for one year), and a random sample of offenders who did not apply for an I-PDL (who were followed for one year).

HAMILTON COUNTY, OHIO (Hamilton County)
This study comprises the data collected over the first 30 months of the quasi-experimental, longitudinal Hamilton County Drinking

and Driving Study. Eligibility for the study was limited to: a) all first-time offenders with a BAC of 0.02 or higher at arrest, b) repeat offenders convicted of DUI two or more times within the last ten years, and c) offenders who refused a BAC test at the time of their arrest. Judges had the option of offering two sentences to eligible offenders. The first was a suspended licence with driving restricted to an interlock-equipped vehicle; the second was licence suspension sanctions and probation terms. Offenders offered the interlock option could accept, or refuse and serve out their original licence suspension and probation period.

ILLINOIS (Illinois)
The participants in the interlock programme were multiple DUI offenders who had obtained a Restricted Driving Permit (RDP). A legislative change which took place July 1 1994, required an ignition interlock for anyone who lost their licence for DUI and who subsequently applied for a RDP. The interlock group consisted of those who received a RDP from July 1 1994 through to June 30 1997, while the control group comprised those who received an RDP between 1st July 1991 through to 30th June 1994. The interlock device was installed for one year.

NORTH CAROLINA (North Carolina)
All drivers convicted for the second time of DWI received a four-year licence suspension. At the end of the second year, offenders were eligible to apply for a conditional licence. This was a quasi-experimental design of second-time DWI offenders to examine recidivism rates. Four groups of drivers convicted of their second offence were assigned: 1) non-application, 2) denied licence (including those offered the interlock but who declined), 3) interlock and 4) conditional licence. However, for this review, we chose to compare the following two groups; 407 interlock participants and 916 conditional licence controls.

OREGON (Oregon)
Oregon usually waives prosecution for first-time offenders who enrol in an alcohol rehabilitation/treatment programme, and the first conviction is usually the second offence. The interlock group are nearly always repeat offenders or the interlock programme was a requirement for hardship licence applicants. At the end of the one to three year DWI suspension, offenders must use the ignition interlock device for six months or face an additional six months suspension. Eleven of 36 counties in Oregon use the interlock programme. Subjects were selected from driver record files. Results were for the six months when an interlock was required, and an average of 406 days after the requirement expired. As this study showed that reinstatement of a licence at the end of the suspension period was a cofactor that affected the results of the study, we chose to compare the ignition interlock device-installed group to the control group who later reinstated.

QUEBEC (Quebec)
An ignition interlock programme started in December 1997. For first-time offenders, the interlock reduced their suspension sentence by nine months (i.e. three months suspension plus nine months interlock) and (until July 1999) an 18-month reduction for second time offenders (i.e. six month suspension plus 18 months interlock). Second-time offenders (after July 1999) were no longer eligible for the interlock, as they were required to complete a minimum two-year suspension. This study is a cohort study comprised of a study group of convicted offenders who took part in the ignition interlock programme and a control group of convicted offenders who did not participate.

WEST VIRGINIA (West Virginia)
Participants in this programme had to be enrolled in, or have completed the "Safety and Treatment Program" and could not have had a conviction recorded against them of driving while their licence was revoked or suspended in the previous two years. Controls were offenders who had elected not to participate. First-time offenders were required to have the interlock installed in the vehicle for five months, while second offenders were required to participate for 12 months. In June 1994, this requirement was increased to 18 months.

Ongoing programmes

QUEENSLAND (Queensland)
This trial commenced in February 2001. The interlock programme is open to all types of offenders. Offenders have full licence disqualification, during which they complete a rehabilitation programme called 'Under The Limit'. The programme is run through the courts. Courts are randomly assigned to either the treatment or control arm. If assigned to the treatment, following suspension, offenders either are on probation or can install an interlock device for the remainder of the sanctioning period. Participation is to be voluntary. There are two control groups, one from the courts randomised to the control group and another control group formed by the people who decline the interlock. Offenders are monitored by a Community Corrections Officer. Depending on the seriousness of the offence, those who breach the conditions of probation will face actions such as receiving written censure, or being sent back to court to have their sentences re-evaluated. Analysis: survival analysis of rates of re-offence.

SWEDEN (Sweden)
Three of Sweden's 21 counties are in the experiment programme. Sweden's first interlock was installed in March 1999. Offenders remain on the interlock programme for two years. After one year, biomedical indicators of alcohol use have to be consistent with those of a 'normal' person. The interlock recorder is checked every second month. The number of 'fails' on the device is limited. If a person does not have normal biomedical indicators or too many positive BACs recorded on the interlock device, the person will be removed from the programme and suspension ensues. There are two control groups comprising: 1) a group of those who did not participate in the interlock programme (called K2), 2) a group residing in counties not taking part in the programme (called K1). There were 285 interlock participants as at 2002; number of controls is not stated.

Concern: offenders who cannot maintain 'normal' biomedical indicators are removed from the programme. This means that those who remain on the programme are more motivated to succeed and may inflate the success rate of the programme, unless an 'intention-to-treat' analysis is used.

VICTORIA (Victoria)
This trial commenced in May 2003, one year after legislation was passed. Participation in the interlock programme is discretionary, through the courts, and is for two groups of offenders. In the first group are offenders who had a BAC of at least 0.15 or a non-BAC offence. These people have a licence suspension for a minimum of 15 months and then if required, an interlock for a minimum of six months. Repeat offenders who either had three or more offences OR multiple offences where the last offence was a BAC of

at least 0.15 or a non-BAC offence. These people receive a 12 or 30 months minimum suspension and then a three-year minimum interlock requirement. If the offender had two prior offences and the last offence had a BAC of under 0.15, the offender receives a minimum 12 month suspension and six months minimum interlock requirement.

Risk of bias in included studies

Fourteen studies are included in this systematic review. See the notes section in the included studies table for concerns regarding specific studies.

Randomised controlled trial

The study (Maryland) is limited to those offenders who had demonstrated an ability to comply with prescribed treatments and were approved for relicensing by the state's Medical Advisory Board. Therefore, this study does not evaluate the effectiveness of the interlock on the less motivated repeat drink driver, as there is a selection bias towards those offenders who had overcome their drink driving habit. The authors were contacted for the randomisation procedure. A computer programme generated 1400 random assignment cards (700 that read "interlock" and 700 that read "control"). These cards were placed into separate envelopes consecutively numbered from one to 1400. Offenders granted approval for relicensing were assigned a case number and only then was the envelope opened. Analysis was "intention to treat".

Controlled trials

The studies of this type have shown various methodological problems. Three of the controlled trials were administered through the courts. Without randomisation, this method can lead to judicial bias; i.e. judges may choose offenders with certain characteristics for the intervention group. Also, courts may not have the resources to screen drivers and monitor/enforce licence restrictions. However, involvement of the courts can produce a higher motivational factor, as not complying can lead to heavier penalties, whereas administrative departments can only determine whether or not a licence is reinstated.

Only one study had mandatory participation, despite which only 62% of the target population where recruited. Some programmes were 'semi-mandatory' (i.e. offenders had to install an interlock to regain their licence) but applying for an licence was voluntary. This gives rise to self-selection bias, whereby those who choose to participate in the programme may be more motivated to succeed. It also means that comparison groups are then usually made up of those people who refused to participate in the intervention.

Four of the studies had a control group in which people were legally allowed to drive and, therefore, would potentially have the same exposure 'on the road' as those who had an interlock installed. The other studies have control groups which were still suspended, potentially being more cautious and driving less miles, which would therefore limit the exposure to being caught.

The initial results from the quality assessment of trials was disappointing with an agreement rate of only 61%. However, upon examination of the disagreements it became obvious that part of the low agreement rate was due to interpretation differences in the wording used in the assessment tool. These interpretation differences were discussed and resolved. On removing those questions where there was 70% or higher disagreement (i.e. interpretation differences) the agreement rate rose to 80%. After discussing the remain areas of disagreement, CW and NB came to a 100% agreement rate and no arbitration was necessary. Final scores are given in the included studies table.

Effects of interventions

In the RCT included in this review (Maryland), recidivism was lower in the intervention group while the device was still installed in the vehicle; relative risk 0.36 (95% confidence interval 0.21 to 0.63). The benefit disappeared once the device was removed; relative risk 1.33 (95% confidence interval 0.72 to 2.46). The results from the post-interlock period severely effect the overall effectiveness of the interlock, when both the interlock and post-interlock periods are combined.

In all 13 non-randomised controlled trials, interlock participants again had lower recidivism than the controls. In nine of the trials, the difference between the groups would be regarded as statistically significant (i.e. the 95% CI does not include the value 1.0); see Analysis Figure 2. In repeat offenders, the evidence is stronger with six of the eight studies showing that the offenders have significantly lower recidivism rates while the device is installed in the vehicle. Once again, however, the favourable result does not extend to the time period after the interlock is removed.

The two controlled trials which reported an overall effect both showed that the interlock did not reduce recidivism in the drink driving population.

DISCUSSION

This review has found evidence that the ignition interlock has the ability to curb drinking and driving when it is installed in a vehicle but that the benefit disappears once the device is removed. The overall effectiveness of the device is, therefore, questionable from a traffic safety point of view.

However, the review also found that, while numerous trials have been conducted in the area of alcohol ignition interlock programmes, only one has been an RCT. An RCT limits various sources of potential bias in a study. As noted, the RCT in this review did not evaluate the effectiveness of the interlock on the less motivated repeat drink driver, as there was selection bias towards those offenders who had overcome their drink driving habit.

All non-randomised controlled trials are subject to bias and may limit the extrapolation that the intervention can work in the general population of offenders. The low participation rates in the non-randomised trials in this review are also of concern. Further concerns regarding individual trials have also been noted − see Table of included studies. In consequence, the strength of the review's findings are weakened. The question of the effectiveness of alcohol ignition interlock programmes has yet to be answered. One RCT, and the low participation rates, have not allowed the rigorous testing that this device requires.

For public safety, an effective sentence needs to be based on the merits and demerits of the defendant (Raub 2001). Voas 1999 used as a measure of programme effectiveness, the overall recidivism rates for participants and non-participants. However, the numbers of participants was so small as to have a negligible effect (6% decrease) on the overall recidivism rate. Voas et al state that,

"unless a procedure is found to increase the offender participation rate, interlock programmes will have limited value as an overall control method for all DUIs." Other questions raised by this group are: the effect of mandatory versus voluntary participation (Beirness 2000a), different support services provided with the interlock device (Marques 2000c), and whether using failed BAC tests recorded by the device can predict future recidivism rates (Marques 2000b). Not withstanding methodological challenges and data limitations, alcohol ignition interlock programmes have the potential to reduce the frequency of DUI and may favourably influence the burden and costs of alcohol-related road traffic accidents. Strategies to improve participation rates, compliance and durability of effect are particularly challenging.

AUTHORS' CONCLUSIONS

Implications for practice

This review confirms that the ignition interlock reduces recidivism, while installed in a vehicle. The majority of the evidence supports the conclusion that the interlock device has no long-term effects for reducing recidivism in the population of drivers that use them. Also, the percentage of drivers who have participated in these programmes is so low that the device has had little effect on the drink driving population as a whole. Most studies have concluded that participation rates need to be increased, in order for the ignition interlock programme to have effects on the drink driving population at large.

Implications for research

There is some evidence that rehabilitation programmes coupled with the interlock device have positive effects for maintaining a reduced level of recidivism after the interlock has been removed. The emerging data for predicting repeat offenders from the interlock data logs is interesting and needs to be followed up. The population which is best affected by the interlock has yet to be defined. Also, further research needs to investigate whether increasing the length of time (perhaps indefinitely) the interlock device is installed in the drink driving recidivist vehicle will decrease recidivism.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Alberta

Methods	Retrospective record review.
Participants	First and repeat offenders analysed separately. 2763 interlock participants (6% of which had mandatory sentencing) and 28427 controls.
Interventions	After a proportion of their suspension period had been completed and an educational/interventional program completed, interlocks were installed on vehicles for six months, or until the end of their suspension. July 1987 - Sept 1996
Outcomes	Survival analysis during and post interlock.
Notes	Program managed by the Driver Control Board. Quality assessment score 19/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

California

Methods	Quasi experimental longitudinal study.
Participants	All offenders combined. 584 interlock participants and 506 controls.
Interventions	No set policy on interlock sentence. Voluntary participation. March 1987 - Jan 1990
Outcomes	Recidivism rates while the interlock was installed in the vehicle.
Notes	Program administered by the courts but there was no supervision of participants. The study contexts(demographics of counties and profile of offenders sentenced to interlock) were heterogeneous. Time at risk was short. One fourth of drivers sentenced to interlock did not install, yet no action taken against them. No standardised procedures to determine who received interlock sentence or for notification of compliance. Interlock participants were more likely to have prior DUI offenses and were less likely to have a BAC 0.2 or under. Quality assessment score 17/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Colorado

Methods	Longitudinal study.
Participants	Repeat offenders. 501 interlock participants and 349 did not installs.
Interventions	Offenders had to have applied for an Interlock Probationary Licence. Participation was voluntary. Sept 1998 - Oct 2000.
Outcomes	Recidivism rates while the interlock was installed in the vehicle and for one year following the removal of the device.
Notes	Program managed by the Hearings Section of the Colorado Department of Revenue. Interlock applicants were older, had higher family income, were non-hispanic whites and had at least a high school or equivalent education than non-applicants. Quality assessment score 16/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Hamilton County

Methods	Quasi experimental longitudinal study.

Hamilton County *(Continued)*

Participants	All offenders combined. 273 interlock participants and 273 controls.
Interventions	Suspended license with driving restricted to an interlock equipped vehicle. Participation was voluntary. July 1987 - Feb 1989.
Outcomes	Probability of rearrest.
Notes	Program administered through the courts. Quality assessment score 18/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Hancock County

Methods	Before and After Analysis. Matched comparison groups.
Participants	Hancock County is the interlock group with six similar counties as control. 21325 first time offenders and 9356 repeat offenders were included in the analysis.
Interventions	Most offenders have mandatory sentencing of the interlock. Jan 1987 - Dec 1999.
Outcomes	Survival analysis with Cox regression.
Notes	Program administered through the courts. Threats of jail or electronically monitored house arrest for failure to comply. Counties may not be equivalent in levels of policing DUI or have the same education/advertising measures in place. Due to sampling time frame, many repeat offenders would not have post interlock data. Quality assessment score 18/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Illinois

Methods	Before and after study.
Participants	All offenders combined. 1560 interlock participants and 1384 controls.
Interventions	All offenders who receive a Restricted Driving Permit (RDP) must install an interlock for one year. Offenders were monitored for up to two years post interlock. Applying for a RDP is voluntary. Control: July 1991 - June 1994.

Illinois *(Continued)*

	Interlock: July 1994 - June 1997.
Outcomes	Recidivism rates
Notes	Program managed by the Driver Licencing Authority. Control and interlock participants were from different time periods and therefore potentially exposed to different exposures of anti drink driving measures. No measure to detect whether the two groups have similar drink driving records. Those who apply for an RDP are prepared for the inconvenience and monetary outcome of an interlock and therefore may be more likely to succeed than those who do not apply. Quality assessment score 16/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Maryland

Methods	Randomised Controlled Trial.
Participants	Multiple offenders who had applied to, and been approved by, the Medical Advisory Board for licence reinstatement. 698 interlock participants and 689 controls.
Interventions	Alcohol ignition interlock device to be installed in vehicle for one year. And mandatory participation in treatment or support programs.
Outcomes	Recidivism (in terms of committing an alcohol traffic violation) within the first year (while the interlock device is installed) and for the 365 days following removal of the device.
Notes	Program managed by the Motor Vehicle Administration. Participants in the trial were those most likely to succeed. They had already passed medical and psychiatric evaluations. Therefore, the effectiveness on drunk drivers not in recovery is not tested. Not all those in the interlock owned a car and therefore a proportion of the interlock group never experienced the interlock. Quality assessment score 24/27 Jadad score 3

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

North Carolina

Methods	Quasi experimental longitudinal study.
Participants	Repeat offenders. 407 interlock participants and 916 controls.

North Carolina *(Continued)*

Interventions	After two years of suspension, offenders may apply for a conditional license. Conditional licenses could be granted with or without an interlock. Participation was voluntary. Jan 1986 - Nov 1989
Outcomes	Recidivism rates while the interlock is installed in the vehicle and then for a follow period after the device is removed from the vehicle.
Notes	Program managed by the North Carolina Division of Motor Vehicles. Length of follow up was short, particularly for recidivism once the interlock is removed from the vehicle. Quality assessment score 15/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Oregon

Methods	Retrospective record review.
Participants	Repeat offenders. 648 interlock participants and 1543 controls.
Interventions	After 1-3 years suspension, offenders must use the interlock device for six months or face an additional six months suspension therefore participation was voluntary.
Outcomes	Rearrest rate per hundred drivers per year for the six months that the interlock was required and for follow up for an average of 406 days.
Notes	Program managed by the Oregon Division of Motor Vehicles. Interlock counties were substantially more urban, incorporating all of the large metropolitan areas. Statistically significant differences in prior DUI offenses. Quality assessment score 15/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Quebec

Methods	Longitudinal study.
Participants	First and repeat offenders. 8846 first time offenders on interlock and 25559 controls. 1050 repeat offenders on interlock and 7108 controls.
Interventions	First time offenders have the interlock installed for nine months while repeat offenders have the interlock installed for 18 months. Participation was voluntary.

Quebec *(Continued)*

	Dec 1997 - Jan 2001.
Outcomes	Survival analysis and Risk Ratios for the suspension period (including time when interlock on car) and for ther follow up period.
Notes	Program managed by Societe de l'assurance automobile du Quebec. First time interlock participants were a higher proportion of men, who were slightly older than the control group while repeat offenders were slightly younger than the control group. Quality assessment score 15/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

West Virginia

Methods	Retrospective record review.
Participants	First and repeat offenders. 137 first time offenders on interlock and 10198 controls. 591 second offenders on interlock and 20062 controls.
Interventions	Had to have completed or enrolled in the "Safety and Treatment program". First time offenders installed interlock for five months, second time offenders for 12 months (later increased to 18 months). Participation was voluntary Jan 1990 - March 1996.
Outcomes	Survival analysis while the interlock was installed in the vehicle and for an unspecified follow up period.
Notes	Program managed by the State Motor Vehicle Department. Quality assessment score 16/27

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Alberta (Weinrath)	Data are unlikely to be independent from that of Voas et al, 1999. Data set is smaller than Voas et al and has all offenders combined.
Beirness 2000	This paper investigates the impact of mandatory versus volunatary participation in an ignition interlock program on recidivism. This means that the control group for this paper is is not independant from the interlock program. Also the data can not necessarily be considered independent from that of Voas et al, 1999 as the recruitment period overlaps.

Study	Reason for exclusion
Marques 1999	This paper investigates the effect that behavioral monitoring has on the effectiveness of the ignition interlock program. This means that the control group for this paper is is not independant from the interlock program. Also the data can not necessarily be considered independent from that of Voas et al, 1999 as the recruitment period overlaps.
Marques 2000	This paper investigates the support services provided during interlock usage and post-interlock repeat DUI. This means that the control group for this paper is is not independant from the interlock program. Also the data can not necessarily be considered independent from that of Voas et al, 1999 as the recruitment period overlaps.
Marques 2000a	This paper investigates using the pass/fail data collected from individual breath tests to predict future recidivism. This means that the control group for this paper is is not independant from the interlock program. Also the data can not necessarily be considered independent from that of Voas et al, 1999 as the recruitment period overlaps.
Marques 2001	This paper investigates using the pass/fail data collected from individual breath tests to predict future recidivism. This means that the control group for this paper is is not independant from the interlock program. Also the data can not necessarily be considered independent from that of Voas et al, 1999 as the recruitment period overlaps.

Characteristics of ongoing studies *[ordered by study ID]*

Queensland

Trial name or title	Queensland Ignition Interlock Program
Methods	
Participants	Six courts are participating in the trial. Participation is voluntary and open to all types of offenders.
Interventions	The interlock device becomes a part of the condition of probation.
Outcomes	Recidivism
Starting date	February 2001
Contact information	CARRS-Q
Notes	The interlock program is in addition to the "Under The Limit" program. Offenders are monitored by a Community Corrections Officer

Sweden

Trial name or title	Swedish Ignition Interlock Programme
Methods	
Participants	Volunteers in the three (of 21) participating counties in Sweden. Two control groups; K2 those who do not volunteer for the program and K1, those not in one of the three participating counties

Sweden *(Continued)*

Interventions	Two years on the ignition interlock program. Interlock data recorder checked every second month and medical check-ups every three months.
Outcomes	Recidivism
Starting date	February 1999
Contact information	
Notes	Participants are also monitored with the AUDIT questionnaire and biological markers. If they do not show a "sober lifestyle" after the first year they are removed from the program

Victoria

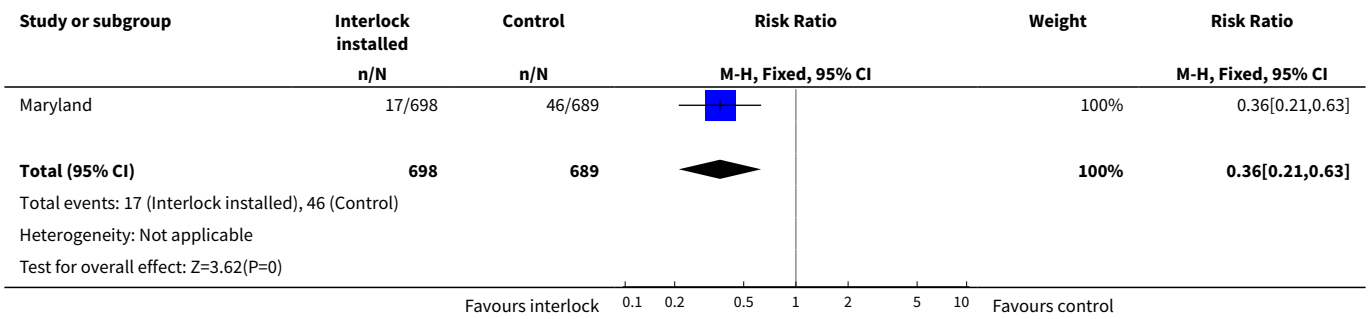
Trial name or title	Victorian Alcohol Interlock Program
Methods	
Participants	First and repeat offenders required by the courts to install an interlock before their licence can be restored
Interventions	A minimum licence cancellation period that will depend on previous DUI history of the offender, then an interlock licence condition, also variable on type of offender
Outcomes	Recidivism
Starting date	May 2003
Contact information	Victorian Government
Notes	

DATA AND ANALYSES

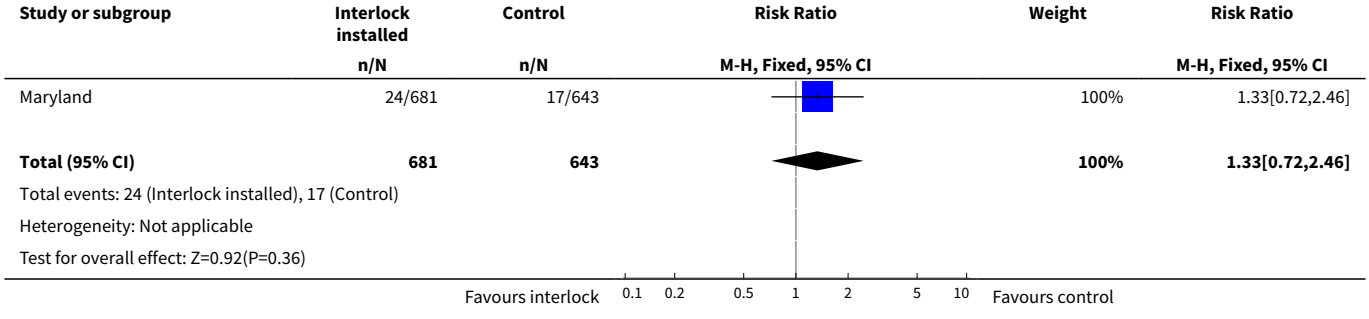
Comparison 1. Randomised Controlled Trials

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Recidivism while the interlock device is installed in offender's vehicle	1	1387	Risk Ratio (M-H, Fixed, 95% CI)	0.36 [0.21, 0.63]
2 Recidivism after the interlock device has been removed from the offender's vehicle	1	1324	Risk Ratio (M-H, Fixed, 95% CI)	1.33 [0.72, 2.46]
3 Total recidivism during study period	1	1387	Risk Ratio (M-H, Fixed, 95% CI)	0.64 [0.44, 0.94]

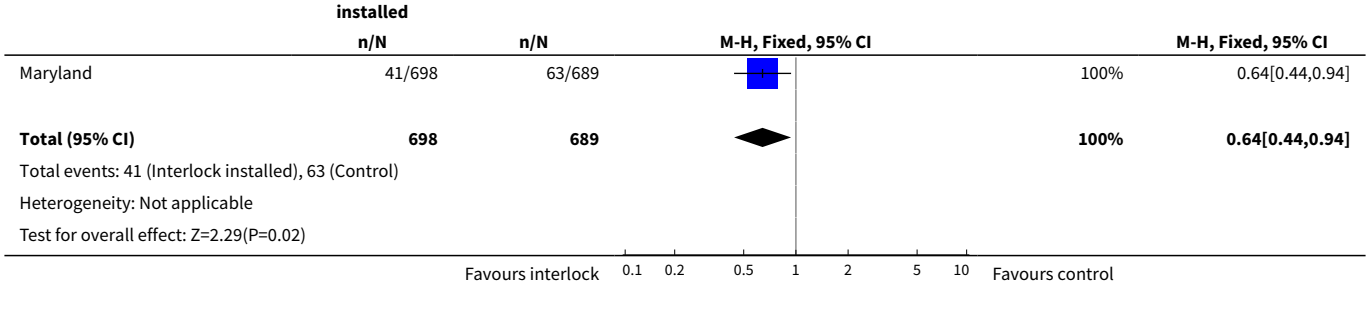
Analysis 1.1. Comparison 1 Randomised Controlled Trials, Outcome 1 Recidivism while the interlock device is installed in offender's vehicle.



Analysis 1.2. Comparison 1 Randomised Controlled Trials, Outcome 2 Recidivism after the interlock device has been removed from the offender's vehicle.



Analysis 1.3. Comparison 1 Randomised Controlled Trials, Outcome 3 Total recidivism during study period.



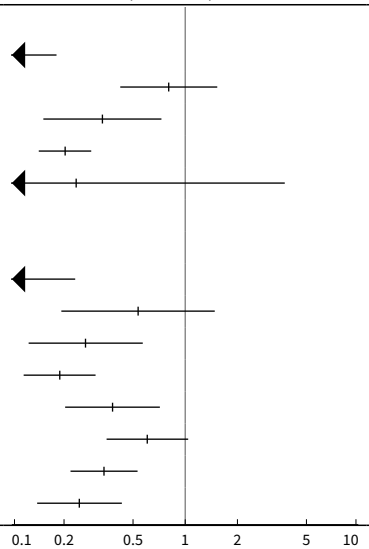
Comparison 2. Controlled Trials

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Recidivism while the interlock device is installed in offender's vehicle	9		Risk Ratio (M-H, Random, 95% CI)	Totals not selected

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 First time offenders (or not described)	5		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 Repeat offenders	8		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2 Recidivism after the interlock device has been removed from the offender's vehicle	7		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
2.1 First time offenders (or not described)	3		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 Repeat offenders	7		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
3 Total recidivism during study period	2		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
3.1 First time offenders (or not described)	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 Repeat offenders	2		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]

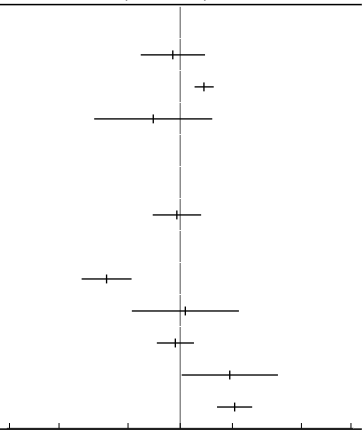
Analysis 2.1. Comparison 2 Controlled Trials, Outcome 1 Recidivism while the interlock device is installed in offender's vehicle.

Study or subgroup	Interlock installed n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
2.1.1 First time offenders (or not described)				
Alberta	2/1982	393/17587		0.05[0.01,0.18]
California	16/283	19/270		0.8[0.42,1.53]
Hamilton County	8/273	24/273		0.33[0.15,0.73]
Quebec	34/8846	485/25559		0.2[0.14,0.29]
West Virginia	0/137	157/10198		0.23[0.01,3.75]
2.1.2 Repeat offenders				
Alberta	7/781	878/10840		0.11[0.05,0.23]
California	6/293	9/235		0.53[0.19,1.48]
Colorado	8/501	35/584		0.27[0.12,0.57]
Illinois	20/1560	94/1384		0.19[0.12,0.3]
North Carolina	11/407	65/916		0.38[0.2,0.71]
Oregon	16/648	63/1541		0.6[0.35,1.04]
Quebec	20/1050	398/7108		0.34[0.22,0.53]
West Virginia	12/761	1290/20062		0.25[0.14,0.43]



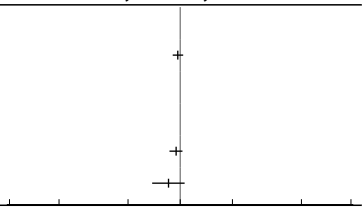
Analysis 2.2. Comparison 2 Controlled Trials, Outcome 2 Recidivism after the interlock device has been removed from the offender's vehicle.

Study or subgroup	Interlock installed n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
2.2.1 First time offenders (or not described)				
Alberta	25/1479	127/6805		0.91[0.59,1.39]
Quebec	332/8846	698/25559		1.37[1.21,1.56]
West Virginia	6/137	629/10041		0.7[0.32,1.53]
2.2.2 Repeat offenders				
Alberta	41/586	224/3061		0.96[0.69,1.32]
Colorado	0/1	0/1		Not estimable
Illinois	48/1540	107/1290		0.38[0.27,0.52]
North Carolina	10/160	25/428		1.07[0.53,2.18]
Oregon	78/648	198/1541		0.94[0.73,1.2]
Quebec	12/1050	42/7108		1.93[1.02,3.66]
West Virginia	70/749	851/18772		2.06[1.63,2.6]



Analysis 2.3. Comparison 2 Controlled Trials, Outcome 3 Total recidivism during study period.

Study or subgroup	Interlock installed n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
2.3.1 First time offenders (or not described)				
Hancock County	760/3230	4398/18095		0.97[0.91,1.04]
2.3.2 Repeat offenders				
Hancock County	396/1312	2565/8044		0.95[0.87,1.03]
Oregon	94/648	261/1541		0.86[0.69,1.06]



APPENDICES

Appendix 1. Search strategy

CENTRAL (*The Cochrane Library* 2002, Issue 3),
MEDLINE (Silverplatter, 1966 to Sept 2002),
National Research Register (2002, issue 3);
#1 "automobile-driving"
#2 explode "alcohol-drinking"
#3 explode "alcoholic-intoxication"
#4 alcohol* or dr?nk* or driving or driver* or recidiv*
#5 #1 or #2 or #3 or #4
#6 (ignition near interlock*) or (interlock* near program*)
#7 #5 and #6

EMBASE (OVID 1980 to 2002 Sept week 3)
#1 exp alcohol intoxication/
#2 exp drunken driving/
#3 exp alcohol consumption/
#4 (alcohol$ or drink$ or drunk$ or driving$ or driver$ or recidiv$)
#5 1 or 2 or 3 or 4

#6 ((ignition$ adj5 interlock$) or (interlock$ adj5 program$))
#7 5 and 6

TRANSPORT (1988 to 2002/06)
#1 alcohol* or drunk* or drink* or driving* or driver* or recidiv*
#2 (ignition* near interlock*) or (interlock* near program*)
#3 #1 and #2
#4 alcohol* near #2
#5 #3 and #4

Science Citation Index (WoS, 1981 to Sept 2002)
(alcohol* or drunk* or drink* or driving* or driver* or recidiv*) and (ignition* or interlock* or program*) and trial*
#1 “Automobile-Driving”
#2 explode “Alcohol-Drinking”
#3 explode “Alcoholic-Intoxication”
#4 alcohol* or dr?nk* or driving or driver* or recidiv*
#5 #1 or #2 or #3 or #4
#6 (ignition near interlock*) or (interlock* near program*)
#7 #5 and #6

A general search of the Internet (Google) for US trials was conducted from 29/5/03 until 3/6/03 using the search terms:
(alcohol interlock program *state*) where state = the 42 states and territories that use interlock according to MADD as at 29/5/03 (http://www3.madd.org/laws/law.cfm?LawID=ILCK)

A general search of the Internet (Google) on the 30 May 2003 using the search terms:
(evaluation alcohol interlock university)

WHAT'S NEW

Date	Event	Description
8 September 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

SL forewarded the idea of reviewing alcohol ignition interlock devices. CW did the searching and locating of trials. CW and SL applied the inclusion/exclusion criteria, and extracted the data. CW and NB rated the trials for quality. CW wrote the review with editorial comments from NB and SL

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- University of Queensland infrastructure, Australia.

External sources

- Motor Accident Insurance Commission, Australia.

INDEX TERMS

Medical Subject Headings (MeSH)

*Alcohol Drinking; *Automobile Driving; *Protective Devices; Controlled Clinical Trials as Topic; Licensure; Randomized Controlled Trials as Topic; Recurrence

MeSH check words

Humans