Drugs and medicines

SWOV Fact sheet, March 2020

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Summary

Driving under the influence of drugs or impairing medicines reduces fitness to drive[1] and increases crash risk. Drugs have a numbing, stimulating or mind-altering effect on the brain, or a combination of these effects, which impair traffic task performance. For drug use in traffic, we (unfortunately) have to rely on research dating back to 2011. This research showed that, in the Netherlands, an approximate 3.4% of drivers participated in traffic under the influence of drugs and/or medicines and that over 2% of the car kilometres were travelled under the influence of drugs. There are no recent representative data about drug use in traffic. Judging by these older data and recent figures about newly emerging drugs, cannabis seems to be the drug most often used by road users who are under the influence of drugs, and cocaine, ecstasy and amphetamines – and more recently – laughing gas (nitrous oxide) are also often used. The exact number of road casualties on account of drug use is unknown.

Risk groups for driving under the influence of drugs or medicines are young drivers (drugs) and older drivers (multiple medicines). Among drivers, knowledge about the dangers of drugs and medicines needs improving. Yet, even well-informed drugged drivers sometimes keep driving. Possible mechanisms that come into play are: overestimation of one's own abilities, optimistic comparisons ('my tolerance to the effects is higher'; 'drugs are less dangerous that alcohol'), and a lack of alternative modes of transport. Possible measures against driving under the influence of drugs or medicines are improving drug tests and enhancing medicine and drug enforcement (provided this does not reduce the number of alcohol checks).

Information about the effect of alcohol on road safety can be found in SWOV fact sheet *Driving under the influence of alcohol*.

1. In this fact sheet, we consistently use the term fitness to drive (and not driving skill) when discussing the possibly temporary effects of drug or medicine use on driving behaviour. *Driving skill* is the result of learning and gaining experience and concerns vehicle control and traffic insight for instance. *Fitness to drive* concerns the driver's temporary and permanent physical and mental abilities: is the driver in good health, well rested, focused and not under the influence of alcohol, drugs or medicines? [1] Although driving skill is often used when discussing driving under the influence, fitness to drive is the correct term to use when discussing effects on driving behaviour.

1 What is the effect of drugs and medicines on driving behaviour?

Drugs and medicines affect fitness to drive differently for each type of drug, and there are also different effects within drug types [2] [3] [4]. Drugs have a numbing, stimulating or mind-changing effect on the brain, or a combination of these effects, which impair traffic task performance. Narcotics or sedatives such as cannabis and benzodiazepines (relaxing medicines) slow down the central nervous system activity, which, in traffic, may result in fatigue, diminished concentration, reaction time and information processing [2] [3] [4]. By contrast, stimulating drugs like amphetamines, cocaine and ecstasy accelerate the central nervous system activity, which may result in distraction, restlessness, aggressive and dangerous driving, increased risk taking and overrating one's fitness to drive. Psychedelic drugs like LSD distort the perception of reality (hallucinogenic effect). Medicines with side-effects such as blurred vision, serious dizzy spells or sleep attacks may also affect fitness to drive [5]. The Dutch Association of Pharmacists (KNMP) has classified impairing medicines into three categories on the basis of the (acute) effect when starting the medication [6]. Recent years have shown a surge in the use of narcotics like GHB [7], ketamine [8] and laughing gas (nitrous oxide) [9] for recreational purposes.

Table 1 summarises the effects of the main drug and medicine groups on skills and functions relevant to safe driving or riding.

Medicine groups are too plentiful to mention them all in *Table 1*. The Dutch website https://www.rijveiligmetmedicijnen.nl/medicijnen/adviezen presents a comprehensive survey of information on medicines and fitness to drive.

Table 1. Ways in which drugs and medicines affect skills relevant to fitness to drive (✓drug results in deterioration; - drug/medication does not lead to deterioration). General sources: [2], Ketamine: [8][10][11]; laughing gas (nitrous oxide) [9]; GHB [7][12].

Main group	Subgroups	Diminished task performance by effects on*						
		Alertness	Cognitive skills	Motor skills	Mood	Lateral vehicle control	Time perception	Balance
Drugs	Cannabis	✓	✓	✓	✓	✓	✓	✓
	Cocaine	–	✓	✓	✓	–	–	–
	Amphetamines	–	✓	✓	✓	–	✓	✓
	GHB	✓	✓	✓	✓	✓	?	?
	MDMA (substance in Ecstasy/xtc)	–	✓	–	✓	–	–	✓
	Hallucinogens (e.g. LSD, mescaline)	–	✓	✓	✓	–	✓	✓
	Ketamine	✓	✓	✓	✓	✓	✓	✓
Medicines	Benzodiazepines (sedatives like diazepam and oxazepam)	✓	✓	✓	–	✓	–	✓
	Opioids (painkillers like morphine and oxycodone)	✓	✓	✓	✓	✓	–	✓
	Other sedatives	✓	✓	✓	✓	✓	–	✓
New psychoactive substances	Laughing gas (nitrous oxide)	✓	✓	✓	✓	✓	?	?
	Synthetic cannabinoids	✓	✓	✓	✓	✓	✓	✓
	Synthetic cathinones	–	✓	✓	✓	–	–	–

* Cognitive skills: reaction time, prompt and correct information processing
Motor skills: speed and accuracy of movements
Lateral vehicle control: ability to drive in a straight line without swerving
Time perception: correct subjective time perception is relevant to planning traffic manoeuvres correctly/realistically
Balance: effect on posture and poise (particularly relevant to cyclists and motorised two-wheelers)

2 How frequent is driving under the influence of drugs and/or medicines in the Netherlands?

From research dating back to 2011, 3.4% of drivers in the Netherlands were shown to drive while under the influence of drugs and/or medicines [13]. More recent data are unavailable. Judging by general figures about drug use and figures about occasional measurements, it may be assumed that cannabis is the drug most commonly used in Dutch traffic, and that ecstasy, laughing gas (nitrous oxide), cocaine and amphetamines are also often used. In a 2018 comprehensive questionnaire study of driving behaviour in the previous 30 days, 5.1% of Dutch drivers indicated having occasionally driven under the influence of drugs and 14.9% having occasionally driven under the influence of medicines impairing fitness to drive [14].

Drugs

European research figures (DRUID) about driving under the influence of drugs in the Netherlands date back to 2011 or earlier and are therefore outdated [13]. This European study showed that an approximate 2.8% of the Dutch drivers tested had traces of drugs in their systems. Of these, 2.1% drove under the influence of cannabis (hashish and weed), followed by cocaine (0.66%) and amphetamines (0.37%). Research carried out by the Dutch Public Prosecution Service between June 2017 and July 2018 showed that almost half (600) of the 1250 drug users caught while driving had used a combination of intoxicants; either different kinds of drugs or drugs together with alcohol [15]. Among the Dutch population, cannabis is known to be the most commonly used drug, while cocaine, ecstasy, amphetamines and laughing gas (nitrous oxide) are also often used [16]. In 2018, 63 drivers out of 106 confirmed cases of drug use in the Dutch province of Zeeland were shown to have only used cannabis, 22 to have used hard drugs like cocaine, xtc, or amphetamines and 21 to have used multiple drugs (source: Provinciale Zeeuwse Courant [17]). These figures are based on selective police drug checks rather than from scientific random sampling of Dutch traffic.

Medicines

The 2011 European study showed benzodiazepines (medicines with a relaxing effect) to be the medicine most commonly found in the blood of drivers (0.44% [13]). This is not surprising since one in ten Dutch people (18+) use sleeping pills or sedatives [18] and most of these are benzodiazepines. A 2013 estimate showed that 30-45% of the over-65s (about 750,000 to 1 million people) in the Netherlands used five or more different medicines [19]. Research has shown an increased crash risk on account of medicine combinations [20]. Data about the number of crashes among drivers under the influence of multiple impairing medicines are unavailable.

3 Which laws about driving under the influence of drugs and/or medicines apply in the Netherlands?

For driving under the influence, four legal provisions are relevant: Article 8 of the Road Traffic Act, the Decree Alcohol, Drugs and Medicines, the Regulation Fitness Requirements 2000 and the Medical Treatment Agreement Act (WGBO).

Article 8 of the Road Traffic Act

Article 8 of the Road Traffic Act stipulates: "Anyone is forbidden to operate a vehicle (or to let the vehicle be operated by someone else who is known to be) under the influence of a substance which is (reasonably) known to impair the ability to drive, to such an extent that usage of this substance – whether or not combined with a different substance – may impair the ability to drive so that appropriate operation is not deemed possible." Article 8 applies to *drivers, motor cyclists, light-moped riders, cyclists and disability vehicle users (motorised or unmotorised)*. When assigning penalties three factors are taken into account: the type of vehicle involved in the offence, the danger to other road users and the extent to which the road user is able to safely operate the vehicle. Pedestrians may be fined for public drunkenness if they behave in an annoying or anti-social way.

The Decree Alcohol, Drugs and Medicines

On 15 June 2017, Dutch legislation on drug use in traffic was tightened. Since then saliva testers have been used for enforcement. The new decree is based on limits for use of separate drugs (single drug use) and for combined use. In the Netherlands, the threshold values for impairment of fitness to drive have been set up to equal the impairment thresholds of alcohol use of 0.5 g/l. The threshold values have been laid down in the 'Decree Alcohol, drugs and medicines in traffic'.

Regulation fitness requirements 2000

The Regulation fitness requirements 2000 mentions which medicines (chapter 10) and ailments (chapter 8) may render someone unfit to participate in traffic.

Medical Treatment Agreement Act (WGBO)

Pursuant to the Medical Treatment Agreement Act (WGBO) article 448:1 and 448:2, pharmacists are obliged to inform patients about possible side effects of and alternatives to medicines. On the basis of this information, patients themselves have to take responsibility for the decision whether or not to drive. In the Netherlands, physicians, pharmacists, package leaflets and the site rijveiligmetmedicijnen.nl inform patients about the effect of medicines on fitness to drive.

4 How many casualties are caused by driving under the influence of drugs or medicines in the Netherlands?

Drugs

The number of casualties caused by drug use in traffic is unknown. A 2011 estimate indicated that blood testing showed one in ten seriously injured drivers to have used drugs. Half of them had also used alcohol. These figures are based on the European DRUID study and date back to 2007-2009 [21]. In comparison: the same study showed that 25% of the seriously injured drivers in the Netherlands had tested positive for alcohol. No information about drug use in traffic by other road users, such as cyclists and moped riders, is available.

Medicines

In 2012, data sourced by the European DRUID study resulted in an estimate of 5 to 10% of the road deaths being attributable to the use of impairing medicines by drivers [22]. No information about medicine use in traffic by other road users, such as cyclists and moped riders, is available.

5 What risk is attached to driving under the influence of drugs and medicines?

Figure 1 presents the general risk increase of using certain drugs, medicines or alcohol (and combinations thereof) in traffic. The risks for drugs and medicines are described below.

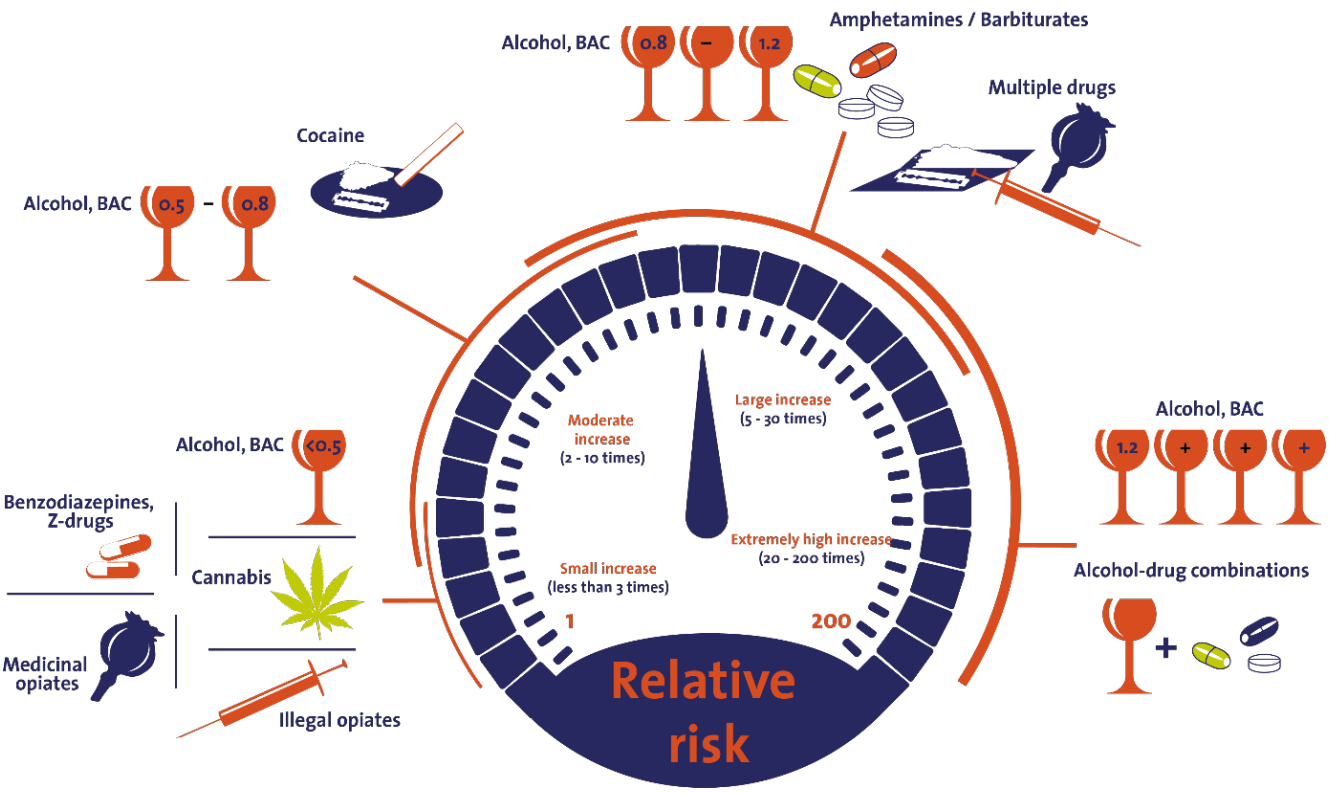

Figure 1. Schematic representation of the traffic risk attached to different drugs, medicines and alcohol (or combinations thereof) expressed in odds ratios[2].

Drugs

Table 2 shows the crash risk increase after drug use as found in meta-analyses of several effect studies. The highest risk increase, at least five times higher than for driving without drugs, is found for amphetamine use, simultaneous use of multiple drugs, and for combining alcohol and drugs. Use of benzodiazepines, cocaine and opiates also involves a higher crash risk (about one and a half to three times higher).

2. Here, the risk associated with medicines is expressed in odds ratios. Formally speaking, odds ratios do not equal risk increases (crashes * exposure), but they are usually interpreted as such.

Table 2. Traffic risk increase caused by driving under the influence of drugs: results from meta-analysis (figures rounded to the nearest decimal).

Drug	Crash severity	Risk increase (expressed in odds ratios[2])	95% confidence interval
Amfetamines	Fatal [23]	5.2	2.6 - 10.4
	Injuries [23]	6.2	3.5 - 11.1
Cannabis	Fatal [23]	1.3	0.9 - 1.8 (Not significant)
	Injuries [23]	1.1	0.9 - 1.4 (Not significant)
	Fatal and injuries [24]	1.4	1.1 - 1.6
	Fatal and injuries [25]	2.5	1.7 - 3.7
	Fatal and injuries [26]	1.3	1.2 - 1.4
Cocaine	Fatal [23]	3.0	1.2 - 7.4
	Injuries [23]	1.7	0.9 - 3.0
Opiates	Fatal [23]	1.7	1.0 - 2.8
	Injuries [23]	1.9	1.5 - 2.4
Multiple drugs	Crashes [27]	5 - 30	-
Combination alcohol and drugs	Crashes [27]	20 - 200	-

Table 2 shows that several meta-analyses have been carried out on the risk increase related to driving under the influence of cannabis. The estimates in these meta-analyses vary from a less than one and a half times increased risk [23] [24] [26] to an approximate two and a half times increased risk [25]. According to Rogeberg and Elvik [24], the higher risk estimates are mainly found in studies characterised by a lower-quality research methodology and by limited control of confounders (unmeasured variables), among which use of a cannabis-alcohol combination.

Risk figures about some newly emerging drugs, such as laughing gas (nitrous oxide), are still unavailable. Laughing gas is used as a sedative in (minor) surgery. Studies show that the effect of laughing gas on fitness to drive is short-lived [28] [29]. Recent studies give rise to concerns about serious impairment of health and behaviour in case of chronic and/or intensive use [30] [31]. Moreover, the short-lived effect of laughing gas does give rise to concern when people use laughing gas while driving. According to Trojan et al. [32], laughing gas impairs the psychomotor skills relevant to driving. In this study, half of the participants were again completely attentive eight minutes after dosing had been discontinued, although some participants had not completely recovered after thirty minutes. During the first half hour after dosing, laughing gas may therefore have a negative effect on fitness to drive.

In December 2019, the Dutch Cabinet announced that it was working on a ban on recreational laughing gas [33]. Laughing gas is expected to be included in list II of the Opium Act. This decision followed a 2019 report of the Coordination Point Assessment and Monitoring new drugs (CAM) on the health risk concerning laughing gas [34].

Medicines

The risk[ii] associated with medicines depends on the type of medicine, but increases when driving under the influence of medicines such as benzodiazepines, antidepressants and opiates (see *Table 3* and [20] [23]).

Table 3. Risk increase of several medicine groups, expressed as odds ratios in different studies[ii]; all odds ratios are statistically significant unless stated otherwise (figures rounded to the nearest decimal).

Medicines	Crash category	Risk increase (expressed in odds ratios[2])	95% confidence interval
Antidepressants [23]	Injury crashes	1.3	1.1 - 1.6
Antihistamines [23]	Injury crashes	1.1	1.0 - 1.2
Barbiturates [20]	Crashes motorised	7.5	2.3 - 23.9
Benzodiazepines [23]	Fatal crashes	2.3	1.6 – 3.3
Benzodiazepines [23]	Injury crashes	1.2	1.1 – 1.3
Narcotics (strong painkillers) [20]	Crashes motorised	2.2	2.0 - 2.5
Analgesics (mild painkillers) [23]	Injury crashes	1.0 (none)	0.9 - 1.1 (Not significant)
Opiates [35]	Crashes motorised	2.3	1.69 - 3.5

The figures in *Table 3* only concern some of many medicine groups. The Dutch websites rijveiligmetmedicijnen.nl and apotheek.nl keep and update a register of all medicines that pose a risk to driving. Within medicine groups, risks for individual medicines may vary [36] and composition and effect of medicines sometimes change.

6 Which risk groups are there in the Netherlands?

In the Netherlands, young men and older adults (70+) are important groups at risk of driving under the influence of drugs and medicines respectively.

Drugs

The DRUID study found that, throughout Europe, the risk of driving under the influence of drugs (both of a single drug or of combined drugs) was highest among young men [13]. The younger the driver, the more often cannabis was used. Male drivers aged 25 to 34 also used cocaine and amphetamines quite often [37]. Heroin was mostly used by male drivers aged 35 to 49 [37].

Not much is known about the relationship between drug dependency and road crashes [38]. Therefore, we do not know to what extent drug addicts are a risk group for road safety.

Medicines

Older adults use three times as many medicines as the average Dutch citizen (source: Stichting Farmaceutische kengetallen). How many of these are impairing medicines and to what extent users drive while under their influence is, however, unknown.

Older adults (70+) often have multiple ailments and take several medicines to remedy them (polypharmacy) [19]. Use of multiple medicines may, especially for older adults, result in unwanted side effects. When aging, the body composition changes and liver and kidney functions are often impaired, which results in slower or less thorough elimination of medicine effects. These bodily changes and the possible interaction of multiple medicines may result in unwanted side effects, among which impairment of fitness to drive [39]. Increased crash risks on account of medicine combinations have been proven in research [20].

7 Are road users aware of the effect of drugs and/or medicines on driving behaviour?

A significant proportion of drivers using drugs or medicines is probably not fully aware of the possible risks. Research shows that information on this subject does not reach everyone, or it is not read or understood by everyone.

A review of several European studies on risk information and education about drugs/medicines showed that 50 to 80% of the patients had received risk information ((package) leaflets). Of all patients that had received the information, 90% had read the leaflets. But, in a knowledge test, not even 40% of the questions was correctly answered by a majority (> 60%) [40]. Similar figures were found in Dutch research: 56% of the users had received some information, 86% of them had read the information entirely and 30% had correctly answered all knowledge questions [41].

Dutch research among younger users of drugs and impairing medicines shows that knowledge and awareness about risks are present to a certain extent, but are far from complete. In the Netherlands, a proportion of young people are indeed aware of the general and personal dangers involved in driving under the influence of drugs. A 2018 questionnaire among 361 young drivers (aged 18-24) showed that 63% agreed with the statement that crash risk is higher after drug use and 53% with the statement that they are themselves behaving dangerously when using drugs in traffic [42]. The need for better information and more knowledge about drugs is also felt: 60% of the young participants indicated they would like to have more information about drug safety; 49% would like more information about the risk of drug use in traffic [42].

More knowledge about the dangers of drugs and medicines is a prerequisite for changing one's own attitude or behaviour, but it is insufficient in itself. Several studies show that people systematically overestimate their own abilities to drive safely. They do not realise that drugs and medicines may be just as dangerous as alcohol and that the effects are greater when combined substances are used [43]. In this respect, optimism bias may be relevant: in general, people think they run fewer risks than others [44]. Consequently, risk information in package leaflets of medicines may be considered relevant to others, but not to themselves [45] [46]. Research shows

that even when patients are informed about adverse side effects of impairing medicines, more than half of them do not adapt their driving behaviour. Research also shows that experience with medicine use may even lead to reduced risk assessment [41] [47]. The effect of information and education may be short-lived and may quickly fade. In France, the introduction of pictograms concerning the danger of medicines led to adaptation of medicine users' driving behaviour shortly after the introduction, thereby reducing the risk of causing a crash. Over time, however, this risk increased again [48].

8 What measures may counteract driving under the influence of drugs and medicines and how effective are they?

Introducing and enforcing limits

On 1 July 2017, legal limits for drug use in traffic were introduced, which enable police to determine usage by means of a saliva test (see the question *Which laws about driving under the influence of drugs and/or medicines apply in the Netherlands?)*. The European DRUID study of driving under the influence of alcohol and drugs concluded that intensifying roadside drug testing may favourably effect road safety, provided this does not undermine roadside alcohol testing [49]. Also see SWOV fact sheet *Traffic enforcement*.

Increasing knowledge and risk awareness of drug use in traffic

The limited number of studies of the effectiveness of programmes to prevent drug use in traffic suggest a positive effect, but this same scarcity and the design limitations of the studies do not permit firm conclusions. The DRUID study gathered information about 75 information and education campaigns concerning drugs and medicines from 13 different countries. The campaigns targeted the general public, young people, physicians/pharmacists, parents, teachers or medicine/drug users. Only 7 of these 75 campaigns were evaluated and in merely one of these a positive effect was found for a road safety related indicator (drug related deaths) [50]. In a more recent study of 13 evaluated drug campaigns, a positive effect was only found for one of them [51]. Since the campaign was coupled with stiffer penalties for driving under the influence, it is hard to determine the effect of the campaign itself.

An example of appealing and effective education about alcohol use is to have young people experience a drive under the influence of alcohol (in safe conditions) [52]. Drug education could also benefit from such a method.

Providing information about impairing medicines

Measures to counteract the negative road safety effects of medicines mainly focus on providing information on responsible medicine use. In the Netherlands information on medicines is aimed at two target groups: patients themselves and healthcare professionals (pharmacists and GPs). The options used for providing information to both target groups are presented in *Figure 2*. Patients may acquire knowledge about medicines themselves by reading package leaflets or stickers on medicine packages and by looking for information on websites. In addition, healthcare professional will provide information about side effects and secondary effects of medicines. Healthcare professionals themselves have access to the latest information about the effects of medicines through the knowledge base and helpdesk of the Pharmacists Association KNMP, and by means of further training by the Dutch Institute for Rational Use of Medicine IVM.

IVM provides patients and healthcare professionals with (further) training and informative websites, such as rijveiligmetmedicijnen.nl. The government regularly initiates national campaigns, such as 'Rij veilig met geneesmiddelen' (Drive safely with medicines), aimed at making users of impairing medicines aware of the risk of traffic participation. Faber et al. [6] concluded that information on stickers and labels is not sufficiently adapted to users to provide reliable advice on whether or not they can participate in traffic (for more information see the question *Are road users aware of the effect of drugs and/or medicines on driving behaviour?*).

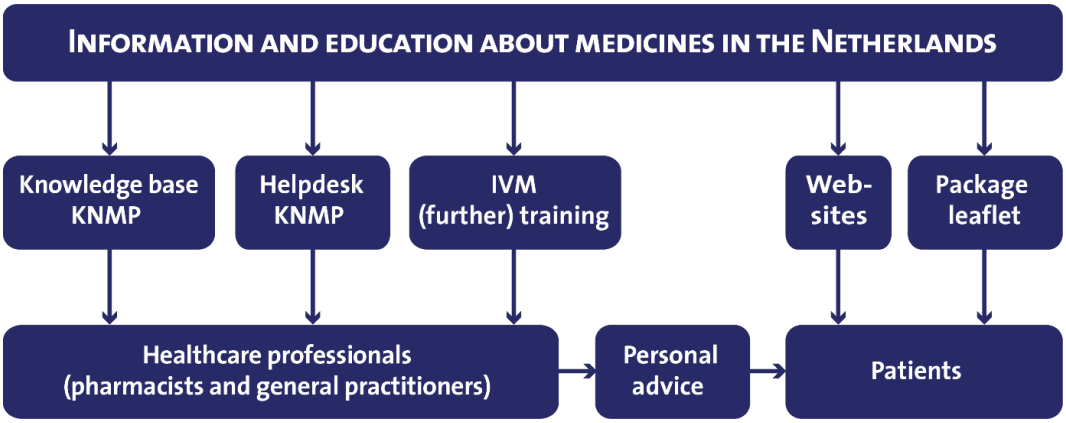

Figure 2. Information and education about medicines in the Netherlands: channels and target groups (KNMP = Koninklijke Nederlandse Maatschappij ter bevordering der Pharmacie (Pharmacists Association), IVM = Instituut Verantwoord Medicijngebruik (Dutch Institute for Rational Use of Medicine) ().

9 Which other measures are possible?

Additional measures are possible for the development of new drug tests, for improving information and education about drugs and medicines, for providing information and education about driving under the influence of drugs and/or medicines, and about driving under the influence of laughing gas (nitrous oxide), and for improving the safety culture within companies.

New tests

The current saliva tests are better than the previous ones, but there is room for further improvement [53]. New drug tests that enable the easy and reliable detection of drug use in traffic are being developed. One of them is a reliable breath test for cannabis and other drugs [54] [55].

Information and education about medicines

Users of impairing medicines most often mention participating in traffic nonetheless, as they do not notice any effect on their responsiveness. By having people do an online responsiveness test before and after medicine use, they will gain insight into the effect of the medicines on their responsiveness and their fitness to drive [41]. In addition, the current provision of information about medicines could be improved by informing patients about the risks of medicine use step-by-step. This may be done by GPs or pharmacists [56] or the information may be presented on medicine packaging [57]. But effectiveness of information improvement is not guaranteed: in France, the introduction of pictograms on drug packaging only had a short-lived reducing effect on crash risk, while, in the long run, risk increased again [48]. GPs and pharmacists may also give patients some tips about how to recognise negative effects on their fitness to drive and how to self-test to what extent their medicines affect them [58]. Physicians should also, if possible, counteract negative effects on fitness to drive by prescribing less impairing medicines, and by prescribing limited dosages or by suggesting an appropriate time of intake (for example at the beginning of the night) [58].

Information and education about driving under the influence of laughing gas (nitrous oxide)

Research by Nabben et al. [59] brings to light that, when targeting the young, the following three starting points should be heeded in the prevention of and education about driving under the influence of laughing gas:

1. When deciding on an approach, differentiate between groups of young people on the basis of their experience in using substances;
2. Present an honest message;
3. Pay attention to the risk that the aftereffects of a laughing gas intoxication may linger.

Informing and educating parents (of children aged 12 or over) is another way to prevent the use of laughing gas [59].

Safety culture companies; include drug tests?

Developing a safety culture and safety management are effective strategies to prevent professional drivers from crash involvement [60]. The safety culture could, among other things, entail transport companies testing their drivers for alcohol and/or drug use [60]. American companies report encouraging results of periodically testing their drivers for drug/alcohol use. These tests have resulted in some drivers getting caught, after which the companies have taken targeted measures and offered them further guidance [60].

For reasons of privacy, a Dutch employer cannot simply test employees for alcohol or drug use [61]. The Dutch Data Protection Authority that supervises processing of personal data says that testing employees for alcohol or drug use is only allowed after the relevant legal arrangements have been made (see autoriteitpersoonsgegevens.nl).

Publications and sources

Below you will find the list of references that are used in this fact sheet; all sources can be consulted or retrieved. Via Publications you can find more literature on the subject of road safety.

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Colophon

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