Vaping - An inquiry into reducing rates of e-cigarette use in Queensland

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The Facts Behind the Dangers of E-Cigarettes.

This document is to ensure that scientific facts are available to people planning to use E-Cigarettes and people who design laws to ensure the community is protected from chemicals that are confirmed to damage and likely eventually kill members of that community.

This document contains the foundation of information for a more detailed confirmation that vaping is a very dangerous practice that should not occur if the government bases its decisions on confirmed science and not on the poorly based opinions which lacks a factual foundation.

E-cigarettes, aka JUULs and vape pens, use a battery to heat up a special liquid into an aerosol that users inhale. It's not just harmless water vapor. The "e-juice" that fills the cartridges usually contains nicotine (which is extracted from tobacco), propylene glycol, flavorings and other chemicals. Studies have found that even e-cigarettes claiming to be nicotine-free contain trace amounts of nicotine. Additionally, when the e-liquid heats up, more toxic chemicals are formed.

Because the Food and Drug Administration (FDA) has not begun its review of any e-cigarette or its ingredients, nor has FDA issued any standards on the products, e-cigarette composition and effects vary. What researchers do know is that these toxic chemicals and metals have all been found in e-cigarettes:

- Nicotine – a highly addictive substance that negatively affects adolescent brain development
- Propylene glycol – a common additive in food; also used to make things like antifreeze, paint solvent, and artificial smoke in fog machines
- Carcinogens- chemicals known to cause cancer, including acetaldehyde and formaldehyde – these are Group 1 chemicals (Volumes Sup 7, 62, 88, 100F)
- Acrolein – a herbicide primarily used to kill weeds, can cause irreversible lung damage
- Diacetyl – a chemical linked to a lung disease called bronchiolitis obliterans aka "popcorn lung"
- Diethylene glycol – a toxic chemical used in antifreeze that is linked to lung disease
- Heavy metals such as nickel, tin, lead – these are Group 1 chemicals (Volumes Sup 7, 49, 100C)
- Cadmium – a toxic metal found in traditional cigarettes that causes breathing problems and disease – these are Group 1 chemicals (Volumes 58, 100C)
- Benzene – a volatile organic compound (VOC) found in car exhaust – this is Group 1 chemical proven to cause cancer (Volume 58 & 100C).
- Ultrafine particles that can be inhaled deep into the lungs

Nicotine

A Paper assessing the dangers of Nicotine sheds light on the Nicotine content in vaping liquids, when many parties believe the only danger of Nicotine is it's well documented addictive properties.

Front Oncol. 2015; 5: 196.
Published online 2015 Aug 31. doi: 10.3389/fonc.2015.00196
PMCID: PMC4553893
PMID: 26380225

Nicotine: Carcinogenicity and Effects on Response to Cancer Treatment – A Review

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Abstract

Tobacco use is considered the single most important man-made cause of cancer that can be avoided. The evidence that nicotine is involved in cancer development is reviewed and discussed in this paper. Both tobacco smoke and tobacco products for oral use contain a number of carcinogenic substances, such as polycyclic hydrocarbons and tobacco-specific *N*-nitrosamines (TSNA), which undoubtedly contribute to tobacco related cancer. Recent studies have shown that nicotine can affect several important steps in the development of cancer, and suggest that it may cause aggravation and recurrence of the disease. TSNA may be formed from nicotine in the body. The role of nicotine as the major addictive component of tobacco products may have distracted our attention from toxicological effects on cell growth, angiogenesis, and tumor malignancy. Effects on cancer disease are important aspects in the evaluation of possible long-term effects from sources of nicotine, such as e-cigarettes and products for nicotine replacement therapy, which both have a potential for life-long use.

Acetaldehyde

Alcohol and Cancer
https://www.cdc.gov/cancer/alcohol/
Why Does Alcohol Use Raise Cancer Risk? When you drink alcohol, your body breaks it down into a chemical called **acetaldehyde**. **Acetaldehyde** damages your DNA and prevents your body from repairing the damage. DNA is the…

Supplementary Exposure Limits | NIOSH
https://www.cdc.gov/niosh/npg/nengapdxc.html

Aldehydes (Low-Molecular-Weight). Exposure to **acetaldehyde** has produced nasal tumors in rats and laryngeal tumors in hamsters, and exposure to malonaldehyde has produced thyroid gland and pancreatic islet cell tumors in rats.…

Publication of Current Intelligence Bulletin 55: Carcinogenicity of Acetaldehyde and Malonaldehyde, and Mutagenicity of Related Low-Molecular-Weight Aldehydes
https://www.cdc.gov/mmwr/preview/mmwrhtml/00016261.htm
Acetaldehyde and malonaldehyde were also mutagenic in a variety of assays. Adequate epidemiologic data are not available from workers exposed to **acetaldehyde** or malonaldehyde.

Formaldehyde

Formaldehyde - Reproductive Health | NIOSH
https://www.cdc.gov/niosh/topics/repro/formaldehyde.html
Why should I be concerned about exposure to **formaldehyde**? **Formaldehyde** is known to cause cancer. Working with **formaldehyde** may increase your chances of having fertility problems or a miscarriage.

Formaldehyde: Evidence of Carcinogenicity (81-111) | NIOSH
https://www.cdc.gov/niosh/docs/81-111/
Formaldehyde has also been shown to be a mutagen in several short-term laboratory studies. In addition to the **carcinogenic** potential, other adverse health effects caused by **formaldehyde** are describe.

CDC - Immediately Dangerous to Life or Health Concentrations (IDLH): Formaldehyde - NIOSH Publications and Products
https://www.cdc.gov/niosh/idlh/50000.html
May 1994 Immediately Dangerous to Life or Health Concentrations (IDLH). CAS number: 50–00–0. NIOSH REL: 0.016 ppm TWA, 0.1 ppm 15-minute CEILING; NIOSH considers **formaldehyde** to be a potential occupational **carcinogen**

Acrolein

Acrolein is *possibly carcinogenic to humans (Group 2B)*.

CDC - Immediately Dangerous to Life or Health Concentrations (IDLH): Acrolein - NIOSH Publications and Products
https://www.cdc.gov/niosh/idlh/107028.html
According to MCA [1961], the irritation properties of **acrolein** are clearly evident at 1 ppm. ACGIH [1971] reported that 1 of 6 rats died after being exposed to 8 ppm for 4 hours and all died from exposure to 16 ppm [Smyth 1956].

Acrolein is a major cigarette-related lung cancer agent - PNAS

https://www.pnas.org › content

by Z Feng · 2006 · Cited by 402 — Although the carcinogenicity of Acr in the lung has not been studied because of the severe toxicity associated with Acr treatment in animals, i.p. injection

Acrolein from Cigarettes Causes Cancer-Specific p53 Mutations
https://consumer.healthday.com *› hematology-oncology-12*

11 Oct 2006 — *Acrolein is* 10000 times more abundant in cigarette smoke than more well-known carcinogen.

Acrolein contributes to human colorectal tumorigenesis ...

https://www.nature.com *› scientific reports › articles*

by HC Tsai · 2021 · Cited by 1 — Colorectal *cancer* (CRC) *is* one of the most well-known malignancies with high prevalence and poor 5-year survival.

Effect of Carcinogenic Acrolein on DNA Repair and Mutagenic ...
https://www.ncbi.nlm.nih.gov *› articles › PMC3320987*

by HT Wang · 2012 · Cited by 88 — *Acrolein* (Acr), a ubiquitous environmental contaminant, *is* a human carcinogen. Acr can react with DNA to form mutagenic α- and γ-hydroxy-1, ...

ACROLEIN

https://dec.alaska.gov › media › acrolein3

PDF
z *Acrolein* - 0.00002 mg/m3 (0.000008 ppm) for scaling and hardening of, ... NOTE: *Acrolein is* in cigarette smoke. ... of its *cancer causing* properties.

E-cigarettes can damage DNA - American Chemical Society

https://www.acs.org › pressroom › newsreleases › august

20 Aug 2018 — The type of damage, called a DNA adduct, occurs when toxic chemicals, such as *acrolein*, react with DNA. If the cell *does* not repair the damage ...

Benzene

***Benzene is* carcinogenic to humans (Group 1).**

What Chemicals Are In Cigarette Smoke? - Medical News Today

https://www.medicalnewstoday.com › articles

Facts About Benzene - CDC Emergency Preparedness

13 July 2015 — Benzene – used in gasoline, *causes* several *cancers*, including leukemia; Benzo[a]pyrene – this chemical *is* found in coal tar pitch, and creosote.

The Department of Health and Human Services (DHHS) has determined that **benzene causes cancer in humans**. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Benzene and Cancer Risk

https://www.cancer.org *› cancer › cancer-causes › benz...*

5 Jan 2016 — *Benzene* is known to *cause cancer*, based on evidence from studies in both people and lab animals. The link between *benzene* and *cancer* has largely .

Benzene - Exposure, Leukemia & Other Health Risks

https://www.drugwatch.com › benzene

Several federal agencies list the chemical as a known *cause* of *cancer*. Studies show *benzene* exposure can increase the risk of certain *cancers* by as much as 40 ...

Current understanding of the mechanism of benzene-induced ...

https://www.ncbi.nlm.nih.gov › articles › PMC3271273

by CM McHale · 2012 · Cited by 285 — *Benzene* is a *cause* of acute myeloid *leukemia* (AML) and myelodysplastic syndrome and a probable *cause* of other hematological malignancies,

Benzene | SA Health

https://www.sahealth.sa.gov.au › connect › conditions

The International Agency for Research on *Cancer* (IARC) has established that *benzene* can *cause cancer* in humans. If *benzene* enters the body it may be ...

Benzene: What to Know - WebMD

https://www.webmd.com › Healthy Beauty › Reference

24 Nov 2021 — *Benzene* is one of the substances that the Environmental Protection Agency calls a “known human carcinogen.” That means that it *causes cancer* in

Propylene glycol

The truth behind propylene glycol | Euronews

https://www.euronews.com › Green › Living

7 Jan 2019 — A more preoccupying fact may be that some scientists have tied *propylene glycol* to a raised risk of *cancer* or to neurodevelopmental issues. A ...

Propylene Glycol: Composition, Uses, Risks

https://www.verywellhealth.com › propylene-glycol-50...

23 Sept 2020 — Other studies also indicate that *propylene glycol* is converted into *cancer-causing* compounds when it's heated up in the e-cigarettes.6 ...

Propylene Glycol | ToxFAQs™ | ATSDR

https://wwwn.cdc.gov › ToxFAQs › ToxFAQsDetails

How likely is *propylene glycol* to *cause cancer*? ... The Department of Health and Human Services (DHHS), the International Agency for Research on *Cancer* (IARC), ...

Vaping propylene glycol and vegetable glycerine may lead to ...

https://www.news-medical.net › news › Vaping-propyle...

18 Oct 2019 — Researchers have found that using e-cigarettes with the e-liquid refills containing *propylene glycol* (PG) and vegetable glycerine (VG) may ...

General

Vaping and Cancer: Five Important Questions and Their ...

https://www.foxchase.org › blog › vaping-and-cancer-f...

21 Feb 2020 — Some of these substances are suspected to *cause cancer*, and some are linked to other lung diseases (such as acute lung injury) that have put ...

What's in an E-Cigarette? | American Lung Association

https://www.lung.org › quit-smoking › whats-in-an-e-ci...

13 July 2020 — Carcinogens- chemicals known to *cause cancer*, including acetaldehyde and formaldehyde; Acrolein – a herbicide primarily used to kill weeds, can...

E-cigarettes | Cancer Council NSW

https://www.cancercouncil.com.au › ... › Smoking

They may expose users and bystanders to chemicals and toxins such as *propylene glycol*, glycerol or ethylene glycol that *cause* adverse health effects, ...

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
https://www.theverge.com/2016/7/27/12299784/electronic-cigarettes-e-cigs-chemicals-cancer-fda

More cancer-causing chemicals found in electronic cigarettes

37 comments
By Alessandra Potenza@ale_potenza Jul 27, 2016, 2:40pm EDT
Via Berkeley Lab

Tibanna79 / SHUTTERSTOCK

The vapor from electronic cigarettes contains two previously unidentified chemicals that can cause cancer, according to a new study. The new research, published in *Environmental Science & Technology*, also shows that levels of harmful chemicals vary between e-cigs.

Researchers in the Lawrence Berkeley National Laboratory used two different electronic cigarettes and simulated vaping at different battery power settings. Then they analyzed the e-cigs' vapor. They found that the vaporizers released 31 harmful chemicals, including two possibly cancer-causing compounds that had never been previously found in e-cig vapor. The amount of chemicals produced varied, based on the temperature at which liquids are "vaporized" by the device's "heating coil." The higher the temperature inside the coil, the higher the amount of chemicals emitted. E-cigs with one heating coil instead of two also released higher chemical levels, probably because two coils better distribute the heat between them, which means their temperatures don't climb quite as high.

E-cigs released 31 harmful chemicals

Previous studies had already shown that e-cigarettes contain toxic chemicals. In 2009, the FDA warned that some e-cigs contain diethylene glycol, an ingredient used in antifreeze. And in 2015, a study showed that aerosols from e-cigs contain formaldehyde, another carcinogen. Some of these chemicals are also found in cigarette smoke.

An e-cig with only one heating coil operated at 3.8 volts was found to emit 0.46 micrograms of acrolein — a severe eye and respiratory irritant — per puff in the first five puffs, while the coil was heating up. But when the heat got steady, the e-cig emitted much more: 8.7 micrograms per puff. The amount of acrolein released is still much less

than a regular cigarette, which delivers 400 to 650 micrograms. About 20 puffs on an e-cigarette release 90 to 100 micrograms in comparison.

"Advocates of e-cigarettes say emissions are much lower than from conventional cigarettes, so you're better off using e-cigarettes," Berkeley Lab researcher and study co-author Hugo Destaillats said in a statement. "I would say, that may be true for certain users — for example, long time smokers that cannot quit — but the problem is, it doesn't mean that they're healthy. Regular cigarettes are super unhealthy. E-cigarettes are just unhealthy."

"Regular cigarettes are super unhealthy. E-cigarettes are just unhealthy."

Chemical emissions also changed based on the e-cig's battery voltage. The higher the voltage, the higher the temperature in the coil — and the heat meant higher chemical amounts were released. Emissions also varied based on how long the e-cig had been used. The longer it was used, the higher the level of chemicals it released, including formaldehyde, acetaldehyde, and acrolein — which are all carcinogens or respiratory irritants. That's because chemical residue was accumulated on or near the heating coil. As this residue was heated up, it released even more chemicals.

The researchers also analyzed two chemicals often used as solvents in e-cigs: propylene glycol and glycerin. Both are used to make artificial smoke, though little is known about whether it's safe to heat and inhale them. The researchers found that the solvents created 31 harmful chemicals, including propylene oxide and glycidol, both of which are probable carcinogens. These two chemicals has never been reported in e-cigs before. This is possibly because e-cigarettes are relatively new compared to traditional cigarettes, which have been studied for more than 50 years.

The use of e-cigarettes has spiked.

The use of e-cigarettes has spiked: the percentage of US adults who smoke e-cigs rose to 8.5 percent in 2013 from 3.3 percent in 2010. And in 2014, nearly 13 percent of adults said they tried electronic cigarettes, according to the CDC. Though some experts think e-cigs are a good alternative for regular cigarette smokers, health officials are particularly concerned about how popular vapes are among teenagers. Many e-cigs contain nicotine and could expose children to the addictive chemical. In 2015, three million American teens used e-cigs. (In May, the FDA finally banned e-cig sales to minors.) But much more research is needed to actually understand how harmful they are.

The paper's goal was to learn more about the risks of e-cigarettes, so that manufacturers, users, and regulators can try to minimize the harm the electronic cigarettes pose. "Understanding how these compounds are formed is very important," Destaillats said. "One reason is for regulatory purposes, and the second is, if you want to manufacture a less harmful e-cigarette, you have to understand what the main sources of these carcinogens are."

Appendix

Extract from WHO web Page www.iarc.who.int.

Understanding Group Definitions

Group 1: The agent is carcinogenic to humans.
This category is used when there is *sufficient evidence of carcinogenicity* in humans. Exceptionally, an agent may be placed in this category when evidence of carcinogenicity in
humans is less than *sufficient* but there is *sufficient evidence of carcinogenicity* in experimental animals and strong evidence in exposed humans that the agent acts through a relevant mechanism of carcinogenicity.

Group 2.
This category includes agents for which, at one extreme, the degree of evidence of carcinogenicity in humans is almost *sufficient*, as well as those for which, at the other extreme, there are no human data but for which there is evidence of carcinogenicity in experimental animals.
Agents are assigned to either Group 2A (*probably carcinogenic to humans*) or Group 2B (*possibly carcinogenic to humans*) on the basis of epidemiological and experimental evidence of carcinogenicity and mechanistic and other relevant data.
The terms *probably carcinogenic* and *possibly carcinogenic* have no quantitative significance and are used simply as descriptors of different levels of evidence of human carcinogenicity, with *probably carcinogenic* signifying a higher level of evidence than *possibly carcinogenic*.

Group 2A: The agent is probably carcinogenic to humans.
This category is used when there is *limited evidence of carcinogenicity* in humans and *sufficient evidence of carcinogenicity* in experimental animals. In some cases, an agent may be classified in this category when there is *inadequate evidence of carcinogenicity* in humans and *sufficient evidence of carcinogenicity* in experimental animals and strong evidence that the carcinogenesis is mediated by a mechanism that also operates in humans. Exceptionally, an agent may be classified in this category solely on the basis of *limited evidence of carcinogenicity* in humans. An agent may be assigned to this category if it clearly belongs, based on mechanistic considerations, to a class of agents for which one or more members have been classified in Group 1 or Group 2A.

Group 2B: The agent is possibly carcinogenic to humans.
This category is used for agents for which there is *limited evidence of carcinogenicity* in humans and less than *sufficient evidence of carcinogenicity* in experimental animals. It may also be used when there is *inadequate evidence of carcinogenicity* in humans but

there is *sufficient evidence of carcinogenicity* in experimental animals. In some instances, an agent for which there is *inadequate evidence of carcinogenicity* in humans and less than *sufficient evidence of carcinogenicity* in experimental animals together with supporting evidence from mechanistic and other relevant data may be placed in this group. An agent may be classified in this category solely on the basis of strong evidence from mechanistic and other relevant data.

Group 3: The agent is not classifiable as to its carcinogenicity to humans.
This category is used most commonly for agents for which the evidence of carcinogenicity is *inadequate* in humans and *inadequate* or *limited* in experimental animals. Exceptionally, agents for which the evidence of carcinogenicity is *inadequate* in humans but *sufficient* in experimental animals may be placed in this category when there is strong evidence that the mechanism of carcinogenicity in experimental animals does not operate in humans.
Agents that do not fall into any other group are also placed in this category.
An evaluation in Group 3 is not a determination of non-carcinogenicity or overall safety. It often means that further research is needed, especially when exposures are widespread or the cancer data are consistent with differing interpretations.

Group 4: The agent is probably not carcinogenic to humans.
This category is used for agents for which there is *evidence suggesting lack of carcinogenicity* in humans and in experimental animals. In some instances, agents for which there is *inadequate evidence of carcinogenicity* in humans but *evidence suggesting lack of carcinogenicity* in experimental animals, consistently and strongly supported by a broad range of mechanistic and other relevant data, may be classified in this group.

(e) Rationale
The reasoning that the Working Group used to reach its evaluation is presented and discussed. This section integrates the major findings from studies of cancer in humans, studies of cancer in experimental animals, and mechanistic and other relevant data. It includes concise statements of the principal line(s) of argument that emerged, the conclusions of the Working Group on the strength of the evidence for each group of studies, citations to indicate which studies were pivotal to these conclusions, and an explanation of the reasoning of the Working Group in weighing data and making evaluations. When there are significant differences of scientific interpretation among Working Group Members, a brief summary of the alternative interpretations is provided, together with their scientific rationale and an indication of the relative degree of support for each alternative.

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PMID:14283879