Second-hand Smoke

Second-hand Smoke: General Information and Health Effects

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What is second-hand smoke?

Second-hand smoke refers to exposure to tobacco smoke – not from your smoking, but from being exposed to someone else's cigarette, cigar, or pipe smoke. It can also be described as the material in indoor air that originates from tobacco smoke. Breathing in second-hand smoke is known as passive smoking, environmental tobacco smoke, or involuntary smoking.

What information is covered in this document?

This document will cover the basic issues of what second-hand smoke is and what are the health effects of passive smoking. Secondhand exposure to vapours from electronic cigarettes (e-cigarettes) is also covered. Examples from workplace exposure situations are used wherever possible.

For information on policies and programs in the workplace, please see the OSH Answers document Second-hand Smoke: Workplace Policy.

What is the general composition of tobacco smoke?

Tobacco smoke consists of solid particles and gases. More than 7,000 different chemicals have been identified in tobacco smoke. The number of these chemicals that are known to cause cancer in animals, humans, or both is reported to be about 70.

The solid particles make up about 10 percent of tobacco smoke and include "tar" and nicotine. The gases or vapours make up about 90 percent of tobacco smoke. The major gas present is carbon monoxide. Others include formaldehyde, acrolein, ammonia, nitrogen oxides, pyridine, hydrogen cyanide, vinyl chloride, N-nitrosodimethylamine, and acrylonitrile. Of these, formaldehyde, N- nitrosodimethylamine and vinyl chloride are suspected or known carcinogens in humans. Acrylonitrile has been shown to cause cancer in animals.

What is the general composition of electronic cigarette (e-cigarette) vapour?

E-cigarettes are battery-operated devices that heat a liquid to produce an aerosol. The aerosol (usually known as the vapour) is inhaled. Generally speaking, the aerosol can contain:

- Nicotine
- Cancer-causing chemicals
- Heavy metals such as nickel, tin or lead
- Volatile organic compounds
- Ultrafine particles
- Flavourings, such as diacetyl
- Vaping liquids such as glycerol and propylene glycol

Vaping at high power and temperature can create a greater number and amount of potentially harmful chemicals. When heated at high temperatures, chemicals such as glycerol and propylene glycol can break down and form new chemicals, including aldehydes (such as formaldehyde, acetaldehyde, and acrolein). Some of the metals may also enter the aerosol as the heating element ages.

Note that the US Center for Disease Control and Prevention (CDC) states that some flavourings used in e-cigarettes may be safe to eat but not to inhale because the lungs process substances differently than the digestive system.

What is meant by "mainstream" and "sidestream" smoke?

The smoke that is inhaled and then exhaled from the smoker's lungs is called mainstream smoke (MS).

Sidestream smoke (SS) is the smoke that enters the air directly from the burning end of a cigarette, cigar, or pipe. The burning end of a cigarette is not usually hot enough for the complete combustion of the tobacco to occur. Since some chemicals are favoured by this incomplete burning, undiluted sidestream smoke contains higher concentrations of several chemicals than the mainstream smoke inhaled by the smoker. These chemicals include 2-naphthylamine, N-nitrosodimethylamine, 4-aminobiphenyl, and carbon monoxide.

Second-hand smoke is composed of both mainstream and sidestream smoke. This smoke is diluted by the air in the room before it is inhaled and is, therefore, less concentrated than mainstream or sidestream smoke.

Every person – both smokers and non-smokers – in a room with second-hand smoke will have similar exposure because nearly 85 percent of second-hand smoke in a room comes from sidestream smoke. The smoker is also exposed to mainstream smoke, but this exposure is limited to the time it takes to smoke a cigarette. However, exposure to second-hand smoke remains constant for the entire time spent in that room.

Vaping does not generate sidestream vapour between puffs, although some mainstream vapour is emitted when an e-cigarette user exhales. Health Canada states that there is some evidence that nicotine may enter indoor air and be present on indoor surfaces.

Can exposure to second-hand smoke be measured?

Second-hand smoke exposure can be measured by testing the indoor air for suspended particles or individual chemicals (such as nicotine or other components of the smoke).

Exposure can also be determined by using levels of biomarkers, such as cotinine, in a person's blood, saliva, or urine.

What are the health effects of exposure to second-hand smoke?

Second-hand smoke is associated with several diseases and premature death in non-smoking adults and children.

Lung Cancer

Health Canada states that people who smoke are 25 times more likely to die from lung cancer than a person who has never smoked.

Cancers Other than Lung Cancer

Health Canada also states that smoking can lead to:

- cancer of the blood (leukemia)
- respiratory and upper digestive tract cancers, especially cancer of the mouth, esophagus, throat (pharynx), and voice box (larynx)
- cancers of the cervix, kidney, bladder, stomach, pancreas, colon and liver

Respiratory Diseases

Chronic Obstructive Pulmonary Disease (COPD) is the term given to a group of respiratory diseases that include emphysema and chronic bronchitis.

Cardiovascular Diseases

Cardiovascular diseases are injuries to the heart and blood vessels. Smoking can cause:

- heart attacks
- angina (coronary heart disease)
- strokes (cerebrovascular disease)
- blockages in the legs (peripheral vascular disease)

Effects on Persons with Pre-existing Diseases

Non-smokers with heart disease (angina pectoris) exposed to second-hand smoke in ventilated and unventilated rooms had increased heart rates, elevated blood pressures and increased carbon monoxide in the blood.

Second-hand smoke aggravates allergy symptoms. It is generally more irritating to the respiratory tract of asthmatics, and it can aggravate some asthmatic symptoms such as wheezing.

Pregnant Workers (Effects on Fetus)

Generally speaking, second-hand smoke exposure has been associated with lower fertility, complications during pregnancy, and poor birth outcomes (including impaired lung development, low birth weight, and preterm delivery). Babies with low birth weight have a smaller chance of survival.

Irritant Effects

Many of the substances in cigarette smoke are very irritating to the eyes, throat and respiratory mucous membranes. A high proportion of non-smokers report eye irritation, headache, nasal discomfort, cough, sore throat, or sneezing.

Does exposure to second-hand smoke have other health implications in the workplace?

Yes. While most of the studies have looked at the health effects of active smokers, it has been shown that tobacco smoke can interact with other materials and chemicals in the workplace.

Cigarette smoke can:

- transform existing chemicals into more harmful ones
- increase exposure to existing toxic chemicals
- add to the biological effects caused by certain chemicals, and
- interact synergistically with existing chemicals (the effects will be more than the sum of the effects from the exposure to each chemical or material alone). (Also known as multiplicative effects)

What are examples of smoke interacting with other occupational hazards?

Examples of these situations (as studied with active smokers) include:

Occupation	Exposure	Smoking / Occupation Interaction +: Additive X: Multiplicative X?: Probably Multiplicative	Disease
Asbestos workers, construction workers and others in contact with asbestos	Asbestos	+ , X	Lung cancer Chronic lung disease
Aluminum smelter workers	Polynuclear aromatic hydrocarbons (PAHs)	+ or X	Bladder cancer
Aircraft and mining industry and many others	Noise	+	Loss of hearing and hearing acuity
Cement workers	Cement dust	+	Chronic bronchitis Obstructive lung disease
Chlorine manufacturing	Chlorine	+	Chronic obstructive lung disease
Coal miners	Coal dust	+	Chronic obstructive lung disease
Copper smelter workers	Sulphur dioxide	+	Chronic obstructive lung disease
	Arsenic	+ or X	Lung cancer
Grain workers	Grain dust	+	Chronic bronchitis Obstructive lung disease
Organic chemicals	Carcinogens	+ or X	Cancer of various organs and tissues
Rock cutters	Silica dust	+	Chronic obstructive lung

Occupation	Exposure	Smoking / Occupation Interaction +: Additive X: Multiplicative X?: Probably Multiplicative	Disease
Foundry workers			disease
Textile workers	Cotton, hemp, flax, dust	X?	Acute airway obstruction (byssinosis) Chronic bronchitis
Uranium miners and many other workers in radioactive environments	Alpha radiation (Radon)	X?	Lung cancer
Welders	Irritant gases, metal fumes, dusts, (Radon)	+	Chronic bronchitis Obstructive lung disease

Source: Smoking Control in the Workplace. J. Rudnick. In Encyclopaedia of Occupational Health and Safety. 4th edition. Geneva: International Labour Office, 1998. page 15.37

What is third-hand smoke?

Third-hand smoke is cigarette smoke particles that become embedded or re-suspended in the air after being on the furniture or clothes. For example, when smoking indoors, smoke particles can become adsorbed into indoor surfaces such as clothes, curtains, carpets or cushions and remain on these surfaces even after the room has been ventilated. Concern is centred around individuals living in the same home, especially small children who may place non-food objects near or in their mouths. Washing all clothing, bedding, linens, carpets, and curtains can help. Clean toys, counters, walls, floors and ceilings.

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