Technology Saving Lives

Proceedings of the 17th International Alcohol Interlock Symposium

September 17-19, 2023 | Oslo, Norway

Hannah Barrett & Robyn D. Robertson

TRAFFIC INJURY RESEARCH FOUNDATION

The knowledge source for safe driving

Traffic Injury Research Foundation

The vision of the Traffic Injury Research Foundation (TIRF) is to ensure people using roads make it home safely every day by eliminating road deaths, serious injuries, and their social costs. TIRF's mission is to be the knowledge source for safe road users and a world leader in research, program and policy development, evaluation, and knowledge transfer. TIRF is a registered charity and depends on grants, awards, and donations to provide services for the public. Visit tirf.ca.

Traffic Injury Research Foundation

171 Nepean St. Suite 200
Ottawa, ON K2P 0B4
Ph: (613)238-5235
Email: tirf@tirf.ca

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The continued commitment of these sponsors and the many exhibitors encourages the pursuit of innovative ideas, the sharing of perspectives and the strengthening of initiatives to advance interlock programs.

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The content of this report is based on the summary of the ideas and perspectives emerging from the symposium and does not necessarily reflect the views of individual presenters, participants, or sponsors.

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Impaired driving

Alcohol-impaired driving remains a critical global concern, posing significant risks to road safety and public health worldwide. Despite extensive efforts to combat this issue, alcohol-impaired driving continues to claim thousands of lives annually and inflict substantial economic costs on societies. Understanding trends in and the dynamics surrounding alcohol-impaired driving is essential for policymakers, law enforcement agencies, public health officials, and communities to develop effective strategies for prevention and intervention. This report describes the 2023 International Alcohol Interlock Symposium proceedings in Norway organized in three sections: the impaired driving problem, alcohol ignition interlock programs, and device technologies. This section provides an overview of current trends in alcohol-impaired driving, the use of roadside alcohol breath checks for impaired driving in the European Union (EU), and the role of cannabis in fatal crashes in Canada as well as enforcement challenges associated with cannabis impaired driving.

Impaired driving prevalence

The frequency of impaired driving varies significantly depending on the geographical region, cultural norms, legislative frameworks, enforcement practices, and public awareness campaigns in individual jurisdictions. It remains a pervasive problem in many countries, contributing to preventable traffic crashes, injuries, and fatalities despite considerable progress having been achieved.

In Austria, approximately 26,000 impaired drivers lose their licence annually.[1] Of these, 7,000 (27%) continue to drive unlicenced and, among those drivers, 4,000 (57%) continue to drive alcohol impaired. In Norway, impaired driving accounts for approximately 25% of all road deaths, with 24 persons killed by impaired driving in 2020.[2] In The Netherlands, there were 737 traffic fatalities in 2022, with approximately 17.5% being alcohol-related.[3] In Ireland, 37% of driver fatalities from 2015-2019 were positive for alcohol.[4]

Across the European Union, 20,678 people died in road traffic crashes in 2022 with one in four (25%) of these deaths being alcohol-related. It is positive that from 2011 to 2021 there was a 31% decrease in alcohol-impaired driving deaths across the EU. Despite a slight increase from 2020 to 2021, overall rates have continued in a downward trend. But, of

[1] Statistics Austria (2023) Share of alcohol-related road accidents at record level in 2022. Press release: 13 055-0823/23. https://www.statistik.at/en/statistics/tourism-and-transport/accidents/road-traffic-accidents

[2] ETSC (2023). Drink-driving in Norway. https://etsc.eu/issues/drink-driving/drink-driving-in-norway/#:~:text=Figures,2021%20data%20were%20not%20available.

[3] Institute for Road Safety (SWOV). (18 April, 2023). Number of traffic fatalities increased by 155 to 737 in 2022. https://swov.nl/en/news/number-traffic-fatalities-increased-155-737-2022

[4] Road Safety Authority. (2023). Road traffic collision data. https://www.rsa.ie/road-safety/statistics/road-traffic-collision-data

concern, alcohol-related crashes were still the leading cause of death among young adults aged 16-25 years in the EU. Of all vehicle kilometers travelled in the EU, it was estimated that up to 2% are driven with a BAC above the legal limit (ETSC, 2023).

A study of 48 countries across Europe, Asia Oceania, America, and Africa examined the prevalence of impaired driving among a sample of 45,000 drivers (Meesmann et al., 2022).[5] Drivers completing this survey self-declared their driving behaviours over the past thirty days. In Europe, 13% of drivers said they drove when they were alcohol-impaired over the legal limit, 14.9% were impaired by medication, and 5% were impaired by drugs. Furthermore, 18.4% of drivers were checked by the police for alcohol consumption (i.e., a breathalyser) at least once within the past 12 months.

Alcohol breath checks in the EU

Roadside alcohol breath tests are crucial to make roads safe by identifying and deterring impaired drivers and removing them from the road to face sanctions. These tests provide law enforcement with a quick and reliable method to measure a driver's blood alcohol content (BAC) on the roadside, reducing the potential for alcohol-related crashes. These roadside breath checks serve as a strong general and specific deterrent by encouraging drivers to think twice before getting behind the wheel while intoxicated. Additionally, the presence of these checkpoints promotes a culture of responsibility and accountability among drivers. They also facilitate the gathering of data to inform public health and safety initiatives, aiding in the development of targeted interventions and policies.

When asked if they thought they were likely to be tested for drink-driving on a regular car journey, 22% of EU survey respondents in 2018 said yes (Meesmann et al., 2022). This is an increase from 18% in 2016. From 2011-2021, six EU countries achieved progress increasing the number of alcohol roadside breath checks compared to ten countries where breath tests declined. While Hungary had the largest increase in alcohol roadside breath checks per 1,000 population at 8%, Ireland had the lowest with a decrease of 39%. In Hungary, 1.2% of roadside breath checks were positive above the legal limit while just 0.6% of Ireland breath checks were positive above the legal limit. Estonia completed 576 roadside breath tests per 1,000 population in 2021 which was the most across the EU, with 0.8% positive above the legal limit.

Cannabis impaired driving

Cannabis legalization has resulted in the need for increased research and understanding of fatal crashes in jurisdictions where cannabis has been legalized, particularly because cannabis will undoubtedly continue to be legalized across the globe, both medically and recreationally.

[5] Meesmann, U., Wardenier, N., Torfs, K., Pires, C., Delannoy, S. & Van den Berghe, W. (2022). A global look at road safety. Synthesis from the ESRA2 survey in 48 countries. ESRA project (E-Survey of Road users' Attitudes). Brussel, Belgium: Vias institute.

As such, it is imperative to understand the impact of legalization on fatal road crashes as well as related enforcement issues. Cannabis legislation has been implemented in Uruguay, Mexico, Canada, United States (19 states recreationally and two medically), Australian Capital Territory, Germany, Malta, The Netherlands, Luxembourg, Spain, Italy, Portugal, and France.

In the past 20 years (from 2000-2020), testing rates in Canada for drugs among fatally injured drivers have increased from 37% to 77% of drivers killed being tested. The prevalence of drugs detected in drivers killed has also increased. Whereas just 34% of drivers tested in 2000 were positive for any drug, this increased to 55% in 2020. Moreover, among the 55% who tested positive in 2020, there were four drug categories which were the most prevalent and are presented in Table 1.[6]

Table 1 | Test results for drug positive fatally injured drivers (2020, Canada)

Drug category	% tested positive
Cannabis	54.7
CNS depressants	36
CNS stimulants	35.8
Narcotic analgesics	19.4

In 2020, among fatally injured drivers, females (58%) were more likely than males to test positive for drugs (54%). However, males were more likely to test positive for cannabis (31.6%) and CNS stimulants. Drivers aged 20-34 years of age were more likely to test positive for drugs than other age cohorts. Cannabis was more prevalent among young drivers aged 20-34 (39.4% vs. 13.5% CNS depressants) whereas older drivers, aged 65+, were more likely to test positive for CNS depressants (31.5% vs. 7.1% cannabis). Fatality data further revealed 56% of fatally injured drivers tested positive for drugs on weekends compared to 50% in weekday crashes.

The prevalence of cannabis in drivers in fatal crashes in Canada has nearly doubled since 2000. In 2020, almost one-third (30.1%) fatally injured drivers tested positive for cannabis compared to 15.9% in 2000. Further, between 2000 and 2020, males who tested positive for cannabis increased from 17.5% to 31.6% while female fatally injured drivers who tested positive for cannabis increased from 8.1% in 2000 to 23.2% in 2020. Prior to the legalization of cannabis in Canada (January 2016 - October 2018), the percentage of fatally injured drivers testing positive for cannabis was 24%, however, post-legalization (November 2018 – December 2020), more than one-quarter (28.1%) of fatally injured drivers tested positive for cannabis.[7]

[6] TIRF National Fatality Database
[7] Brown, S., Vanlaar, W. G. M., & Robertson, R. D. (2023). Drug use in fatal collisions, 2000-2020.

Enforcement

The legalization of cannabis in Canada highlighted important barriers to the enforcement of drug-impaired driving laws with an inadequate number of trained officers to enforce these laws. In 2020 there were approximately 1,300 trained Drug Recognition Experts (DREs) who conducted nearly 6,000 DRE evaluations, and also 27,300 Standardized Field Sobriety Test (SFST) trained officers. Roadside testing is a complex issue given the different protocols for alcohol and cannabis impairment. Further, delays in capturing a blood sample for toxicological analysis while the DRE exam is completed have meant cannabis can disappear from the driver's body before a test sample is collected. These delays in testing are often due to the unavailability of a DRE officer to attend a scene or conduct testing at the police detachment and the subsequent length of the DRE exam. Comparatively, in the US approximately 1% of sworn officers are DREs and 35,000 evaluations are conducted annually.

Research has demonstrated that DRE calls by trained police officers are accurate nearly 80% of the time (IACP, 2022).[8] While labs may not confirm with respect to these calls, impairment may not be present by the time samples are collected due to time delays and cut-off levels based on jurisdiction. Thus, there is progress to be made in enforcing cannabis impaired driving and the need for the immediacy when collecting the forensic sample from a suspected driver is paramount to proving impairment, particularly in relation to cannabis.

Trends in legalizing cannabis, both medical and recreational, are anticipated to continue around the globe. The impact of legalization on drug-impaired driving is evident in several jurisdictions. In turn, this requires greater allocation of resources for enforcement, toxicological, and court resources. Collaboration and efforts to establish greater uniformity in the types of tools used to assess impairment and the recording of results is a priority to enable researchers to pool data and better assess the effects of growing legalization on traffic safety and accelerate learning.

Ultimately, while progress reducing impaired driving has been achieved in some jurisdictions, room for improvement remains. Utilizing technologies, such as alcohol ignition interlocks, are proven methods to decrease impaired driving.

Alcohol Interlock Programs

Introduction

In the past thirty years, robust evidence has been accumulated demonstrating the positive effects of alcohol interlock programs on road safety. This proven tool prevents impaired

[8] International Association of Chiefs of Police. (2022). 2021 Annual Report. Drug evaluation & classification program. Alexandria, V.A. https://www.theiacp.org/sites/default/files/2022-05/2021 DECP Annual Report.pdf

driving among impaired driving offenders, thereby reducing driving after drinking, repeat offences, and alcohol-related crashes. Research has provided compelling evidence that installed interlocks reduce impaired driving recidivism (Elder et al. 2011; Marques et al. 2010) and alcohol-related crashes (Vanlaar et al. 2017; Kaufman & Wiebe 2016; Toeh et al. 2018). In the past decade, interlock installation and usage has substantially increased, with more jurisdictions making installation mandatory upon an impaired driving arrest or conviction. Further, jurisdictions which did not yet have interlock programs in place have moved to pilot and implement legislation and programs requiring impaired drivers to complete an alcohol interlock program.

This section describes alcohol interlock legislation, programs and best practices from presenting countries across the European Union and United States.

EU legislative developments

As of 2023, eight[9] among 27 EU countries have implemented alcohol interlock legislation for impaired driving offenders. An additional three[10] countries have discussed the implementation of alcohol interlock legislation and three[11] have put voluntary interlock programs for offenders in place. The remaining nine countries do not have alcohol interlock programs or legislation in place. Further, almost all EU countries have a .05 breath alcohol concentration (BAC) limit which is in line with the 2001 EU recommendation on the maximum BAC legal limit for all drivers. Additionally, 23 EU countries applied lower BACs (.00 or .02) for novice and professional drivers. Not only are interlocks required for impaired driving offenders, but they are also used as a preventative measure in public transportation (i.e., buses, cabs/taxis), delivery trucks, and commercial vehicles.

A 2022 study by the European Commission[12] showed action could be taken across the EU to further promote the adoption of a .02 BAC limit for professional drivers and further facilitate the introduction of alcohol interlocks. It also suggested public authorities could promote the use of interlocks through the requirement of having an interlock in all new vehicles purchased, or in the vehicles used for the provision of publicly procured services.

Future legislative challenges in the EU for consideration include mandating the use of alcohol interlocks for all professional drivers as well as ensuring the timely adoption of legislation which would require auto manufacturers to facilitate the implementation of alcohol interlocks on all new motor vehicles.

[9] Austria, Belgium, Denmark, Finland, France, Lithuania, Poland, Sweeden
[10] Ireland, Italy, Norway
[11] Germany, Portugal, Spain
[12] Modijefsky, M., Janse, R., Spit, W., Jankowska-Karpa, D., Buttler, I., & Eikefjord, B. (2021). Prevention of driving under the influence of alcohol and drugs. Directorate-General for Mobility and Transport, European Commission.

Austria

The Austrian alcohol interlock program began in September 2017. It has since expanded and shown promise in reducing impaired driving recidivism among impaired driving offenders. Interlock program participants are required to have the interlock device installed on their vehicle for a minimum of four months, although the average was eight months, with a pre-set BAC limit of .01.

A 2022 evaluation of 561 interlock program participants showed that although 8% of them dropped out of the program, participants who completed the program had a recidivism rate twelve times lower compared to impaired drivers who did not install an interlock device. In addition to lower recidivism, participants personally reported changes in their behaviour, specifically, their alcohol consumption habits.

Belgium

The Belgian interlock program was established in 2010 with the first device being installed in 2013. Impaired drivers are required to participate if they are a first offender with a .18 BAC or a repeat offender with a .12 BAC. Impaired drivers who do not install an interlock device are unable to drive during the length of their sentence whereas those who install the device can legally drive with a zero BAC pre-set limit.

While participating in the interlock program, impaired drivers receive training and guidance from psychologists. After completing four months of the program, participants attend a three-hour training session to share experiences, intentions, and strategies to separate driving and drinking. Interlock data is frequently downloaded and reviewed for tampering and failed starts. The monitoring of participants is associated with a lowered risk of recidivism and helps implement lasting behavioural change.

The Netherlands

The Dutch alcohol interlock program was introduced in December 2011 and was terminated in September 2016 due to legal challenges. During its operation the program was available to impaired drivers with a BAC of .13 to .18. The program included an educational component in addition to behavioural feedback, and it cost drivers approximately 4,000 euros to participate.

An evaluation was conducted to examine the effectiveness of the Dutch interlock program and whether it reduced impaired driving recidivism. Results showed less than 1% of interlock program participants recidivated during the program and 6% recidivated within two years after program completion. Compared to impaired drivers who do not participate in the interlock program, those who completed the interlock program had a 29% lower risk of impaired driving recidivism.

In sum, while the Dutch interlock program was effective in reducing recidivism among participants it was disbanded due to legal challenges related to double jeopardy. At this time, solutions for this legal issue are being explored in an effort to reinstate the effective program.

Norway

The Norwegian Alcohol Interlock Committee was established in 2011 and consisted of diverse transportation stakeholders who provided input into the formation of an interlock program. The Committee has since pursued a comprehensive strategy for the implementation of alcohol interlocks in Norway. The first component of the strategy was to build consensus among transportation companies, drivers, unions and political decision-makers about the effectiveness of the technology. Secondly, the committee aimed to pave the way for political decisions by presenting a legitimate basis for implementing a program for the use of these devices. Lastly, the committee encouraged transportation companies, customers of transportation companies and local authorities to understand the advantages associated with using these devices, and to include requirements for their use when contracting for vehicle services.

The Norwegian Alcohol Interlock Committee positioned the use of alcohol interlocks more as a quality assurance tool in the transportation of goods with the benefit of also acting as a consequence for unsafe behaviour. This strategy has decreased the stigma for users of alcohol interlocks in Norway, and it has been generally accepted as a safety device by professional drivers. The committee has undertaken substantial effort to encourage political support and processes to strengthen the implementation of alcohol interlocks.

As of 2023, alcohol interlocks were mandatory in buses and minibuses, and also used among drivers of heavy machinery, public service vehicles, taxis, and fleet transportation services. While not yet required as a sanction for impaired drivers, the devices do prevent drivers of heavy transport vehicles from driving impaired.

A key part of the implementation process was ongoing communication and collaboration with the bus unions. This was due to the direct impact of interlocks on the working environment of drivers. It was important for drivers and companies to work together to put safety first, and for drivers to trust the main purpose of the company in using these devices was to make roads safer for all road users.

Behaviour change & the role of interlocks in the United States

Research has shown interlocks can be an effective behaviour change tool when implemented within a well-designed program. However, there is a subset of the impaired driving population who simply do not adhere to certain interventions, such as those who are unable to modify their drinking behaviours. This can be due to being either under- or over-monitored or treated for substance use disorders.

Criminogenic risks are factors or conditions that can influence the potential of an individual to commit a crime. These conditions can be static (i.e., unchanging) or dynamic (i.e., can change overtime and may be amendable to treatment). Risks for impaired driving can include prior involvement in the justice system specifically related to impaired driving, prior involvement with alcohol and other drugs, mental health and mood adjustment disorders, and resistance to and non-compliance with current and past involvement in the justice system. Impaired drivers classified as high-risk are those who are likely to persist in risky behaviours if they receive standard or traditional probation supervision alone.

Two examples of ways in which alcohol interlock programs in the US can incorporate supervision and treatment features to help reduce the risk of recidivism among impaired drivers.

Florida, US. Interlock program participants were mandated to participate in alcohol-use-disorder (AUD) treatment after three interlock program violations. AUD treatment was individualized and lasted approximately 8-12 weeks. Successful completion of this treatment was required before the interlock was removed. For example, offenders received one violation following two failed breath tests resulting in lockouts within four hours. This study compared 640 repeat impaired drivers in AUD treatment to 806 repeat impaired drivers not in AUD treatment. Results showed 32% lower recidivism over three years among drivers who completed AUD treatment. This was estimated to have prevented 3.13 crashes and 2.18 injuries per ten arrests.

Study: Mandating Treatment Based on Interlock Performance: Evidence for Effectiveness

Michigan, US. A five-year study evaluating the effects of a sobriety court program in Michigan revealed a 97% interlock compliance rate, with only 1% of participants tampering with the device while it was installed. Compared to impaired drivers who did not install an interlock device, alcohol and drug use was substantially lower among those who did. Additionally, interlock participants spent less time incarcerated and had higher rates of successful program completion. Participants also had the lowest recidivism rates for impaired driving and general crimes compared to impaired drivers who did not install the device.

Study: Michigan DWI/Sobriety court ignition interlock evaluation

This research demonstrates that when alcohol interlocks are implemented in a well-designed program, they are effective in reducing impaired driving recidivism among impaired drivers, including those who are repeat offenders. Recidivism rates were also lower post-program completion, meaning even after the device was removed from the vehicle.

Best practices for alcohol interlock programs in the United States

A study funded by the National Highway Traffic Safety Administration examined interlock programs in all US jurisdictions. Program information across a range of dimensions was collected with a national survey. Results revealed the most important features of interlock

programs included legislation and administrative rules, program funding mechanisms, data management and communication, vendor oversight, and interlock technology features. A brief summary of why these features is important is below.

Legislation and administrative rules. Most states (n=36) and the District of Columbia have all-offender legislation. This legislation requires all alcohol-impaired drivers, regardless of their BAC or number of previous impaired driving offences to participate in the state interlock program. Nine states require repeat and high-BAC alcohol-impaired drivers to participate in the interlock program, and three states require only repeat alcohol-impaired drivers to participate in the interlock program. Interlock program participation in two states is based on judicial discretion with alternative impaired driving interventions in place.

Program funding. All U.S. state interlock programs require offenders to pay all costs associated with the interlock device and program participation. Costs include device installation, removal, calibration, driver licence reinstatement, and other fees for services as applicable. Some states have implemented funding mechanisms to help offenders who are unable to afford program fees. Indigency and unaffordability funding are two mechanisms used to assess participants' ability to pay program costs. Indigency is commonly defined as the inability of impaired drivers to afford legal costs whereas unaffordability provides a more holistic picture of the finances and monthly expenses of the impaired driver and assesses their ability to pay program costs. Thirty-six states and D.C. provide indigent funding to eligible interlock participants and eligibility is determined by a variety of requirements including:

- being below the poverty line (15 states);
- in receipt of food stamps or enrollment in a state nutrition program (11 states);
- court determined (7 states); and,
- individual application process (4 states).

In South Carolina, the indigent fund is sustained by charging all non-indigent offenders a $30 monthly surcharge. Indigency is determined using the Federal Poverty Guidelines. Applications for indigent funding are reviewed by a committee and are approved for a 90-day period. In Virginia, the Virginia Alcohol Safety Action Program (VASAP) grants less than 1% of requests for indigent funding. Impaired drivers must first be declared indigent by the courts and then apply to VASAP for assistance, at which point they assess the participants' monthly expenses to determine whether interlock fees should be waived entirely or reduced.

Data management. Although interlock data may be collected across states, due to older data system technology or disparate systems it is often not used to inform program delivery or pursue program improvements. A 2023 survey of states revealed 16 of them noted the need for better data collection and management tools and processes. Five states reported all interlock data was collected and owned by vendors within the state, making the data

unusable or inaccessible to interlock program staff to guide decision-making. In many states, inadequate and/or inconsistent data collection and management was largely the result of budgetary constraints, inadequate staffing, and a lack of good quality data management systems (i.e., paper-based or legacy-based systems are used). The implementation of an effective automated data management system has the potential to make program and offender management much more effectual and save jurisdictions money by increasing efficiency and decreasing staff workload. This was demonstrated in Maryland, where the Motor Vehicle Administration (MVA) pioneered an automated interlock monitoring program that combined electronic data receipt and program management leading to a reduction of an average of 20,000 paper documents each month.

Vendor oversight. A vendor oversight program component is an essential element of any alcohol ignition interlock program. The purpose of this feature is to ensure the use of high-quality devices that are accurate, reliable, and prevent drivers from starting a vehicle with a BAC in excess of .025 (or the requisite set point required by the state). In addition, such a feature can ensure uniform and professional service delivery across manufacturers and service centers within a jurisdiction (Barrett & Robertson, 2019).

A vendor oversight protocol describes the approval process for interlock devices, as well as how and by whom services are delivered to interlock-restricted drivers. It also describes operational practices associated with monitoring to ensure operations are consistent with device and delivery requirements specified in legislation, administrative rules, or in any contract or certification process. Ultimately, an oversight plan can demonstrate the integrity of the interlock program and demonstrate states have undertaken due diligence obligations regarding the management of impaired driving offenders. It can also ensure competition among approved manufacturers and service centers is equitable and fair (Barrett & Robertson, 2019).

Interlock technology features. Most states require an enhanced technology feature as part of device functioning. These enhanced technology features can assist monitoring agencies with making determinations with respect to reported violations by providing additional data (i.e., GPS coordinates, photos, real-time monitoring) when drivers blow into the interlock over the pre-set limit. Practical experience demonstrates the need to balance risk management with available resources by using certain enhanced technology features as part of a graduated sanctioning scheme. For example, real-time monitoring is resource-intensive and may only be needed with clients who persistently violate program rules.

Based on presentations by Antonio Avenoso, *European Transport Safety Council;* Armin Kaltenegger, *European Transport Safety Council;* Annaliese Heren, *Belgian Federal Public Service for Mobility and Transport;* Martine Blom, *Research and Documentation Centre;* Gier Kvam, *Transport Worker's Union;* Jim Esperbacher, *Impaired Driving Solutions;* Hannah Barrett, *Traffic Injury Research Foundation*

Technology

The rapid pace of advances in interlock technology has greatly facilitated the efficient monitoring of alcohol interlock program participants. This has been achieved by devices capturing visual identification of drivers as well as their geographic location and breath test results in real-time. These advances have laid the groundwork for jurisdictions to collaborate with other agencies and create more efficient processes. It has also meant that updating program policies and procedures to take advantage of new features has become essential for all jurisdictions.

This final section describes device testing (e.g., alcohol and cannabis) and legislative updates from the EU and contains an overview of alcohol testing technologies. It also addresses the issue of using of interlock technology in work environments.

Prevention of driving under the influence of alcohol & drugs

In 2018, approximately 25% of road fatalities in Europe involved alcohol. Comparatively, in 2019 illicit drugs were prevalent in 1.9% of fatalities, medical drugs in 1.4% of fatalities, and a combination of drugs and alcohol in 0.37% of fatalities (ETSC, 2019).

Alcohol detection technologies

In 1970, Alcohol Countermeasure Systems (ACS), developed breath testing technology to prevent vehicle operation by impaired drivers. This was followed by the development of the Dräger Alcotest 7110 in 1985 which utilized an infrared sensor which responded to alcohol. Eventually, these devices were combined with an electrochemical sensor to create a portable breath testing device.

Data used to calculate breath alcohol content were stored in the device and could be used in court as evidence of an offence. Alcohol interlock technology was based on this same roadside breath testing technology used by police to detect impaired drivers on the road. In Europe, both of these device types comply with the same safety standard, CENELEC EN 50436. This standard for interlocks was developed and has been updated multiple times since 2005. This European Standard describes alcohol interlocks used as a general preventive measure in traffic safety as well as in drink-driving-offender programmes.

There are multiple technologies used to detect and measure alcohol content among impaired drivers. Some methods are more invasive than others, such as blood samples, compared to breath, saliva, and transdermal samples.

- **Blood.** Blood testing has been well-established for the last 90 years and remains the most accurate method of precisely measuring a blood alcohol concentration. Blood samples to detect alcohol are typically drawn by a medical professional in a sterile, safe location. While blood has high reliability and accuracy for detecting alcohol and

drugs, it is also a costly and time-consuming method for detection. Further, it is invasive and more complex method of testing, making it impractical at the roadside.

- **Breath.** Breath sampling provides an accurate reading of alcohol impairment in exhaled air (i.e., a deep lung sample) and results are accepted as evidence in court and deemed equivalent to a blood test. Breath testing is common world-wide for roadside detection of alcohol in drivers. For accurate readings, it is important breath testing devices are regularly recalibrated.
- **Saliva.** Saliva samples provide a fairly accurate reading, however in many jurisdictions a blood test is required alongside the saliva test for the purpose of court proceedings. Saliva samples can determine if alcohol and drugs are present but cannot determine the precise concentration within the person's system. However, instruments are available for roadside testing purposes.
- **Transdermal (skin contact).** Transdermal (i.e., skin contact) devices measure perspiration. Approximately 30-60 minutes after the consumption of alcohol, it can be detected through sweat on the skin. Given the time lag of alcohol detection through perspiration, this method of alcohol detection is less useful for detecting driver impairment at roadside. In other words, these devices are not designed for this purpose.

Additional non-invasive testing tools are based on tissue spectroscopy. While not widely used, these devices detect alcohol through light absorption in tissue; distance spectroscopy, in which sensors detect alcohol in the ambient air in the vehicle; and optical sensors, a sensor in a vehicle detecting alcohol in the air. At this time, apart from blood draws, there are no operational instruments which accurately detect the concentration of drugs.

The technology used to measure breath samples includes electrochemical sensors (i.e., fuel-cells), semiconductors, and infrared transmission spectroscopy without a mouthpiece. Electrochemical sensors are the most prevalent sensor technology and commonly used in alcohol interlocks. These sensors require periodic recalibration and occasional replacement of degraded sensor elements, but when maintained properly, these devices can reliably detect alcohol. Semiconductor sensors are devices which detect gas through an increase in electrical conductivity when reducing gases are adsorbed on the sensor surface. These devices are more sensitive and dependent on constant, well-controlled ambient conditions of temperature and humidity which greatly influence their stability and accuracy. As such, their long-term accuracy may be limited. Lastly, infrared tissue spectroscopy measures ambient air to detect alcohol. This technology has not yet reached widespread commercial use due to the dilution of the alcohol breath sample as it is mixed with ambient air. Currently, only electrochemical sensors are compliant with EN 50436, which specifies test methods and essential performance requirements for alcohol interlocks in vehicles.

Alcohol interlocks in the EU

As per the CENELEC 50435, part 3, chapter 6, alcohol interlocks are a tool to improve road safety. Employers, workers, and society as a whole may gain from the increased and proactive usage of alcohol interlocks since it may lessen public anxiety about crossing paths with intoxicated drivers. It can also be feasible to intervene early with individuals who may be at risk for alcohol abuse by utilizing alcohol interlock registry data appropriately in conjunction with corporate Human Resources regulations.

Alcohol interlocks can be used both reactively and proactively. When used reactively, these technologies are required for impaired driving offenders as part of supervision and rehabilitation programs (i.e., alcohol interlocks as a condition of reinstating driver's licence). Many of these programs allow impaired driving offenders to resume their day-to-day life, driving safely and legally to work, school, and other obligations. Proactive use of these technologies includes compulsory use of alcohol interlocks in vehicles at places of employment (i.e., public transportation), as a safety measure to prevent impaired driving.

Legislative recommendations for the European Union

Increased alcohol interlock use could prevent not only alcohol impaired driving crashes, but also impaired driving fatalities. Mandatory interlock legislation would require all impaired drivers, regardless of BAC or number of previous impaired driving offences, to install an interlock on their vehicle prior to reinstating their driver's licence.

Harmonized EU legislation could increase compliance among impaired drivers. Mandatory interlock legislation across the EU, in addition to common standards for alcohol interlocks (i.e., BAC set points, use, and maintenance) could decrease impaired driving across the EU. Mandatory, proactive interlock programs increase road safety in general, if the following sectors included alcohol interlocks installed in all vehicles:

- school buses;
- public transportation;
- taxis;
- transport fleet sectors (i.e., cities and public services);
- heavy transport sector; and,
- construction vehicles.

Offender-based interlock legislation is less common across EU countries, with more of them opting to adopt preventive interlock programs focused on public transit and other commercial vehicle applications.

Device testing & the future of alcohol interlocks

With the evolution of vehicle technology there is a need to adapt the way alcohol interlocks function and are installed. New vehicle designs require mandating a different way for vehicles and devices to interface and communicate. To address the emergence of new vehicles, the EU has established regulations designed to facilitate the installation of interlocks in new vehicles using a standard interface. Regulation (EU) 2019/2144 obliges vehicle manufacturers to include this interlock interface in all new vehicles as of 2026.

There are three pillars that must be managed to facilitate the installation of alcohol interlock technology on advanced vehicles such as hybrid and electric vehicles.

1) **Scope.** The target includes specific interlock device models that are tested and certified.
2) **Method.** A standardized generic interface installed on a vehicle.
3) **Access.** Vehicle manufacturers provide interlock installers with access to necessary design schematics needed to install alcohol interlocks.

While engine schematics and designs for traditional combustion engines were typically easily available to interlock installers, this is not the case with newer vehicles with more modern engine designs comprised of complex wiring and electrical components. Moreover, many vehicle manufacturers are reluctant to share their schematics due to the complicated and intricate components and the costly nature of repairs as well as safety issues associated with batteries in electric vehicles. At present, device installers who require access to schematics to troubleshoot problems and repair devices installed on a vehicle must register with each individual vehicle manufacturer. Further, access to safety and security-related documentation such as vehicle schematics requires extended registration with the manufacturers. To overcome this barrier, the EU is moving towards developing regulation to facilitate the installation of interlock devices on all vehicles. This would involve a standard connection port along with access to schematics needed to install interlock devices.

Ultimately, the purpose of a vehicle is to enable movement whereas the purpose of an alcohol interlock is to restrict vehicle movement in unsafe circumstances. To ensure these objectives are met, both the vehicle and interlock must be serviced and repaired properly when needed.

Alcolock™ V3 LE

The Alcolock™ V3 LE device is designed for both original equipment manufacturing (OEM) and aftermarket installation, and commercial fleet safety management programs. Administrators can ensure drivers are not alcohol-impaired driving in remote locations since alcohol interlocks prevent vehicles from starting when they have a positive alcohol level over

the preset limit. The test results are captured in the handset or engine control unit (ECU) and the event log maybe uploaded at each service center visit.

Anti-circumvention is an important feature of this interlock device. It prevents drivers from tampering with the device and driving impaired. The Alcolock™ V3 LE is equipped with special sensors that prevent non-humans (i.e., machines, air compressors, etc.) from providing a sample. Any attempt to circumvent the interlock device is logged in the device's software program and uploaded at the service center visit. Further, these devices allow a real-time alerting system of alcohol violations which are sent to the company administrator.

In addition to ensuring drivers have not been drinking alcohol prior to driving, there are many benefits to installing interlock devices in commercial fleet vehicles. These benefits include:

- a competitive advantage when soliciting new business by showing the company takes measures to keep their drivers, cargo, and passengers safe;
- ensures that long-distance drivers are following alcohol abstention policy while driving the company vehicles;
- eliminates the need for random alcohol testing;
- administrators do not need to be present to check the drivers for alcohol; and,
- less down time and fewer crashes.

Nor-log AS

Nor-log is the parent company of a consortium of local transport companies. They formed a strong national network for transport and logistics solutions for primarily temperature regulated vehicles in Norway. As of December 2022, Nor-log was comprised of 910 employees, 1,080 transport units, and 20 fridge/freezer terminals. In early 2017, the company determined all new trucks must be equipped with interlock devices.

Important considerations for the company with respect to implementing interlock devices on commercial trucks were the quick startup of the interlock project and the ability to swap hand units for calibration and service when needed. This was important to ensure vehicles were not out of service. Additionally, interlock devices sent an immediate notification to Nor-log management via text message if drivers did not pass a breath test, meaning actions can be taken and consequences can be imposed immediately.

Nor-log drivers have reported they understood the importance of using interlock devices in the vehicles. Among the trucks with installed interlock devices, none had any incidents of drivers driving under the influence of alcohol. There have been very few technical issues with the interlocks as well, meaning service issues have been minimal and not resulted in interruptions in service because of the interlock program within the company.

Moving forward, all new trucks used by Nor-log will have an interlock device installed. It is anticipated that Nor-log will have interlocks installed in over 90% of their vehicles by the end of 2024.

Drug-testing technologies

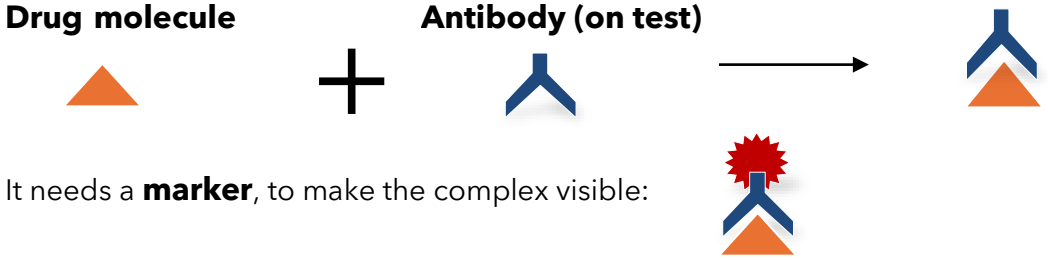
Drug consumption is a major road safety concern, representing a statistically significant factor in road crashes and injuries. In Europe, nearly all countries have strengthened their traffic legislation in recent years to address drug driving and prevent this risky behaviour. Technology to detect recent drug consumption in drivers has been tested in projects such as ROSITA and DRUID. Mobile saliva drug testing technology has emerged as a very promising tool for police forces to tackle drugged driving. Saliva drug tests can be conducted by the police anywhere, at any time. The increasing number of positive cases among drivers detected by drug enforcement policies also presents challenges for the collection of evidence samples needed to support legal cases.

As public awareness of drug-impaired driving grows, these advancements aim to provide law enforcement with better tools to ensure road safety, ultimately reducing crashes and fatalities associated with impaired driving. An overview of some of the available methods for detecting drugs in drivers is provided below.

Immunoassay tests

Immunoassay tests are popular for drug testing due to their speed, simplicity, and cost-effectiveness. They detect drugs or their metabolites in biological samples like urine, saliva, or blood using antibodies or antigens. These highly sensitive and selective tests can effectively measure the presence and concentration of target molecules while excluding others. Widely accepted in various diagnostic applications, including pregnancy tests, immunoassay testing accounts for over 95% of drug screening, highlighting its importance in the field.

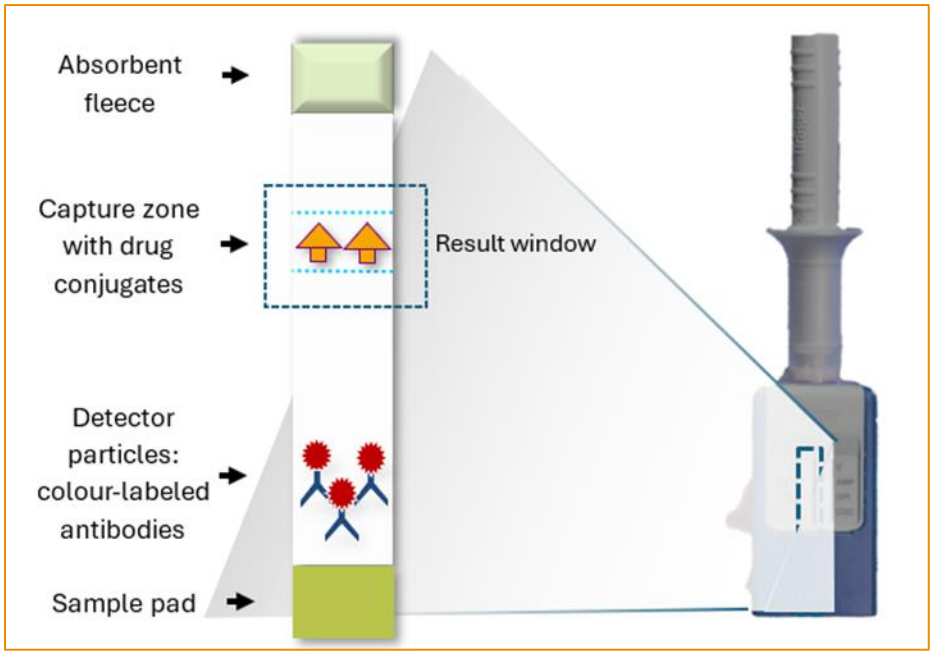
Figure 1 | Immunoassay molecule testing



Source: Drägerwerk AG & Co. KGaA, 2019

An immunoassay test strip is comprised of many parts, which are illustrated below in Figure 2.

Figure 2 | Magnification of immunoassay test strip



Source: Drägerwerk AG & Co. KGaA, 2019

Each component of the immunoassay test strip plays a crucial role in ensuring accurate results. The absorbent fleece serves as a reservoir, absorbing excess liquid and preventing backflow, which allows for controlled sample movement through the strip. This consistency contributes to uniform test results, reducing variability. The capture zone contains antibodies or antigens labeled with detectable markers; as the sample flows through, target analytes bind to these markers, producing a visible signal if present. The control line ensures the test is valid, while the sample pad filters and absorbs the liquid. Overall, immunoassay tests provide rapid and effective drug detection, promoting safety and timely interventions.

Breath testing

Measuring cannabis impairment through breath testing is far more difficult than assessing alcohol, as individuals exhale alcohol in large quantities when drinking. Cannabis, specifically THC, is believed to be carried in aerosol particles that people exhale; however, the total volume of these aerosols can be very small, making it challenging to accurately measure their THC content, often falling into the low picogram range,[13] making it very small and difficult to measure. Additionally, there is currently no standard method or reproducible protocol for breath measurements of THC which further complicates the process. While analytically possible, effective measurement requires super-sensitive techniques to detect the minuscule amounts present.

[13] A picogram is one-trillionth of a gram.

THC breathalyzers

Thin-layer chromatography and ion mobility spectrometry (IMS) technology are being explored for detecting THC. These methods utilize bulky base devices for analysis, although they also allow for handheld sampling and disposable components for convenience. The total analysis time exceeds 15 minutes, with several minutes required just to collect a breath sample, which can be a drawback in urgent situations. Furthermore, the detection window for THC is relatively short, typically lasting only 2 to 3 hours after consumption. Despite the potential of these technologies, clinical and study data supporting their efficacy remain limited, highlighting the need for further research and development in this area.

Drug ignition interlocks

Presently, it is unlikely a drug interlock will be on the market. Existing ignition interlock devices are not capable of detecting drugs in the system, and it is not as simple as tweaking the design of existing alcohol-testing devices. THC and other cannabinoids have low vapor pressures, with a very low concentration of cannabis being present (nangram range in blood). Existing THC-breathalyzers are simply too big in size, and sample collection takes too long to make it function effectively in a vehicle similar to an alcohol ignition interlock.

Oral fluid tests

Independent studies indicate that oral fluid can serve as a valuable biological specimen for identifying drugs. This has led to the development of various on-site tests, ranging from simple *pocket tests* to more sophisticated *mini-labs*. Research has demonstrated the usability of on-site oral fluid tests in naturalistic environments, highlighting their practical applications in real-world settings. However, it is essential to consider country-specific legislation and regulations regarding drug testing. Additionally, the evolving drug landscape, which includes cannabinoids, new psychoactive substances (NPS), and opioids, necessitates cross-reactivity studies and the development of new assays to ensure accurate detection. These factors underscore the growing importance of oral fluid testing in the context of drug enforcement and public safety.

Sweat testing & fingerprint testing

Variation among individuals in the amount of sweat they excrete presents challenges for transdermal drug testing through the skin. Sweat patch testing involves using an absorbent pad designed to capture sweat from the skin, which can be worn continuously for up to seven to ten days. This method serves as an alternative for verifying drug history but is not classified as a point-of-care test. On the other hand, wipe tests require a clear protocol due to several factors, including high intrasubject variability, the risk of environmental contamination before wiping, and the potential removal of drugs through washing. These complexities underline the need for standardized procedures to ensure accurate results in both sweat patch and wipe testing.

Evidential measures

Gas Chromatography–Mass Spectrometry (GC-MS) and Liquid Chromatography–(Tandem) Mass Spectrometry (LC-(MS/)MS) offer accurate qualification and quantification of substances, yet they face significant limitations for roadside testing. These techniques require bulky instruments that are impractical for on-site use, necessitating regular maintenance and calibration to ensure reliable results. Additionally, skilled personnel are needed to operate the equipment and interpret findings, which may not be readily available in all situations. Both methods require off-line sampling and preparation, complicating the process and potentially delaying results.

A recent report published by Homeland Security entitled Field Portable Gas Chromatograph Mass Spectrometers reports the findings of the System Assessment and Validation for Emergency Responders (SAVER) Program which assessed field portable gas chromatograph mass spectrometer (GC/MS) instruments at the City of Seattle Joint Training Facility, in Seattle, Washington, USA. Portable gas chromatograph-mass spectrometers (GC-MS) are used by first responders during field operations to chemically analyze substances suspected to be narcotics, explosives, toxic industrial chemicals, chemical warfare agents, or other hazardous materials. These devices can measure a wide variety of gases, volatile and semi-volatile liquids, and vapors produced by certain solids, with the ability to detect trace amounts of chemical compounds at parts-per-billion to parts-per-trillion levels. However, they come with a significant cost of approximately $150,000 and face challenges related to vehicle vibrations, maintenance, battery power, and the need for skilled personnel. Importantly, these portable systems do not involve sample collection or preparation, allowing for mobile forensic use; however, they are not applicable for testing drugs of abuse in body fluids, such as oral fluid.

Standardized field sobriety tests

A 2023 study (Fitzgerald et al.)[14]1 assessed the impact of toxicology testing on driving performance and its potential to enhance the classification accuracy of field sobriety tests. A placebo-controlled, randomized double-blinded protocol was employed to examine the effects of cannabis on driving performance, with participants receiving either a placebo or THC at concentrations of 5.9% or 13.4%. Following a series of driving simulations, trained law enforcement officers administered field sobriety tests. Toxicology samples were collected from blood, oral fluid, and breath for analysis. The results indicated field sobriety tests classified 81% of participants who received the active drug as impaired; however, surprisingly, 49% of those who smoked the placebo were also deemed impaired at the same time point. Notably, combining saliva screening with positive findings from field sobriety tests

[14] Fitzgerald, R. L., Umlauf, A., Hubbard, J. A., Hoffman, M. A., Sobolesky, P. M., Ellis, S. E., ... & Marcotte, T.D. (2023). Driving under the influence of cannabis: impact of combining toxicology testing with field sobriety tests. Clinical chemistry, 69(7), 724-733.

eliminated any controls being classified as impaired, highlighting the potential of toxicology testing to refine assessments of impairment in driving contexts.

The introduction of legal drugs will heighten the need for proven enforcement tools and well-crafted legislation to keeps roads safe from impaired drivers. As these substances become available, effective drug testing programs will be crucial to reinforce the prohibition of driving under their influence. Recommendations include establishing random testing by law while allowing selective testing in practice, as seen in Norway and Belgium. Immunoassay testing in saliva offers a practical solution due to its ease, mobility, precision, and cost-effectiveness. While drug testing is complex, it has proven effective, supported by organizations like the National Highway Traffic Safety Administration and the National Institute on Drug Abuse. However, no significant technological shifts are expected in the next five to ten years, suggesting a continued reliance on existing methods.

Based on presentations by Bjarne Eikfjord, Norwegian Alcohol Interlock Committee; Stefan Morley, CENELEC BTTF 116; Sergey Krasaev, Alcohol Countermeasure Systems (ACS); Thomas Lund, Director of Quality and Safety in NORLOG; David Ragnevi, Dräger; Wildried Sooth, Securetec Detektions-Systeme AG.

171 Nepean Street, Suite 200
Ottawa, Ontario, Canada K2P 0B4
tirf.ca

Toll Free: 1-877-238-5235
Fax: 613-238-5292

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