European Road Safety Observatory

Road Safety Thematic Report – Alcohol, drugs and medicine

This document is part of a series of 20 thematic reports on road safety. The purpose is to give road safety practitioners an overview of the most important research questions and results on the topic in question. The level of detail is intermediate, with more detailed papers or reports suggested for further reading. Each report has a 1-page summary.

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Contents

Summary 2

1 Highlights 3

2 What is the problem? 3

2.1 Definition and measurement 3

2.2 Extent of problem 3

2.3 Effects of impairment 4

2.4 What is the prevalence of impaired driving? 4

3 How dangerous is impaired driving? 5

3.1 Share of impairment-related crashes 5

3.2 Cognitive effects 5

3.3 Crash risk 5

3.4 Some features of impairment-related crashes 7

4 Why do road users drive while impaired? 8

5 Rules and legislation 8

6 Countermeasures 9

6.1 Policies to decrease alcohol and drugs consumption 9

6.2 Regulation and police enforcement 9

6.3 Policies to improve responsible driving with medicines 10

6.4 Alternative means of transport 10

6.5 Campaigns, rehabilitation, and safety culture 10

6.6 Vehicle technology 11

7 Further reading 11

8 References 12

Summary

Impairment due to alcohol and/or drugs is a major cause of motor vehicle crashes worldwide. Alcohol, drugs and various medicines impair several of the driver's functional capabilities, and this leads to increased crash risk.

The crash risk for drivers with a blood alcohol concentration (BAC) of 0.5 g/L is estimated to be about 1.4 times higher than that of a sober driver; at 1.0 g/L, the risk is nearly 5 times higher; and at 1.5 g/L around 20 times higher. Looking at fatal crash data, the risk curve is even steeper, with the risk estimated to be almost twice as high with a BAC of 0.3 g/L, five times as high with a BAC of 0,5 g/L, and ten times as high at 0.8 g/L. The crash risk associated with illegal drugs or medicines depends on the type of drug or medicine. The greatest risk increase for illegal drugs - at least 5 times higher - was found for amphetamines, multiple drug use, and combined alcohol-drugs use. For medicines, significant risk increases were found for driving under the influence of barbiturates (used for treating headaches, insomnia, and seizures), benzodiazepines (used to relieve anxiety and insomnia), anti-depressants (used to alleviate depression), and opiates (used to treat pain or sleeping problems). The mechanisms through which drugs and medicines affect the body, the extent to which they impair driving, and the time taken for driving to be impaired differ greatly among drugs and medicines.

It has been estimated that 1.5 to 2% of kilometres travelled in the EU are driven by persons with an illegal BAC, while around 25% of all road deaths in the EU are alcohol-related. There is no reliable estimate of how many traffic crashes in Europe are drug-related. In a survey in European countries, asking about their driving in the previous 30 days, 21% of drivers admitted to have driven after drinking alcohol, 13% to have driven while they may have been over the legal alcohol limit, 15% to have driven after taking medicines that may affect driving ability, and 5% to have driven within 1 hour after taking drugs other than medication.

The reasons people drive while impaired reflect the opportunities that society provides for this, as well as individual motivation. In regard to the repeat offenders group, medical (psychiatric) problems related to problematic alcohol and drugs use often underly their habitual pattern of impaired driving.

Countermeasures against impaired driving include:

- General policies to decrease the consumption of alcohol and drugs
- Policies to reduce drink and drug use before intended driving
- Strict legislation combined with active police enforcement
- Provision of alternative means of transport
- Awareness campaigns, rehabilitation courses, and safety culture in companies
- Alcohol interlocks (breathalyser linked to ignition lock)
- In-vehicle technology that warns/intervenes when impairment leads to critical events.

At EU level, in 2001 the European Commission recommended legal blood alcohol limits of maximum 0.5 g/L with a lower limit of 0.2 g/L for novice and professional drivers. In 2022 (new vehicle types) and 2024 (all new vehicles) alcohol interlock installation facilitation will be mandatory for cars, vans, trucks, and buses.

1 Highlights

- Whereas 1.5 to 2% of kilometres travelled in the EU are driven by persons with an illegal alcohol level, around 25% of all road deaths in the EU are alcohol-related.
- In 2010, 15% of drivers severely injured or killed in a selection of European countries were found to be under the influence of drugs (including medicines).
- In a self-reported study, 13% of European drivers admitted to having driven with a BAC over the legal limit, 15% after taking medicines that may affect driving, and 5% within 1 hour after taking non-medical drugs. All data were in relation to the previous 30 days.
- Countermeasures range from general policies against the consumption of alcohol and drugs to (combinations of) strict legislation and enforcement, provision of alternative means of transport, awareness campaigns, rehabilitation programmes, vehicle-related measures such as alcohol interlocks and dedicated measures in transport companies.

2 What is the problem?

2.1 Definition and measurement

Impaired driving can be defined as a reduction in the performance of critical driving tasks due to the effects of alcohol or other drugs (Baker, 2007). The term 'drugs' here refers to alcohol, illegal drugs, and medical treatment (medicines[1]). In most countries, the presence of alcohol or drugs is initially tested at the roadside by a screening device and/or field sobriety test. Subsequent evidence for court prosecution is determined by measuring blood alcohol concentration (BAC) or the presence of drugs in the blood. The BAC is generally reported in terms of grams of alcohol per litre blood (g/L).

2.2 Extent of problem

Impairment due to alcohol and/or drugs is a major cause of motor vehicle crashes worldwide (Brubacher et al., 2018; Fell, 2019; Hels et al., 2011; Marillier & Verstraete, 2019). It has been estimated that 1.5 to 2% of kilometres travelled in the EU are driven by persons with an illegal BAC, while around 25% of all road deaths in the EU are alcohol-related (EC, 2018). There have however been some positive developments. In 15 European countries, progress in reducing alcohol-related road deaths has been faster than the overall reductions in road deaths (Le Lièvre et al., 2019). Self-reports on drink-driving in Europe confirm the positive trend (Goldenbeld et al., 2020).

There is less information on how drug-impaired driving is developing. In 2010, 15% of drivers severely injured or killed were found to be under the influence of psychoactive drugs (including medicines) – which was a smaller group than drivers under the influence of alcohol (Isalberti et al., 2011).

1. Note that medicines also may be necessary to restore the patient's ability to drive.

2.3 Effects of impairment

Both alcohol and drugs impair several of the driver's functional capabilities, including reaction time, tracking ability, proper speed management, vision, divided attention, and vigilance. This leads to increased crash risk (e.g. Ogden & Moskowitz, 2004; Martin et al., 2013; Marillier & Verstraete, 2019).

The mechanisms through which alcohol and drugs (legal and illegal) affect the body, the extent to which they impair driving, and the duration of the impairment differ greatly among drugs (Compton, 2017). Álvarez (2011) classified medicines into different risk groups according to their influence on driving ability. Several other factors, including patterns of use, reasons for use, dose ingested, mode of administration, tolerance, and driver characteristics, also affect the crash risk level (Beirness et al., 2021).

2.4 What is the prevalence of impaired driving?

Between 2007 and 2009, 50,000 drivers from 13 European countries were randomly tested at the roadside to assess the prevalence of alcohol and drugs use in the general driving population (the DRUID project). It was estimated that, on average, 3.5% of European drivers drive with alcohol in their blood (> 0.1 g/L), 1.9% with illegal drugs, 1.4% with (a limited list of) medicinal drugs, 0.37% with a combination of alcohol and drugs, and 0.39% with different types of drugs (Houwing et al., 2011).

In 2018-2019, the prevalence of drugs and alcohol use was studied by self-reports (the ESRA-study), asking about impaired driving in the previous 30 days (Achermann Stürmer et al., 2021; Meesmann et al., 2021). Amongst European drivers, 21% reported they had driven after drinking alcohol, 13% with a BAC over the legal limit, 15% after taking medicines that may affect driving ability, and 5% within 1 hour after taking drugs other than medication. The self-reported prevalence varies between countries (see Figure 1).

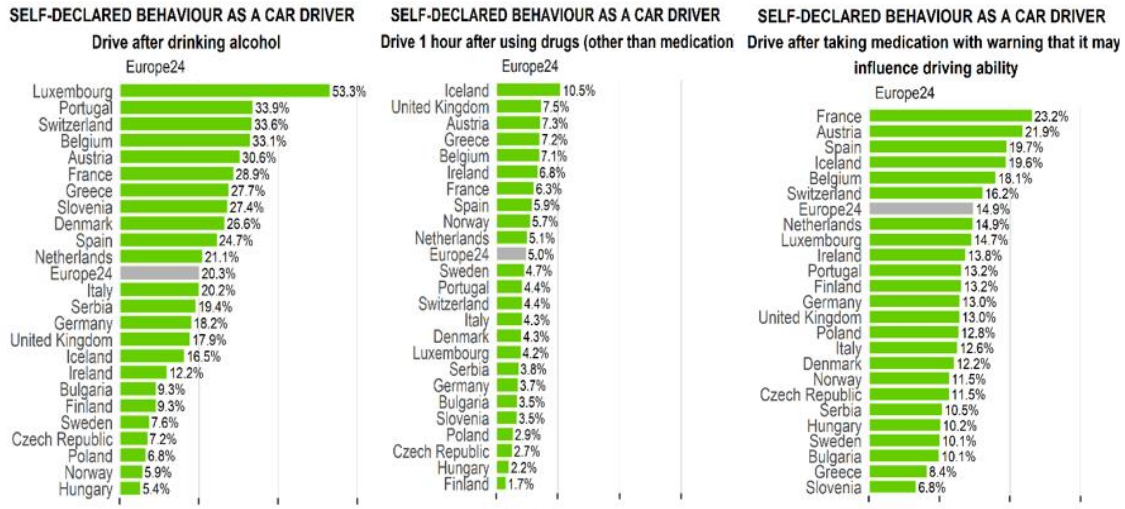

Figure 1. Self-declared use of alcohol, drugs and medicines (Source: Achermann Stürmer et al., 2021 .

3 How dangerous is impaired driving?

3.1 Share of impairment-related crashes

It has been estimated that about one quarter of road fatalities in Europe are alcohol-related (European Commission, 2018). There is no recent overall estimate of the number of drug-related casualties in Europe. Table 1 below summarises the main findings on the prevalence of alcohol, illegal drugs, and medicines in seriously or fatally injured drivers, based on data from nine European countries (EMCDDA, 2012). Among drivers seriously injured or killed, the most commonly consumed substance was alcohol alone, followed by alcohol combined with another substance. Combinations of different drugs and/or medicines were least common.

Table 1. Alcohol, drugs, and medicine prevalence among injured drivers (Source: EMCDDA, 2012).

	Prevalence among seriously injured casualties	Prevalence among fatalities
Alcohol only	14.1 – 30.2%	15.6% - 38.9%
Alcohol with drugs and/or medicines	2.3 - 13.2%	4.3 - 7.9%
Combinations of drugs and/ or medicines	0.5 - 4.3%	0.4 - 7.3%

3.2 Cognitive effects

Alcohol and drug consumption before driving impairs several of the driver's functional capabilities. In a general review of the effects of alcohol intoxication on cognitive driving tasks, Garrison et al. (2021) conclude that:

- deficits in aspects of visual perception begin at a BAC of 0.3 g/L
- impairments in vigilance start at a BAC of 0.3 g/L
- deficits in divided attention and sustained attention commence at BACs between 0.5 g/L and 0.8 g/L
- problems with dividing attention over several tasks begin at a BAC of 0.8 g/L.

3.3 Crash risk

In general, the risk of a crash increases considerably when a driver is impaired by combined alcohol and drugs. For **alcohol**, the risk for drivers with a BAC of 0.5 g/L is estimated to be about 1.4 times higher than that of a sober driver; at 1.0 g/L the risk is nearly 5 times higher, and at 1.5 g/L around 20 times higher (see Figure 2; Blomberg et al., 2005). These data are based on all crashes reported to the police, including crashes without personal injury. Looking at fatal crash data from both the USA and Great Britain, Allsop (2020) reported that the risk of being involved in a fatal crash is almost doubled at a BAC of 0.3 g/L, 5 times higher at a BAC of 0,5 g/L, and 10 times higher at a BAC of 0.8 g/L. The increase in risk differs for different age and gender groups. For example, for young male drivers (16-19 years), the risk of being involved in a single

vehicle fatal crash is already 4 times higher at BACs between 0,2 and 0.5 g/L (Zador et al., 2000).

Figure 2. Relative increase in risk at increasing blood alcohol content (Blomberg et al., 2005).

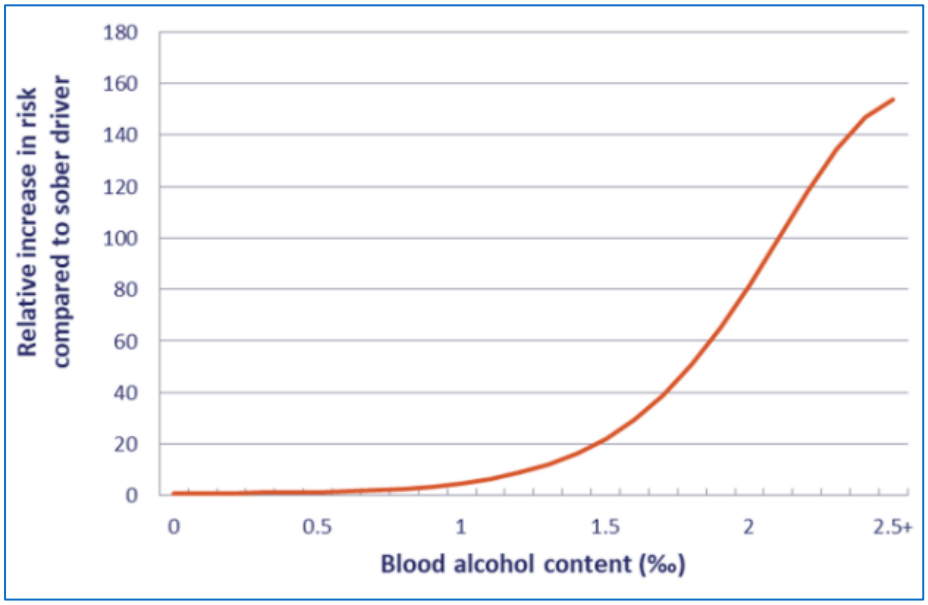

Table 2. Risk increase for several groups of illegal drugs (Source: SWOV, 2020).

Drug	Crash severity	Risk increase	95% CI
Amphetamines	Fatal (Elvik, 2013)	5.2	(2.6 – 10.4)
	Injuries (Elvik, 2013)	6.2	(3.5 – 11.1)
Cannabis	Fatal (Elvik, 2013)]	1.3	(0.9 – 1.8)
	Injuries (Elvik, 2013)	1.1	(0.9 – 1.4)
	Fatal and injuries (Rogeberg & Elvik, 2016)	1.4	(1.1 – 1.6)
	Fatal and injuries (Els et al., 2019)	2.5	(1.7 – 3.7)
	Fatal and injuries (Rogeberg, 2019)	1.3	(1.2 – 1.4)
Cocaine	Fatal (Elvik, 2013)	3.0	(1.2 – 7.4)
	Injuries (Elvik, 2013)	1.7	(0.9 – 3.0)
Opiates	Fatal (Elvik, 2013)	1.7	(1.0 – 2.8)
	Injuries (Elvik, 2013)	1.9	(1.5 – 2.4)
Multiple drugs	Crashes (Hels et al., 2011)	5 - 30	-
Combination alcohol & drugs	Crashes (Hels et al.., 2011)	20 - 200	-
Abbreviations: CI = Confidence Interval; the 95% confidence interval defines a range of values that you can be 95% certain contains the (true) population mean.			

Table 2 shows the crash risk increase for **illegal drugs** as found in several meta-analyses (Els et al., 2019; Elvik, 2013; Hels et al., 2011; Rogeberg & Elvik, 2016; Rogeberg,

2019). The largest risk increase was found for *amphetamines, multiple drug use, and combining alcohol and drugs*.

Table 3 gives an overview of the increase in risk due to different **medicines** reported in various studies (Chihuri & Lee, 2017; Elvik, 2013; LeRoy & Morse, 2008). Significant risk increases have been found for driving under the influence of barbiturates (used for treating headaches, insomnia, and seizures), benzodiazepines (used to relieve anxiety and insomnia), antidepressants (used to alleviate depression). and opiates (used to treat pain or sleeping problems).

Table 3. Risk increase for various medicine groups (Source: SWOV, 2020).

Medicine	Crash severity	Risk increase	95% CI
Antidepressants	Injury crashes (Elvik, 2013)	1,3	1,1 - 1,6
Antihistamines	Injury crashes (Elvik, 2013)	1,1	1,0 - 1,2
Barbiturates	Crashes motorised (LeRoy & Morse, 2008)	7,5	2,3 - 23,9
Benzodiazepines	Fatal crashes (Elvik, 2013)	2,3	1,6 - 3,3
Benzodiazepines	Injury crashes (Elvik, 2013)	1,2	1,1 - 1,3
Narcotics (strong painkillers)	Crashes motorised (LeRoy & Morse, 2008)	2,2	2,0 - 2,5
Analgesics (mild painkillers)	Injury crashes (Elvik, 2013)	1,0 (none)	0,9 - 1,1
Opiates	Crashes motorised (Chihuri & Li, 2017).	2,3	1,69 - 3,5
Abbreviations: CI = Confidence Interval; the 95% confidence interval defines a range of values that you can be 95% certain contains the (true) population mean.			

3.4 Some features of impairment-related crashes

An in-depth investigation of just over 1,500 fatal passenger car crashes in Norway from 2005 to 2015 revealed a number of driver, road and vehicle features associated with impairment-related crashes (Høye, 2020):

- Alcohol-impaired and alcohol/drug-impaired crashes are disproportionately high at night-time and at the weekend.There are disproportionately high cases of both unlicensed driving and non-use of seat belts among impaired drivers, especially among alcohol-impaired drivers.
- The proportion of young drivers among drug- and drug/alcohol-impaired drivers is disproportionately low, but not among alcohol-impaired drivers.
- The number of old cars and cars without electronic stability control (ESC) is disproportionately high in alcohol-related crashes, but not in alcohol/drug-related crashes.
- The number of alcohol-related crashes on roads with high-speed limits is disproportionately high and disproportionately low on roads with low-speed limits.
- The average annual daily traffic (AADT) is lower on roads with alcohol-related crashes than on roads with crashes involving sober drivers.
- Alcohol-related crashes are strongly correlated with being unbelted, unlicensed and male, and with single-vehicle crashes in conditions of low traffic volumes.

4 Why do road users drive while impaired?

Bearing in mind the self-discipline required to remain unimpaired, people engage in impaired driving because they are motivated to do so, have the capability to do so, and have the opportunity to do so (Michie et al., 2011). The retail availability of alcohol, alcohol serving and sales practices, and the price of alcohol are factors that define this opportunity. It has been shown that these opportunity factors have a great impact on actual drinking and on subsequent drink-driving (PIRE, 2021). For drivers driving under the influence of medicines, the personal, social, and legal setting is different and therefore the underlying motivation is also different.

According to the theory of planned behaviour (TPB), the intention to engage or not in impaired driving can be explained by attitudes towards the particular behaviour, the subjective norms, and the perceived difficulty of performing the behaviour (Marcil et al., 2001; Parker et al., 1992). Additional variables, including personality characteristics such as sensation-seeking, sense of invulnerability, and impulsiveness, provide a fuller explanation of impaired driving (Chan et al., 2010; Cestac et al., 2011; Moan & Rise, 2011; Vankov & Schroeter, 2021). Other studies have highlighted the unplanned nature of impaired driving (Sykes et al., 2010; Keatly et al., 2016). According to these studies, peer pressure and the social situation (e.g. others around you drinking) may change a person's original plan not to drink before driving.

People using illegal drugs before driving see some of these drugs (e.g. cannabis) as producing less impairment than other drugs or alcohol (Kelly et al., 2004; Watson et al., 2019). Drivers engaging in driving under influence of cannabis often do not consider cannabis as impairing their ability to drive (Watson et al., 2019; Goodman et al., 2019).

For the repeat offenders group, medical (psychiatric) problems related to problematic alcohol and drugs use often underly a habitual pattern of impaired driving (Streff, 2001; Nochajski & Stasiewicz, 2006; Goldenbeld et al., 2016).

Many of the drivers who use (multiple) medicines are not fully aware of the possible risks. Information on medicines and driving does not reach all users, or users do not read or understand the information (SWOV, 2020). Also, health professionals may lack sufficient knowledge of the risk of driving with medication (Artime et al., 2019; SWOV, 2020). In addition, information on the effects of medicines seems to lead to only temporary behavioural effects (Orriols et al., 2016). Experience with medicines may even lead a patient to overestimate their ability to drive (Sargent et al., 2011).

5 Rules and legislation

In 2001, the European Commission recommended legal blood alcohol limits of maximum 0.5 g/L with a lower limit of 0.2 g/L for novice and professional drivers (EC, 2001). Most EU countries apply a legal blood alcohol limit of 0,5g/L, but Lithuania has a legal limit of 0.4g/L; Finland of 2.2 g/L; Poland, Sweden and Norway of 0.2g/L. The Czech Republic, Hungary, Romania, and Slovakia have a zero limit. Calinescu & Adminaite

(2018) report that 22 EU countries apply a lower legal limit for novice drivers and 19 EU countries for professional drivers; in both cases 0.0g/L or 0.2g/L.

Legislation against drugged driving in EU countries has applied '*per se*' laws that establish a fixed substance limit or zero tolerance laws. These laws are often combined with legislation that defines how the impairment should be proven (Atchison, 2017).

The EU Driving Licence Directive 2006/126/EC states that '*Driving licences shall not be issued to or renewed for applicants or drivers who are dependent on psychotropic substances or who are not dependent on such substances but regularly abuse them, whatever category of licence is requested*' (Article 15).

Seven EU countries (Denmark, Finland, Hungary, Ireland, Lithuania, Spain and Sweden) have national guidelines on how patients should be informed of the impact of a prescribed medicine on their fitness to drive (ETSC, 2021).

Also nine EU countries (Austria, Belgium, Denmark, Finland, France, Italy, Lithuania, Poland, Sweden) have included alcohol interlock programmes in their legal systems (ETSC, 2021[2]).

6 Countermeasures

6.1 Policies to decrease alcohol and drugs consumption

General health policies that decrease the (excessive) consumption of alcohol and/or drugs also contribute effectively to the reduction of impaired driving (PIRE, 2012). For example, policies which set a minimum price and increase taxes for alcohol beverages, and which set strict marketing regulations and limit availability of alcohol beverages for children and young adults have been effective in reducing alcohol-related harm (Burton et al., 2016; Teutsch et al., 2018). The EU has formulated a common drug policy strategy for 2021-2025, including targeting high-risk crime groups, counteracting digitally enabled illicit drug markets, evidence-based prevention interventions, and provision of alternatives to coercive sanctions (Official Journal of the European Union, 2021).

6.2 Regulation and police enforcement

The EC recommends legal blood alcohol limits of maximally 0.5 g/L with a lower limit of 0.2 g/L for novice and professional drivers (EC, 2001). The European Transport Safety Council (ETSC) advises adopting a zero tolerance level for drink-driving: in practice this would mean a limit of 0.2g/L (Calinescu & Adminaite, 2018).

Evidence worldwide (see SWOV, 2021 for an overview) shows that lowering the general legal blood alcohol limit from 0.5/0.6 g/L to 0.2/0.3 g/L as well as lowering the legal limit for novice drivers to 0 or 0.2 g/L would have a favourable effect on road safety. However, lowering legal limits has an effect only when combined with highly publicised, visible, and frequent police enforcement, preferably deploying random breath-testing

[2] https://etsc.eu/issues/drink-driving/alcohol-interlock-barometer/

methods (Erke et al, 2009; Fell, 2019). There is no evidence that more severe penalties are effective in reducing alcohol offences (SWOV, 2021).

6.3 Policies to improve responsible driving with medicines

ETSC (2021) has proposed several policy measures which may improve responsible driving with medicines, including (p. 8-9):

- Within national medical fitness to drive guidelines and regulations, stress the role of General Practitioners (GPs) as the primary point of call for identifying those who may be at-risk in terms of their fitness to drive, initiating an assessment of a person's fitness to drive, and influencing how long and under what circumstances a person continues driving.
- Apply the DRUID categorisation and labelling of medicines that affect driving ability and support information campaigns promoting awareness among medical professionals and among the general population.
- Develop and promote materials to assist individuals in undertaking assessment of their own fitness to drive and in making informed decisions about reduced driving and driving cessation if needed.

6.4 Alternative means of transport

Promoting the use of alternative means of transport – e.g. free or subsidised taxi and ride-sharing services, voluntary or paid designated driver programmes, or more accessible public transport – is a possible strategy for reducing impaired driving (Fell et al., 2020). However, the evidence regarding effectiveness in terms of drink-driving, drink-driving offences, or crashes is inconclusive. The lack of transport options in rural areas is often cited as a barrier in preventing drink-driving (Howard et al., 2020).

6.5 Campaigns, rehabilitation, and safety culture

Road safety **campaigns** on drink-driving can help to increase awareness, change social norms and inform people how to change behaviour (Delhomme et al., 2009; SWOV, 2017). However, general publicity campaigns as a stand-alone measure without related police enforcement cannot be expected to actually change behaviour and reduce alcohol-related crashes (Fell, 2019).

Rehabilitation courses provide an alternative treatment for alcohol or drug driving offenders, aiming at reducing recidivism (Boets et al., 2008). The courses are educational or psychologically oriented, typically organised in small groups (Slootmans et al., 2017). Rehabilitation programmes are commonly provided by private organisations, following national guidelines, and can be voluntary or compulsory, depending on the country and offence in question (Houwing, 2016; Atchison, 2017). There is evidence that rehabilitation can decrease recidivism (Slootmans et al., 2017). However, not all studies show positive results.

For professional drivers, employers can play an important role. As part of a **safety culture** approach, employers must clearly set, communicate, and monitor company policies for impaired driving through education, testing, and employee assistance

programmes (Transport Safety Group, 2006). Periodically screening drivers for alcohol/drugs has shown positive results in US transport companies (Camden et al., 2019).

6.6 Vehicle technology

Alcohol interlocks are automatic control systems to prevent driving with excess alcohol by requiring the driver to blow into an in-car breathalyser before starting the ignition. Research has shown that **alcohol-interlock programmes** (AIPs) reduce the risk of recidivism by 75% during the period when the interlock is operational (Bax et al., 2001; Elder et al., 2011; ETSC, 2020; Nieuwkamp et al., 2017). There is also evidence of a positive effect of AIPs on alcohol-related fatalities (McGinty et al., 2016; Teoh et al., 2018). For some AIPs the effects continued after removal of the alcohol interlock device ((Bjerre & Thorsson, 2008; Gustafsson & Forsman, 2016; Voas et al., 2016). These AIPs included medical and psychological guidance that was continued after removal of the interlock. In 2022, as part of the General Safety Regulation, (new vehicle types) and 2024 (all new vehicles) alcohol interlock installation facilitation will be mandatory for cars, vans, trucks, and buses (EC, 2019).

Advanced driver assistance systems (ADAS) can help to timely warn or intervene when a critical driving situation arises, e.g. due to alcohol or drug impairment. The most promising ADAS for alcohol-impaired drivers are lane departure warning systems and forward collision warning systems (Teutsch et al., 2018).

Driver monitoring systems (DMS) collect observable driving information to make real-time assessment of drivers' capacity to perform the driving task (Haley et al, 2021). DMS are recommended as a primary safety feature for European vehicles seeking a 5-star EuroNCAP safety rating (EuroNCAP, 2020). According to Haley et al. (2021), these systems can be functionally adapted and expanded to reliably detect driving impaired by alcohol or drugs.

7 Further reading

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