

FAQ

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E-cigarettes: anything but harmless

→ Changes compared to the version dated 11 May 2021: Added questions on psychoactive substances and coolants, minor editorial revisions

The term "e-cigarette" is short for "electronic cigarette". The term "vape", which is derived from the English word "vaporiser", is often used synonymously for electronic cigarettes. E-cigarettes contain a liquid that usually contains the highly addictive substance nicotine as well as various flavouring and aromatic substances. This liquid is heated and vaporised by a battery-powered heating element and then inhaled through a mouthpiece. The exact composition of the liquid depends on the product and therefore varies greatly. Health risks can arise from the nicotine contained, the atomising agents, active ingredients and additives as well as possible impurities. Furthermore, other substances that are hazardous to health can be formed due to the effect of heat. The vapour from e-cigarettes may contain substances that are harmful to health and that may also be inhaled by uninvolved third parties ("passive vapers"). Little is currently known about the long-term health consequences of e-cigarettes.

How do e-cigarettes work?

An e-cigarette consists of a vaporiser with a battery-powered heating element, a cartridge or tank with the liquid to be vaporised, and a battery. Refill packs are available for the cartridges. In contrast to conventional cigarettes, tobacco is not burned. Instead, the liquid is heated and vaporised at 150 to 200 degrees Celsius in most devices. The e-cigarette is a further development of the "nicotine inhaler", which looks like an inhalation device and is used as a medical device for smoking cessation.

What is in the liquid used in e-cigarettes?

Due to the large number of different products, it is only possible to name a few common substances. The main ingredients are usually propylene glycol and/or glycerine. They serve as a nebulizing agent and as a carrier for other ingredients. These include nicotine as well as aromatic substances (e.g. ethyl acetate, linalool, cinnamaldehyde) and flavouring substances (e.g. vanilla extract, menthol or malic acid). A US study detected pharmacological active ingredients (including a drug used to treat erectile dysfunction as well as an appetite suppressant). The BfR does not know whether such products are available in Germany.

What are e-shishas?

Contrary to what the name shisha might suggest, e-shishas are not just electrically powered hookahs, but e-cigarettes that usually do not contain nicotine. Some of the e-cigarettes offered as e-shishas are based on the taste of hookah smoke. In some cases, mouthpieces similar to those for hookahs are also used. E-shishas are offered in a variety of different designs.

What different models of e-cigarettes are available?

The technical aspects of e-cigarettes are subject to continuous development. Early models resembled a tobacco cigarette on the outside and were disposable products. Second-generation devices are more powerful as well as refillable. Third-generation e-cigarettes can also be modified in terms of electrical voltage or power and are thus referred to as "mods". Current devices also allow for the adjustment of temperature and airflow. "Sub-ohm" devices develop more vapour, which leads to higher nicotine uptake and a more intense taste experience. The vapour is inhaled directly. With "pod" e-cigarettes, ready-to-use pods, which already contain the liquid and the heating element, are placed onto rechargeable batteries. Over the past few years, an increasing number of disposable e-cigarettes have also been sold in Germany. The liquids of these cannot be refilled.

Do e-cigarettes always contain nicotine?

E-cigarettes usually contain solutions with nicotine. However, nicotine-free liquids are also available. The wide variety of products currently makes it difficult to provide a general statement about the nicotine content of the liquids and the amount ingested when using e-cigarettes. However, a study from Germany showed that an average nicotine concentration of 10 mg/ml in liquids is quite realistic. A rough estimate based on this data results in a possible daily intake of approx. 15 mg nicotine per day through e-cigarette consumption. This is comparable to a daily nicotine intake equivalent to the consumption of around 15 cigarettes. German tobacco legislation allows a maximum nicotine concentration of 20 mg/ml for liquids.

Are the ingredients of the liquids disclosed on the packaging?

Nicotine-containing and nicotine-free liquids are subject to the Tobacco Products Act and the Tobacco Products Ordinance, according to which all ingredients must be disclosed.

Are e-cigarettes – with and without nicotine – harmful to health?

According to current knowledge, when used as intended the vapour from e-cigarettes contains significantly smaller amounts of carcinogenic and other harmful substances compared to the smoke from tobacco cigarettes. Nevertheless, the consumption of e-cigarettes can be associated with health risks. This is because the vapour emitted contains a large number of solid and liquid substances that can damage the body, including the cardiovascular system and the lungs. Analytical data indicates that heating the e-cigarette liquids can lead to the formation of carcinogenic substances such as formaldehyde and acetaldehyde as well as acrolein, which is toxic to cells.

Depending on the draw intensity, the cartridge fill level, the battery voltage, and the design of the device, the composition of the inhaled vapour varies. So far, there have been no longterm studies on the health effects of inhaling the smoke simulants propylene glycol and glycerine. There is also evidence that some of the flavouring substances used in the liquids may trigger allergies.

Another important health risk factor is the highly addictive substance nicotine that is added to many liquids. From BfR's point of view, nicotine addiction is already a serious impairment to health. In the body, nicotine leads to higher blood pressure, an increased risk of thrombosis, the release of stress hormones, and increased formation of stomach acid. This can aid the development of cardiovascular diseases and increases the risk of a stroke. In children and adolescents, nicotine can also disrupt brain development and lead to increased anxiety.

Due to the variety of products, it is often unknown which substances are contained in the liquids. Cases of poisoning among consumers of e-cigarettes must be viewed in this context. Another health risk is the accidental ingestion of liquids – especially after self-mixing, which is strongly discouraged for this reason. There is a health risk of severe poisoning and even death.

How does propylene glycol, the vaporizing agent often used in e-cigarettes, work?

Sensitive people may experience eye irritation and respiratory difficulties. In experiments in which laboratory animals inhaled propylene glycol over a longer period of time, changes in the blood count were detected. Nothing is known about the long-term consequences in humans. It is also not known whether inhaling propylene glycol can trigger an allergy. According to the current state of science, carcinogenic aldehydes may be formed when smoke simulants (propylene glycol or glycerine) are heated. The BfR believes that further investigation is required.

Are nicotine-free liquids harmless to health?

No. Nicotine-free liquids also consist of smoke stimulants as well as aromatic and flavouring substances, which pose health risks as liquids with nicotine. The ingredients of the vapour can damage the cardiovascular system. In addition, carcinogenic substances such as

formaldehyde and acetaldehyde as well as cell-toxic acrolein can be formed when the liquids are heated.

How are e-cigarettes and e-liquids regulated by law?

In the European Union, the legal provisions are based on whether the products contain nicotine. If they do, the EU Tobacco Products Directive (2014/40/EU) applies. In Germany, legal regulations and provisions can be found in the Tobacco Products Act (Tabakerzeugnisgesetz) and the Tobacco Products Ordinance (Tabakerzeugnisverordnung). These also apply to nicotine-free e-cigarettes. In addition to nicotine, the concentration of which may not exceed 20 milligrams per millilitre, other ingredients are regulated separately in German tobacco law. Hazardous substances (such as diacetyl or bitter almond oil) as well as substances that have a stimulating effect (e.g. caffeine and taurine) or simulate a health benefit (vitamins) are prohibited. Tobacco law also regulates how the products must be designed. For example, they must be labelled with a warning as well as information on the ingredients and nicotine content. Every e-cigarette must contain a package insert with instructions for use and storage.

Should you mix liquids for e-cigarettes yourself?

Liquids should not be mixed by users. This is especially true for consumers who do not have sufficient knowledge and experience. When liquids are mixed by users, there is, for example, the risk that mineral or vegetable oils are used. Oils should not be included in liquids under any circumstances, as they can lead to serious respiratory diseases if inhaled. E-cigarettes and liquids of unclear origin or composition are also not recommended. Such products generally do not comply with tobacco regulations and may contain ingredients that are harmful to health which are prohibited in liquids.

Is the vapour from e-cigarettes in the air ("passive vaping") a health problem for third parties?

When consuming e-cigarettes, substances are released into the air in the form of visible vapour. According to the current state of science, health risks for third parties are possible. It should also be noted that liquids may contain illegal or unauthorised substances. Neither direct users nor those passively affected can assess whether the vapour poses any health risks. The BfR therefore recommends that e-cigarettes should only be used in smoking areas and that these products should be treated in the same way as conventional cigarettes. E-cigarettes should not be used in the presence of children, pregnant women or sick people.

Can e-cigarettes be addictive?

It should be assumed that the use of nicotine-containing e-cigarettes can lead to a nicotine addiction. Studies show that even a single puff of an e-cigarette can increase the nicotine concentration in the brain to 50 % of the maximum within an average of 27 seconds. As nicotine from e-cigarettes reaches the brain just as quickly as from conventional cigarettes, there is a risk of addiction. The rapid intake increases the reward effect and can encourage the development of an addiction.

A few years ago, people in the USA died after using e-cigarettes. Are the causes known?

In the USA, more than 2,800 people suffered lung damage, some of it severe, after ecigarettes. According to the American health authority CDC, 68 people have died (as of 18 February 2020). Vitamin E acetate has been linked to these cases. However, it has not been proven that this substance is actually responsible for the illnesses. So far, there is only limited and sometimes contradictory data on the inhalation of this substance. However, due to its properties, it seems plausible that inhalation of vitamin E acetate in high concentrations could trigger lung diseases. The substance presumably accumulates in the alveoli, which would hinder the intake of oxygen. Consequences may also include inflammation and tissue damage.

Many sufferers in the USA appear to have consumed products containing tetrahydrocannabinol (THC) oils. THC is a psychoactive cannabinoid. In the US, vitamin E acetate is used as a diluent, particularly in products containing drug substances, which – according to US authorities – are offered on the black market. In consistency and colour, vitamin E acetate is similar to THC oils. It is therefore suitable for designing the products in such a way that a higher proportion of THC oil is simulated. Initial analyses by US authorities revealed surprisingly high concentrations of vitamin E acetate in cartridges containing THC. In Germany, liquids are not permitted to contain vitamins under tobacco law. When using legally compliant products, it is therefore unlikely that consumers will purchase e-liquids with a high concentration of vitamin E acetate. In cooperation with the Chemical and Veterinary Investigation Offices in Sigmaringen and Karlsruhe, the BfR carried out an analysis of e-liquids on the German market in 2020. This study included a trace analysis of vitamin E and vitamin E acetate. Small traces of vitamin E acetate were only detected in one sample. In principle, however, both nicotine-containing and nicotine-free e-cigarettes can impair health.

Have there been cases of poisoning with e-cigarettes in Germany?

In Germany, no fatalities have yet been reported in causal connection with the intended use of or accidents involving e-cigarettes. This was the result of an evaluation of enquiries to German poison centres by the Gesellschaft für Klinische Toxikologie (GfKT) and the BfR as part of a study to establish a national poisoning register (PiMont). In this study, no serious poisonings after regular use of e-cigarettes were registered for the period from mid-2015 to mid-2019. The majority of enquiries related to accidental ingestion of refill liquids, often by children. These liquids often contain nicotine. Even small amounts of the substance swallowed can cause health problems such as severe vomiting. Larger quantities of nicotine can be life-threatening.

Independently of this, according to a report in the medical literature, three patients had to be treated in hospitals in 2019 after suffering lung damage. According to the case report, it was suspected that the use of e-cigarettes might have played a role. The doctors were unable to find any other causes.

Further poisonings in connection with e-cigarettes were reported in Bremerhaven in 2019 in eight young people who suffered from impaired memory and consciousness (fainting) as well as seizures and tachycardia. According to a preliminary assessment by the BfR, there is a very high probability that the symptoms are due to the use of synthetic cannabinoids in e-liquids. The adolescents had stated that they had smoked cannabidiol (CBD). CBD is a weakly psychoactive cannabinoid. A year earlier, CBD liquids containing psychoactive cannabinoids had already been detected in the USA. The same symptoms were reported as those experienced by the young people in Bremerhaven.

Can liquids with synthetic cannabinoids be hazardous to health?

Tests carried out in the USA and in various European countries detected synthetic cannabinoids in liquids for e-cigarettes. In Germany, the majority of these substances are subject to the New Psychoactive Substances Act (NPSG) and their use is therefore illegal. These ingredients were often not listed on the packaging or were listed in inaccurate quantities.

Cannabinoids are primarily known as the active ingredients in cannabis (marijuana, hashish). Among other things, they have psychoactive effects, meaning they can influence consciousness or perception. Natural cannabinoids are extracted from the hemp plant. Synthetic cannabinoids, on the other hand, are produced using chemical processes.

The data on synthetic cannabinoids in e-cigarettes is currently still very patchy. For example, the BfR does not yet have any information on the use of such substances in e-cigarettes in Germany. There is also a lack of reliable studies on the exact effects of the individual cannabinoids that have been identified to date on the human body. However, there is a risk that the consumption of e-cigarettes containing these substances can cause health impairments and undesired effects.

What are coolants in e-cigarettes and how do they work?

Coolants in the liquids are intended to produce a cooling sensation when inhaled, which is often perceived as pleasant. They activate certain cold receptors (TRPM8) when consumed without actually lowering temperature. One well-known coolant is menthol, the use of which has been banned in cigarettes in the EU since 2020. Synthetically produced coolants such as WS-23, WS-3 and WS-5 are now frequently used in e-cigarettes.

Are coolants in e-cigarettes hazardous to health?

There is currently not enough information available on the potential health risks of all the coolants used in e-cigarettes. In particular, the effects of inhaling such substances have often been insufficiently investigated.

According to the current state of knowledge, a health risk for consumers must be expected at least for the particularly frequently used coolants WS-23, WS-3 and WS-5. This is particularly the case with high concentrations and regular consumption. <u>Due to these</u> potential health risks, the BfR advises against the use of e-liquids containing these coolants.

As the cooling effect when inhaled makes consumption more attractive, the cooling substances may lead to increased nicotine intake and possibly to greater dependence, especially among young and inexperienced users.

Are e-cigarettes actually less hazardous than conventional cigarettes?

The consumption of conventional cigarettes is responsible for the premature death of more than 120,000 people in Germany every year. Scientific studies show that e-cigarettes themselves are much less hazardous than conventional cigarettes. For example, the vapour from e-cigarettes contains significantly lower levels of harmful substances than cigarette smoke from conventional cigarettes.

However, studies have also shown that many people use e-cigarettes alongside tobacco cigarettes, in what is known as dual use. This can increase the health risk under certain

circumstances if larger quantities of harmful substances are ingested through the consumption of e-cigarettes.

For the sake of health protection, the BfR generally recommends not using e-cigarettes. Smokers looking for help quitting can find help and information on the "<u>rauch-frei</u>" <u>information portal</u> of the <u>German Federal Institute for Public Health (BIÖG)</u>.

Are e-cigarettes and e-liquids controlled in Germany?

The German federal states ("Laender") are responsible for monitoring the safety of products sold or manufactured in Germany. The authorities assess the legal conformity of products and can initiate measures. Checks are carried out both on a random basis and on an ad hoc basis, for example in the event of suspicion.

Can e-cigarettes explode?

There have been repeated reports that the batteries used in e-cigarettes have exploded and caused burns. An evaluation of hospital data from 2018 in the USA showed that around 1,000 such cases were reported each year. No comparable statistical studies are known for Germany. The BfR recommends only using chargers and batteries intended for the respective product by the manufacturer.

Further information on the BfR website on e-cigarettes

BfR opinion 010/2025, Coolants in e-cigarettes are poorly researched – health impairments possible <u>https://www.bfr.bund.de/cm/349/coolants-in-e-cigarettes-are-poorly-</u>researched-health-impairments-possible.pdf

Aromatic substances in e-cigarettes: updated assessment of safrole, sucralose and menthol (in German)

https://www.bfr.bund.de/cm/343/aromastoffe-in-e-zigaretten-aktualisiertebewertung-von-safrol-sucralose-und-menthol.pdf

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