SECONDHAND SMOKE –

Tobacco, Nicotine, Cannabis

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ABSTRACT

This document references scientific and social studies that describe the range of human health issues resulting from exposure to secondhand smoke (SHS). Sources of SHS include tobacco smoking, nicotine vaping, and cannabis smoking and vaping.

It has been well documented that secondhand smoke (SHS) from burning tobacco contains carcinogens and toxins. The advent of nicotine vaping as an alternative to tobacco cigarettes has gained popularity worldwide. With less odor, it is commonly thought that secondhand smoke from vaping is harmless. However, scientific studies identify how vaping nicotine results in secondhand smoke that contains carcinogens and harmful toxins.

In the cannabis industry, many operators assume that secondhand smoke from smoking or vaping cannabis is harmless since marijuana is a 'natural' substance. However, scientific studies on cannabis secondhand smoke tell a different story. Cannabis SHS contains many of the same carcinogens and toxins as that from nicotine and tobacco, and some are in higher concentrations.

Exposure to both nicotine and cannabis secondhand smoke commonly occurs in private settings. Although regulations have reduced SHS exposure in public spaces, it still occurs and is likely to grow with increasing cannabis legalization.

It would be a healthier world if smoking and vaping did not exist, but this is unlikely to occur. Understanding the impact of SHS on human health can lead to appropriate solutions.

SECONDHAND SMOKE FROM TOBACCO

Tobacco smoking has existed for several millennia, but it's only been in the last half century that the harmful impact of secondhand smoke from tobacco has been documented. The National Cancer Institute indicates there are more than 7,000 chemicals in tobacco secondhand smoke, at least 69 of which are carcinogenic. Secondhand smoke (SHS) exposure can occur in homes, cars, public places and the workplace.[1]

The American Cancer Society notes that secondhand smoke from tobacco can cause lung cancer in those that have never smoked[2]. There is also evidence linking other cancers to secondhand smoke exposure, including:

- Larynx cancer (voice box)
- Nasopharynx cancer (part of throat behind the nose)
- Nasal sinuses cancer
- Breast cancer

Young children are most affected by SHS. The American Cancer Society reports that children of parents who smoke typically have the following health issues:

- Get sick more often
- Have more lung infections (bronchitis, pneumonia)
- More likely to cough, wheeze, have shortness of breath
- Get more ear infections

Both the CDC and the American Cancer Society indicate that there is no safe level of secondhand smoke.

NICOTINE VAPING & SECONDHAND SMOKE

In the past two decades, nicotine vaping and e-cigarettes have been replacing tobacco smoking, partly as a healthy alternative to smoking cigarettes. Nicotine vape devices do not have the sidestream smoke that comes off the burning end of a cigarette and have less odor than tobacco cigarettes. As a result, many assume secondhand smoke from nicotine vaping is safe. However, the scientific evidence points to considerable harm from vaping secondhand smoke that is aligned with the harm from cigarettes.

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[1] National Cancer Institute, Secondhand Tobacco Smoke, https://www.cancer.gov/about-cancer/causes-prevention/risk/substances/secondhand-smoke

[2] American Cancer Society, *Health Risks of Secondhand Smoke*, https://www.cancer.org/cancer/risk-prevention/tobacco/health-risks-of-tobacco/secondhand-smoke.html

The exhale from vaping nicotine creates an aerosol, which is the suspension of tiny liquid or solid particulates in the air. Secondhand smoke aerosols from nicotine vaping contain several known carcinogens including[3] [4]:

- Lead
- Formaldehyde
- Volatile organic compounds (Benzene, Toluene)

The American Lung Association reports that secondhand vape emissions contain ultrafine particles which easily enter the lungs, flavorings such as diacetyl that is linked to lung disease, and heavy metals such a nickel and lead. The US Surgeon General and the National Academies of Science, Engineering and Medicine have warned about the risks associated with exposure to the exhalent from e-cigarette use.[5]

A multi-year study out of University of Southern California in Los Angeles on young adults, aged 17 – 22 over 5 yrs., demonstrated the harmful impact of secondhand vape smoke to those who do not vape. Exposure to secondhand aerosols from e-cigarettes is associated with increased risk of bronchitis and shortness of breath, with a stronger association among those who did not smoke or vape.[6]

Emory University, a private research university, reported the dangers to children exposed to nicotine vape secondhand smoke. Children aged 4-12 years who were exposed to secondhand e-cigarette vapor had significantly higher levels of metabolites linked to chemicals found in e-cigarette liquids when compared to unexposed peers. These metabolites interfere with the body's normal operations including disrupting normal dopamine levels, causing inflammation and oxidative stress, which leads to cellular damage and is linked to numerous diseases including diabetes, heart disease and cancer.[7]

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[3] Heathline, *Secondhand Vaping is a Thing – Here's What to Know*, https://www.healthline.com/health/second-hand-vape

[4] Medical News Today, *Can secondhand vape exposure be harmful?* https://www.medicalnewstoday.com/articles/secondhand-vape-exposure

[5] American Lung Association, *The Inhalation of Harmful Chemicals Can Cause Irreversible Lung Damage and Lung Disease*, https://www.lung.org/quit-smoking/e-cigarettes-vaping/impact-of-e-cigarettes-on-lung

[6] Thorax, *Secondhand nicotine vaping at home and respiratory symptoms in young adults*, https://thorax.bmj.com/content/77/7/663

[7] Emory News Center, *Children at risk: Emory study uncovers the hidden dangers of secondhand vape exposure*, https://news.emory.edu/stories/2024/03/hs_nursing_research_vaping_26-03-20243/story.html

The idea that vaping e-cigarettes is safe for those in the vicinity of exposure to secondhand smoke is not supported by scientific evidence.

CANNABIS & SECONDHAND SMOKE

Many cannabis consumers and those in the cannabis industry do not perceive secondhand smoke from cannabis as harmful. However, the preponderance of evidence indicates harm from cannabis SHS is similar to that from nicotine.

Despite the relatively short history of legal medicinal and recreational cannabis, the AHA, CDC, and NIH have published reports about the harmful nature of cannabis secondhand smoke. The CDC reports that cannabis secondhand smoke contains many of the same toxic and carcinogenic compounds found in tobacco, and some occur in higher amounts.[8] Several studies reported in Very Well Health noted the harmful components of cannabis secondhand smoke, including the following:[9]

- Levels of ammonia were 20x higher in marijuana compared to tobacco
- Levels of hydrogen cyanide and aromatic amines were 3 – 5x higher compared to tobacco
- Carcinogens such as benzene, cadmium, nickel
- Other chemicals implicated in respiratory diseases[10]

Research presented at the American Heart Association meeting as early as 2014 stated that cannabis secondhand smoke should be considered a public health problem.

A recent study comparing the secondhand smoke from cannabis and nicotine was done at UC Berkeley where bongs were used for cannabis consumption. Bong inhalation through water is generally considered to be less harmful. The strength of this study comes from taking measurements during actual bong smoking sessions without artificial constraints. The resulting cannabis secondhand smoke after bong usage indicate that:[11]

- Harmful particulate matter ($PM_{2.5}$) increased 100-fold to 1,000-fold compared to the base background level in 75% of the sessions. The other 25% of sessions, that had a higher base level PM2.5 for comparison, had a 20-fold increase in $PM_{2.5}$ level.

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[8] CDC, *Cannabis and Secondhand Smoke*, February 2024, https://www.cdc.gov/cannabis/health-effects/secondhand-smoke.html

[9] Very Well Health, *Secondhand Marijuana Smoke: Risks and Drug Testing*, https://www.verywellhealth.com/secondhand-marijuana-smoke-risks-2248848#citation-8

[10] ACS Publications, *A Comparison of Mainstream and Sidestream Marijuana and Tobacco Cigarette Smoke Produced under Two Machine Smoking Conditions*, https://pubs.acs.org/doi/10.1021/tx700275p

[11] JAMA Network, *Fine Particulate Matter Exposure from Cannabis Bong Smoking*, March 2022, https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2790510

- At 15 minutes post session, the mean $PM_{2.5}$ level was more than twice what the EPA considers to be the hazardous air quality threshold (250 microgram/cubic meter). For comparison, non-smoking homes have $PM_{2.5}$ at 15 micrograms/cubic meter
- At 90 minutes post session, the elevated $PM_{2.5}$ had only declined 50% from the peak.
- At 12 hours post session, $PM_{2.5}$ levels remained 10x higher than the base background level.
- In comparison to smoking tobacco, the study demonstrated that cannabis SHS has 4x the harmful particulate matter ($PM_{2.5}$).

Human studies on cannabis SHS have been difficult to construct due to the Schedule 1 classification of marijuana. We anticipate more studies to occur driven by the anticipated marijuana re-classification to Schedule 3, and the expanding legalization of cannabis use for medicinal and recreational use. There are animal studies on the impact of cannabis secondhand smoke which point to the need for additional human studies. One animal study using rats noted how a one-minute exposure to cannabis SHS led to endothelial stress in the femoral artery.[12] Similar exposure levels of SHS were used relative to real world tobacco SHS conditions. The impairment to the femoral artery from cannabis SHS was similar to that from tobacco SHS, but the recovery time from cannabis SHS was considerably slower.

Endothelial tissue is on the inside of blood vessels, and releases substances that control the opening and closing of arteries. Endothelial tissue dysfunction increases the risk of coronary artery disease from atherosclerosis. Endothelial tissue affects the following:[13]

- Blood pressure, and how hard the heart pumps
- Controls fluids and electrolytes in blood
- Keeps toxins out of tissues
- Regulates tissue inflammation
- Helps blood clot when needed.

The negative impact of tobacco SHS on children and adolescents has been well documented. Pediatric Research reports the impact of cannabis SHS exposure to children resulted in increased viral respiratory infections relative to those who were exposed to tobacco SHS or had no exposure to secondhand smoke.[14] There was no indication in the study of increased use of emergency or urgent care from parents consuming cannabis, demonstrating a level of quality parenting in the study group.

[12] NIH, *One Minute Marijuana Secondhand Smoke Exposure Substantially Impairs Vascular Endothelial Function,* July 2016, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5015303/

[13] Cleveland Clinic, *Endothelial Dysfunction*, https://my.clevelandclinic.org/health/diseases/23230-endothelial-dysfunction

[14] Pediatric Research, *Association between secondhand marijuana smoke and respiratory infections in children,* July 2021, https://www.nature.com/articles/s41390-021-01641-0

WHERE CONSUMERS SMOKE & VAPE

We examine where nicotine and cannabis consumption commonly occurs to better understand the exposure to secondhand smoke. Our market intelligence from surveying consumers of PHILTER™ Proof-of-Concept products indicates a predominance of cannabis smoking occurs in the home. (See *Consumer Behavior Metrics*)

Publicly available studies on preferred locations for nicotine and cannabis consumption are not recent but they do provide a profile of location diversity and an understanding of where SHS exposure occurs. A study reported in 2019 by the NIH pointed towards a range of venues where nicotine vaping commonly occurs. Three out of the top four selected locations are mostly public spaces where nicotine consumption may affect others.

Location	Percent
Social Venues	17.9%
Living Space	16.7%
Stores	15.9%
Transportation	15.5%

The top four categories define 66% or approximately 2/3's of the respondents. The most popular category was social venues, followed by living spaces.[15]

A study done at two southeastern colleges in 2014 examined the location where students allowed cigarette and cannabis smoking, so the focus was on private spaces. Due to the randomized selection, only 16.3% were cigarette smokers, and 19.8% were marijuana smokers. When taking this into consideration, the locations allowed for smoking essentially defines where cannabis and cigarette smokers consume. It is interesting to note that consumption in cars is higher than the percentage of those that smoke. This points to the allowance of smoking in cars from non-smokers of cigarettes and cannabis.

Cannabis Users In Study
19.8%

Location Allowed	Percent
Cannabis in home	17.0%
Cannabis in car	27.3%

Cigarette Users In Study
16.3%

Location Allowed	Percent
Cigarettes in home	14.5%
Cigarrettes in car	35.9%

The CDC reports that there is no exposure to SHS that is not harmful. And yet the behavior of many vapers and smokers points to the belief that the car is a safe place for eliminating SHS. The CDC examined the SHS exposure to middle school and high school students from 2011 – 2019. Over this time period, 25.3% of students reported home exposure to secondhand smoke, while 23.3% reported vehicle SHS exposure.[16] This high rate of vehicle exposure compared to home exposure points to home and vehicle as common locations of SHS exposure.

[15] NIH, Where do People Vape? Insights from Twitter Data, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6747114/

[16] CDC, *Exposure to Secondhand Smoke in Homes and Vehicles Among US Youths*, https://www.cdc.gov/pcd/issues/2020/20_0107.htm

Public setting exposure to secondhand smoke has been reduced with regulations. And yet the legalization of medicinal and recreational cannabis creates another source of SHS in public spaces. The secondhand smoke exposure location data points to the prevalence of SHS exposure in private spaces.

PARTICULATE MATTER

Particulate matter (PM) refers to the suspension of small solids or liquids suspended in air. PM_{10} refers to particulate matter that is 10 microns or smaller. These particles are readily inhaled, and some can be directly absorbed into the bloodstream. $PM_{2.5}$ refers to particles that are 2.5 microns or smaller, commonly referred to as fine particles. These fine particles can be inhaled deeply into the lung and pose the greatest risk to human health.[17] For comparison purposes, the average human hair is about 70 microns, or about 30x larger than the largest fine particle.

The Air Quality Index (AQI) established by the EPA and readily used to report on air quality changes due to smoke from fires and industrial outdoor pollution, is based on the concentration of particulate matter.

Air Quality Index		
Low	**High**	**Air Quality**
0	50	Good
51	100	Moderate
101	150	Unhealthy for Sensitive Groups
151	200	Unhealthy
201	300	Very Unhealthy

A more complete description of EPA recommendations for human behavior based on the AQI reading points to suggestions of reduced physical activity when the AQI reading is above 100.[18]

It is interesting to note that the UC Berkeley study on SHS resulting from bong usage indicated an AQI reading of 500 at 15 minutes post session. And at 90 minutes post session, the AQI had declined just 50% from its peak, or to an approximate mean level of 250, which is in the Very Unhealthy AQI index. This means that the harmful impact of particulate matter from cannabis SHS lingers for a considerable time.

[17] EPA, *Particulate Matter Basics*, https://www.epa.gov/pm-pollution/particulate-matter-pm-basics

[18] EPA, *Particle Pollution and Your Health*, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1001EX6.txt