

# SECOND HAND SMOKE

PHYSICIANS FOR A SMOKE-FREE CANADA

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# PART 1

## What is Second-Hand Smoke?

**When tobacco is lit, thousands of chemicals are released in the smoke. Some of these chemicals are found only in tobacco smoke. Many of them are also highly toxic. (see Appendix A)**

Some of the smoke is inhaled by the smoker, but a larger amount of smoke is released into the air at the lit end of the tobacco product.

Two-thirds of the smoke from a cigarette is not inhaled by the smoker.

The smoke that is exhaled by the smoker (mainstream smoke) mixes with the smoke from the lit end of the tobacco (sidestream smoke) to form what is known as “second-hand smoke” or ETS, “environmental tobacco smoke”.

*Sources: “Nowhere to Hide”, Health Canada factsheet; Morawska, Barron, Hitchins, “Experimental Deposition of Submicrometer Particulate matter in the Human Respiratory Tract”, American Industrial Hygiene Association Journal, 60:334-339, 1999; Grossman, Price, Tobacco Smoking & The Law In Canada, 1992.*

### **Why Should I Be Concerned About Second-Hand Smoke?**

Chemicals in second-hand smoke are virtually the same chemicals that the smoker inhales, sometimes in greater concentrations.

- Discomfort, illness or even death may result when second-hand smoke is involuntarily inhaled by non-smokers.
- For every 8 smokers tobacco smoke kills, 1 nonsmoker is also killed by inhalation of second-hand smoke.
- Smoke-filled rooms can have up to 6 times the air pollution of a busy highway.
- Over 40 of the chemicals in tobacco smoke are known to cause cancer. (Appendix B)
- 8 of these are Class A carcinogens, for which there is no safe level of exposure
- Being in a smoky bar for only two hours is the same as smoking four cigarettes.

### **If second-hand smoke is so dangerous, why has it been allowed for so long?**

The following are a few of the reasons that regulations and public support for smoke-free indoor spaces has lagged behind science:

- Misinformation by the tobacco industry
- Tobacco industry lobbying efforts
- Health effects of smoking not usually immediate

*Sources: Glantz, Parmley, "Passive Smoking and Heart Disease", AHA Circulation, Vol. 83, No. 1, January 1991; California Restaurants and Bars: Going Smoke Free Outreach Kit, October 1997; UC Berkeley School of Public Health; California EPA Report 1997; UC Berkeley School of Public Health.*

# PART 2

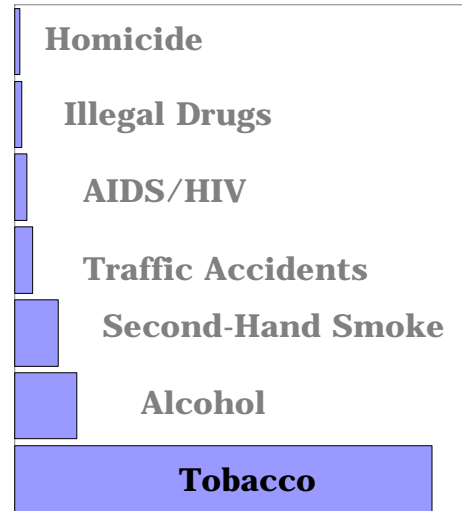
## Death and Disease

**Second-hand smoke exposure is the third leading preventable cause of death in Canada, killing an estimated 4,700 Canadians annually.**

The most exhaustive research on second-hand smoke and mortality was conducted in 1997 by the California EPA.

The populations of Canada and California are similar, and legislation to protect people from tobacco smoke is more stringent in California; therefore, the number of deaths per year from second-hand smoke for California, listed below, may be comparable to those of Canada.

- 360 Lung Cancer Deaths
- 4200-7440 Ischaemic Heart Disease Deaths
- 16-25 Infant Bronchitis/Pneumonia Deaths
- 120 Sudden Infant Death Syndrome (SIDS)



Sources: Canadian Centre on Substance Abuse: *The Costs of Substance Abuse in Canada Full Report*; Health Canada Press Release Jan. 18, 1999; Canadian Council for Tobacco Control: "Selected Causes of Death and Associated Federal Prevention Budgets", Jan. 1999; *Health Effects of Exposure to ETS: Final Report* September 1997 California EPA, Office of Environmental Health Hazard Assessment.

## What are the health effects of second-hand smoke?

The chemicals in tobacco smoke can cause many adverse health reactions for both smokers and non-smokers who breathe second-hand smoke.

Certain medical conditions are made substantially worse by tobacco smoke: 25% of the population suffers from asthma, heart failure, emphysema, anemia and other medical conditions that are exacerbated by second-hand smoke.

The truth about how tobacco smoke affects human health has been known for over a century. And knowledge about the harmful effects of indoor tobacco smoke to non-smokers is decades old.

### Second-hand smoke has been causally linked with:

- eye and nasal irritation
- coronary and ischaemic heart disease
- lung cancer
- stroke
- nasal sinus cancer

### Evidence also suggests an association with:

- spontaneous abortion
- adverse impact on cognition and behavior
- asthma exacerbation in adults
- exacerbation of cystic fibrosis
- decreased pulmonary function
- breast and cervical cancer.

### In children, second-hand smoke has been causally linked to:

- respiratory infections and irritation
- reduced lung function
- increased episodes and severity of asthma
- reduced oxygen flow to tissues.

### Childhood exposure has also been associated with:

- sudden infant death syndrome (SIDS)
- middle ear infections
- meningococcal infections
- and cancers and leukemia in childhood

Sources: California EPA Report 1997; He, Vupputuri, et al, "Passive Smoking and the Risk of Coronary Heart Disease – A Meta-Analysis of Epidemiologic Studies" *The New England Journal of Medicine*, March 25, 1999, pages 920 – 926; Law, et al, "Environmental Tobacco Smoke Exposure and Ischaemic Heart Disease: An Evaluation of the Evidence", *BMJ*, October 18, 1997, 315:973-988; Bonita, et al, *Passive smoking as well as active smoking increases the risk of acute stroke*, *Tob. Control* 1999; 8:156-160; Health Canada, *Passive Smoking: Nowhere to Hide*; Lash et al, "Active and Passive Smoking & The Occurrence of Breast Cancer", *Am. J. Epidemiol.* 1999 Jan 1, 149(1):5-12.

# PART 3

## Cleaning the Air

### What Options Are Available?

- **Separate Room, Shared Ventilation:**  
ventilation that is shared with the rest of the building will circulate hazardous chemicals throughout the building
- **Separate Room, Separate Ventilation:**  
employees may still be exposed when work requires them to enter the smoking area  
chemicals will leak into non-smoking areas each time the door is opened
- **Smoke-Free Building:**  
saves cost of building smoking rooms  
eradicates exposure to harmful tobacco smoke  
eliminates the possibility of lawsuits by employees or customers harmed by ETS  
reduces cleaning and maintenance costs  
provides incentive for smokers to quit

### The air in buildings is kept breathable with the use of ventilation.

#### Ventilation systems may:

- recycle the air within a building
- &/or import or release air into or out of the building
- &/or filter particles from the air

### Do Ventilation Systems Remove Any Tobacco Smoke From Indoor Air?

Ventilation systems may remove part of the tobacco smoke by filtering or by replacing indoor air with outdoor air.

Ventilation systems may remove some of the smell or sight of tobacco smoke indoors, however many of the harmful chemicals in tobacco smoke are invisible and odorless.

**Do Ventilation Systems Make The Air Safe?**

No. Ventilation systems do not remove all of the toxic and cancer-causing components.

Ventilation does not eliminate the health risks.

Even if a smoking section is located in a separate room, ventilation systems can circulate the chemicals into the non-smoking rooms.

Just because you cannot see or smell tobacco smoke doesn't mean you are not being exposed: many of the harmful chemicals in tobacco smoke are colourless and odorless.

**What is a safe level of tobacco smoke?**

An acceptable indoor air quality would be one in which there are "no known contaminants at harmful concentrations". Tobacco smoke contains thousands of chemicals, over 40 of which cause cancer (carcinogens).

Because there is no safe level of exposure to certain carcinogens in tobacco smoke, it would be difficult if not impossible to find an acceptable indoor concentration of tobacco smoke.

This fact has been recognized by the government of British Columbia in their Occupational Health and Safety Regulation (296/97). Workers in BC are now protected from tobacco smoke by law.

**Who Sets The Standards For How Clean Indoor Air Should Be?**

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is the body which sets ventilation standards. Ventilation levels are normally set to minimize health risks.

To date, no cognizant health authority has established acceptable concentration levels of tobacco smoke; therefore, ASHRAE has stated that it cannot design a ventilation system that can accommodate tobacco smoke. Ventilation may dilute tobacco smoke, but it will not eliminate the health risk.

Other studies have concluded that to reach a level of tobacco smoke where the risk of an employee contracting cancer would meet acceptable U.S. federal standards, ventilation would have to be increased 270-fold. This is technologically impossible – it would create a windstorm indoors - and the cost would be prohibitive.

*Sources: British Columbia Worker's Compensation Board, Occupational Health and Safety Regulation 296/97; ASHRAE Appeals Panel Recommendation – Addendum e to ANSI/ASHRAE Standard 62-1989, June 14, 1999; Health Canada: Smoking and Indoor Air Quality, Sept. 1, 1998; "Smoking in the Workplace: Ventilation", Smoking Policy: Questions and Answers, National Cancer Institute.*

# PART 4

## Bars and Restaurants

### **Isn't exposure to tobacco smoke a known and accepted occupational risk for service industry workers?**

Some people say that those who don't like inhaling tobacco smoke should just "get another job"; everyone knows bartenders and waiters will be exposed to tobacco smoke! After all, every job carries risks. Tobacco smoke exposure isn't any different than other occupational exposures ... or is it?

#### **Carcinogenic and toxic chemical emissions are banned or restricted in other industries.**

Chemicals that are banned or restricted in other industries may be emitted via tobacco smoke in restaurants, bars and other workplaces. Many employees in the service industry are exposed to these chemicals in the form of tobacco smoke on a daily basis. When these hazardous chemicals are emitted from a tobacco product, it stands to reason that they be regulated to protect the health and safety of all concerned.

#### **Tobacco smoke exposure carries serious - and avoidable - health risks.**

These include coronary and ischaemic heart disease, stroke, & lung cancer.

These tobacco-related health risks are completely avoidable.

#### **Other restrictions are already in place in the service industry.**

Restaurants and bars are subject to health inspections to ensure that sanitary conditions for food preparation are maintained. Strict regulations about ventilation levels in kitchen areas are in place. Establishments cannot serve alcohol to someone who is visibly intoxicated. Rules of conduct for patrons also exist: customers may be required to wear shoes and shirts on the premises, for example.

#### **Legislation already exists to protect certain groups of workers from tobacco smoke.**

For example, Federal workplaces are smoke-free. In British Columbia, workers are protected from second-hand smoke. All Canadians deserve equal protection under the law

### What a typical restaurant employee would inhale

Below is a list of the amount of selected chemicals, emitted in sidestream smoke, that a restaurant employee, weighing approximately 65 kg (140 lbs), would directly inhale (not the total exposure amount) over an 8-hour shift in a 300m<sup>2</sup> area (15 meters x 20 meters).

All of the chemicals below cause adverse health effects. The chemicals marked with an asterisk (\*) are carcinogens; those with two asterisks (\*\*) are Class A carcinogens for which there is no safe level of exposure (Appendix B).

These calculations assume 10 smokers per 300m<sup>2</sup> each smoking 2 cigarettes per hour, totaling 160 cigarettes over the 8-hour time period, and take into account standard ventilation rates.

Further information about these calculations can be found at: [www.smoke-free.ca/eng\\_issues/etschems2.htm](http://www.smoke-free.ca/eng_issues/etschems2.htm)

CHEMICAL	amount (ug)	CHEMICAL	amount (ug)	CHEMICAL	amount (ng)
carbon monoxide	5606	*1,3-butadiene	25	resorcinol	123
tar	3128	hydroquinone	24	*benzo[a]pyrene	18
nicotine	678	methyl ethyl ketone	23	**cadmium	9.7
*acetaldehyde	207	catechol	22	1-aminonaphthalene	8.5
nitric oxide	190	propionaldehyde	17	**chromium	7.1
isoprene	151	cresols	15	*lead	6.0
acetone	121	hydrogen cyanide	14	**2-aminonaphthalene	5.2
toluene	66	styrene	13	**nickel	4.2
*formaldehyde	54	butyraldehyde	12	3-aminobiphenyl	2.4
phenol	44	*acrylonitrile	11	**4-aminobiphenyl	1.4
acrolein	40	*crotonaldehyde	10		
**benzene	36	*quinoline	1.3		
pyridine	33				

Sources: *Americans for Nonsmokers' Rights: Questions and Answers Regarding Eliminating Smoking in Restaurants. February 5, 1992;* ASHRAE Standard (62-1981) office ventilation rate of 10L/second per person (assuming 7 persons per 100 meters squared floor space).

# PART 5

## Costs & Benefits

### Won't Bars and Restaurants Lose Money If They Are Smoke-Free?

Although there is a seeming abundance of anecdotal evidence that businesses would lose money if they went smoke-free, research indicates the opposite is true: **business is maintained or improved following the implementation of smoke-free bylaws.** In June 1999, the Alberta Tobacco Control Centre compiled a list of all available literature on the economic effects of smoke-free by-laws (called ordinances in the United States) on the restaurant and bar businesses. Every study conducted independently of the tobacco industry found that smoke-free laws:

- Do not adversely affect, and may increase, tourist business
- Do not adversely affect restaurant or bar sales, according to sales tax data from 22 American cities
- Do not lead to job losses
- Attract more business (and money) than they drive away
- Do not have a negative effect on other local businesses

Restaurant representatives' self-reported experience after enactment also suggested that concerns about non-smoking ordinances were not realized.

### Hidden Costs of Smoking

Monetary benefits to industry by going smoke-free include:

- Reduction in insurance costs
- Decreased absenteeism and increased productivity
- More rapid customer turnover and lower operating costs
- Reduced property maintenance and cleaning: Cdn\$85 per smoker per year
- A non-smoking business pays about US\$56 per employee per year in health-care work-attendance costs, compared with an average of US\$490 per employee per year in businesses where smoking is allowed.

*Sources: The Conference Board of Canada: Smoking and the Bottom Line: The Costs of Smoking in the Workplace, Jan. 1997; Alberta Tobacco Control Centre, June 1999; U.S. EPA 1994*

# PART 6

## Smoke-Free Q&A

### **Why regulate tobacco smoke?**

Toxic and carcinogenic emissions from factory smokestacks are regulated.

When these same chemicals are emitted from a tobacco product, it stands to reason that they must also be regulated to protect the health and safety of all those concerned.

### **Isn't smoking legal?**

Yes. But there are many reasons why allowing smoking should not simply be a matter of choice. The most compelling, however, is that tobacco smoke affects everyone who breathes.

Many other activities are both legal and regulated. For example, propane barbeques are legal but cannot be used indoors. Note that some of the toxic chemical emissions from barbeques may also be found in tobacco smoke, and yet these emissions are regulated.

While smoking is still legal in Canada, exposing others to tobacco smoke endangers their health. Laws banning or restricting tobacco use in workplaces and public places acknowledge this fact.

### **Isn't smoking just a personal choice?**

If smoking were a personal choice, it would affect only one person: the smoker.

However, 25% of the population suffers from medical conditions, such as asthma and heart disease, that are worsened by tobacco smoke chemicals.

Second-hand smoke also kills an estimated 4,700 Canadians each year (see Part 2).

### **Don't smoking bans discriminate against smokers?**

No. Smokers may enter a smoke-free area, but may not smoke tobacco in that area. Smoke-free allows equal access for all, smokers and non-smokers alike.

Smoking in enclosed spaces does discriminate against others, however. Access may be restricted for those who cannot tolerate tobacco smoke chemicals.

### **Tobacco smoke doesn't bother me, why all this fuss over others' "habits"?**

Although you may not feel immediately affected by tobacco smoke, certain individuals may be especially sensitive to tobacco smoke.

One recent study has shown that non-smokers who report sensitivity to tobacco smoke may have a much higher level of tobacco particle deposition in their respiratory tract than other non-smokers. (95% compared to an average 56%).

And even if you don't feel any immediate discomfort in the presence of tobacco smoke, this does not mean that tobacco smoke isn't harming you.

### **Do smoking bans improve health?**

A study published in the Journal of the American Medical Association reported that less than two months after the implementation of a California law prohibiting smoking in bars, both smoking and non-smoking bartenders reported improved respiratory health and showed improved lung function (rate and volume of exhalation).

*Sources: Morawska, Barron, Hitchins, "Experimental Deposition of Submicrometer Particulate Matter in the Human Respiratory Tract", American Industrial Hygiene Association Journal, 60:334-339, 1999; Journal of the American Medical Association, 1998, 280:1909-1914.*

### **Why Should I Support Smoking Bans?**

- ✓ Over 70% of Canadians do not smoke.
- ✓ About 25% of the population suffer from health conditions that is exacerbated by tobacco smoke.
- ✓ Second-hand smoke is the third leading preventable cause of death.
- ✓ Smoke-free allows equal access to facilities & services for everyone, smokers and non-smokers alike.
- ✓ Going smoke-free reduces property damage and maintenance costs.
- ✓ Equal treatment for all Canadian workers, from Federal public servants to waiters and bartenders.
- ✓ Less employee sick days.
- ✓ Reduce worker's compensation costs.
- ✓ Eliminate risk of liability for exposed employees suffering from tobacco-related illness.
- ✓ Lower insurance costs for smoke-free businesses.
- ✓ Studies show that in cities where smoking bans have been implemented, business has remained constant or increased.
- ✓ Ventilation is not sufficient to eliminate the health risks of tobacco smoke exposure.
- ✓ Smoke-free is the only way to ensure protection for employees and customers from the detrimental health effects of second-hand smoke.

# Appendix A:

## Health Effects of Chemicals found in Cigarette Smoke

**The government of British Columbia has required cigarette manufacturers to measure levels of 40 chemicals in both sidestream and mainstream smoke from each of their cigarette brands.**

These chemicals are associated with the following health effects. A list of sources for the information on this page may be obtained from Physicians for a Smoke-Free Canada.

### 1-AMINONAPHTHALENE

- 1-aminonaphthalene has been shown to cause lung, liver and leukemia cancers in animals.
- 1-aminonaphthalene may cause cancer in humans.
- 1-aminonaphthalene has been shown to have moderate toxicity in fish.
- Absorption occurs both by inhalation and through the skin.
- Absorption through the skin may occur without a sense of irritation or other warning.
- The main industrial uses of 1-aminonaphthalene include dyes, rubber, and weed control.

### 2-AMINONAPHTHALENE

- 2-aminonaphthalene causes cancer in humans.

- There is no safe exposure limit for 2-aminonaphthalene.
- Absorption of 2-aminonaphthalene occurs both by inhalation and through the skin.
- Because it causes cancer, the industrial use of 2-aminonaphthalene is restricted or banned.

### 4-AMINOBIHENYL

- 4-aminobiphenyl is confirmed to cause cancer in humans.
- The carcinogenic nature of 4-aminobiphenyl has been known since at least 1974.
- This chemical has been called 'one of the most potent known bladder carcinogens'.
- There is no known safe level of 4-aminobiphenyl.
- Absorption occurs through the skin.-4-aminobiphenyl is no longer produced on a commercial scale for use in industry.

### 3-AMINOBIHENYL

- 3-aminobiphenyl is a mutagen, and causes mutation in microorganisms.

### 1, 3-BUTADIENE

- 1,3-butadiene suspected to cause cancer in humans.
- Joint exposure to styrene (also found in tobacco smoke) may increase the risk of disease.

- The toxicity of 1,3-butadiene is increased by prolonged or repeated exposures.
- The main industrial uses of 1,3-butadiene include synthetic rubber and tire manufacture.

#### ACETALDEHYDE

- Studies have shown that acetaldehyde causes cancer in animals, and may cause cancer in humans. Small amounts of acetaldehyde irritate the eyes, skin, and respiratory tract of humans and animals.
- Animal studies in which pregnant rats were exposed to acetaldehyde found that acetaldehyde interfered with the exchange of nutrients from the mother to the placenta, resulting in growth retardation, malformation, delayed bone growth and death of the fetus.
- Acetaldehyde may increase the absorption of the other hazardous chemicals in tobacco smoke into the bronchial tubes.
- The main industrial uses of acetaldehyde include silvering of mirrors, leather tanning, fuel, glue, dyes, plastics and synthetic rubbers.
- Acetaldehyde decomposition products include carbon monoxide.

#### ACETONE

- Acetone is an irritant to eyes, nose and throat.
- Acetone irritates, dries, and may burn skin.
- Absorption occurs both via inhalation and through the skin.
- Higher doses can cause dizziness, lightheadedness, damage to the liver and kidneys.

#### ACROLEIN

- Acrolein has not been found to cause cancer. However, in the body, acrolein produces glycidaldehyde which does cause cancer.
- Long term inhalation studies on animals found that acrolein causes emphysema and inflammation of the lung, liver and kidney.
- Acrolein is intensely irritating to the eyes and upper respiratory tract in human and animals.
- Acrolein is 5 times stronger an irritant than formaldehyde, acetaldehyde or crotonaldehyde (all of which are found in tobacco smoke).
- The main industrial uses of acrolein include polyurethane manufacture, polyester resins, herbicides and tear gas.

#### ACRYLONITRILE

- Acrylonitrile is suspected to cause cancer in humans.
- Acrylonitrile is highly toxic. It is similar to cyanide in toxicity, and is also known as 'vinyl cyanide'.
- Absorption of acrylonitrile is from the respiratory and gastrointestinal tract and through the skin.
- Studies on pregnant animals showed 'a significant maternal toxicity', leading to increased possibility of deformation in the fetus and offspring.
- The main industrial uses of acrylonitrile include manufacture of bottles and as a fumigant for tobacco.
- In the United States, acrylonitrile has been withdrawn as a fumigant for all other food commodities.

#### AMMONIA

- Ammonia possesses a sharp, irritating odor detectable as low as 1 ppm.
- At high concentrations, ammonia causes intense irritation, severe eye damage, and asthma.

#### BENZENE

- Benzene is confirmed to cause cancer in humans.
- Benzene is known to cause leukemia in humans.
- Cumulative exposure to benzene is the most likely predictor of the possibility of developing leukemia.
- Leukemia may manifest 2 to 50 years after exposure to benzene.
- Benzene is highly toxic.
- Benzene produces chromosomal aberrations in humans and in animals.
- Benzene is absorbed through the skin.
- Previously, benzene was used in industry to manufacture inks, rubber, lacquers and paint remover.

#### BENZO[a]PYRENE

- Benzo[a]pyrene (B[a]P) is suspected to cause cancer in humans. There is a significant correlation between B[a]P exposure and lung cancer mortality.
- B[a]P was found to cause cancer in animals and fish in every study to date.
- Animal studies showed that as low a dose as 0.05 mg B[a]P caused tumors.
- B[a]P deposits in the lung. Elimination of B[a]P from the lung is severely restricted by cigarette smoking.
- Cancer is more likely to occur with repeated B[a]P exposures than with a single dose of the same amount.

- B[a]P exposure may also cause skin cancer, dermatitis, photoallergy, non-neoplastic respiratory disease and emphysema.
- Exposure to B[a]P results in decreased reproductive capacity for both males and females.
- Absorption of B[a]P also occurs through the skin.

#### **BUTYRALDEHYDE**

- Butyraldehyde is an irritant to eyes, nose, throat and lungs.
- Higher doses of butyraldehyde causes dizziness and lightheadedness, and may burn skin.
- The main industrial uses of butyraldehyde include resins, solvents and plasticizers.

#### **CADMIUM**

- Cadmium is confirmed to cause cancer in humans.
- Cadmium primarily targets the kidneys.
- Chronic cadmium exposure is linked to gastrointestinal symptoms, anemia, rhinitis, discoloration of teeth, microfractures, pulmonary emphysema and kidney disease.
- The main industrial uses of cadmium include metal coatings, bearings, reactor control rods, storage batteries, television phosphors, semiconductors, pigments, and dry film lubricants.

#### **CARBON MONOXIDE**

- Tobacco Smoke is the major source of personal inhalation of carbon monoxide.
- Carbon monoxide is absorbed into the blood, resulting in reduction in exercise tolerance, increased angina and headaches.
- Carbon monoxide binds to haemoglobin, reducing the oxygen-carrying capacity of the blood.
- As little as 3% absorbed carbon monoxide in haemoglobin results in decreased psychomotor function, and therefore can impair driving skills. Headaches may occur at 10% carbon monoxide in haemoglobin.
- Carbon monoxide binds to myoglobin, decreasing heart and muscle function.
- Carbon monoxide is a possible Reproductive Toxin.
- Studies on pregnant animals show decreased birth weights, fetal death or damage at moderate levels of carbon monoxide.
- Fetal carbon monoxide levels are generally 10 to 15% higher than maternal levels.

- Inhaled tobacco smoke increases the level of carbon monoxide in the fetus, increasing the chance of low birth weight, and possible perinatal death or retardation of mental abilities.

#### **CATECHOL**

- Catechol, when inhaled with benzo[a]pyrene (also found in tobacco smoke), is co-carcinogenic.
- Catechol causes increased blood pressure, upper respiratory tract irritation and eczematous dermatitis in humans.
- At higher doses, catechol causes kidney damage and convulsions.
- The main uses of catechol in industry include photography, rubber, dye, oil, insecticides, and inks.

#### **CHROMIUM**

- Cr VI compounds are recognized to cause cancer.
- Cr VI compounds can easily pass into the cell through the cell membrane.
- Cr VI compounds are sensitizers, and can therefore induce an allergic reaction in some individuals.

#### **CROTONALDEHYDE**

- Crotonaldehyde is known to cause cancer in animals.
- Crotonaldehyde causes cancer by interfering with DNA function (a genotoxic carcinogen).
- Crotonaldehyde is a fast-acting (within seconds) irritant to the nose and upper respiratory tract.
- The main use of crotonaldehyde in industry is as a warning agent in fuel gases.

#### **CRESOL**

- Cresol was found to promote tumors in mice.
- Cresol is strongly irritating to skin, and causes dermatitis in humans.
- Long term exposure to cresol leads to headaches, nausea, vomiting, elevated blood pressure, impaired kidney function, blood-calcium imbalance and marked tremors, in humans.
- Cresol is absorbed through the skin.
- The main uses of cresol in industry include ore flotation, disinfectants, synthetic resins, dyes, fumigants, and explosives.

**FORMALDEHYDE**

- Formaldehyde is suspected to cause cancer in humans.- Formaldehyde occurs naturally at 0.12 to 0.38 parts per BILLION [ppb].
- Sidestream smoke increases this by 0.23 to 0.27 parts per MILLION [ppm] (a 1000+ increase).
- Long-term exposure at levels greater than 0.1 ppm appears to be a risk for cancers of the lung, pharynx, buccal cavity, liver, bone, skin, prostate gland, bladder, kidney and eye, leukemia and Hodgkin's disease.
- Animal studies showed formaldehyde is an irritant to eyes, nose, throat and lungs, and causes cellular changes in the upper respiratory tract, a decrease in respiratory rate, and adversely affects the liver.
- Formaldehyde exposure greater than 0.22 ppm is linked to respiratory symptoms such as cough, phlegm, chronic bronchitis, asthma, shortness of breath and chest colds.
- Formaldehyde is known to produce allergic reactions and induction of asthma-like conditions, lightheadedness, dizziness, diminished dexterity, itching eyes, dry and sore throats, disturbed sleep, unusual thirst, and malignant disease in humans.
- Human eyes are sensitive to formaldehyde at concentrations of 0.01 ppm, and are irritated by formaldehyde at concentrations of 0.05 to 0.5 ppm.
- The main uses of formaldehyde in industry include fertilizer, dyes, disinfectants, germicides, preservatives, and embalming fluid.

**HYDROGEN CYANIDE**

- Hydrogen cyanide causes nasal irritation, confusion, headache, dizziness, weakness and nausea in humans at moderate doses.
- At higher doses, hydrogen cyanide causes asthenia, vertigo, loss of weight and gastrointestinal problems.
- The main uses of hydrogen cyanide in industry include fumigation, as an insecticide, electroplating, metallurgy and photography.

**HYDROQUINONE**

- Exposure to hydroquinone leads to eye injury, skin irritation and central nervous system effects in humans.
- The main uses of hydroquinone in industry include rubber production, photography, paints, varnishes and in motor fuel.

**ISOPRENE**

- Isoprene causes skin, eye and mucous membrane irritation.

**LEAD**

- Lead is known to cause cancer in animals. Lead may cause cancer in humans.
- Lead is toxic, and soluble in body fluids when inhaled.
- Lead interacts with enzymes, especially those associated with heme synthesis (blood).
- Absorption of low levels of lead causes an increase in blood pressure in humans.
- Lead causes anemia at blood levels above 80 ug/dl.
- Lead poisoning effects on the brain may not be reversible.
- Long term exposure to lead may lead to kidney disease.
- Lead is a possible Reproductive Toxin.
- Lead may affect sperm formation (at greater than 11.9 ug/dl blood lead).
- Lead exposure affects the development of fetuses. Children who were exposed to blood lead levels of greater than 10 ug/dl in the womb have been found to have developmental effects such as depressed intellectual development.
- Air to blood lead levels: 0.03 to 0.19 ug/dl blood per mg/m3 of lead in air.
- The main uses of lead in industry include alloys (solder, bronze, brass), paint pigments, storage batteries, glass, plastics, ceramics.

**METHYL ETHYL KETONE**

- Methyl ethyl ketone causes nose, throat, and eye irritation in humans at moderate levels.
- The odor of methyl ethyl ketone is detectable at 10 ppm.
- The main uses of methyl ethyl ketone in industry include solvents, resins, artificial leather, rubbers, lacquers, varnishes and glues.

**NICKEL**

- Inhalable, insoluble nickel is confirmed to cause cancer in humans.-Up to 5% of the general population are sensitized (allergic) to nickel.
- Nickel inhalation increases the risk of cancer or of gastrointestinal symptoms.
- Exposure to inhalable nickel may result in chronic irritation of the upper respiratory tract or bronchial asthma.

- Nickel inhalation exposure increases susceptibility to respiratory infection, allergic contact dermatitis, and pulmonary edema.
- The main uses of nickel in industry include production of stainless steel, alloys, electroplating, coinage, and alkaline batteries.

#### **NICOTINE**

- Free-base nicotine (in tobacco smoke) is absorbed almost instantly by inhalation, ingestion and skin contact.
- Nicotine concentrates in the brain, the kidney, the stomach mucosa, the adrenal medulla, the nasal mucosa and the salivary glands.
- Studies show that nicotine exposure can result in seizures, vomiting, depressions of the central nervous system, growth retardation, developmental toxicity in fetuses, and preterm birth with reduced body weight and brain development in animals.
- Nicotine is excreted in breast milk.
- Mild nicotine poisoning in humans results in the following symptoms: vomiting, diarrhea, increase in respiration, heart rate, blood pressure, headache, dizziness, and neurological stimulation.
- Nicotine is considered responsible for many of the acute psychological and physiological effects of smoking, chewing or inhaling tobacco.
- The main uses of nicotine in industry (besides tobacco) include insecticides (now mostly banned) and as tranquilizing darts for wildlife.

#### **NITRIC OXIDE**

- Nitric oxide reacts with haemoglobin to hinder oxygen uptake in the blood.
- Nitric oxide reacts with haemoglobin 1400 times more effectively than carbon monoxide reacts with haemoglobin.
- The toxicity of nitric oxide when combined with carbon monoxide (also in tobacco smoke) is additive.

#### **PHENOL**

- Studies have shown phenol to be toxic to the respiratory, cardiovascular, hepatic, renal and neurological systems of animals.
- Higher doses of phenol may damage the lungs and central nervous system and induce convulsions in humans.

- Phenol is irritating to the skin, mucous membranes and eyes in humans.
- Phenol may be absorbed by inhalation or through the skin.
- The main industrial uses of phenol include chemicals and drugs, disinfectants, germicidal paints and slimicides.

#### **PROPIONALDEHYDE**

- Inhalation of propionaldehyde causes severe irritation of the respiratory system.
- Propionaldehyde causes irritation to skin and eyes.

#### **PYRIDINE**

- Pyridine vapour causes eye and upper respiratory tract irritation in humans.
- Exposure to pyridine results in an increased production of blood platelets.
- Longer duration exposure to pyridine causes nausea, headache, insomnia, nervousness, and abdominal discomfort in humans.
- The disagreeable odor of pyridine is detectable at less than 1 ppm.
- The main industrial uses of pyridine include solvents, pesticides and resins.

#### **QUINOLINE**

- Quinoline causes genetic mutations (mutagen) and therefore may increase your risk of cancer.
- Repeated exposure damages the retina of the eye, affecting vision.
- Repeated exposure to quinoline may damage the liver.
- Quinoline exposure may lead to allergy, with rash and itching (sensitizer).
- Quinoline is irritating to the eyes, nose, throat and bronchial tubes, and may cause sore throat, nose bleeds, cough and phlegm.
- Absorption occurs both by inhalation and through the skin.
- Quinoline bioaccumulates in the tissues of fish.
- The main industrial uses of quinoline include dyes, catalysts, insecticides, herbicides, corrosion inhibitors and to preserve anatomical specimens.

#### **RESORCINOL**

- Resorcinol was found to be irritating to skin and eyes in humans.

- The main industrial uses of resorcinol include tanning, photography, resins, dyes, laminates and adhesives.

#### **STYRENE**

- Styrene is a possible human carcinogen.
- Styrene has been found to produce headaches, ocular and conjunctival irritation and slowed reaction time, fatigue, dizziness and nausea, reduced attention and manual dexterity, and reductions in colour discrimination, in humans.
- Reproductive effects of styrene include a possible increased incidence of spontaneous abortion and increased number of abnormal sperm.
- When styrene and butadiene (also in tobacco smoke) are combined, they produce 4-phyglycolhexene, a suspected sensitizer.
- The main industrial uses of styrene include plastics, coatings, polyesters, resins, and synthetic rubbers.

#### **TAR**

- Tar is the tobacco industry term for all non-gaseous, non-nicotine, non-water chemicals in tobacco smoke.

#### **TOLUENE**

- Toluene is highly toxic.
- Toluene is a possible Reproductive Toxin.
- Inhaled toluene appears in blood circulation within 10 seconds and accumulates in body fat.
- Toluene is a depressant to the central nervous system in animals and in humans.
- Long term low level exposure results in headaches, lassitude, loss of appetite, disturbances in menstruation, reductions in intelligence and psychomotor skills.
- Higher exposure results in encephalopathy, headache, depression, lassitude, impaired coordination, transient memory loss, impaired reaction time, dizziness, nasal discharge, drowsiness, and metallic taste.
- The main uses of toluene in industry include rubbers, oils, resins, adhesives, inks, detergents, dyes, and explosives.

#### **TOBACCO SPECIFIC NITROSAMINES**

##### **NNN (N-nitrosornicotine)**

- NNN is a carcinogenic Tobacco-Specific Nitrosamine (TSNA) found only in tobacco products.
- NNN is formed from nicotine directly and is the most abundant cancer-causing TSNA.
- NNN is a yellow, oily liquid that is known to cause nose, throat, lung and digestive tract cancer in animals.

- NNN may cause reproductive damage in humans.
- There is no safe level of exposure to NNN.

##### **NNK**

- [(4-methylnitrosamino)-1-(3-pyridyl)-1-butanone] is a carcinogenic Tobacco-Specific Nitrosamine (TSNA) found only in tobacco products.
- NNK is a powerful lung carcinogen.
- NNK induces adenoma and AC tumors of the lung.
- There is no safe level of exposure to NAT.

##### **NAT (N-nitrosoanatabine)**

is a possibly carcinogenic Tobacco-Specific Nitrosamine (TSNA) found only in tobacco products

# Appendix B:

## Carcinogens in Tobacco Smoke

(International Agency for Research on Cancer - IARC)

### Group 1: Carcinogenic to Humans

4-Aminobiphenyl  
Benzene  
Cadmium  
Chromium  
2-Naphthylamine  
Nickel  
Polonium-210 (Radon)  
Vinyl Chloride

### Group 2A: Probably Carcinogenic to Humans

Acrylonitrile  
Benzo[*a*]anthracene  
Benzo[*a*]pyrene  
1,3-Butadiene  
Dibenz[*a,h*]anthracene  
Formaldehyde  
*N*-Nitrosodiethylamine  
*N*-Nitrosodimethylamine

### Group 2B: Possibly Carcinogenic to Humans

Acetaldehyde  
Benzo[*b*]fluoranthene  
Benzo[*j*]fluoranthene  
Benzo[*k*]fluoranthene  
Dibenz[*a,h*]acridine  
Dibenz[*a,j*]acridine

### Group 2B Continued

7*H*-Dibenz[*c,g*]carbazole  
Dibenzo[*a,i*]pyrene  
Dibenzo[*a,l*]pyrene  
1,1-Dimethylhydrazine  
Hydrazine  
Indeno[1,2,3-*cd*]pyrene  
Lead  
5-Methylchrysene  
4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK)  
2-Nitropropane  
*N*-Nitrosodiethanolamine  
*N*-Nitrosomethylethylamine  
*N*-Nitrosomorpholine  
*N*-Nitrosornicotine (NNN)  
*N*-Nitrosopyrrolidine  
Quinoline  
*ortho*-Toluidine  
Urethane (Ethyl Carbamate)  
**Group 3: Limited Evidence**  
Chrysene  
Crotonaldehyde  
*N*-Nitrosoanabasine (NAB)  
*N*-Nitrosoanatabine (NAT)

Source: *Reducing the Health Consequences of Smoking: 25 years of progress, a report of the Surgeon General. 1989, U.S. Department of Health and Human Services.*

# Appendix C:

## Suggested Reading

### 1. Economics of Smoking Bans

**"Tourism and hotel revenues before and after passage of smoke-free restaurant ordinances";** S.A. Glantz, A. Charlesworth, *Journal of the American Medical Association* 281: 1911-1918, 1999.

'Conclusion: smoke-free ordinances do not appear to adversely affect, and may increase, tourist business.'

**"Analysis of taxable sales receipts: Was New York City's Smoke-Free Air Act bad for restaurant business?";** A. Hyland, K.M. Cummings, E. Nauenberg, *Journal of Public Health Management Practice* 5(1):14-21, 1999.

'Real taxable sales from eating and drinking places and hotels in NYC increased by 2.1 % and 36.9 % respectively'

**"Restaurant employment before and after the New York City Smoke-Free Air Act";** A. Hyland, K. M. Cummings, *Journal of Public Health Management Practice* 5(1): 22-27, 1999.

'The data suggest that the NYC Smoke-Free Air Act did not result in job losses for the city's restaurant industry'

**"The Economic Effect of Smoke-Free Restaurant Policies on Restaurant Businesses in Massachusetts";** W. J. Bartosch, G. C. Pope, *Journal of Public Health Management Practice*, 5(1): 53-62, 1999.

'The study failed to find a statistically significant effect of local smoke-free policies on restaurant business.'

**"Prohibiting Smoking in Restaurants: Effects on Restaurant Sales"**, J.P. Sciacca, M.I. Ratliff, *American Journal of Health Promotion* 12(3): 176-184, 1998.

'Conclusions: Study findings indicate that prohibiting smoking in Flagstaff, Arizona restaurants has had no effect on restaurant sales'

**"Environmental tobacco smoke regulations have not hurt restaurant sales in North Carolina"**; A.O. Goldstein, R. A. Sobel, *North Carolina Medical Journal* 59(5): 284-287, 1998.

'Even in the number one tobacco-producing state in the US, ETS regulations present no adverse economic impact'

**"The effect of ordinances requiring smoke-free restaurants and bars on revenues: A follow-up"**; S.A. Glantz, L.R.A. Smith, *American Journal of Public Health* 87(10): 1687-1693, 1997.

'Conclusions: Smoke-free ordinances do not adversely affect either restaurant or bar sales'

**"Assessment of the impact of a 100% smoke-free ordinance on restaurant sales – West Lake Hills, Texas, 1992-1994"**; P. Huang, S. Tobias, S. Kohout, M. Harris, D. Satterwhite, D.M. Simpson, L. Winn, J. Foehner, L. Pedro, *Morbidity and Mortality Weekly Report* 44(19): 370-372, 1995.

'...the total sales of the restaurants did not decrease after implementation of the ordinance.'

**"The effect of ordinances requiring smoke-free restaurants on restaurant sales"**; S.A. Glantz, L.R.A. Smith, *American Journal of Public Health* 84(7): 1081-1085, 1994.

'Conclusions: Smoke-free restaurant ordinances do not adversely affect restaurant sales'

**"Effects of a city ordinance regulating smoking in restaurants and retail stores"**; J. Sciacca, M. Eckrem, *Journal of Community Health* 18(3): 175-182, 1993.

'Gross sales increased an average of 16 to 25.8 % per store during the year following prohibition of smoking in retail stores.'

**"The economics of smoke-free restaurants"**; Toronto: The Conference Board of Canada, 1996.

'The case studies and the validation survey do not support the fear that going smoke-free would be detrimental overall for business.'

## 2. Perception and Behavior

**"Perceptions of the effect of an impending restaurant smoking ban on dining-out experience";** M. Wakefield, L. Roberts, C. Miller, *Preventive Medicine*, 29(1): 53-56, July 1999.

'The public expects bans on smoking in restaurants to result in both increased enjoyment and increased patronage of restaurants'

**"Restaurateur reports of the economic impact of the New York City Smoke-Free Air Act";** A. Hyland, K.M. Cummings, *Journal of Public Health Management Practice* 5(1): 37-42, 1999.

'The objective of this study was to determine the extent to which restaurateurs have reported a change in business... there is no evidence to suggest that the smoke-free law has had a detrimental effect on the city's restaurant business'

**"Behavior intentions of the public after bans on smoking in restaurants and bars";** L. Biener, M. Siegel, *American Journal of Public Health* 87(12): 2042-2044, 1997.

'Smoke-free policies are likely to increase overall patronage of bars and restaurants'

**"A mandatory smoking ban in restaurants: Concerns versus experiences";** J.P. Sciacca, *Journal of Community Health* 21(2): 133-150, 1996.

'While some customers appeared to have negative reactions to an ordinance that prohibited smoking, four times that many appeared to have positive reactions to the ordinance'

**"The response of Winnipeg retail shops and restaurants to a bylaw regulating smoking in public places";** R. S. Stanwick, M.P. Thomson, P.M. Swerhone, L.A. Stevenson, D.G. Fish, *Canadian Journal of Public Health*, 79: 226-230, 1988.

'Business response was generally positive...over 87% of respondents favoured regulating smoking in public places.'

### 3. Health Effects of Exposure to Second-hand Smoke

**"Health effects of exposure to environmental tobacco smoke: Final Report"**; California Environmental Protection Agency, Office of the Environmental Health Hazard Assessment, September 1997.

**"Environmental tobacco smoke exposure and ischaemic heart disease: an evaluation of the evidence"**; M.R. Law, J.K. Morris, N.J. Wald, *British Medical Journal* 315: 973-988, 18 October 1997.

**"Passive Smoking and the Risk of Coronary Heart Disease – A Meta Analysis of Epidemiologic Studies"**; J. He, S. Vupputuri, K. Allen, M.R. Prerost, J. Hughes, P.K. Whelton, *The New England Journal of Medicine*, 340(12):920-926, March 25, 1999.

**"Passive Smoking as well as Active Smoking Increases the Risk of Acute Stroke"**, R. Bonita, J. Duncan, T. Truelsen, R. T. Jackson, R. Beaglehole, *Tobacco Control* 8:156-160, Summer 1999.

Other sources include:

**The Health Effects of Second-hand Smoke: A Selection of Studies**; *National Clearinghouse on Tobacco and Health Bibliography*. <http://www.cctc.ca/ncth/publicinfo/lists-B1.html>



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