

Passive smoking from new nicotine devices

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Introduction

Passive smoking also occurs from new nicotine devices (heated tobacco devices and electronic nicotine vaporizers). Instead of being pollution free, there are some compounds in the vapor (aerosol) even if they are difficult to see. With combustible tobacco, the density of smoke (or soot) can be measured as particulate matter of 2.5 microns or smaller (PM_{2.5}), but in the case of novel nicotine devices, the density of vapor is measured as total volatile organic compounds (TVOC).

I Effects of passive smoking from new nicotine devices

1. Experience of a patient with allergies to various compounds who was exposed to passive smoking on an overnight bus:

Initially, I wondered if smoking passengers had smoke infused into their clothes and luggage (“third hand” smoke), but after smelling the odor for a second time, I developed a severe headache and nausea, and I could not move to a cleaner seat.

I had a splitting headache, and felt like I was about to vomit due to the nausea. I could not report this to the bus crew and had to endure the fumes during the night. It was not easy to breathe, and I could have died from an asthma attack. I lost consciousness (I could say that I fell asleep, but instead I felt faint with a severe headache and nausea) and became aware again near the destination at dawn.

After that event, nausea and headaches continued. Although these afflictions had previously occurred only from tobacco, they now also occur with strong fragrances like from fabric softeners, hair styling products, diesel exhaust and coffee.

2. Asthma patients

Coughing

3. I feel my nasal passages burn.

(I often hear about stuffy and burning nasal passages.)

4. Complaints of passive smoking

In a new neighboring house, two family members use heated tobacco repeatedly every day and blow their smoke/exhaust towards my house with a ventilation fan. Inside of my house, there is an odor of various chemicals, and I went to the hospital for inflammation of sinuses/nasal cavities and a headache. Once I even called an ambulance because of an unbearable headache, and the pain dissipated after I was able to breathe clean air outside of the home. Even after diplomatically broaching the topic to my neighbor, the situation has not improved. Smokers say that heated tobacco devices are odorless, but I can smell the vapor. After a year and a half of suffering symptoms, I ended up developing sinusitis that now occurs from exposure to various chemicals including those in tobacco and nicotine vapor.

Known symptoms of passive smoking from heated tobacco devices include headache, nasal congestion, itchy or red eyes, sore or irritated throat, cough, phlegm, fatigue, forgetfulness, drowsiness, eczema and others.

In sum, vapor from heated tobacco exposes one to many chemicals.

5. Remarks of those who encountered passive smoking from heated tobacco devices

A few days ago, a woman was inhaling from a IQOS device 15 to 20 meters away, and I was exposed to the vapor downwind. I immediately felt an uncomfortable sensation on the left side of my nasal passages.

When exposed to combusted tobacco smoke, I hold my breath to prevent inhaling smoke. But the heated vapor/steam is difficult to smell and has little particulate matter. Nonetheless, when I inhaled it, I felt like something was sticking to my mucous membranes.

I left the scene immediately, but this discomfort lasted for an hour or so.

6. Cases of allergies to multiple compounds

I live in Chiba prefecture and work in Tokyo. I am in my forties (male).

In the middle of this year, exhalation from heated tobacco smokers (exhaled air after vaping) was the main reason that I developed allergies. I also have a medical certificate.

Nowadays, passing by a user of heated tobacco causes symptoms such as dizziness, constriction of the respiratory tract, difficulty breathing and numbness. (Common leaf tobacco does not cause such symptoms.)

I also now have a strong reaction to the odors from fabric softeners, detergents and new clothing in stores.

Other people have become atopic (asthmatic) due to heated tobacco in their surroundings. Philip Morris, JT and other tobacco companies advertise that their heated tobacco devices reduce toxic substances by 90%, but the substances in heated tobacco are completely different from those combustible tobacco and pose separate harms.

7. Passive smoking symptoms caused by heated tobacco

In my case, the symptoms change a little depending on the brand of heated tobacco. From IQOS: my tongue becomes numb; I have stomatitis; and I have difficulty breathing. From Plume Tech and Glo: No numbness, but I feel sick. I can not breathe easily. I frequently hyperventilate.

II. What is in the new type of nicotine vape aerosol?

Propylene glycol and glycerol are the main components of nicotine vaping solution used with heated tobacco devices and nicotine vaporizers. These are oxidized through ordinary use of the devices^{1,2}.

When propylene glycol is oxidized through the heating process; it becomes formaldehyde, acetaldehyde, and methylglyoxal. When glycerol is oxidized through the heating process; it becomes formaldehyde, acrolein, glyoxal, and methylglyoxal.

Risk assessment of carbonyls containing e-cigarettes

Assessment of electronic cigarettes

Implementation procedure based on "Initial Risk Evaluation Report" Independent Administrative Institution (Product Evaluation Technology Infrastructure Organization)

1. MOE (margin of exposure) calculation based on NOAEL (no observed adverse effect level)
2. Comparison of MOE and uncertainty coefficient product

It is calculated by $(NOAEL) / (\text{exposure amount (estimated intake amount)})$ with a coefficient indicating how far the MOE exposure amount is from the human NOAEL.

Although this value is large, the current exposure amount indicates that there is a large margin until it develops harmfulness to humans.

Uncertainty coefficient product = difference between animals and humans Species difference (10) x individual difference (10) x LOAEL use (10) x test period (1-10)

The amount of smoke absorbed per day for electronic cigarettes was set to 14500 ml based on the report 1) by Matsumoto et al.

The average weight was 50 kg

Concentration Daily cigarette smoke Smoker's electronic cigarette NOAEL MOE Uncertainty coefficient product

Grounds for NOAEL (from the initial risk assessment report for chemical substances)

$(\text{mg} / \text{m}^3) \times 2) \times \text{Smoke absorption (ml)} / \text{Average body weight (kg)} (= A * B / C) (\text{mg} / \text{kg} / \text{day}) (\text{mg} / \text{kg} / \text{day}) (= NOAEL / D)$

Formaldehyde 61. 0.0177 0.039 2.2 200 A 26-week inhalation exposure test using monkeys with NOAEL 0.2 ppm as an index, using the metaplasia of the nasal cavity mucosa and turbinate mucosa as an index.

Acetaldehyde 48. 0.0139 36. 2586.2 1000

IPCS US EPA and Canada's Ministry of Environment and Health applied data from his Wistar rat's tail mucosa using NOAEL 150 ppm as an indicator of degeneration.

Acrolein 36. 0.0104 0.15 14.4 5000 From the index of emphysema and non-specific inflammation in the liver, lungs, kidneys and heart in a 90-day continuous exposure test of dogs.

Glyoxal 29. 0.0084 0.02 2.4 1000

Mucosal or submucosal in a 29-day inhalation exposure test in rats

Mild epiglottis epithelium with lymphocyte-like cell infiltration was used as an index.

Comment

I calculated the MOE for e-cigarette use and found that formaldehyde, acrolein, and glyoxal were lower than the product of uncertainties. That is, it is suggested that he is (has) adversely affected human health.

(From the slide of Dr. Tomiko Mochizuki: 2016 5th Expert Committee of Tobacco Health Impact Assessment: electronic tobacco)

III. Measurement of heated tobacco aerosol

Total volatile organic compounds (TVOC) can be used. Various compounds compose TVOC, but I think that it is primarily propylene glycol. TVOC value of 400 $\mu\text{g}/\text{m}^3$ or more is above normal.

Benzene, toluene, ethylbenzene, xylene, n-propylbenzene,

1,2,4 trimethylbenzene, 1,3,5, trimethylbenzene, 2-ethyltoluene

Styrene, naphthalene, 4-phenylcyclohexene

Aliphatic hydrocarbons (n-C6 to C16) n-hexane, n-heptane, n-octane, n-nonane, n-decane

n-Undecane, n-Dodecane, n-Tridecane, n-Tetradecane, n-Pentadecane

n-hexadecane, n-methylpentane, 3-methylpentane, 1-octene, 1-decene

Cyclic alkane methylcyclopentane, cyclohexane, methylcyclohexane,

Terpen 3-carene, α -pinene, β -pinene, limonene

Alcohol 2-propanol, 1-ptanol, 2-ethyl-1-hexanol

Glycol / glycol ether 2-methoxyethanol, 2-ethoxyethanol
2-Putoxyethanol, 1-methoxy-2-propanol, 2-Putoxyethoxyethanol
Aldecht butanal, pentanal, hexanal, nonanal, benzaldehyde
Ketone Methyl ethyl ketone, methyl isopetyl ketone, cyclohexanone, acetophenone
Halogen katankaiso trichlorethylene, tetrachlorethylene, 1,1,1-trichloroethane 1,4-dichlorobenzene
Acid Caproic acid
Ethyl acetate, petit acetate, isopropyl acetate, 2-ethoxyethyl acetate
Texanol isoptilate

Among these, propylene glycol most likely.

IV. What are other things in it?

Philip Morris (PM) has reported some contents of IQOS to the FDA, but there are substances that were not intentionally reported. These omitted substances are listed below, including some toxic and/or carcinogenic substances³⁾.

何が入っているのか？

PMがアイコスについてFDAに意図的に報告していなかった化学物質。

呼吸器や粘膜に対して毒性を持つ**エチルベンゼン** (Ethylbenzene)
呼吸器や神経への悪影響と発がん性の疑いがある**フラン** (Furan)
急性毒性と発がん性、環境への悪影響のある**2,6-ジメチルアニリン** (2,6-Dimethylaniline)は加熱式タバコの方が、普通のタバコよりも多かった。
生体への影響が不明の**シクロアルケン** (Cycloalkene)類
急性毒性と皮膚刺激性がある**無水性リナロールオキシド** (Dehydro Linalool Oxide)
皮膚炎や神経障害を引き起こす危険性がある**シクロヘキサン** (Cyclohexane)、
DNA損傷を引き起こすことが疑われる**2(5H)フラノン** (2(5H)- Furanone)、
皮膚や喉など粘膜へ刺激を与え、神経系に影響を及ぼす**2-フランメタノール** (2-Furanmethanol)など

V. Summary

Heated tobacco devices and electronic vaporizers generate vapors (aerosols). Glycerol or propylene glycol is used as a base fluid, which are oxidized through the heating process and create various carcinogenic and/or toxic substances. The most concentrated ones include formaldehyde, acrolein and glyoxal, as well as less concentrated ones like ethylbenzene, furan, dimethylaniline, cycloalkene, linalol oxide, cyclohexane, furanone and furanmethanol. In addition to their toxic effects for the primary user, they can generate illness and toxicity for bystanders through passive vaping.

References

Japan Society for Tobacco Control, Smoking Cessation Studies 4th Edition, Nanzando, Tokyo, 2019

- 1) Takahiro Tabuchi: *ibid.*, Heated tobacco p16
- 2) Michiyuki Matsuzaki: *ibid.*, Heated tobacco toxicity p22
- 3) Masahiko Ishida: Why does Aikos' "Philip Morris" repeat "lie"?
<https://news.yahoo.co.jp/byline/ishidamasahiko/20200626-00185035/>