5 OCCUPATIONAL HEALTH

Hazardous materials in the workplace may cause occupational disease in the body at four main sites:

1. Where they enter the body—entry routes such as the lungs, skin, and intestines
2. In the blood that carries the hazardous materials throughout the body
3. In the central nervous system
4. In the organs which have the ability to remove toxic agents from the body: (i.e., the liver, kidneys, and bladder—exit routes).

This section briefly describes four routes of entry—inhalation, absorption, ingestion, and injection—and some of the workplace hazards and diseases commonly associated with them.

The Respiratory System

The body’s respiratory—or breathing—system is one of the most common routes of entry for a toxic substance (Figure 5-1). The substance may cause damage to the system itself or it can pass through the lungs to other parts of the body.

The main function of the respiratory system is to absorb oxygen from the air and pass it on to the blood. It also removes carbon dioxide—the waste gas produced by the body’s processes—from the blood and releases it in exhaled air.

Air reaches the lungs through a branching system of tubes, starting with the trachea, or windpipe, which divides to form two bronchi, one to each lung. Each bronchus, in turn, branches into many smaller divisions, finally ending in a small cluster of tiny air sacs that are known as alveoli. The oxygen and carbon dioxide exchange takes place through a very thin membrane surrounding these air sacs.

The lung is covered by a delicate lining known as the pleura. (Mesothelioma, one of the cancers caused by asbestos, is a cancer of the pleura.)

Inhalation Hazards

The airways of the respiratory system have developed an elaborate system of defence that traps all but the smallest dust particles. This system consists of hairs in the nose and mucus in the trachea or bronchi. The mucus is produced continuously by special cells in the walls of the larger airways. It is moved upward and to the back of the throat by the whipping action of cilia—tiny, hair-like projections on the cells of the trachea and bronchi.

Large dust particles are trapped in the mucus and are either swallowed or spit out. Particles smaller than 0.5 microns (1 inch has 25,400 microns) may remain airborne and are exhaled. The most dangerous size of dust particles is 0.5-7.0 microns. Much too small to be seen with the naked eye, they can evade the defence system and reach the lungs. Once in the lungs, these tiny particles of dust may cause extensive scarring of the delicate air sacs. This scarring can start a disease process that produces severe shortness of breath.

Most dust particles are too large to pass through the walls of the alveoli, but gases, vapours, mists, and fumes can all enter the bloodstream through the lungs. In addition, welding fumes or truck exhausts can stimulate the lung’s defences to produce large amounts of phlegm, causing the condition known as chronic bronchitis. These same substances can destroy the delicate air sacs of the lungs, causing emphysema.

Carcinogens

Carcinogens are substances that can cause cancer. It’s not well understood exactly how a carcinogen produces cancer. Some are thought to interact with the genetic material of the cell, while others may interact with the immune system. Still others are thought to act with other agents, but do not initiate cancer themselves. Whatever the mechanism, the effect is very often delayed, sometimes up to 30 years.

The lungs are the prime target for occupational carcinogens because they:

- are in intimate contact with workplace air pollutants
- have such a large surface area (100-140 m²).

Defining a chemical as carcinogenic usually involves animal studies as a first step. If the substance causes cancer in animals, particularly those that have biological systems similar to humans, it is classed as a suspected carcinogen. Two examples are silica and refractory ceramic fibres, which cause lung cancer.
Some chemicals have also been shown to be cancer-causing through industrial experience. These include asbestos (cancer of the larynx, lung, and abdomen), vinyl chloride (liver cancer), coal tar pitch (skin cancer), chromium (lung cancer), and benzidine (bladder cancer). All chemicals that have been classified as carcinogens should be handled with extra care.

**Asbestos**

Inhaling asbestos dust has been shown to cause the following diseases:

- Asbestosis
- Lung cancer
- Mesothelioma (cancer of the lining of the chest and/or abdomen).

**Asbestosis** is a disease of the lungs caused by scar tissue forming around very small asbestos fibres deposited deep in the lungs. As the amount of scar tissue increases, the ability of the lungs to expand and contract decreases, causing shortness of breath and a heavier workload on the heart. Ultimately, asbestosis can be fatal.

**Lung cancer** appears quite frequently in people exposed to asbestos dust. While science and medicine have not yet been able to explain precisely why or how asbestos causes lung cancer to develop, it is clear that exposure to asbestos dust can increase the risk of contracting this disease. Studies of asbestos workers have shown that the risk is roughly five times greater than for people who are not exposed to asbestos.

Cigarette smoking, another cause of lung cancer, multiplies this risk. Research has shown that the risk of developing cancer is at least fifty times higher for asbestos workers who smoke than for workers who neither smoke nor work with asbestos.

**Mesothelioma** is a relatively rare cancer of the lining of the lungs, chest wall, and/or abdomen. While this disease is seldom observed in the general population, it appears frequently in groups exposed to asbestos.

**Other illnesses**—There is also some evidence of an increased risk of cancer of the stomach, rectum, and larynx. However, the link between asbestos exposure and the development of these illnesses is not as clear as with lung cancer or mesothelioma.

The diseases described above do not respond well to current medical treatment and, as a result, are often fatal.

See Chapter 34: Asbestos in this manual for more information.

**Silica**

Crystalline silica is a basic component of soil, rock, and sand. It is found in cement and concrete as well as many other common construction materials. Silica exposure can occur from any operation where dust containing silica is generated.

When silica is inhaled it travels into the deep parts of the lungs, where it can cause damage. Because silica cannot be seen with the naked eye, you may not see any dust in the air. Therefore you should always take precautions to protect yourself and others whenever you are working with materials containing silica.

Silica can cause a variety of diseases, including

- **Silicosis**—an inflammation and scarring of the lungs that makes it difficult to breathe and is often fatal
- **Chronic obstructive pulmonary disorder (COPD)**—a combination of chronic bronchitis and emphysema that is often fatal
- **Scleroderma**—an autoimmune disease that causes hardening of the skin and sometimes of the vital organs
- **Lung cancer**.

**NOTE:** There is no cure for most of the diseases caused by silica. The only way to prevent them is to avoid being exposed to it.

**Preventing exposure to silica**

- Use water and wet working methods to keep the silica dust that is generated out of the air.
- If you must cut or grind, use a wet-cut saw.
- Only mix cement in well-ventilated areas.
- Work upwind from sources of dust. Allow the wind to carry the dust away from you.
- Use tools and equipment that have dust collectors or water attachments.
- Use respiratory protection. Depending on the concentration of dust, an N95 filtering facepiece respirator may be suitable.
- Clean up the workplace frequently to prevent a buildup of dust and silica. Do not dry-sweep or use compressed air to clean.
- Wash your face and hands before eating, drinking, or smoking and before going home.

For more detailed information about silica controls, see the Ministry of Labour’s guideline *Silica on Construction Projects* at: www.labour.gov.on.ca/english/hs/pubs/silica

**Asphyxiants**

Chemicals that interfere with the transfer of oxygen to the tissues are called asphyxiants. The exposed individual literally suffocates because the bloodstream cannot supply enough oxygen for life.

There are two main classes of asphyxiants—simple and chemical. **Simple asphyxiants** displace oxygen in the air, thereby leaving less or none for breathing.
Chemical asphyxiants cause the same effect by interfering with the body’s ability to take up, transport, or use oxygen. Simple asphyxiants are a major hazard in confined spaces, where breathable air can be displaced by gas from sewage, for instance.

When the normal oxygen level of 21% drops to 16%, breathing and other problems begin, such as lightheadedness, buzzing in the ears, and rapid heartbeat. Simple asphyxiants in construction include argon, propane, and methane. These chemicals usually have no other toxic properties.

Carbon monoxide is one example of a chemical asphyxiant. It combines with the oxygen-carrying compound in the blood and reduces its ability to pick up “new” oxygen. Hydrogen sulphide, on the other hand, interferes with the chemical pathways which transfer the oxygen, while hydrogen cyanide paralyzes the respiratory centre of the brain.

Carbon Monoxide
Carbon monoxide (chemical abbreviation: CO) is a colourless, odourless, and poisonous gas. It is produced by the incomplete burning of fuels. Workers who use gasoline-powered tools and equipment in buildings or semi-enclosed spaces are at risk of being exposed to carbon monoxide.

Carbon monoxide can accumulate rapidly, building up to dangerous or fatal levels within minutes. Since you cannot see or smell CO, you need a detector to warn if this hazard is present.

Breathing in CO gas interferes with your body’s ability to use oxygen. Eventually, it deprives the body tissues of the oxygen that it needs for survival.

Tools, vehicles, and equipment powered by gasoline can be a source of CO.

Health effects of CO
CO causes the following effects in the body:
• Headache
• Fatigue
• Nausea
• Weakness
• Dizziness
• Confusion
• Shortness of breath
• Impaired vision or hearing
• Loss of consciousness and death.

Workers with heart and lung disease are particularly sensitive to CO exposure. In addition, smokers have higher levels of CO in their blood and may experience symptoms sooner than non-smokers.

Preventing exposure to CO
• Avoid using fuel-powered equipment indoors whenever possible. Use electric-powered equipment, especially in confined spaces and poorly ventilated areas.
• If fuel-powered tools and equipment must be used indoors, avoid unnecessary idling, racing the engine, or braking erratically.
• Use personal CO monitors equipped with audible alarms to warn you when CO levels are too high. If dangerous levels are reached, evacuate the work area immediately. (See Table 5-1 for some suggested alarm settings.).
• If compressors or generators are used, keep them outside.
• Make sure the work area is well-ventilated. Use air movers (large fans) and keep windows and doors open to bring fresh air inside. Note: This alone may not reduce CO to safe levels.
• Learn to recognize the symptoms of CO overexposure and keep an eye out for symptoms in yourself and co-workers.
• If you notice any symptoms, turn the equipment off immediately and go outdoors. Notify your supervisor. If symptoms persist, call 911 for medical attention. DO NOT drive or operate a motor vehicle.
• Inspect and maintain fuel-powered tools and equipment in accordance with the manufacturer’s instructions to ensure they run properly and as cleanly as possible. Ensure that the air intake and fuel systems are working correctly.
• Your company’s Health and Safety Program should have written policies and procedures in place to control and monitor CO exposure in the workplace.

As of July 1, 2016, changes to section 47 of the Regulation for Construction Projects (213/91) require maintenance and servicing of internal combustion engines and air testing to ensure that the concentration of CO does not exceed the Occupational Exposure Limit (OEL). OELs restrict the amount and length of time a worker can be exposed to hazardous chemicals in the air.

The TWA is the amount of chemical substance in air that a worker may be exposed to averaged over an 8-hour workday or 40-hour work week. If exposure limits are kept below the TWA, adverse health effects should not occur. The time-weighted average limit of CO must not exceed
• 25 ppm for an 8-hour shift
• 75 ppm for any 30-minute period
• 125 ppm at any time.

(See O. Reg. 213/91, s. 47.)
The Skin
Absorption through the skin is another common form of entry for toxic substances (e.g., organic solvents). The skin is the largest organ of the body, with a surface area of 1 to 2 m\(^2\). Some chemicals can penetrate through the skin, reach the bloodstream, and get to other parts of the body where they can cause harm. Toluene and Cellosolve are examples of chemicals that are absorbed through the skin. Mineral spirits and other solvents used in the manufacturing of paint can easily penetrate the skin.

The skin protects the internal organs of the body from the outside environment. Its outer layer is composed of hardened, dead cells that make the skin resistant to daily wear and tear. Sweat glands cool the body when the environment is hot. Sebaceous glands produce oils, which repel water. A network of small blood vessels, or capillaries, plays a key role in controlling body temperature. These capillaries open when it is hot, radiating heat outward into the air, and constrict when it is cold, conserving heat in the body. The skin also has a protective layer of oils and proteins that helps to prevent injury or penetration by harmful substances (Figure 5-2).

Hazards
A substance may be absorbed and travel to another part of the body, or it may cause damage at the point of entry (the skin), and start the disease process. Such substances are usually identified in an (M)SDS with a notation “skin” along with their exposure limits, indicating that the exposure can occur through the skin, mucous membranes, or eyes, or may damage the skin itself.

Skin Irritants
Dermatitis is an inflammation of the skin that can be caused by hundreds of workplaces substances like solvents (paints), epoxy resins, acids, caustic substances, and metals. Dermatitis appears as redness, itchiness, or scaling of the skin.

There are two types of dermatitis:
1. Primary irritation dermatitis (contact dermatitis)
2. Sensitization dermatitis (allergic dermatitis).

Major dermatitis hazards in construction are listed in Table 5-2.

Contact dermatitis is caused by friction, heat or cold, acids, alkalis, irritant gases, and vapours. Skin in contact with the chemical turns red, becomes itchy, and may develop eczema (inflammation, scaling, and collection of fluid droplets under the skin’s surface). Typical hazards in construction include caustics, acids, many chlorinated solvents, wet concrete, chromic acid, and calcium hydroxide. Allergic contact dermatitis, is the result of an allergic reaction to a given substance. Sensitization may be the result of prolonged or repeated contact and becomes established usually within 10 to 30 days. The process could also take years.

Once sensitized, even a slight exposure can produce a severe reaction. Substances like organic solvents (paints), chromic acid, and epoxy resins can produce both primary and contact dermatitis. Sensitizers include epoxy materials (especially the hardener), nickel, and chromium.

Certain agents such as coal tar and creosote can have a strong sensitizing effect when combined with exposure to sunlight—they are known as photosensitizers.

Solvents
Keratin solvents: These injure or dissolve the outer layer of the skin producing dry, cracked skin. All the alkalis such as ammonium hydroxide, sodium hydroxide, and calcium chloride are keratin solvents.

Fat and oil solvents: These remove the surface oils of the skin so that it can no longer hold water efficiently. Dry, cracked skin results. Organic solvents such as toluene and xylene will cause this condition.

Keratin stimulants: On contact these primary irritants cause a change in the skin so that unusual growth appears, as with exposure to coal tar pitch and arsenic.

Some hazardous materials used in the workplace have been linked with skin cancer. A number of them are listed below.

<table>
<thead>
<tr>
<th>Suspected Causes of Skin Cancer at the Workplace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
</tr>
<tr>
<td>Asphalt</td>
</tr>
<tr>
<td>X-rays</td>
</tr>
<tr>
<td>Cutting Oils</td>
</tr>
</tbody>
</table>

OCCUPATIONAL HEALTH
Table 5-1: CO Alarm Settings

<table>
<thead>
<tr>
<th>Alarm Setting</th>
<th>Airborne Concentration of CO (parts per million)</th>
<th>Precautions</th>
</tr>
</thead>
</table>
| Low           | 25 ppm (8-hour work shift) 17.5 ppm (10-hour work shift) | • Turn off unneeded fuel-powered equipment and tools.  
• Increase ventilation by opening windows and doors or using a fan.  
• Record the alarm event in a log book and discuss it with your superintendent.  
**If the alarm continues to sound or activates again after the precautions above have been taken:**  
• Increase ventilation by opening more windows and doors or using additional fans where needed.  
• Have the company superintendent meet with the constructor to resolve fresh air ventilation issues before continuing work. |
| High          | 75 ppm                                           | • Use the same precautions as for the “Low” alarm setting.  
• Turn off all fuel-powered equipment.  
• Limit the number of workers in the area while exhaust emissions are being ventilated.  
• Notify the company superintendent immediately.  
• Complete a CO Action Form. |

**NOTE:** Consult your company’s Joint Health and Safety Committee (JHSC) or Health and Safety Representative as well as the equipment manufacturer for alarm settings that are appropriate to your workplace.

Table 5-2: Major Dermatitis Hazards in Construction

<table>
<thead>
<tr>
<th>Material</th>
<th>Type</th>
<th>Occupation/Activity</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Concrete</td>
<td>Allergic/Corrosive</td>
<td>Concrete Workers</td>
<td>Rubber boots, rain pants, rubber gloves if necessary.</td>
</tr>
<tr>
<td>Epoxy Materials</td>
<td>Allergic/Defatting (solvents may aggravate allergy)</td>
<td>Cement Finishers, Seamless Floor Installers, Painters, Tile/Terrazzo Installers</td>
<td>Barrier creams, Gloves resistant to specific solvents (see Glove Selection Chart in Chapter 16), Good personal hygiene</td>
</tr>
<tr>
<td>Coal Tar</td>
<td>Allergic</td>
<td>Roofers, Waterproofer</td>
<td>Change work clothing daily if doing dusty work, Barrier creams usually work well, Good personal hygiene</td>
</tr>
<tr>
<td>Solvents/Degreasers</td>
<td>Defatting</td>
<td>Mechanics, Painters, Service Trades, Millwrights</td>
<td>Appropriate gloves (see Glove Selection Chart in Chapter 16), Minimize skin contact, Good personal hygiene</td>
</tr>
<tr>
<td>Cleaners</td>
<td>Corrosive/Defatting</td>
<td>Labourers, Service Trades</td>
<td>Usually rubber gloves, boots and maybe rain pants, Good personal hygiene</td>
</tr>
</tbody>
</table>

Table 5-3: Chemicals That May Affect the Nervous System

<table>
<thead>
<tr>
<th>Depression of Central Nervous System</th>
<th>Brain Poisoning</th>
<th>Brain Damage by Oxygen Deprivation</th>
<th>Nerve Function Disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetates</td>
<td>Carbon disulfide</td>
<td>Asphyxiating gases, Carbon monoxide</td>
<td>Organo-phosphate pesticides, Organo-phosphate plasticizers, Heavy Metals, Mercury, Lead, Manganese, Arsenic</td>
</tr>
<tr>
<td>Alcohols</td>
<td>Hydrogen cyanide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brominated chemicals</td>
<td>Hydrogen sulfide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorinated chemicals</td>
<td>Stibine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethers</td>
<td>Arsine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketones</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Digestive System

A third major route of entry for toxic substances is through the mouth and digestive tract (Figure 5-3). Toxic materials may reach the stomach when food or drink is consumed, when cigarettes are smoked in a dusty work area, when clean lunchrooms are not provided, when workers fail to wash their hands before eating or smoking, or when food is left unwrapped in a dusty place.

Lead dust, for example, is easily ingested in this way and can have serious health effects. Once swallowed, the substances enter the digestive tract and may enter the bloodstream.

The digestive tract is a continuous tube that extends from the mouth to the rectum. The organs of the digestive system provide the means of ingestion, digestion, and absorption of food. Almost all digestion and absorption of food and water take place in the small intestine. The large intestine generally absorbs vitamins and salts.

Hazards

Once swallowed, the toxic substances enter the digestive tract, where they may enter the bloodstream and move on to the liver. The liver and kidneys try to remove the poisons and make the substances less harmful to the body, but they are not always successful.

The Circulatory System

In rare cases the chemical may enter the body by injection. Skin can be punctured by paint from a high-pressure spray gun or oil from a high-pressure hydraulic hose. This is very serious and requires prompt medical attention. Chemicals in the paint or oil can damage the immediate area and be transported by the blood to a target organ. Chemicals can also be injected into the body by means of puncture wounds from nails or staples, for example.

The circulatory system is not usually in direct contact with hazardous materials. Once in the bloodstream, however, harmful substances can be transported to any part of the body.

The centre of the circulatory system is the heart (Figure 5-4). It pumps blood outward through a vast network of blood vessels which branch like a tree, becoming smaller and smaller as they go. The vessels branch so extensively that no cell is more than a few millimeters from a blood vessel or capillary.

Hazards

Food and oxygen reach every cell in the body through capillaries, but so do toxic substances from the workplace. Oxygen is carried by a protein called hemoglobin, which is contained in the red blood cells. Oxygen binds strongly to hemoglobin, but unfortunately, so does carbon monoxide, a common workplace hazard produced by combustion engines in trucks, machinery, etc. In fact, carbon monoxide binds or attaches to hemoglobin about 200-300 times more readily than oxygen.
In high concentration, carbon monoxide can kill because it overloads the hemoglobin in the red cells and replaces the oxygen which the body needs to survive. But even low levels of repeated carbon monoxide exposure may have serious effects on the heart and the central nervous system.

Many toxic substances attack the blood cells directly. The body forms blood cells continually in the marrow cavity inside the bones. Hazardous materials like benzene can interfere with this formative process and cause anemia, a shortage of red blood cells. Some of the workplace materials that may cause anemia are listed below.

<table>
<thead>
<tr>
<th>Substances That May Cause Anemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsine Gas</td>
</tr>
<tr>
<td>Copper</td>
</tr>
<tr>
<td>Lead</td>
</tr>
<tr>
<td>Compounds</td>
</tr>
</tbody>
</table>

The Liver

The liver is the chemical factory of the body. The cells which make up the liver contain enzymes that can convert certain toxic substances into forms that are more easily handled by the body. But the liver itself may be damaged if it is overwhelmed by toxic substances.

The liver may become inflamed, producing the condition known as hepatitis. This disease may be caused by a virus or by chemicals like alcohol, carbon tetrachloride, and other chlorinated hydrocarbons. Repeated bouts of hepatitis may lead to liver scarring and a disease called cirrhosis of the liver. Generally speaking, it means that there are not enough normal liver cells remaining to detoxify body chemicals.

Overexposure to chemicals like acrylonitrile, benzene, carbon tetrachloride, DDT, chloroform, phenol, styrene, tetrachloroethane, and tetrachloroethylene may also cause liver damage. Vinyl chloride, a substance used in the production of plastics, has been linked to a rare and deadly form of liver cancer called angiosarcoma. Some substances that may cause liver damage are listed below.

<table>
<thead>
<tr>
<th>Suspected Causes of Liver Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile</td>
</tr>
<tr>
<td>Antimony</td>
</tr>
<tr>
<td>Arsenic</td>
</tr>
<tr>
<td>Beryllium</td>
</tr>
<tr>
<td>Bismuth</td>
</tr>
<tr>
<td>Cadmium</td>
</tr>
<tr>
<td>Copper</td>
</tr>
<tr>
<td>Indium</td>
</tr>
<tr>
<td>Manganese</td>
</tr>
<tr>
<td>Nickel</td>
</tr>
<tr>
<td>Phosphorus</td>
</tr>
<tr>
<td>Selenium</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The Kidneys and Bladder

The kidneys act as a filter for substances in the blood (Figure 5-5). Each kidney contains over a million small filters. These filters clean the blood, removing a number of impurities that are deposited in the urine. The urine then passes to little tubes that monitor the levels of acid and the amount of water in the body, keeping them balanced. From these tubes, the urine moves to the bladder, which stores it until it is released from the body.

Since the kidneys act as filters, they can be seriously injured by toxic substances passing through the body. Kidney disorders may result in high or low blood pressure, which in turn may cause heart strain or heart failure.

Kidney malfunction may also upset the body’s delicate chemical balance, resulting in further harm to the body. Just as the lungs are vulnerable to hazardous materials because they are a major route of entry, the kidneys and bladder are vulnerable because they are a major route of exit.

<table>
<thead>
<tr>
<th>Suspected Causes of Kidney Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
</tr>
<tr>
<td>Mercury</td>
</tr>
<tr>
<td>Cadmium</td>
</tr>
<tr>
<td>Chromates</td>
</tr>
<tr>
<td>Copper</td>
</tr>
<tr>
<td>Uranium</td>
</tr>
<tr>
<td>Beryllium</td>
</tr>
<tr>
<td>Arsenic</td>
</tr>
<tr>
<td>Arsenic</td>
</tr>
<tr>
<td>Sodium Fluoride</td>
</tr>
<tr>
<td>Iodine</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
</tr>
</tbody>
</table>

Figure 5-5: The Kidney System

Some of the suspected causes of kidney damage are listed below.
The Nervous System

To stay alive, we must breathe continuously, our heart must pump constantly, and all the other organs must function. We also think and respond to emotions and sensations. All these functions performed by the mind and body are controlled by the nervous system.

The central nervous system is the control centre. The spinal cord connects the brain to the nervous system. Part of the nervous system reaches the outer areas and is called the peripheral nervous system.

Most injuries of the central nervous system are permanent, although damage to the peripheral nervous system can sometimes be reversed. Exposure to metals like lead and mercury may interfere with nerve impulses and result in tremors and loss of reflexes or feeling.

Central nervous system depression covers effects such as headache, lightheadedness, drowsiness, and unconsciousness. The organ affected is the brain and the result is depressed performance. Many solvents such as toluene, xylene, ether, and acetone produce this effect if the vapour concentration is high enough. Workers exposed to these chemicals in cleaning solvents, paints, thinners, and degreasers may have experienced these effects.

The brain needs a constant supply of oxygen. Some toxic chemicals interfere with the functioning of the central nervous system and disrupt the oxygen supply. The first warning signs are dizziness and drowsiness. Warning signs should be heeded immediately and appropriate action taken. For example, you should immediately leave the area and seek medical assistance.

The operations of the nervous system are very complicated. It is a delicately balanced system and several chemicals can damage it, such as those shown in Table 5-3.

The Reproductive System

Workplace hazards affect the worker, but the problem reaches into the worker’s home as well.

The reproductive organs—the testes in men and the ovaries in women—produce the cells that allow us to reproduce. Any damage to these cells can have disastrous consequences. Deformities in children may result or the developing embryo may be so severely damaged that it is unable to survive and is miscarried.

Some chemicals cause miscarriages or birth defects by attacking the genetic material of cells or the systems which control its functions. Similar damage may also be involved in cancer—cancer-causing substances are often the cause of birth defects and miscarriages.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Reduced fertility</th>
<th>Microangiopathy</th>
<th>Chromosomal damage</th>
<th>Malformations</th>
<th>Sperm damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaesthetic gases</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>♂♂</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epichlorohydrin</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethylene dibromide</td>
<td>♂♂</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ethylene oxide</td>
<td>♂♀</td>
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<td></td>
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<tr>
<td>Glutaraldehyde</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ionizing radiation</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroprene</td>
<td>♂♂</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic solvents</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon disulphide</td>
<td>♂♀</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>♂♀</td>
<td></td>
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</tr>
</tbody>
</table>

Legend:
♂ = Male exposure
♀ = Female exposure

Source: Finland’s Institute for Occupational Health, Helsinki.

Designated Substances

“Designated substances” are substances that have been targeted for special regulation by the Ministry of Labour. Generally these substances are well-known toxic materials that present serious risk of illness.

Designated substances encountered in construction include asbestos, lead, coal tar products, silica, and other chemicals. If any designated substances are present where construction, maintenance, or renovation is planned, the parties involved must be notified and informed.

The OHSA requires that owners notify contractors of the presence of any designated substance. Contractors also have a responsibility to advise subcontractors. This notification must take place before binding contracts are arranged.

IHSA has developed a guide for creating an owner’s notification report. Owner’s Duties: Designated Substances on Construction Projects (W130) is available to download for free from the [ihsa.ca website](http://ihsa.ca) (Figure 5-6).

It is also available in French: Obligations du propriétaire: Substances désignées dans les chantiers de construction (W130F).
Latency of Workplace Diseases

The effects of exposure to workplace safety hazards are sometimes immediate, painful, and obviously damaging, but it is not always easy to observe when and how the body’s cells are attacked by hazardous products or substances in the workplace. Many of the most serious diseases do not occur until 10 to 30 years after exposure. Latency refers to the time lag between exposure to a hazardous material and the eventual development of a disease. The latency period does not refer to the total duration of exposure to a substance, but to the time that has elapsed since the first exposure. For many occupational hazards, the latency period is from ten to twenty years. It may even be as long as thirty or forty years.

Latency has a number of important implications for the worker. An individual exposed to a highly dangerous substance may feel no ill effects at the time of exposure. The effects may only show up many years later. For instance, exposure to ionizing radiation or asbestos causes very little in the way of symptoms at the time of actual exposure, but the long-term effects can be deadly.

Past scientific studies have often failed to address the problem of latency in evaluating the incidence of disease (such as asbestosis). In order to develop a clear picture of diseases that appear many years after exposure, researchers must study not only the current workforce (including many workers who have worked in a particular environment for less than twenty years), but also those workers who had exposure in the past.

Finally, a workplace free of disease is not necessarily a workplace free of hazards. The diseases of today generally reflect the working conditions of several decades ago. Similarly, the workplace hazards of today may produce the health problems of the future.

Acute and Chronic Effects

Workplace hazards may have both immediate and long-term effects on the body. These are termed acute and chronic effects. The sudden collapse of a worker who has been exposed to massive doses of carbon monoxide, or the headaches of a backhoe operator working in a poorly ventilated cab, are examples of acute effects.

The acute effects of toxic substances occur immediately or very soon after the worker’s exposure, and are generally caused by high levels of exposure. They may cause death, but are often treatable if caught quickly. Sudden and dramatic, they result from the direct action of the hazardous material on the cells of the body.

Often more serious, however, are the chronic effects of toxic substances. Chronic effects become apparent only after many years. By and large, they are not treatable. They often result from the body’s attempts to repair itself or to compensate for the acute effects of a substance. For example, cancer is a chronic effect, as is the lung scarring caused by silica dust or the hearing damage caused by excessive noise. Chronic disease becomes evident only after severe damage has occurred.

The acute effects of hazardous material are usually very different from the chronic effects. Table 5-4 illustrates the difference between the acute and chronic effects of some of the hazards discussed earlier.

Exposure limits have been developed for various hazardous materials to protect workers, but they should not be treated as a fine line between safe and unsafe workplaces. Not all individuals react in the same manner to the same amount of a harmful material. The levels of workers’ exposures should be reduced to the lowest practical level achievable.

Efforts to reduce workers’ exposures should start at half the exposure limit. This is known as the “action level”.

Table 5-4: Acute and Chronic Effects of Common Workplace Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Acute</th>
<th>Chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid Mists</td>
<td>Irritation of the eyes and throat, watering of the eyes, cough, sore throat, chest pain</td>
<td>Chronic bronchitis and emphysema</td>
</tr>
<tr>
<td>Asbestos</td>
<td>Mild respiratory irritation, cough, sneezing</td>
<td>Asbestosis; cancer of the lung, pleura, larynx, stomach, and intestines</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>Drowsiness, headache, confusion; in very high amounts, unconsciousness and death</td>
<td>May contribute to heart attacks</td>
</tr>
<tr>
<td>Dust (containing silica)</td>
<td>Cough, irritation, bronchitis, asthma</td>
<td>Silicosis, cancer, bronchitis</td>
</tr>
<tr>
<td>Noise</td>
<td>Temporary threshold shift, tinnitus, pain</td>
<td>Noise-induced hearing loss, tinnitus</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>Lightheadedness, euphoria, “drunken” feeling, numbness</td>
<td>Liver and kidney damage, possibly liver cancer</td>
</tr>
<tr>
<td>Vibration</td>
<td>Tingling and stiffness in the joints</td>
<td>Arthritis, tendinitis</td>
</tr>
</tbody>
</table>
Toxic Effect Factors Related to the Substance

a) Chemical composition
Different chemicals produce different effects, but changes in composition may influence the toxic effect. For example, pressure-treated wood presents very little problem when dry. However, when the wood is burned the preservative decomposes, producing more toxic chemicals.

In some instances, exposure to more than one chemical may change the toxic effect. For example, a person who works with solvents and then has a drink after work will get drunk faster and may have an increased risk of liver damage than from either factor alone.

b) Physical properties
With respiratory hazards, the two main concerns:
1. Particle size
2. Vapour pressure.

Particles greater than 10 micrometers in diameter are removed from inhaled air in the nose and upper respiratory system. As particle size decreases, the system’s ability to remove particles also decreases until it is unable to filter out the substance.

Vapour pressure measures the potential of a liquid to vaporize. The higher the vapour pressure, the greater the hazard. If, for example, two solvents of equal toxicity are available for use, the one with the lower vapour pressure will present less of a vapour hazard and will therefore be the safer choice.

c) Solubility in body fluids
Certain chemicals are more soluble in body fluids than others. Chemicals termed lipid soluble are soluble in cell membranes. They can very easily penetrate the body and are more mobile once inside. By being lipid soluble, they may also remain longer in the body before being excreted. Organic solvents such as toluene, xylene, acetone, and methanol are considered lipid soluble.

Toxic Effect Factors Related to the Exposure

a) Dose
With most chemicals, the frequency and severity of toxic effect is directly related to how much of the hazard the individual is exposed to and for how long. This is commonly referred to as the dose/effect or dose/response relationship. With ethyl alcohol, for example, there is no adverse effect if the dose is within the body’s ability to control it. However, if the dose exceeds that capacity, the effect increases with the amount consumed.

By examining the past use of toxic materials in the workplace, by conducting animal studies, and by comparison with other substances, it is possible to assign “safe working levels” of exposure for many materials. The “threshold” is the level up to which no significant adverse effect is likely to occur in most people.
Preventing exposure to sensizers

- Make sure you receive WHMIS training. Consult the Safety Data Sheet (SDS) for the product you're using and familiarize yourself with the health effects, the ways to control exposure, and the handling and storage procedures.
- Ensure adequate ventilation to prevent vapours from building up.
- Store materials in tightly sealed containers when not in use.
- Use the right kind of personal protective equipment (PPE) when handling products containing sensizers. Refer to the SDS for the product. PPE may include:
  - Supplied-air respiratory protection
  - Impermeable gloves (neoprene, nitrile, etc.)
  - Eye protection such as chemical goggles
  - Coveralls or other clothing to protect the skin
- Keep the area clear of workers who are not protected by PPE. Use barriers and warning signs.
- Clean up spills quickly while using the right PPE.
- Follow good hygiene practices—wash hands and face before eating, drinking, or smoking.

Outdoor Hazards

Those who work outside can be exposed to such hazards as disease-carrying insects and poisonous plants. It is important that workers learn to recognize these hazards and ways to prevent exposure to them.

West Nile Virus

Those who work outdoors in the summer and early autumn can contract West Nile virus, which is transmitted by the bite of an infected mosquito. Even if infected, however, most people (about 80%) don't show any sign of illness.

Health effects

Common symptoms of West Nile virus include:
- Headache
- Fever
- Body Ache
- Nausea
- Rash on chest, stomach, or back

Treatment

Approximately one in 150 people will have serious symptoms including brain damage, which may be fatal in severe cases. If you think you may have contracted West Nile virus, contact your doctor immediately.

Precautions

- Wear long-sleeved shirts, long pants, and socks when possible.
- Use an insect repellent containing DEET or Picaridin on the skin and on the outside of thin clothing. Do not spray insect repellent on skin that is under your clothing.
- After working, use soap and water to wash the insect repellent off your skin and any clothing that has been treated with the repellent.
- Be extra cautious when mosquitoes are most plentiful—from early evening to early morning.
- Stay indoors when your work allows it.
- Reduce or eliminate mosquito breeding grounds (stagnant or standing water).

Lyme Disease

Lyme disease is an infection caused by a bacteria, Borrelia burgdorferi. Blacklegged ticks (a.k.a. deer ticks) can transmit Lyme disease. These ticks can be found in wooded, bushy areas or around tall grasslands primarily in southern Ontario.

The risk of tick bites increases between early spring and late fall. Those who work in certain outdoor areas are at risk and need to protect themselves.

Health effects

Early symptoms and signs may include:
- Fever
- Headache
- Muscle and joint pains
- Fatigue
- Swollen glands
- Skin rash (usually looks like a red bull’s eye).

Treatment

If you develop any of these symptoms, tell your doctor immediately. Patients who are treated early with antibiotics usually experience a complete recovery.

Precautions

- Wear light-coloured clothing to help find ticks more easily.
- Wear long-sleeved shirts and long pants. Tuck your pants into your socks. Wear a hat if in contact with overhead vegetation.
- Use a bug (tick) repellent that contains 20 to 30% “DEET”. Read the manufacturer’s instructions before applying repellent. Spray or apply it to exposed skin and outer clothing.
- Check any equipment or gear that you may have brought with you outside for ticks.
• Avoid bushy areas and long grass if possible.
• Wear protective gloves when handling dead animals.
• Immediately after outdoor work, do a total body inspection for ticks. Pay close attention to armpits, in and around ears, behind knees, areas with body hair, and the navel and groin.
• Take a shower soon after being outdoors. Put clothes in the dryer for one hour on high heat to kill any ticks.
• If you find any ticks, report it immediately so that other workers can be made aware of the hazard.
• If you have been bitten by a tick, contact your local public health department for proper procedures to follow.

Hazardous Plants
Several hazardous plants throughout Ontario can cause painful reactions if they touch a worker’s skin. Outdoor workers should learn to recognize these hazardous plants so they can avoid them (Figure 5-7). They include:
• Giant hogweed – has purple blotches and coarse hairs on its stalk and jagged leaves.
• Wild parsnip – has umbrella-like clusters of yellow flowers.
• Poison sumac – has 3 to 6 pairs of oval-shaped leaflets on the sides and one at the top. These leaves turn red in the fall.
• Poison ivy – has three leaflets, but the middle one is longer than the two side leaflets.
• Stinging nettle – has leaves that are dark green, egg-shaped, toothed and tapered. It produces greenish-white flowers.

Health effects
Symptoms and signs of exposure include:
• Itchy rashes
• Swelling and inflammation of the skin
• Burning sensations with reddening or blistering of the skin
• Long spots or streaks on the skin
• Temporary or permanent blindness

Treatment
If exposed, workers should:
• Wash the affected skin immediately with soap and cold water.
• Stay out of the sun and cover up exposed areas.
• Get medical attention.

Precautions
• Never touch or brush up against these plants with bare skin.
• Wear coveralls, boots, and rubber gloves. Use a face shield to protect your eyes and face.
• Avoid using power tools near these plants and don’t burn them. This can release toxic sap or oil.
• Wash all equipment that has touched the plant, sap, or oil.
• Carefully remove clothing to avoid contact with sap that may be on them.
• Wash your boots and rubber gloves with soap, water, and a scrub brush before taking off protective clothing.
• Put non-disposable clothing in the laundry and wash with soap and water.