

# ATSDR Case Studies in Environmental Medicine Taking an Exposure History



**U.S. Department of  
Health and Human Services**  
Agency for Toxic Substances  
and Disease Registry

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

*CASE STUDIES IN ENVIRONMENTAL MEDICINE (CSEM)*

# Taking an Exposure History

**Course:** WB 2579

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- Key Concepts**
- Because many hazardous exposures from environmental and occupational sources either manifest as common medical problems or have nonspecific symptoms, an exposure history is vital for correct diagnosis.
  - By taking a thorough exposure history, the primary care clinician can play an important role in detecting, treating, and preventing disease due to toxic exposure.

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**About This and Other Case Studies in Environmental Medicine**

This educational case study document is one in a series of self-instructional modules designed to increase the primary care provider's knowledge of exposures to hazardous substances and to promote the adoption of medical practices that aid in the evaluation and care of potentially exposed patients. The complete series of Case Studies in Environmental Medicine is located on the ATSDR Web site at URL: <http://www.atsdr.cdc.gov/csem/csem.html> In addition, the [downloadable PDF](#) version of this educational series and other environmental medicine materials provides content in an electronic, printable format, especially for those who may lack adequate Internet service.

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Please Note: Each content expert for this case study has indicated that there is no conflict of interest that would bias the case study content.

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**U.S. Department of Health and Human Services**

**Agency for Toxic Substances and Disease Registry**

**Division of Toxicology and Human Health Sciences**

**Environmental Medicine Branch**

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## How to Use This Course

<b>Introduction</b>	The goal of <i>Case Studies in Environmental Medicine</i> (CSEM) is to increase the primary care provider's knowledge of hazardous exposures and to help in evaluation and treating of potentially exposed patients. This CSEM focuses on taking an exposure history.
<b>Availability</b>	Two versions of the <b>Taking an Exposure History</b> CSEM are available. <ul style="list-style-type: none"> <li>• The HTML version (<a href="http://www.atsdr.cdc.gov/csem/csem.asp?csem=33&amp;po=0">http://www.atsdr.cdc.gov/csem/csem.asp?csem=33&amp;po=0</a>) provides content through the Internet</li> <li>• The downloadable PDF version (<a href="http://www.atsdr.cdc.gov/csem/exp/history/docs/exposure_history.pdf">http://www.atsdr.cdc.gov/csem/exp/history/docs/exposure_history.pdf</a>) provides content in an electronic, printable format, especially for those who may lack adequate Internet service.</li> <li>• The HTML version offers interactive exercises and prescriptive feedback to the user.</li> </ul>
<b>Instructions</b>	To make the most effective use of this course. <ul style="list-style-type: none"> <li>• Take the Initial Check to assess your current knowledge about taking an exposure history.</li> </ul>

- Read the title, learning objectives, text, and key points in each section.
- Complete the progress check exercises at the end of each section and check your answers.
- Complete and submit your assessment and posttest response online if you wish to obtain continuing education credit. Continuing education certificates can be printed immediately upon completion.

**Instructional Format**

This course is designed to help you learn efficiently. Topics are clearly labeled so that you can skip sections or quickly scan sections you are already familiar with. This labeling will also allow you to use this training material as a handy reference. To help you identify and absorb important content quickly, each section is structured as follows

<b>Section Element</b>	<b>Purpose</b>
<b>Title</b>	Serves as a “focus question” that you should be able to answer after completing the section
<b>Learning Objectives</b>	Describes specific content addressed in each section and focuses your attention on important points
<b>Text</b>	Provides the information you need to answer the focus question(s) and achieve the learning objectives
<b>Key Points</b>	Highlights important issues and helps you review
<b>Progress Check Exercises</b>	Enables you to test yourself to determine whether you have mastered the learning objectives
<b>Progress Check Answers</b>	Provide feedback to ensure you understand the content and can locate information in the text



**Learning Objectives**

Upon completion of the ATSDR *CSEM: Taking an Exposure History*, you should be able to perform the following learning objectives.

<b>Section Title</b>	<b>Learning Objective(s)</b>
What Is the Purpose of Taking an Exposure History?	Explain the importance of taking an exposure history.
What Role Do Primary Health Care Providers Have in Detecting, Treating, and Preventing Disease Resulting from Toxic Exposures?	Explain why primary health care providers should be knowledgeable about the exposure history process.
Which Organ Systems Are Affected By Toxic Exposure(s)?	Explain how organ systems may be affected by toxic exposure(s).
What Are Possible Sources	Identify possible sources of indoor air pollution.

	<p>of Indoor Air Pollution?</p>	
<p>What Are Other Potential Sources and Pathways of Hazardous Exposure in the Home and Environment?</p>	<p>Identify additional potential sources of hazardous exposure in the home and environment.</p>	
<p>What Are the Components of an Exposure History?</p>	<p>Describe the components of an exposure history.</p>	
<p>What Is Included in the Exposure Survey (Part 1) of an Exposure History Form?</p>	<p>Explain how temporal relationships between a patient's symptoms and their non-work or work environments are identified.</p>	
<p>What Is Included in the Work History (Part 2) of an Exposure History Form?</p>	<p>Describe how a seasoned clinician reveals a possible temporal relationship between a patient's symptoms and their workplace.</p>	

	<p>What Is Included in the Environmental History (Part 3) of an Exposure History Form?</p>	<p>Describe how a seasoned clinician reveals a possible temporal relationship between a patient's symptoms and their home and surrounding environment(s).</p>
	<p>What Instructions Should Be Given to Patients?</p>	<p>Describe instructions that should be given to patients exposed or potentially exposed to hazardous substances.</p>
	<p>What Are Additional Environmental Health Resources?</p>	<p>Describe additional environmental health resources.</p>

## Initial Check

<p><b>Instructions</b></p>	<p>This Initial Check will help you assess your current knowledge about taking an exposure history. To take the Initial Check, read the case below, and then answer the questions that follow.</p>
<p><b>Case Study</b></p>	<p>On Tuesday afternoon, a 52-year-old man with previously diagnosed coronary artery disease</p>

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controlled by nitroglycerin describes episodes of recurring headache for the past 3 weeks. Mild nausea often accompanies the headache; there is no vomiting. He describes a dull frontal ache that is not relieved by aspirin. The patient states that the headaches are sometimes severe; at other times they are a nagging annoyance. The durations range from half an hour to a full day.

His visit was also prompted by a mild angina attack that he suffered this past weekend shortly after he awoke on Sunday morning. He has experienced no further cardiac symptoms since that episode.

History of previous illness indicates that the patient was diagnosed with angina pectoris 3 years ago. He has been taking 0.4 milligrams (mg) of sublingual nitroglycerin prophylactically before vigorous exercise. He also takes one aspirin every other day. He has been symptom-free for the past 2½ years.

Sublingual nitroglycerin relieved the pain of the Sunday morning angina attack within several minutes.

The patient does not smoke and rarely drinks alcohol. He is a trim man with a slightly ruddy complexion.

At present, he is afebrile and his vital signs are

- Blood pressure 120/85,
- Pulse 80, and
- Respirations 20.

Physical exam is within normal limits.

The results of an electrocardiogram (ECG) with a rhythm strip performed in your office are unremarkable.

Subsequent laboratory testing reveals normal

- Blood lipids,
- Cardiac enzymes,
- Complete blood cell count (CBC),
- Sedimentation rate,
- Glucose,
- Creatinine, and
- Thyroid function.

**Initial  
Check  
Questions**

1. What would you include in the patient's problem list?
2. What would you include in the differential diagnosis?
3. What additional information would you seek to assist in the diagnosis?

**Initial  
Check  
Answer(s)**

1. The patient's problem list includes recurrent headache and nausea, and unstable angina pectoris.
2. The patient's differential diagnosis of chest pain includes myocardial infarction. The differential diagnosis of headache and nausea includes
  - Tension headaches,
  - Migraine,
  - Brain tumor,
  - Tooth or sinus problems,
  - Psychogenic headache,
  - Medication reaction (nitroglycerin can cause headaches),
  - Viral syndrome, and

	<ul style="list-style-type: none"> <li>• Exposure to toxicants (carbon monoxide, solvents).</li> </ul> <p>3. The additional information sought to make a diagnosis would include all aspects of a work and environmental exposure history.</p>
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## What Is the Purpose of Taking an Exposure History?

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### Learning Objective

Upon completion of this section, you will be able to

- Explain the importance of taking an exposure history.

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### Purpose

Most environmental and occupational diseases either manifest as common medical problems or have nonspecific symptoms. Unfortunately, hazardous exposures rarely enter into the clinician's differential diagnosis. As a result, clinicians may miss the opportunity to make correct diagnoses that might influence the course of disease. A correct diagnosis may help stop exposure and might prevent disease in others by avoiding exposure [Gehle et al. 2011; Goldman and Peters 1981].

What can a clinician do to improve recognition of disease related to current or past exposures?

- First, one must be suspicious and think about the possibility of environmental and occupational factors of disease.
- Next, one needs to incorporate an exposure history questionnaire into clinical practice.

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This course illustrates the principles and practices involved in the development of a differential diagnosis that includes possible hazardous exposure related etiologies.

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**Benefits**

Taking an exposure history may enable physicians to

- Make more accurate diagnoses,
- Influence the course of disease by stopping current exposure,
- Prevent disease in others by avoiding future exposure, and
- Prompt workplace evaluations and the protection of workers.

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**Goals**

The goals of taking an exposure history are

- Identifying the hazard,
- Avoiding or stopping the exposure,
- Preventing disease,
- Identifying and treating disease early, and
- Arresting or reversing the progression of the patient's illness.

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**Exposure  
Factors and  
Etiology**

The preceding case study describes a patient with angina. He has new, nonspecific symptoms of headache and nausea.

Suppose this patient lived near a hazardous waste site.

- Would your differential diagnosis change?
  - If the patient refinished furniture as a hobby, would you consider this important?
-

- 
- Is there a connection between his headaches and cardiac symptoms?
  - How would you investigate the possible correlation?
  - Could he be exposed to chemicals in his workplace?

Each of these factors could play a role in the etiology of this patient's illness; each exposure could cause disease.

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### **Three Scenarios**

The patient described in the case study—a 52-year-old male with angina—is portrayed in three scenarios throughout this document. An exposure history provides clues that prompt the clinician to investigate the possibility of toxic exposure.

- Scenario 1: This patient is an accountant who has had the same job and the same residence for many years.
- Scenario 2: This patient owns a commercial cleaning service and uses cleaning products at various industrial and commercial sites.
- Scenario 3: This patient is a retired advertising copywriter who lives in the vicinity of an abandoned industrial complex.

In each scenario, the clinician's pursuance of the exposure history led to discovery of toxic exposure in each of the three cases.

In each case, the diagnosis and treatment might have been inappropriate without an exposure history.

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### **Etiology Denotes Environmental and**

Most environmental and occupational diseases either manifest as common medical problems (e.g., rashes, asthma, angina, spontaneous abortion) or have nonspecific symptoms (e.g., headache, difficulty



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**Occupational Diseases**

concentrating, behavioral problems, myalgias, difficulty conceiving) [Amdur MO 1991; Marshall et al. 2002; Wigle D 2000].

Establishing the etiology can distinguish a disorder as an environmental illness.

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**Table 1. Examples of Environmental & Occupational Causes of Medical Problems**  
 [Goldman and Peters 1981; Nelson et al. 2011]

<b>Symptoms and Diseases</b>	<b>Agent</b>	<b>Mode of Exposure</b>
<b>Immediate or Short-Term Effects</b>		
dermatoses (allergic or irritant)	metals (chromium, nickel), fibrous glass, solvents, caustic alkali, soaps	electroplating, metal cleaning, plastics, machining, leather tanning, housekeeping
headache	carbon monoxide, solvents	firefighting, automobile exhaust, wood finishing, dry cleaning
acute psychoses	lead, mercury, carbon disulfide	removing paint from old houses, fungicide, wood preserving, viscose rayon industry

asthma or dry cough	Formaldehyde, toluene diisocyanate, animal dander	textiles, plastics, polyurethane kits, polyurethane foam, lacquer, animal handlers
pulmonary edema, pneumonitis	nitrogen oxides, phosgene, halogen gases, cadmium	welding, farming, chemical operations, smelting
cardiac arrhythmias	solvents, fluorocarbons	metal cleaning, using solvents, refrigerator maintenance
angina	carbon monoxide, methylene chloride	car repair, traffic exhaust, foundry, wood finishing
abdominal pain	lead	battery making, enameling, smelting, painting, welding, ceramics, plumbing

hepatitis (may become chronic)	halogenated hydrocarbons (e.g., carbon tetrachloride)	using solvents, lacquer use, hospital workers
<b>Latent or Long-Term Effects</b>		
chronic dyspnea, pulmonary fibrosis	asbestos, silica, beryllium, coal, aluminum	mining, insulation, pipefitting, sandblasting, quarrying, metal alloy work, aircraft or electrical parts, foundry work
chronic bronchitis, emphysema	cotton dust, cadmium, coal dust, organic solvents, cigarettes	textile industry, battery production, soldering, mining, solvent use
lung cancer	asbestos, arsenic, nickel, uranium, coke-oven emissions	insulation, pipefitting, smelting, coke-ovens, shipyard workers, nickel refining, uranium mining

bladder cancer	â-naphthylamine, benzidine dyes	dye industry, leather, rubber-workers, chemists
peripheral neuropathy	lead, arsenic, hexane, methyl butyl ketone, acrylamide	battery production, plumbing, smelting, painting, shoemaking, solvent use, insecticides
behavioral changes	lead, carbon disulfide, solvents, mercury, manganese	battery makers, smelting, viscose rayon industry, degreasing, manufacture/repair of scientific instruments, dental amalgam workers
Extrapyramidal syndrome	carbon disulfide, manganese	viscose rayon industry, steel production, battery production, foundry work

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aplastic anemia, leukemia	benzene, ionizing radiation	chemists, furniture refinishing, cleaning, degreasing, radiation workers
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Unless an exposure history is pursued by the clinician, the etiologic diagnosis might be missed, treatment may be inappropriate, and exposure can continue.

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### Key Points

- Most environmental and occupational diseases either manifest as common medical problems or have nonspecific symptoms. Unless an exposure history is pursued by the clinician, the etiologic diagnosis might be missed, treatment may be inappropriate, and exposure can continue.
- The goals of taking an exposure history are
  - Identifying the hazard,
  - Avoiding or stopping the exposure,
  - Preventing disease,
  - Early identification and treatment of disease, and
  - Arresting or reversing the progression of the patient's illness.

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**Progress  
Check  
Exercise(s)**

1. Which of the following statements about taking an exposure history is **NOT TRUE**? Most environmental and occupational diseases have specific symptoms. An exposure history provides clues that prompt the clinician to investigate the possibility of toxic exposure.
  - C. Etiology distinguishes a disorder as an environmental or occupational illness.
  - D. Taking an exposure history may enable physicians to influence the course of disease.

*To review relevant content see this entire section.*

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## **What Role Do Primary Health Care Providers Have in Detecting, Treating, and Preventing Disease Resulting from Toxic Exposures?**

<b>Learning Objective(s)</b>	Upon completion of this section, you will be able to <ul style="list-style-type: none"><li>• Explain why primary health care providers should be knowledgeable about the exposure history process.</li></ul>
<b>Introduction</b>	Environmental and occupational factors contribute to more than 25% of all global disease [Smith et al. 1999; WHO 2007], and toxic agents ranked fifth in underlying causes of U.S. deaths in 2000 [Mokdad et al. 2004].  Many people with illness caused or exacerbated by exposure to hazardous substances obtain their medical care from clinicians who are not

	<p>specialists in environmental or occupational medicine.</p> <p>Consideration of environmental and occupational exposures rarely enters into the clinician's history taking or diagnosis [Marshall et al. 2002]. Environmental medicine education is largely omitted in the continuum of U.S. medical education, leaving future physicians and current practitioners without expertise in environmental medicine to provide or facilitate environmental preventive or curative patient care [Gehle et al. 2011].</p>
<p><b>What Happens in the Clinical Setting</b></p>	<p>A chart review of 2,922 histories taken by 137 third-year medical students showed that smoking status was documented in 91%, occupation in 70%, and specific occupational exposures in 8.4% of the total number of cases. Patients less than 40 years of age and women were significantly less likely than older patients or men to have their occupation and industry noted [Marshall et al. 2002; McCurdy et al. 1998].</p> <p>Findings from another study showed that work-related issues might not be adequately addressed or documented in the provider's clinical notes and that opportunities for preventive care relating to work-related injuries and illnesses may not be realized in the primary care setting [Thompson et al. 2000].</p> <p>A recent report about U.S. medical schools disclosed that graduating students received inadequate instruction in environmental health [AAMC 2010].</p> <p>A recent national online survey of American Congress of Obstetricians and Gynecologists</p>



	<p>(ACOG) fellows showed that among 2,514 survey responses, 50% reported that they rarely take an environmental health history; less than 20% reported routinely asking about environmental exposures commonly found in pregnant women in the United States; and only 1 in 15 reported any training on the topic [Stotland et al. 2014].</p> <p>Practicing primary care physicians report the need for environmental medicine education to better recognize, diagnose, and treat patients in their clinical practice with environmental related illness [Gehle et al. 2011].</p>
<p><b>What Clinicians Need to Do</b></p>	<p>The single most important aspect of the approach to patients with potential occupational or environmental disease is to have a high index of suspicion and to follow through on that suspicion [Frank AL 2000].</p> <p>Although many clinicians recognize the importance of taking a work and exposure history to evaluate certain problems, most have had little training or practice in doing so [Becker 1982; Frank AL 2000; Gehle et al. 2011; Kilpatrick et al. 2002; Merritt 1999; Pope AM and Rall DP 1995; Stotland et al. 2014].</p> <p>There are numerous resources available to practitioners who may want to spend the time and effort needed to better understand environmental and occupational issues.</p> <p>Extensive knowledge of toxicology is not needed to diagnose environmental and occupational disease. The criteria employed are the same as those used for diagnosing other medical problems:</p>

- History, including onset and temporal pattern of symptoms, noting palliative and provocative factors;
- Physical examination; and
- Laboratory results.

If necessary, consultation with other health professionals such as industrial hygienists or occupational health nurses, may facilitate the gathering of useful information concerning exposures. See the "[What Are Additional Environmental Health Resources](#)" for additional information.

Industrial hygienists, who are often employed by state health departments or industry, are a source of information to the clinician investigating a possible toxic exposure. Industrial hygiene is the discipline devoted to the recognition, evaluation, and control of workplace-related factors or stresses that may cause illness, impaired health or well-being, or significant discomfort and inefficiency among workers or community members. They can be helpful in assessing whether a significant exposure has occurred.

Occupational health nurses, who often work at patients' work sites, also have expertise and experience that may be valuable to the clinician.

Medical specialists, such as board certified clinicians specializing in occupational and environmental medicine or medical toxicology can assist the primary health care provider in the evaluation and management of patients exposed or potentially exposed to hazardous substances.

	<p>For more information on clinical consultation resources, please see the section <a href="#">“What Are Additional Environmental Health Resources?”</a></p> <p>In addition to current exposures, the clinician must consider the long-term or latent effects of past exposures to agents such as asbestos, radiation, and chemical carcinogens.</p> <p>Taking an exposure history creates the opportunity to counsel patients in appropriate preventive behaviors to mitigate or limit their exposure risk.</p>
<p><b>Exposure History Form</b></p>	<p>The exposure history form (see Appendix I) can be completed by the clinician, other office staff, or by the patient. This information will help guide the clinician through various aspects of the process. This form elicits many important points of an exposure history, including job descriptions and categories associated with hazardous substances, or physical and biologic agents. In addition, it may suggest temporal and activity patterns related to environmental and occupational disease.</p> <p>The form explores past and current exposures and comes in several formats including an editable electronic version (see Appendix I for more information on available formats).</p>
<p><b>Process Takes Just a Few Minutes</b></p>	<p>Taking an exposure history requires only a few minutes and can be</p> <ul style="list-style-type: none"> <li>• Abbreviated,</li> <li>• Expanded, or</li> </ul>

	<ul style="list-style-type: none"> <li>• Focused according to the patient's signs and symptoms.</li> </ul> <p>The exposure history form is designed for quick scanning of important details. Its contents can be added to the electronic health record as baseline information that may aid in the investigation of current or future problems.</p> <p>An exposure history should be taken on every patient. It is of particular importance if the patient's illness occurs at an atypical age or is unresponsive to treatment.</p>
<p><b>Use Sound Judgment</b></p>	<p>The diagnosis of environmental and occupational disease cannot always be made with certainty. Sound clinical judgment must be used and common etiologies should be considered. The multi-factorial nature of many conditions, particularly chronic diseases, should not be overlooked.</p> <p>The clinician must also keep in mind that many organ systems are affected by toxic exposures (<u>Table 2</u>). Exposure and effects can be acute or chronic. The latency period from exposure to disease manifestation can vary, ranging from immediate to delayed (hours or days) or prolonged (decades).</p>
<p><b>Conclusion</b></p>	<p>With practice using the exposure history form and utilizing appropriate clinical resources when necessary, the primary care clinician can play an important role in the detection, treatment, and prevention of diseases that may result from toxic exposures.</p>

<b>Key Points</b>	<ul style="list-style-type: none"><li>• Although many clinicians recognize the importance of taking a work and exposure history to evaluate certain problems, many have had little training or practice doing so.</li><li>• An exposure history should be taken on every patient. It is of particular importance if the patient's illness occurs at an atypical age or is unresponsive to treatment.</li><li>• Taking an exposure history creates the opportunity to counsel patients in appropriate preventive behaviors to mitigate or limit their exposure risk.</li><li>• With practice using the exposure history form and utilizing appropriate clinical resources when necessary, the primary care clinician can play an important role in detecting, treating, and preventing disease resulting from toxic exposures.</li><li>• Multidisciplinary resources can provide valuable input to health care providers on a variety of hazard related issues including characterization of exposure and exposure risk.</li></ul>
<b>Progress Check Exercise(s)</b>	<p>2. Which of the following statements is true?</p> <ul style="list-style-type: none"><li>A. Taking an exposure history requires lots of the clinician's time.</li><li>B. Extensive knowledge of toxicology is needed to diagnose environmental and occupational disease.</li><li>C. Many primary care clinicians have had little training or practice in taking an exposure history.</li><li>D. Many people with illness caused or exacerbated by exposure to hazardous substances obtain their medical care from</li></ul>

	<p>occupational and environmental medicine or medical toxicology specialists.</p> <p><i>To review relevant content see "What Happens in the Clinical Setting", "What Clinicians Need to Do", and "Process Just Takes a Few Minutes" in this section.</i></p> <p>3. Taking an exposure history is an important component in daily clinical settings because without it</p> <p>A. An etiologic diagnosis might be missed.  B. Treatment may be inappropriate.  C. Exposure can continue.  D. All of the above.</p> <p><i>To review relevant content see this entire section.</i></p>
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## Which Organ Systems Are Affected By Toxic Exposure(s)?

<p><b>Learning Objectives</b></p>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"> <li>• Explain how organ systems may be affected by toxic exposure(s).</li> </ul>
<p><b>Introduction</b></p>	<p>All organ systems (Table 2) can be targets of toxic exposures. Different hazards affect various and differing organ systems [Nelson et al. 2011; Pope AM and Rall DP 1995]. Specific current information about the adverse effects of exposures to chemical and biological agents can be obtained from several publically available</p>

	resources mentioned in the “What Are Additional Environmental Health Resources?” section.
<p><b>Respiratory</b></p>	<p>The respiratory system is both a target organ and a portal of entry for toxicants. Asthma morbidity and death from asthma are increasing. More than 100 toxicants cause asthma, and many more can exacerbate it [Rom 2007].</p> <p>A large number of xenobiotics and occupations are associated with the development of work-aggravated and work-related asthma. Many high molecular weight xenobiotics, usually plant or animal derived, have been identified, such as</p> <ul style="list-style-type: none"> <li>• Arthropod and mite related materials,</li> <li>• Latex,</li> <li>• Flour,</li> <li>• Molds,</li> <li>• Endotoxins, and</li> <li>• Biological enzymes.</li> </ul> <p>Lower molecular weight xenobiotics associated with work-related asthma include</p> <ul style="list-style-type: none"> <li>• Isocyanates (used in spray paints and foam manufacturing),</li> <li>• Cleaning agents,</li> <li>• Anhydrides,</li> <li>• Amines,</li> <li>• Dyes, and</li> <li>• Glues [Nelson et al. 2011].</li> </ul>
<p><b>Skin</b></p>	<p>Irritant and allergic contact dermatitis account for 90% of occupational skin disorders. Other skin</p>

	<p>disorders with occupational/environmental exposure etiologies include</p> <ul style="list-style-type: none"> <li>• Pigment alterations,</li> <li>• Chloracne,</li> <li>• Urticaria, and</li> <li>• Malignant neoplasms [Levy BS and Wegman DH 2011].</li> </ul> <p>Children appear particularly at risk for toxicity from percutaneous absorption because their skin is more penetrable than an adult's, and specific anatomic sites, such as the face, often represent larger percentage of body surface areas than in the adult [Nelson et al. 2011].</p>
<p><b>Liver and Kidney</b></p>	<p>The liver is the primary site of biotransformation and detoxification of xenobiotics. Clinical presentations of toxic liver injury range from indolent, often asymptomatic progression of impairment of hepatic function to rapid development of hepatic failure [Nelson et al. 2011].</p> <p>The kidneys are exposed to exogenous or endogenous xenobiotics in their role as primary defenders against harmful xenobiotics entering the bloodstream. The environment, the workplace, and, especially, the administration of medications, represent potential sources of nephrotoxicity. Organic solvents and heavy metals are two major classes of toxicants known to adversely affect renal function [Nelson et al. 2011; Pope AM and Rall DP 1995].</p>
<p><b>Nervous System</b></p>	<p>Neurotoxicants can cause</p> <ul style="list-style-type: none"> <li>• Peripheral neuropathy,</li> </ul>



	<ul style="list-style-type: none"> <li>• Ataxia,</li> <li>• Parkinsonism,</li> <li>• Seizures,</li> <li>• Coma, and</li> <li>• Death.</li> </ul> <p>Many chemicals cause mild central nervous system depression that may be misdiagnosed as inebriation and, if undetected, can progress to psychoses or dementia. Sensory impairment can also be caused by exposure to toxicants (e.g., visual disturbances caused by methanol) and physical agents (e.g., hearing impairment caused by loud noise) [Nelson et al. 2011; Pope AM and Rall DP 1995; Rom 2007].</p>
<p><b>Reproductive</b></p>	<p>Toxicants that target the reproductive system can cause a variety of adverse effects. These effects may include</p> <ul style="list-style-type: none"> <li>• Early or delayed puberty,</li> <li>• Early pregnancy loss,</li> <li>• Fetal death,</li> <li>• Impaired fetal growth,</li> <li>• Infertility,</li> <li>• Low birth weight,</li> <li>• Menstrual irregularities,</li> <li>• Premature birth,</li> <li>• Structural (e.g., cardiac defect) or functional (e.g., learning disability) birth defects, and</li> <li>• Subfertility.</li> </ul> <p>The impact of exposure to a reproductive toxicant may not be immediately evident. Instead, the effects may emerge at key life transitions. For example:</p> <ul style="list-style-type: none"> <li>• When attempting conception,</li> <li>• During pregnancy,</li> </ul>

	<ul style="list-style-type: none"> <li>• During development of the embryo or fetus, in the newborn, and</li> <li>• During the offspring's childhood, puberty, and eventual fertility as an adult [Association of Reproductive Health Professionals 2010; Sutton et al. 2012].</li> </ul>
<p><b>Cardiovascular and Hematologic</b></p>	<p>The cardiovascular and hematologic systems are frequent targets of toxicants. Chemical substances may produce adverse effects on the cardiovascular system by acting on the myocardial cells or the autonomic nervous system to affect the:</p> <ul style="list-style-type: none"> <li>• Heart rate,</li> <li>• Blood pressure, or</li> <li>• Cardiac contractility.</li> </ul> <p>Lead, carbon disulfide, arsenic, cadmium, ozone, and vinyl chloride have all been implicated in the etiology of cardiovascular disease. Benzene can cause bone marrow changes leading to</p> <ul style="list-style-type: none"> <li>• Aplastic anemia,</li> <li>• Acute leukemia, and</li> <li>• Chronic myelogenous leukemia [Kim et al. 2012; Nelson et al. 2011; Patel et al. 2014; Pope AM and Rall DP 1995; Rom 2007; Zeligler 2013].</li> </ul> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p align="center"><b>Table 2. Organ Systems Often Affected by Toxic Exposure</b> [Nelson et al. 2011; Pope AM and Rall DP 1995]</p> </div>

<b>Organ/ System</b>	<b>Exposure Examples</b>
respiratory	asbestos, radon, cigarette smoke, glues
skin	dioxin, nickel, arsenic, mercury, cement (chromium), polychlorinated biphenyls (PCBs), glues, rubber cement
liver	carbon tetrachloride, methylene chloride, vinyl chloride
kidney	cadmium, lead, mercury, chlorinated hydrocarbon solvents
cardiovascular	lead, carbon disulfide, arsenic, cadmium, ozone, vinyl chloride, carbon monoxide, noise, tobacco smoke, physical stress, nitrates, methylene chloride
reproductive	lead, carbon disulfide, methylmercury, ethylene

	<table border="1"> <tr> <td data-bbox="574 233 896 390"></td> <td data-bbox="896 233 1390 390">dibromide, polychlorinated biphenyls</td> </tr> <tr> <td data-bbox="574 390 896 548">hematologic</td> <td data-bbox="896 390 1390 548">arsenic, benzene, nitrates, radiation</td> </tr> <tr> <td data-bbox="574 548 896 783">Neuropsychological</td> <td data-bbox="896 548 1390 783">tetrachloroethylene, mercury, arsenic, toluene, lead, methanol, noise, vinyl chloride</td> </tr> </table>		dibromide, polychlorinated biphenyls	hematologic	arsenic, benzene, nitrates, radiation	Neuropsychological	tetrachloroethylene, mercury, arsenic, toluene, lead, methanol, noise, vinyl chloride
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Neuropsychological	tetrachloroethylene, mercury, arsenic, toluene, lead, methanol, noise, vinyl chloride						
<p><b>Key Points</b></p> <p><b>Progress Check Exercise(s)</b></p>	<ul style="list-style-type: none"> <li>All organ systems can be targets of toxic exposures.</li> </ul> <p>4. Exposure to which of the following hazards are best known to target the renal system?</p> <p>A. Asbestos and tobacco smoke.  B. Organic solvents and heavy metals.  C. Carbon monoxide and nitrates.  D. Noise and vinyl chloride.</p> <p><i>To review relevant content see "Liver and Kidney" in this section.</i></p>						

**What Are Possible Sources of Indoor Air Pollution?**

<b>Learning Objectives</b>	Upon completion of this section, you will be able to
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	<ul style="list-style-type: none"> <li>• Identify possible sources of indoor air pollution.</li> </ul>
<p><b>Introduction</b></p>	<p>Indoor air pollution can pose a serious health threat. EPA studies indicate that the levels of many air pollutants may be two to five times higher in indoor air than outdoors. In some cases, indoor air pollutants may even be 100 times higher than outdoors. High levels of indoor pollutants are of particular concern because people may spend as much as 90% of their time indoors [American Lung Association 2010; U.S. Consumer Product Safety Commission (CPSC) 2012; US Environmental Protection Agency 2012a].</p> <p>The clinician should consider the following possible sources of indoor air pollution when eliciting information on exposures. Possible indoor contaminants include</p> <ul style="list-style-type: none"> <li>• Asbestos,</li> <li>• Biologic agents,</li> <li>• Building materials,</li> <li>• Radon,</li> <li>• Tobacco smoke, and</li> <li>• Wood stoves, gas range, or other heating devices.</li> </ul> <p>The content in this section focuses on the above potential sources of indoor air pollution. The next section discusses additional potential exposure sources and pathways to hazardous substances in the home and environment that may also contribute to poor indoor air quality and pose exposure and health risks.</p>

<p><b>Environmental Tobacco Smoke</b></p>	<p>Environmental tobacco smoke (ETS) is the mixture of smoke that comes from the burning end of a</p> <ul style="list-style-type: none"> <li>• Cigarette,</li> <li>• Pipe, or</li> <li>• Cigar,</li> </ul> <p>as well as smoke exhaled by the smoker. It is a complex mixture of over 4,000 compounds, more than 40 of which are known to cause cancer in humans or animals and many of which are strong irritants. ETS is often referred to as secondhand smoke and exposure to ETS is often called passive smoking. In general, children's lungs are more susceptible to harmful effects from ETS than adults. In infants and young children up to 3 years, exposure to ETS causes an approximate doubling in the incidence of</p> <ul style="list-style-type: none"> <li>• Pneumonia,</li> <li>• Bronchitis, and</li> <li>• Bronchiolitis [U.S. Consumer Product Safety Commission (CPSC) 2012; US Environmental Protection Agency 2012a].</li> </ul> <p>ETS is an entirely preventable public health hazard and strongly linked to major respiratory diseases such as asthma and lung cancer [Dhala et al. 2006; DHHS 2014].</p>
<p><b>Gas Space Heaters, Wood Stoves, and Gas Ranges</b></p>	<p>In addition to environmental tobacco smoke, other sources of combustion products include</p> <ul style="list-style-type: none"> <li>• Fireplaces,</li> <li>• Gas stoves,</li> <li>• Unvented kerosene and gas space heaters, and</li> <li>• Woodstoves.</li> </ul>

	<p>The major pollutants released include</p> <ul style="list-style-type: none"> <li>• Carbon monoxide,</li> <li>• Nitrogen dioxide,</li> <li>• Radon, and</li> <li>• Particulates.</li> </ul> <p>Unvented kerosene heaters may also generate acid aerosols.</p> <p>Combustion gases and particulates also come from chimneys and flues that are improperly installed or maintained and cracked furnace heat exchangers. Pollutants from fireplaces and woodstoves with no dedicated outdoor air supply can be back-drafted from the chimney into the living space, particularly in weatherized homes [US Environmental Protection Agency 2012a].</p> <p><u>Wood stoves</u>, when not properly maintained and vented, emit noxious substances including</p> <ul style="list-style-type: none"> <li>• Carbon monoxide,</li> <li>• Oxides of nitrogen,</li> <li>• Particulates, and</li> <li>• Hydrocarbons.</li> </ul> <p>Studies have shown that children living in homes heated with wood stoves have a significant increase in respiratory symptoms compared with children living in homes without wood stoves [Belanger and Triche 2008].</p> <p><u>Gas ranges</u>, which may produce nitrogen oxide, a respiratory irritant, are used for cooking in more than half of the homes in the United States [Belanger and Triche 2008].</p>
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<p><b>Building Materials</b></p>	<p>Building materials, home improvement products, and textiles used in the home can pose health</p>
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	<p>risks. For example, formaldehyde volatilizes from pressed wood products made using adhesives that contain urea-formaldehyde (UF) resins. Pressed wood products made for indoor use include</p> <ul style="list-style-type: none"> <li>• Particleboard (used as subflooring and shelving and in cabinetry and furniture),</li> <li>• Hardwood plywood paneling (used for decorative wall covering and used in cabinets and furniture), and</li> <li>• Medium density fiberboard (used for drawer fronts, cabinets, and furniture tops).</li> </ul> <p>Formaldehyde exposure can cause</p> <ul style="list-style-type: none"> <li>• Watery eyes,</li> <li>• Burning sensations in the eyes and throat,</li> <li>• Nausea, and</li> <li>• Breathing difficulty in some humans exposed to elevated levels (above 0.1 parts per million).</li> </ul> <p>Higher environmental concentrations may trigger breathing problems in exposed asthmatics. There is evidence that some people can develop sensitivity to formaldehyde. It has also been shown to cause cancer in animals and possibly in humans [US Environmental Protection Agency 2012a].</p>
<p><b>Asbestos</b></p>	<p>Asbestos is most commonly found in older homes [US Environmental Protection Agency 2012a] in</p> <ul style="list-style-type: none"> <li>• Pipe and furnace insulation materials,</li> <li>• Asbestos shingles,</li> <li>• Millboard,</li> <li>• Textured paints and other coating materials,</li> <li>• Floor tiles, and</li> </ul>



	<ul style="list-style-type: none"> <li>• Ceiling tiles and panels.</li> </ul> <p>Intact, undisturbed asbestos-containing materials generally do not pose a health risk. Elevated concentrations of airborne asbestos can occur after asbestos-containing materials are disturbed by</p> <ul style="list-style-type: none"> <li>• Cutting,</li> <li>• Sanding or</li> <li>• Other remodeling activities.</li> </ul> <p>Improper attempts to remove these materials can release asbestos fibers into the air in homes, increasing asbestos levels and endangering people living in those homes. Exposure to these fibers has been associated with</p> <ul style="list-style-type: none"> <li>• Lung cancer,</li> <li>• Asbestosis, and</li> <li>• Mesothelioma [US Environmental Protection Agency 2012a].</li> </ul> <p>Smoking cigarettes with exposure to asbestos has a multiplicative effect on the risk of developing lung cancer (higher than the lung cancer risk from smoking alone or from asbestos exposure alone) [Agency for Toxic Substances and Disease Registry 2001].</p> <p>For more information on Asbestos, please see <a href="#">"What Are Additional Environmental Health Resources?"</a> section.</p>
<p><b>Radon</b></p>	<p>The most common source of indoor radon is uranium in the soil or rock on which homes are built. As uranium naturally breaks down, it releases radon gas (which is a colorless, odorless, radioactive gas). Radon gas enters homes through</p> <ul style="list-style-type: none"> <li>• Dirt floors,</li> </ul>

	<ul style="list-style-type: none"> <li>• Cracks in concrete walls and floors,</li> <li>• Floor drains, and</li> <li>• Sumps.</li> </ul> <p>Exposure to radon becomes a concern when radon becomes trapped in buildings and concentrations increase indoors. Lung cancer is the predominant health effect associated with exposure to elevated levels of radon. Radon causes thousands of preventable lung cancer deaths each year. EPA estimates that radon causes about 14,000 deaths per year in the United States; however, this number could range from 7,000 to 30,000 deaths per year. For persons that smoke and have high home radon levels, the risk of developing lung cancer is especially high [US Environmental Protection Agency 2012a].</p> <p>For more information on radon, please see <a href="#">“What Are Additional Environmental Health Resources?”</a> section.</p>
<p><b>Biological Agents</b></p>	<p>Biological agents include</p> <ul style="list-style-type: none"> <li>• Animal dander, saliva, urine,</li> <li>• Bacteria,</li> <li>• Cockroaches,</li> <li>• House dust mites,</li> <li>• Mildew,</li> <li>• Molds,</li> <li>• Pollen, and</li> <li>• Viruses.</li> </ul> <p>Sources of indoor biologic pollutants include plants, people, and animals. Building materials and/or conditions that support the growth, concentration or dissemination of indoor biologic pollutants should also be considered. It is important not to overlook these potential sources</p>

	<p>of biologic pollutants. Contaminated central air handling systems can become breeding grounds for</p> <ul style="list-style-type: none"> <li>• Mold,</li> <li>• Mildew, and</li> <li>• Other sources of biological contaminants</li> </ul> <p>that can be distributed throughout the home.</p> <p>Some biological contaminants trigger allergic reactions, including</p> <ul style="list-style-type: none"> <li>• Allergic rhinitis,</li> <li>• Hypersensitivity pneumonitis, and</li> <li>• Some types of asthma.</li> </ul> <p>Infectious illnesses, such as influenza, measles, and chicken pox are transmitted through the air. Molds and mildews release disease-causing toxins. Symptoms of health problems caused by biological pollutants include [US Environmental Protection Agency 2012a]</p> <ul style="list-style-type: none"> <li>• Coughing,</li> <li>• Digestive problems,</li> <li>• Dizziness,</li> <li>• Fever,</li> <li>• Lethargy,</li> <li>• Shortness of breath,</li> <li>• Sneezing, and</li> <li>• Watery eyes.</li> </ul>
<p><b>Key Points</b></p>	<ul style="list-style-type: none"> <li>• It is important not to overlook potential exposure sources of indoor air pollution.</li> </ul>

<p><b>Progress Check Exercise(s)</b></p>	<p>5. Which of following statements is <b>NOT TRUE</b>?</p> <ul style="list-style-type: none"> <li>A. Smoking cigarettes in addition to being exposed to asbestos increases the risk of cancer by an order of magnitude above smoking alone or asbestos exposure alone.</li> <li>B. Building materials, home improvement products, and textiles used in the home can pose health risks.</li> <li>C. Environmental tobacco smoke (ETS) is a public health hazard.</li> <li>D. Radon rarely causes lung cancer.</li> </ul> <p><i>To review relevant content see this entire section.</i></p>
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## What Are Other Potential Sources and Pathways of Hazardous Exposure in the Home and Environment?

<p><b>Learning Objectives</b></p>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"> <li>• Identify additional potential sources of hazardous exposure in the home and environment.</li> </ul>
<p><b>Introduction</b></p>	<p>This section discusses additional sources and pathways of exposure to hazardous substances in the home and environment that the health care provider should consider when taking an exposure history. The clinician should also consider the following possible sources when eliciting information on exposures in the home and environment:</p> <ul style="list-style-type: none"> <li>• Household products,</li> <li>• Lead products and waste,</li> <li>• Pesticides,</li> </ul>

	<ul style="list-style-type: none"> <li>• Recreational hazards,</li> <li>• Soil contamination, and</li> <li>• Drinking Water supply.</li> </ul> <p>For educational resources on these and related topics, please see "<a href="#">What Are Additional Environmental Health Resources?</a>" section.</p>
<p><b>Household Products</b></p>	<p>The following household products are potential sources of exposure that should be considered when taking an exposure history:</p> <ul style="list-style-type: none"> <li>• Aerosol sprays,</li> <li>• Air fresheners,</li> <li>• Automotive products,</li> <li>• Candles (leaded wick),</li> <li>• Cleansers,</li> <li>• Disinfectants,</li> <li>• Dry-cleaned clothing,</li> <li>• Fuels,</li> <li>• Hobby supplies,</li> <li>• Moth repellents,</li> <li>• Paint strippers and other solvents,</li> <li>• Paints, and</li> <li>• Wood preservatives.</li> </ul> <p>EPA's Total Exposure Assessment Methodology (TEAM) studies found levels of about a dozen common organic pollutants to be 2 to 5 times higher inside homes than outside, regardless of whether the homes were located in rural or highly industrial areas. Commonly used compounds that can have serious adverse health effects are listed in the table below [US Environmental Protection Agency 2012a].</p>

**Table 3. Commonly Used Compounds that Can Have Serious Adverse Health Effects**

Compounds	Where Found
Methylene chloride	<ul style="list-style-type: none"> <li>• Adhesive removers</li> <li>• Paint strippers</li> <li>• Paint thinners</li> </ul>
Paradichlorobenzene	<ul style="list-style-type: none"> <li>• Air fresheners</li> <li>• Moth crystals</li> <li>• Toilet bowl deodorizers</li> </ul>
Tetrachloroethylene	<ul style="list-style-type: none"> <li>• Dry cleaning fluids</li> </ul>

**Pesticides**

Pesticides are potentially hazardous, especially to children. Pesticide exposure can occur through

- Dermal contact,
- Inhalation, or
- Ingestion.

According to a recent survey, 75% of U.S. households used at least one pesticide product indoors during the past year. Products used most

often were insecticides and disinfectants. Another study suggests that 80% of most people's exposure to pesticides occurs indoors and that measurable levels of up to a dozen pesticides have been found in the air inside homes [US Environmental Protection Agency 2012a].

Exposure to high levels of cyclodiene pesticides, commonly associated with misapplication, has produced various symptoms, including

- Dizziness,
- Headaches,
- Muscle twitching,
- Nausea,
- Tingling sensations, and
- Weakness.

In addition, EPA is concerned that cyclodienes might cause long-term damage to the liver and the central nervous system, as well as an increased risk of cancer [US Consumer Product Safety Commission (CPSC) 2012; US Environmental Protection Agency 2012a].

Despite the ban on certain pesticides in the United States, exposure can still occur through improper

- Use,
- Storage, and
- Disposal.

Some banned pesticides are used in foreign countries and may return to this country on imported foods. There have been reports of unlicensed pesticide applicators in the United States spraying inside homes with pesticides intended for use in outdoor settings resulting in illness and even death [Wasley et al. 2002]. Proper use (including use of licensed pesticide applicators, following all product safety instructions, etc.) and storage of

	<p>household pesticides in their original containers along with proper cleaning of food, especially raw fruits and vegetables, can help protect consumers.</p>
<b>Lead</b>	<p>Lead poisoning continues to be a significant health problem in the United States. Although lead was banned from paint for home use in 1978, millions of homes, particularly those built before 1950 still contain high amounts of lead in paint that is peeling and accessible for ingestion by children.</p> <p>Lead has long been recognized as a harmful environmental pollutant. Humans are exposed to lead through many ways including through</p> <ul style="list-style-type: none"><li>• Air,</li><li>• Drinking water,</li><li>• Food,</li><li>• Contaminated soil,</li><li>• Deteriorating paint, and</li><li>• Dust.</li></ul> <p>Airborne lead enters the body when an individual breathes or swallows lead particles or dust once it has settled. Lead was used in</p> <ul style="list-style-type: none"><li>• Gasoline,</li><li>• Paint,</li><li>• Water pipes, and</li><li>• Many other products</li></ul> <p>before it was known how harmful it could be.</p> <p>Old lead-based paint is the most significant source of lead exposure in the United States today. Harmful exposures to lead can be created when lead-based paint is improperly removed from surfaces by</p> <ul style="list-style-type: none"><li>• Dry scraping,</li><li>• Open-flame burning, or</li></ul>



- Sanding.

Lead affects practically all systems within the body. At high exposure dose levels it can cause

- Convulsions,
- Coma, and
- Even death.

Lower exposure dose levels of lead can adversely affect the

- Brain,
- Central nervous system,
- Blood cells, and
- Kidneys.

The effects of lead exposure on fetuses and young children can be severe. They include

- Delays in physical and mental development,
- Increased behavioral problems,
- Lower IQ levels, and
- Shortened attention spans.

Fetuses, infants, and children are more vulnerable to lead exposure than adults since lead is more easily absorbed into growing bodies, and the tissues of small children are more sensitive to the damaging effects of lead. Children may have higher exposures since they are more likely to eat lead paint chips in addition to having lead dust on hands or toys/objects that they may place in their mouths. [Agency for Toxic Substances and Disease Registry 2005; US Environmental Protection Agency 2012a].

Additional information on this topic can be found in [“What are Additional Environmental Health Resources?”](#) section.

## Recreational Hazards

Recreational areas and products can pose a hazard to health.

The United States has made tremendous advances in the past 25 years to clean up the aquatic environment by controlling pollution from industries and sewage treatment plants. Today, nonpoint source (NPS) pollution remains the nation's largest source of water quality problems. It's the main reason that approximately 40% of our surveyed rivers, lakes, and estuaries are not clean enough to meet basic uses such as fishing or swimming [US Environmental Protection Agency 2012b].

Wooden playground structures that have not been treated with protective sealants may expose children to potentially hazardous wood preservatives. Chromated copper arsenate (CCA) is a chemical wood preservative containing chromium, copper, and arsenic. It is used in pressure treated wood to protect wood from rotting due to insects and microbial agents. CCA treated wood has a greenish tint and has been used in thousands of

- Decks,
- Picnic tables,
- Play sets, and
- Railings.

The EPA has worked with manufacturers since 2003 to eliminate CCA from children's play structures. Unfortunately, many older playgrounds still exist [US Environmental Protection Agency 2011].

Some play sands and clays have been reported to contain asbestos-like fibers. Other materials used in arts and crafts involve potentially hazardous:

- Heavy metals such as lead and cadmium,
- Silica,
- Solvents, and

	<ul style="list-style-type: none"> <li>• Talc.</li> </ul> <p>Toxic materials may be encountered in</p> <ul style="list-style-type: none"> <li>• Making stained glass and jewelry,</li> <li>• Model building,</li> <li>• Oil and airbrush painting,</li> <li>• Soldering, and</li> <li>• Woodworking.</li> </ul> <p>Persons do not need to be directly involved in these activities to become exposed; merely being in the vicinity of a work area may lead to exposure.</p> <p>Federal legislation (the Labeling of Hazardous Art Materials Act) requires that all chronically hazardous materials be labeled as inappropriate for children's use [US Consumer Product Safety Commission (CPSC) 1995].</p>
<p><b>Drinking Water Supply</b></p>	<p>Both contaminated public drinking water supplies and contaminated private wells may be sources of toxic exposure, especially for industrial solvents, heavy metals, pesticides, and fertilizers. For example, an EPA groundwater survey [US Environmental Protection Agency 1985] detected trichloroethylene in approximately 10% of the wells tested. It is estimated to be in 34% of the nation's drinking water supplies. Up to 25% of the water supplies have detectable levels of tetrachloroethylene. Some solvents can volatilize from showers and during laundering of clothes, thereby creating a risk of toxicity via inhalation. Nitrates, a common contaminant of rural shallow wells, pose a risk of methemoglobinemia, especially to infants [Agency for Toxic Substances and Disease Registry 1997, 2013].</p>

	<p>Contamination of drinking water supplies may come from the source water and/or the distribution system after water treatment has already occurred. There are many potential sources of water contamination, including</p> <ul style="list-style-type: none"> <li>• Local land use practices (fertilizers, pesticides, concentrated feeding operations),</li> <li>• Manufacturing processes,</li> <li>• Naturally occurring chemicals and minerals (for example, arsenic, radon, uranium), and</li> <li>• Sewer overflows or wastewater releases.</li> </ul> <p>The presence of contaminants in water may lead to adverse health effects if exposure occurs, including</p> <ul style="list-style-type: none"> <li>• Gastrointestinal illness,</li> <li>• Neurological disorders, and</li> <li>• Reproductive problems.</li> </ul> <p>Infants, young children, pregnant women, the elderly, and people whose immune systems are compromised (i.e., those with AIDS, undergoing chemotherapy, on transplant medications, etc.), may be especially susceptible to illness from some contaminants [US Centers for Disease Control and Prevention 2014].</p>
<p><b>Soil Contamination</b></p>	<p>Ingestion of contaminated soil poses a risk of toxicity, especially to children under the age of six, because of natural mouthing or pica behaviors. Lead is a common soil contaminant. Dioxin also adsorbs to soils. Certain pesticides such as chlordane can remain in the soil for years.</p> <p>Sources of soil contamination include</p> <ul style="list-style-type: none"> <li>• Agriculture,</li> <li>• Chemical and microbial contaminants,</li> </ul>

	<ul style="list-style-type: none"> <li>• Municipal wastewater (and associated biosolids), and</li> <li>• Industry.</li> </ul> <p>Chemical contaminants range from heavy metals like mercury to polychlorinated biphenyls (PCBs) to relatively new emerging contaminants. Sediments and soils may contain multiple chemical contaminants combined with microbial pathogens. Emerging contaminants of concern such as endocrine-disrupting chemicals (EDCs) that might be found in soil, may come from municipal wastewater, concentrated animal feeding operations (CAFOs) and other sources [US Environmental Protection Agency 2013].</p>
<b>Key Points</b>	<ul style="list-style-type: none"> <li>• The clinician should consider all possible sources and exposure pathways to hazardous substances when eliciting information on exposure(s) in the home and environment.</li> </ul>

**Progress Check Exercise(s)** 6. Which of the following statements is **NOT TRUE**? Lead is a common soil contaminant.

- B. Fishing and swimming in contaminated lakes and streams may expose participants to toxins contained in polluted waters.
- C. Both contaminated public drinking water supplies and contaminated private wells may be sources of toxic exposure.
- D. Lead poisoning is not a significant health problem in the United States. *To review relevant content see this entire section.*

## What Are the Components of an Exposure History?

<b>Learning Objectives</b>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"><li>• Describe the components of an exposure history.</li></ul>
<b>What Should an Exposure History Be Composed of?</b>	<p>An exposure history has three components:</p> <ol style="list-style-type: none"><li>1. Exposure Survey,</li><li>2. Work History, and</li><li>3. Environmental History.</li></ol> <p>The main aspects of an exposure history (summarized in Table 4) will be elicited through the exposure history form. For the sample form and links to available formats, see Appendix 1.</p> <p>Although a positive response to any question on the form indicates the need for further inquiry, a negative response to all questions does not necessarily rule out a toxic exposure etiology or significant previous exposure. Each clinical encounter may not require an extensive environmental and occupational exposure evaluation, but having exposure history information in the patient's medical record can alert the health care provider to potential exposure risks that may lead to adverse health effects. As in all data-gathering activities, sound clinical judgment should be exercised when analyzing and interpreting patient data within a clinical context.</p> <div data-bbox="521 1551 1365 1711" style="border: 1px solid black; padding: 10px; text-align: center;"><b>Table 4. Components of an Exposure History</b></div>

### ***Part 1. Exposure Survey***

- Exposures
  - Current and past exposure to metals, dust, fibers, fumes, chemicals, biologic hazards, radiation, noise, and/or vibration,
  - Typical workday (job tasks, location, materials, and agents used),
  - Changes in routines or processes, and
  - Other employees or household members similarly affected.
  
- Health and Safety Practices at Work Site
  - Ventilation,
  - Medical and industrial hygiene surveillance,
  - Employment exams,
  - Personal protective equipment (e.g., respirators, gloves, and coveralls),
  - Lockout devices, alarms, training, and drills,
  - Personal habits (Smoke and/or eat in work area?),
  - Wash hands with solvents?,
  - Shower before leaving work?,
  - Change shoes and clothing before leaving work?, and
  - Launder work clothing at work?

### ***Part 2. Work History***

	<ul style="list-style-type: none"> <li>• Description of all previous jobs including short-term, seasonal, and part-time employment and military service, and</li> <li>• Description of present jobs.</li> </ul> <p><b><i>Part 3. Environmental History</i></b></p> <ul style="list-style-type: none"> <li>• Present and previous home locations,</li> <li>• Present and previous daycare/school settings (as applicable),</li> <li>• Jobs of household members,</li> <li>• Home insulating and heating and cooling system,</li> <li>• Home cleaning agents,</li> <li>• Pesticide exposure,</li> <li>• Water supply (especially drinking water supply),</li> <li>• Recent renovation/remodeling,</li> <li>• Air pollution, indoor and outdoor,</li> <li>• Hobbies and recreational activities (e.g., painting, photography, sculpting, welding, woodworking, piloting, restoring automobiles, shooting firearms, creating stained glass, creating ceramics, soldering, and gardening),</li> <li>• Hazardous wastes/spill exposure,</li> <li>• Home ventilation/moisture control/flooding, and</li> <li>• Food source(s).</li> </ul>
<p><b>Key Points</b></p>	<ul style="list-style-type: none"> <li>• Each clinical encounter may not require an extensive environmental and occupational exposure evaluation, but having exposure history information in the patient’s medical record can alert the health care provider to</li> </ul>



	<p>potential exposure risks that may lead to adverse health effects.</p> <ul style="list-style-type: none"> <li>• It is important for primary health care providers to obtain a complete exposure history for the medical record of each patient.</li> <li>• Obtaining the components of the exposure history can be accomplished in several ways including patient assisted completion of exposure history forms.</li> </ul>
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<p><b>Progress Check Exercise(s)</b></p>	<p>7. Which of the following statements is <b>NOT TRUE</b>? A negative response to all questions should rule out a toxic exposure etiology or significant previous exposure.</p> <p>C. An exposure history form has three components: exposure survey, work history, and environmental history.</p> <p>D. Hobbies are generally a very important part of the environmental history. <i>To review relevant content see this entire section.</i></p>
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## What Is Included in the Exposure Survey (Part 1) of an Exposure History Form?

<p><b>Learning Objectives</b></p>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"> <li>• Explain how temporal relationships between a patient's symptoms and their non-work or work environments are identified.</li> </ul>
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## Introduction

Past and current exposures are recorded on Part 1 of an Exposure History Form (Appendix 1), which is designed for easy completion by the patient and a quick scan for pertinent details by the clinician.

The questions are crafted to investigate

- Changes in routines and work site characteristics,
- Details about known toxicant exposure,
- Known exposure to metals, dust, fibers, fumes, chemicals, physical agents, and biologic hazards,
- Other persons affected,
- Protective equipment use,
- Temporal patterns and activities , and
- Personal habits.

If the patient answers *yes* to one or more questions on Part 1, the clinician should follow up by asking the patient progressively more detailed questions about the possible exposure. Special attention should be directed to the

- Route,
- Dose,
- Duration, and
- Frequency of any identified exposure.

Let's now work on the case presented at the beginning of this case study.

### *Scenario 1*

- 52-year-old male accountant with angina
- Chief complaints: headache and nausea

The chart of the patient described in Scenario 1 of the case study reveals that he has worked as an accountant in the same office for the past 12 years. On Part 1 of the completed Exposure History

	<p>Form, he indicates that no other workers are experiencing similar or unusual symptoms, and he denies recent changes in his job routine.</p> <p>The patient answered <i>yes</i> to these three questions: "Are family members experiencing the same or unusual symptoms?", "Do your symptoms get either worse or better at work?", and "Do your symptoms get either worse or better on weekends?" His explanations of these answers reveal a possible temporal relationship between his symptoms and his home.</p> <p><i>The clue and the clinician/patient dialogue follow.</i></p>
<p><b>Sample Dialogue</b></p>	<p>Clinician: I see that you noted that your wife is having headaches.</p> <p>Patient: Yes; frequently. She has had more than usual in the last 3 or 4 weeks. She usually has one every month or so; this past month she had three.</p> <p>Clinician: You also stated that your headaches are worse on weekends.</p> <p>Patient: Yes, they seem to be. If I wake up on a Saturday or Sunday with a headache, it usually gets worse as the day progresses. In fact, that's usually when I feel nauseated too.</p> <p>Clinician: Do your symptoms seem to be aggravated by certain activities around the home? A hobby or task?</p> <p>Patient: No, I usually wake up with the headache. I don't think there's a connection with anything I do.</p>

	<p>Clinician: Do your symptoms change at all at work?</p> <p>Patient: Now that you mention it, if I wake up with a headache, by the time I get to work—it takes about 25 minutes—the headache is usually gone.</p> <p>Clinician: Your angina attack occurred on a Sunday morning. Describe your weekend leading up to the attack.</p> <p>Patient: It was a fairly quiet weekend. We had dinner at home Friday evening and just relaxed. On Saturday I spent the day packing old books and storing them in the attic and chopping and stacking firewood. I took one nitroglycerin tablet before doing the heavy work, at about 2:00 PM. Saturday night we had friends over for dinner. We had a fire in the fireplace and visited until about 11:00 PM. I had one glass of wine with dinner. I was beginning to feel a little stiff and sore from the work I did that afternoon. Sunday morning I woke up with a headache again. A few minutes after awakening, while I was still in bed, I had the attack. It was mild, not the crushing pain I've had in the past. I had the headache all day.</p>
<p><b>Dialogue Analysis and Conclusion</b></p>	<p>The preceding dialogue reveals that the patient's symptoms may be associated with the home environment, and his cardiac symptoms, headache, and nausea may be related.</p> <p>His symptoms seem to be exacerbated at home and lessen at work. Further questioning is needed to pursue this lead.</p>

**Further  
Sample  
Dialogue**

Clinician: What does your wife do for a living?

Patient: She's an attorney.

Clinician: Do either of you have a hobby?

Patient: My hobby is photography. My wife is an avid gardener.

Clinician: I assume this is digital photography? Have you ever been involved with non-digital photography using film and chemical processing of prints?"

Patient: No, digital photography only.

Clinician: Does your wife use any pesticides or chemicals in the garden?

Patient: No, she does strictly organic gardening and uses only natural means of pest control.

Clinician: Do you work on your car?

Patient: No.

Clinician: Have you gotten any new furniture or remodeled your home in the past few years?

Patient: No.

Clinician: What is your source of heating and cooking in the home?

Patient: We have a natural gas, forced-air heating system. We cook with gas and use the fireplace a lot in winter for supplemental heat.

Clinician: How long have you lived in this home and how old is your furnace?

	<p>Patient: We've lived there for 23 years. The furnace was replaced about 12 years ago.</p> <p>Clinician: I see that you recently insulated your home. What exactly did you do?</p> <p>Patient: Yes. Last month I added extra insulation to the attic, insulated the crawl space, replaced all the windows with double-paned windows, and weatherized all doorways.</p> <p>Clinician: Have you noticed that the headaches coincide with days you have used the fireplace?</p> <p>Patient: There could be a connection. I definitely use the fireplace more on weekends. This past Saturday I had a fire blazing all day.</p>
<p><b>Dialogue Analysis and Conclusion</b></p>	<p>A temporal relationship between the headaches and being in the home has been revealed. Some sources of toxicants have been eliminated (formaldehyde and other volatile organic chemicals from new furniture and rugs and toxic chemicals used in hobbies - gardening).</p> <p>There may be a correlation between symptoms and use of the fireplace. The fireplace could increase negative pressure in the house, causing back drafting of furnace gases. The furnace is old; it may be malfunctioning or producing excessive carbon monoxide. The patient's symptoms, including his angina attack, would be consistent with carbon monoxide poisoning.</p> <p>Although the patient's symptoms could be associated with his preexisting disease, evidence is strong enough at this point to investigate the possibility of a contributing environmental exposure.</p>

It would be appropriate to ask the patient to contact the local gas company to check the furnace and stove for malfunctions and leaks. The fireplace should be checked for proper drafting and for deposits of creosote in the chimney.

A carboxyhemoglobin (COHb) level on the patient may confirm carbon monoxide poisoning. The patient should be advised to ventilate the house until the furnace is checked or to stay out of the house until the gas company deems it safe.

COHb levels are important in the diagnosis of carbon monoxide exposure. In nonsmoking patients, a COHb level greater than 5% confirms exposure (Tomaszewski 1999). A COHb level performed on this patient is 6%, which is high for a nonsmoker. The gas company discovers a cracked heating element in the 12-year-old furnace, which resulted in the circulation of carbon monoxide throughout the house. The use of the fireplace most likely increased the back drafting of fumes. The furnace is replaced, the exposure ceases, and the patient's symptoms abate.

The exposure history form may also alert the clinician to past exposures.

Most often, neither the job title nor the patient's initial description of job duties reveal clues of exposure. It is usually helpful to have a patient describe a routine work day, as well as unusual or overtime tasks. Patients tend to use jargon when describing their jobs. It is the clinician's challenge to persistently question the patient to elucidate possible exposures; it is not necessary to have foreknowledge of a particular trade. Start with general questions and work toward obtaining more specific exposure related details.

	<p><i>Part 1 of the form reveals another clue—this patient was exposed to asbestos about 30 years ago. The questioning that the clinician conducts, despite having neither knowledge of the patient's trade nor understanding of the jargon, follows.</i></p>
<p><b>Further Sample Dialogue about Asbestos Exposure</b></p>	<p>Clinician: You state here that you were exposed to asbestos, fiberglass, and welding fumes way back in 1976.</p> <p>Patient: Yes, during my days as a shipwright.</p> <p>Clinician: Did you actually handle the asbestos?</p> <p>Patient: No, the pipe ladders were the tradesmen that handled the asbestos.</p> <p>Oh, you might be setting a bracket or plate next to a pipe and accidentally hit the pipe and dislodge some asbestos, but otherwise, shipwrights didn't handle it. You only had asbestos where there were steam lines from the boiler carrying high-pressure steam to other units like a winch or an auxiliary motor.</p> <p>Clinician: What does a shipwright do? What was a routine day for you?</p> <p>Patient: There was no routine day. The shipwrights were the cream of the journeymen crop; we did everything from outfitting, to establishing the cribbing on the launching gang, to shoring. I worked on the outfitting docks.</p> <p>We did ship reconversion. I did a lot of work on the forepeak and hawse pipes when I wasn't working below deck.</p>



Clinician: What exactly were your tasks below deck?

Patient: Most transporters were converted to passenger ships after the war; there was a lot of shifting of equipment and pipes. Basically, the ships were gutted. They would be completely revamped. The shipwrights would do all the woodworking, finish work, plates, and so on. Then, when everything was in place, it would be insulated, and the pipes would be lagged.

Clinician: So you worked throughout the ship? And when you finished your tasks, the ladders would come in?

Patient: No, no. There might be 10 different tradesmen working in an afterpeak at one time. You'd be working next to welders, flangers, pipe fitters, riveters, ladders; you name it. These conversions were done round-the-clock, seven days a week; it could take a year and a half to complete a conversion. All the tasks were being done simultaneously.

Clinician: How long would the lagging take?

Patient: The lagging could take 6 to 10 months, sometimes longer. They were constantly cutting these sections of asbestos to fit the pipes. Then they would attach the sections with a paste and wrap it with asbestos wrapping.

Clinician: Could you see the asbestos in the air?

Patient: Oh yes. Sometimes it was so thick you couldn't see 5 feet in front of you. It was white and hung in the welding fumes like smog.

	<p>Clinician: Did you use any protective equipment? Masks? Respirators?</p> <p>Patient: No. Nobody ever said it was dangerous. We were bothered more by the fiberglass and welding fumes than anything. We thought fiberglass was more dangerous because it was itchy and caused a rash. The air was blue from the welding fumes; if you worked in that for a year, you knew it was affecting you. It inspired me to go back to school and get my accounting degree. But we were blue-collar workers; we were more concerned with welders' flash, a boom breaking, or someone getting crushed between plates than we were with asbestos.</p> <p>Clinician: You worked as a shipwright for 6 years?</p> <p>Patient: Yes, about that. Five of those years as an outfitter on conversions.</p>
<p><b>Dialogue Analysis and Conclusion</b></p>	<p>The dialogue in which the clinician engaged the patient neither determines whether the patient's asbestos exposure was significant, nor does it confirm that he suffered adverse effects from the exposure. It is merely a starting point for investigation.</p> <p>The questioning establishes that approximately 30 years ago this patient received a possibly severe exposure to asbestos fibers for duration of 5 or 6 years. Because quantitative data on this patient's exposure are likely impossible to obtain, a qualitative description ("Sometimes it was so thick you couldn't see 5 feet in front of you") can facilitate assessment of the exposure when consulting with an occupational medical specialist.</p>

In this scenario, the disclosure should prompt the clinician to, along with baseline physical exam and laboratory testing/imaging results, monitor the patient closely for early detection of treatable health effects from asbestos exposure. A chest radiograph would be advised, and pulmonary function tests should be considered. When investigating possible asbestos related pulmonary effects, a NIOSH certified B-reader is recommended for standardized rating of chest x-ray findings. However, it should be noted that persons with asbestos related disease may have a normal chest x-ray. Influenza and pneumococcal vaccines should be offered in accordance with Centers for Disease Control and Prevention guidelines as well as other applicable recommended preventive services.

Consulting an occupational medical specialist could help determine the best way to evaluate and treat this patient.

In this scenario, the clinician successfully diagnosed an illness likely due to an environmental toxic exposure (carbon monoxide) and noted a significant past exposure (asbestos) that needs follow-up.

Had the clinician failed to pursue an exposure history, the patient's current illness might have been misdiagnosed, treatment might have been inappropriate, and/or measures might not have been implemented to prevent further carbon monoxide exposure. This could have led to continuing harmful health effects for the patient and other residents of the household from carbon monoxide poisoning.

<p><b>Key Points</b></p>	<ul style="list-style-type: none"> <li>• It is not necessary to understand the jargon of a particular trade; persistent questioning by the clinician can clarify the tasks involved and this may reveal possible exposures.</li> <li>• If a patient responds positively to one or more questions on Part 1 of an Exposure History Form, the health care provider should follow up by asking the patient progressively more detailed exposure related questions.</li> <li>• The clinician should pay special attention to the route, dose, duration, and frequency of any identified exposure.</li> <li>• Along with baseline physical exam and laboratory testing/imaging results, the clinician should perform any necessary monitoring for early detection of treatable health effects associated with identified exposure(s).</li> <li>• Consultation with board certified specialists in occupational medicine can assist the primary health care provider with the assessment and management of exposed or potentially exposed patients.</li> </ul>
<p><b>Progress Check Exercise(s)</b></p>	<p>8. If the patient answers “yes” to one or more questions on Part 1 of an Exposure History Form, the clinician should do what?</p> <ul style="list-style-type: none"> <li>A. Follow up by asking the patient progressively more detailed questions about the possible exposure.</li> <li>B. Pay special attention to the route, dose, duration, and frequency of any identified exposure.</li> <li>C. Along with baseline physical exam and laboratory testing/imaging results, perform any recommended monitoring for early detection of treatable health effects.</li> </ul>

	<p>D. All of the above.</p> <p><i>To review relevant content see "Introduction" in this section.</i></p>
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## What Is Included in the Work History (Part 2) of an Exposure History Form?

<p><b>Learning Objectives</b></p>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"> <li>Describe how a seasoned clinician reveals a possible temporal relationship between a patient's symptoms and their workplace.</li> </ul>
<p><b>Introduction</b></p>	<p>Nearly 3 million nonfatal workplace injuries and illnesses were reported by private industry employers in 2012. This resulted in an incidence rate of 3.4 cases per 100 equivalent full-time workers according to estimates from the Survey of Occupational Injuries and Illnesses (SOII) conducted by the U.S. Bureau of Labor Statistics. The rate reported for 2012 continues the pattern of statistically significant declines that, with the exception of 2011, occurred annually for the last decade [US Department of Labor 2012].</p> <p>Primary care providers see an estimated 80% of occupational and environmental-related illnesses. The work history represents the primary tool for recognizing work-related medical injuries and diseases [Thompson et al. 2000].</p> <p>Part 2 of the Exposure History Form is a comprehensive inventory of hazardous exposures in the patient's present and past occupations.</p>

In evaluating Part 2 of the form, the clinician should note every job the patient has had, regardless of duration. Information on part-time and temporary jobs could provide clues to toxic exposure. Details of jobs may reveal exposures that are not expected based on the job titles. Asking if any processes or routines have been changed recently can be helpful. Military service may have involved toxic exposure.

### *Scenario 2*

- 52-year-old male who owns a commercial cleaning service
- Chief complaints: headache and nausea

Scenario 2 involves another instance of a 52-year-old male who is brought in by his wife to see his primary care physician for an evaluation.

He has been in excellent health until approximately 1 week ago, when he began staying up later and later at night according to the wife. She was not too concerned until he began awakening her to talk about the “revolutionary” new ideas he had about creating an international, commercial cleaning service. She notes he was “full of energy” and talked rapidly about many ideas that he had. She became quite concerned when at 3:00 A.M. (European time) her husband called the manager of the rayon mill, who was in Europe, to discuss his ideas. He then began telephoning European banks in an attempt to find partners for his business venture. When his wife confronted him about the inappropriateness of his phone calls, he became enraged and accused her of purposefully attempting to sabotage his venture.

The patient complains of recurring headaches and nausea that started approximately 1 to 2 weeks ago and of recent angina attacks. This patient is

	<p>the owner of a commercial cleaning service and is extremely proud to tell the clinician he performs some of the cleaning himself.</p> <p>Questioning the patient extensively about the cleaning products fails to yield any suspicious exposure possibilities. Reviewing Part 2 of the Exposure History Form, the clinician notes</p> <ul style="list-style-type: none"> <li>• Detergents,</li> <li>• Ammonia, and</li> <li>• Cleansers.</li> </ul> <p>Pursuance of Part 2, Work History, however, reveals a clue. The clinician's investigation follows.</p>
<p><b>Sample Dialogue</b></p>	<p>Clinician: You own a commercial cleaning service?</p> <p>Patient: Yes. I've been in business for 10 years, and I'm going to be worldwide. Would you like to purchase stock in my company?</p> <p>Clinician: We can discuss that a little later. Do you do the cleaning yourself?</p> <p>Patient: I don't do as much as I used to. I have a crew of about 6 full-time employees. I do more managing than cleaning, but have been known to roll up my sleeves and pitch in when needed.</p> <p>Clinician: You clean residences and commercial businesses?</p> <p>Patient: Yes, I currently have 20 residential accounts and 15 commercial accounts, but have I told you that I will be international?</p> <p>Clinician: Yes, you did, but right now I'd like to know about the commercial accounts that are local.</p>

Patient: The local ones are downtown administrative offices for the school district, several realty offices downtown, and the business offices of the viscose rayon mill. I have 6 accounts in the Shaw Building downtown (small medical offices) and 5 retail stores in the Hilltop Mall, but I don't know why you will not listen to how I will revolutionize the commercial cleaning industry. I'm in touch with people that control the world currency markets. I know this because God spoke to me, telling me how to corner the cleaning market.

Clinician: That is interesting and I'd like to hear more after we finish covering a few more questions about your health.

Patient: Okay, I guess I can answer a few more questions...but you will want to hear about this lucrative opportunity!

Clinician: So your headaches have been occurring for about 1 week now? Have there been any changes in your routine—work or otherwise—in the last week?

Patient: I've worked more hours than usual over the last week. I've been doing a special project for the rayon mill. They built new offices. We moved all the old offices into the new building. That has entailed cleaning and moving

- Furniture,
- Files,
- Books, and
- Exhibits.

It's been tedious, but I have plenty of energy. Fortunately, most of the staff members have been either out on vacation or at an international



conference in Europe, so the building has been empty.

Clinician: Are any of your workers having similar symptoms?

Patient: No, nobody else has complained about feeling sick.

Clinician: What exactly do they produce at that plant?

Patient: They make viscose—transparent paper. I used to work there during summers when I was in college. It was hot, hard work. The whole place smelled like sulfur—rotten eggs. We used wood pulp cellulose, treated it with acids and other chemicals, and made cellulose filaments. I worked on the:

- Blending,
- Ripening, and
- Deaeration process.

You know I called the plant manager to help his business grow to international status.

Clinician: Can you smell the chemicals in the office building you're working in?

Patient: Some days there's a faint odor. Nothing like when I worked on the xanthating process. The business office building is on the northeast end of the complex. It's pretty remote from the processing plant.

Clinician: So how many extra hours have you worked the past week?

Patient: Only about 4 to 6 hours more per day this past week. Also, this past weekend I put in an

extra 10 hours. I had to finish setting up the exhibits. I didn't trust the crew to handle the fragile exhibits, so I did the job myself. My crew is good but not as good as me.

Patient's wife: Tell the doctor about the bottle you broke!

Patient: On Friday, about 2 weeks ago, I worked late setting up a huge model of the xanthating process. It was tedious work and I was stressed by the time constraints to get the job done. I had broken a bottle from the exhibit when I disassembled the thing. I'm really not certain that I broke the bottle; it most likely was stored improperly.

Clinician: What was in this bottle you broke?

Patient: I think it was carbon disulfide. I think I might have put the broken glass and the cleanup rags on the floor of my truck. This stuff had a sweet odor.

Clinician: How did you clean it up?

Patient: I changed into some protective clothing and a face mask because my eyes and nose burned. There wasn't a lot to clean up because it seemed to evaporate quickly.

Clinician: Did you get any of the chemical on you?

Patient: I don't think any got on me when the bottle fell, but I'm not certain.

Clinician: How much of the chemical was in the bottle? Did you report the accident to anyone at the plant?

	<p>Patient: The bottle was about liter size. It wasn't full. There was only a small amount of liquid in the bottle. No, I didn't report the accident. Frankly, I cleaned it up the way I was taught when I worked at the mill before. They know that I'm good. I helped them to become the organization they are today. I'll just talk with the manager when he returns from Europe later this week.</p>
<p><b>Dialogue Analysis and Conclusion</b></p>	<p>The preceding conversation reveals a possible connection with the spill and this patient's symptoms. It warrants further investigation. The results of the patient's physical examination are normal, and the mental status exam shows symptoms and behavior that are typical of a manic episode. The patient is</p> <ul style="list-style-type: none"> <li>• Grandiose,</li> <li>• Irritable,</li> <li>• Has a marked decrease in his need for sleep,</li> <li>• Has pressured speech, and</li> <li>• Possibly is having auditory hallucinations.</li> </ul> <p>The patient identifies the chemical spilled as carbon disulfide, which is consistent with the patient's symptoms.</p> <p>After obtaining permission from the patient, the clinician calls to consult with the poison control center regarding this patient's carbon disulfide exposure.</p>
<p><b>Sample Dialogue About the Call</b></p>	<p>Clinician: My patient is a contract employee at a local textile company. He thinks he broke a bottle that was labeled carbon disulfide in the process of his work. He didn't report the accident and just cleaned it up himself. I am concerned that he may</p>

be experiencing health effects from the possible exposure. He is complaining of

- Nausea,
- Headache, and
- Difficulty sleeping

and appears to be exhibiting signs of

- Agitation,
- Grandiose delusions,
- Pressured speech, and
- Possible auditory hallucinations.

Poison Control Center: It would not surprise me. Carbon disulfide is a dangerous substance. Strict industrial controls should be in effect to prevent exposure. This chemical can cause

- Nausea,
- Headache,
- Insomnia,
- Agitation,
- Mania, and
- Hallucinations,

all the symptoms your patient seems to be currently experiencing. The acute symptoms are mild to moderate irritation of skin, eyes, and mucous membranes from liquid or concentrated vapors. Skin absorption causes

- Headache,
- Fatigue,
- Unsteady gait,
- Vertigo,
- Hyperesthesia,
- Central nervous system depression,
- Garlicky breath,
- Nausea,
- Vomiting,

	<ul style="list-style-type: none"> <li>• Diarrhea,</li> <li>• Abdominal pain,</li> <li>• Coma,</li> <li>• Convulsion, or</li> <li>• Death.</li> </ul> <p>Clinician: Can you send me information on carbon disulfide?</p> <p>Poison Control Center: Certainly. I'll send you the information on carbon disulfide right away. I suggest that the accident be reported to the safety manager at the textile plant.</p>
<p><b>Dialogue Analysis and Conclusion</b></p>	<p>Consultation with the Occupational and Environmental Physician from the Poison Control Center confirms that this patient's symptoms could indeed be caused by exposure to carbon disulfide.</p> <p>The clinician orders a</p> <ul style="list-style-type: none"> <li>• CBC;</li> <li>• ECG;</li> <li>• Urinalysis;</li> <li>• Liver, kidney, and thyroid function tests;</li> <li>• Blood serology; and</li> <li>• An electrolyte panel.</li> </ul> <p>The clinician received a digital Material Safety Data Sheet (MSDS) on carbon disulfide (see Appendix II) from the textile plant safety manager.</p> <p>The clinician reviews the Health Hazard Data section of the MSDS, and notes all pertinent information in the patient's medical record, along with the prior information sent electronically from the Poison Control Center.</p> <p>Air sampling in the office in which the incident occurred reveals airborne concentrations of 0.8</p>

	<p>parts of <a href="#">carbon disulfide</a> per million parts of air (0.8 ppm). The Occupational Safety and Health Administration (OSHA) enforceable standard (permissible exposure limit or PEL) for carbon disulfide in workplace air is 20 parts per million (ppm) averaged over 8 hours of exposure. The concentrations were most likely much higher at the time of the incident 2 weeks ago. However, exposure to carbon disulfide has continued for a limited number of hours each week, while he and the patient drive around with the contaminated rags and bottle in his truck.</p> <p>Results of the laboratory tests on this patient are all within normal limits. Other employees at risk of exposure from this spill are also examined; none incurred acute exposure or suffered ill effects. Once the patient's exposure ceases he improves and experiences no further symptoms.</p>
<p><b>Key Points</b></p>	<ul style="list-style-type: none"> <li>• Primary care providers see an estimated 80% of occupational and environmentally related illnesses.</li> <li>• In evaluating patient's work history, the clinician should note every job the patient had, regardless of duration.</li> </ul>
<p><b>Progress Check Exercise(s)</b></p>	<ol style="list-style-type: none"> <li>9. In evaluating work history, the clinician should       <ol style="list-style-type: none"> <li>A. Note every job the patient had, regardless of duration.</li> <li>B. Pay attention to the information on part-time, temporary jobs and details of jobs including specific job tasks.</li> <li>C. Ask if any processes or routines have been changed recently.</li> </ol> </li> </ol>

	<p>D. All of the above.</p> <p><i>To review relevant content see "Introduction" in this section.</i></p>
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### **What Is Included in the Environmental History (Part 3) of an Exposure History Form**

<b>Learning Objectives</b>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"> <li>Describe how a seasoned clinician reveals a possible temporal relationship between a patient's symptoms and their home and surrounding environment(s).</li> </ul>
<b>Introduction</b>	<p>Part 3 of the Exposure History Form contains questions regarding the home and surrounding environment(s) of the patient. Dialogue with the patient should include queries about</p> <ul style="list-style-type: none"> <li>The location of the house,</li> <li>The house and drinking water supply, and</li> <li>Changes in air quality.</li> </ul> <p>The dialogue should also include other potential exposure settings such as</p> <ul style="list-style-type: none"> <li>Daycare,</li> <li>Recreational and/or</li> <li>School environments, as applicable.</li> </ul> <p>Proximity to industrial complexes and hazardous waste sites could result in residents being exposed to toxicants in the air, water, or soil. Contamination in communities is a growing public health concern;</p>

affected persons usually seek care from their primary care providers first. If a group of people with similar symptoms and exposures is identified, and an environmental problem is suspected, the clinician should call the state health department or the Agency for Toxic Substances and Disease Registry toll-free at 1-888-42-ATSDR (1-888-422-8737).

Hobbies are also potential sources of toxicant exposure. For instance,

- Gardening,
- Model building,
- Photography,
- Pottery-making,
- Silk screening,
- Stained-glass making, and
- Woodworking

have all been associated with exposure to hazardous substances. Ask the patient what his or her hobbies are. All members in a household may be exposed to the hazardous substances from one person's hobby, and small children may be especially susceptible. For more information on taking a complete exposure history for adults and for children, please see "[What Are Additional Environmental Health Resources?](#)" section.

### Scenario 3

- 52-year-old male, retired advertising copywriter with angina
- Chief complaints: headache and nausea

Scenario 3 involves another patient described in the case study. In this scenario, the patient has been retired for two years; he took early retirement from



a stressful job in advertising shortly after being diagnosed with angina.

The patient's answers to the questions on the Exposure Survey (Part 1 of the form) were no: he denies exposure to

- Chemicals,
- Dust,
- Fibers,
- Metals,
- Physical and biologic agents, and
- Radiation.

He is not aware of a connection between his symptoms and activity or time; and to his knowledge, other persons are not experiencing similar symptoms.

A clue appears on Part 3 of this patient's exposure history—the patient lives two miles from an abandoned industrial site, and prevailing winds blow toward his house.

In an effort to investigate this lead, the clinician initiates the following dialogue.

**Sample Dialogue**

Clinician:	You state that you live several miles downwind from an abandoned industrial site. Do you know what chemicals might have been used at the site or what type of industry it was?
Patient:	There was a fire at the site several weeks ago. The newspaper said that they used methylene chloride to make some kind of plastic. The firefighters

	found drums of methylene chloride buried on the property.	
Clinician:	Do you ever smell chemicals in the air?	
Patient:	Yes, in the mornings when the wind blows from that direction, I smell a sweet odor. My neighbors have mentioned it too. In fact, they told me that the smell is really strong when they do laundry or dishes, and when they shower.	
Clinician:	Have you smelled it in your water?	
Patient:	No.	
Clinician:	What is the source of your home and drinking water?	
Patient:	I have city water, but my neighbors have a private well.	
Clinician:	Do you know if any agency is testing your neighborhood for contamination?	
Patient:	Not as far as I know.	

**Dialogue  
Analysis and  
Conclusion**

The preceding dialogue has uncovered the possibility that the patient was exposed to a toxicant. Furthermore, this patient may represent an index case; others may also be exposed. To follow up this lead, the clinician contacts the state health department. The health department confirms that the site contains buried drums of methylene chloride and that it is under investigation.

An industrial hygienist employed by the health department informs the clinician that the methylene chloride can indeed exacerbate signs and symptoms of angina. The odor threshold for the chemicals is 100–300 ppm. An 8-hour exposure to 250 ppm methylene chloride can cause a COHb level of about 8%.

The laboratory reports that the patient's COHb is 6%, indicating probable exposure to methylene chloride in this nonsmoker. COHb, which forms when methylene chloride metabolizes to carbon monoxide, can be detected in blood at levels of 4% to 9% when ambient air concentrations of methylene chloride are about 220 ppm. Many factors can influence body burden, including

- Exposure level and duration,
- Route of exposure,
- Physical activity, and
- Amount of body fat.

A conference call is made, and

- The emergency response coordinator,
- A toxicologist,
- An industrial hygienist, and
- A physician discuss the patient's signs and symptoms.

The clinician is given publically available contact information on board certified specialists with

	<p>expertise and experience in treating patients exposed to hazardous substances including methylene chloride.</p> <p>Although the levels are above background levels, the health department's tests of ambient air reveal no immediate crisis in the vicinity, although the levels are above background levels; test results of water samples from private wells in the area are pending. ATSDR informs the EPA regional office of the situation. EPA provides immediate assistance to the affected area, cleanup is initiated, and threats to the surrounding population are mitigated.</p>
<p><b>Key Points</b></p>	<ul style="list-style-type: none"> <li>• Contamination in communities is a growing public health concern; affected persons usually seek care from their primary health care providers first.</li> <li>• All members in a household may be exposed to the hazardous substances from one person's hobby; small children may be especially susceptible.</li> <li>• Ask the patient about residence water supply, proximity to industrial sites, etc. as valuable exposure source clues.</li> </ul>
<p><b>Progress Check Exercise(s)</b></p>	<p>10. Which of the following statements is correct?</p> <p>A. Contamination in communities is a growing public health concern; affected persons usually seek care from their primary care providers first.</p> <p>B. If a group of people with similar symptoms and exposures is identified, and an environmental exposure problem is suspected, the clinician should call the EPA.</p>

	<p>C. When a person's hobby is identified as a possible exposure risk, questions should focus on the patient's exposure as household members are generally not at risk.</p> <p>D. None of the above.</p> <p><i>To review relevant content see Introduction" in this section.</i></p>
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## What Instructions Should Be Given to Patients?

<b>Learning Objectives</b>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"> <li>• Describe instructions that should be given to patients exposed or potentially exposed to hazardous substances.</li> </ul>
<b>Introduction</b>	<p>Health care providers should educate patients about the many steps they can take to prevent exposure to hazardous substances in the home, other non-work and workplace settings (Association of Reproductive Health Professionals 2010). Providers also should advise patients who work in occupations such as</p> <ul style="list-style-type: none"> <li>• Agriculture,</li> <li>• Construction</li> <li>• Gardening,</li> <li>• Landscaping, or</li> <li>• Pest control</li> </ul> <p>about limiting or mitigating chemical exposure at the workplace. It is important for health care providers to know about exposures to potentially</p>

hazardous materials their patients have had throughout their life. To do this, patients need to describe

- Workplace exposures,
- Exposures at home, and
- Other exposures they may have had.

To obtain a complete, detailed exposure history, physicians need to be able to communicate in a way that facilitates this process. Letting the patient know the purpose and the importance of providing detailed information before and during the history taking process may increase the quality and quantity of information received. Obtaining this information is vital toward preventing exposure or exposure related adverse health effects.

Physicians should also provide patient self-care advice, clinical follow-up instructions, and fully address patient questions using appropriate risk communication messaging techniques. By utilizing effective risk communication techniques, the clinician can promote patient behaviors that may reduce risk of exposure and exposure related adverse health effects.

Preventive messages targeted to at risk populations are also important in preventing adverse health effects from exposure.

<p><b>Imparting the Importance of the Exposure History</b></p>	<p>Patients need to understand that unless an exposure history is pursued by the clinician, the etiologic diagnosis might be missed, treatment may be inappropriate, and exposure can continue.</p> <p>Use of effective risk communication strategies while taking an exposure history can facilitate gathering of complete, detailed information.</p>
<p><b>When Counseling Patients, Providers Should</b></p>	<p>When counseling patients, providers should</p> <ul style="list-style-type: none"> <li>• Recommend that patients try to become familiar with all chemicals used or encountered in their work and non-work settings and learn about the potentially toxic properties of these chemicals.</li> <li>• Direct patients to appropriate sources of information about chemicals.</li> <li>• Instruct patients on steps to take to mitigate exposure or refer them to their employer or to an environmental and occupational health expert who can suggest exposure-reducing strategies (e.g., substitute a safer chemical, wash exposed skin, launder clothing from work separately to prevent contamination of other clothing, etc.).</li> <li>• Ask if patients have access to and are using appropriate protective gear.</li> <li>• Advise patients to avoid contact with clothing, shoes or other “take home” work items that other household members may bring home if there is a potential for toxicant exposure.</li> <li>• Advise patients to take extra care to avoid exposure if they are pregnant or planning pregnancy because standard personal protective equipment may not be sufficient to guard from exposure to reproductive toxicants. Advise them to change clothes</li> </ul>

	<p>before leaving the workplace and to have potentially contaminated clothing laundered at work, if possible.</p>
<p><b>Patient Self Care and Clinical Follow Up Instructions</b></p>	<p>Self-care advice creates awareness and suggests actionable behaviors that may reduce the risk of exposure to hazardous substances in the work and non-work setting as well as exposure related adverse health effects. Patients should be advised to consult their physician if they or their children develop signs or symptoms that may indicate exposure related adverse health effects.</p> <p>ATSDR has developed "<a href="#">Patient Education and Care Instruction Sheets</a>" that can help educate and facilitate clinical follow up. More information on this resource can be found in the "What Are Additional Environmental Health Resources?" section.</p>
<p><b>Where Can Patients Get Information About Their Exposures?</b></p>	<p>There are many printed and online sources of information about exposure to hazardous substances including many federal government agencies like <a href="#">ATSDR</a>, <a href="#">NIOSH</a>, <a href="#">OSHA</a>, and <a href="#">EPA</a>. Universities and U.S. Poison Control Centers may also be able to supply information about potential health hazards.</p> <p>More information on available patient education resources including ATSDR's Patient Education and Care Instruction sheets can be found in the "What are Additional Environmental Health Resources?" section.</p>



<p><b>Key Points</b></p>	<ul style="list-style-type: none"> <li>• Patients need to understand why an exposure history is important.</li> <li>• Patients should be given instructions on how to prevent exposure to hazardous substances in both work and non-work environments.</li> <li>• Primary health care providers and patients should be aware of the many publically available clinical, environmental and occupational health informational and educational resources available to them.</li> <li>• ATSDR has developed Patient Education and Care Instruction Sheets that may facilitate health care provider communications and follow up with the patient.</li> <li>• Physicians should provide patient self-care advice and clinical follow up instructions using appropriate risk communication messaging techniques.</li> </ul>
<p><b>Progress Check Exercise(s)</b></p>	<p>11. When counseling patients, providers should</p> <ul style="list-style-type: none"> <li>A. Instruct patients on steps to take to mitigate exposure.</li> <li>B. Direct patients to appropriate sources of information about chemicals.</li> <li>C. Advise patients to take extra care to avoid exposure if they are pregnant or planning pregnancy.</li> <li>D. Provide patient self care advice and clinical follow up instructions using effective risk communication messaging techniques.</li> <li>E. All of the above. <i>To review relevant content see "When Counseling Patients, Providers Should" in this section.</i></li> </ul>

## What Are Additional Environmental Health Resources?

<b>Learning Objectives</b>	<p>Upon completion of this section, you will be able to</p> <ul style="list-style-type: none"><li>• Describe additional environmental health resources.</li></ul>
<b>Introduction</b>	<p>This section provides a resource listing for more information on</p> <ul style="list-style-type: none"><li>• Hazardous exposures from environmental and occupational sources,</li><li>• Potential adverse health effects, and</li><li>• The prevention, evaluation, treatment and management of exposed or potentially exposed patients.</li></ul> <p>It serves as an overview rather than an exhaustive list of publically available resources that may be of use to the primary health care provider in providing care to patients exposed or potentially exposed to hazardous substances from environmental and occupational sources.</p> <p>Publically available clinical consultation and referral resources are available to assist primary health care providers in the detection, treatment, and prevention of disease(s) resulting from toxic exposure(s). Many federal agencies including the Agency for Toxic Substances and Disease Registry (ATSDR), the Centers for Disease Control and Prevention (CDC), the U.S. Environmental Protection Agency (EPA), the National Institute of Occupational Safety and Health (NIOSH), and the Occupational Safety and Health Administration (OSHA) are appropriate sources for information</p>

	<p>about exposure to hazardous substances and potentially related adverse health effects. Universities and U.S. Poison Control Centers may also be able to supply information about potential health hazards. Many of these same resources can be valuable sources of information for lay audiences.</p> <p>A variety of printed and online sources, including books, databases, journals, websites, and Information can also be obtained from sources such as U.S. Poison Control Centers, board certified specialists with expertise and experience in treating patients with exposures to toxic substances, government agencies, employers, health departments, manufacturers, and unions.</p>
<p><b>Agency for Toxic Substances and Disease Control (ATSDR)</b></p>	<p>Based in Atlanta, GA, ATSDR is a federal public health agency of the U.S. Department of Health and Human Services. It serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.</p> <ul style="list-style-type: none"> <li>• ATSDR <a href="http://www.atsdr.cdc.gov">http://www.atsdr.cdc.gov</a> <ul style="list-style-type: none"> <li>○ For chemical, emergency situations           <ul style="list-style-type: none"> <li>▪ CDC Emergency Response: 770-488-7100 and request the ATSDR Duty Officer.</li> </ul> </li> <li>○ For chemical, non-emergency situations           <ul style="list-style-type: none"> <li>▪ CDC_INFO <a href="http://www.cdc.gov/cdc-info">http://www.cdc.gov/cdc-info</a></li> <li>▪ 800-CDC-INFO (800-232-4636) TTY 888-232-6348 – 24 hours per day</li> </ul> </li> </ul> </li> </ul>

- E-mail: [cdcinfo@cdc.gov](mailto:cdcinfo@cdc.gov)

Please note:

ATSDR cannot respond to questions about individual medical cases, provide second medical opinions, or make specific recommendations regarding clinical treatment/therapy. Please see "Clinical Resources" for publically available clinical resource information.

- ATSDR [Toxicological Profiles](#). By Congressional mandate, ATSDR produces "toxicological profiles" for hazardous substances found at National Priorities List (NPL) sites. These hazardous substances are ranked based on frequency of occurrence at NPL sites, toxicity, and potential for human exposure. Toxicological profiles are developed from a priority list of 275 substances. ATSDR also prepares toxicological profiles for the Department of Defense (DOD) and the Department of Energy (DOE) on substances related to federal sites.
- ATSDR [Case Studies in Environmental Medicine](#) (CSEM) are self-instructional, continuing-education primers designed to increase primary care providers' knowledge of hazardous substances and aid in the evaluation of patients potentially exposed to hazardous substances. Each CSEM comes with additional companion products such as [Grand Rounds in Environmental Medicine](#) and [Patient Education and Care Instruction Sheets](#).

	<ul style="list-style-type: none"> <li>o <a href="#">ATSDR ToxFAQs™</a> are a series of summaries about hazardous substances developed by the ATSDR Division of Toxicology and Human Health Sciences. Information for this series is excerpted from the ATSDR Toxicological Profiles and Public Health Statements. Each fact sheet serves as a quick and easy to understand guide. Answers are provided to the most frequently asked questions (FAQs) about exposure to hazardous substances found around hazardous waste sites and the effects of exposure on human health.</li> </ul>
<p><b>Centers for Disease Control and Prevention (CDC)</b></p>	<p>CDC is the national public health institute of the United States. Its main goal is to protect public health and safety through the control and prevention of disease, injury, and disability.  <a href="http://www.cdc.gov">http://www.cdc.gov</a></p> <ul style="list-style-type: none"> <li>• CDC works to protect public health and the safety of people by providing information to enhance health decisions, and promotes health through partnerships with state health departments and other organizations.</li> <li>• The CDC focuses national attention on developing and applying disease prevention and control (especially infectious diseases), environmental health, occupational safety and health, health promotion, prevention and education activities designed to improve the health of the people of the United States.</li> </ul>
<p><b>The National Institute for Occupational</b></p>	<p><a href="#">NIOSH</a> is the U.S. federal agency that conducts research and makes recommendations to prevent</p>

<p><b>Safety and Health (NIOSH)</b></p>	<p>worker injury and illness. It is part of CDC and is not a regulatory agency.</p> <ul style="list-style-type: none"> <li>• NIOSH produces new scientific knowledge and provides practical solutions vital to reducing risks of injury and death in traditional industries, such as agriculture, construction, and mining.</li> <li>• NIOSH also supports research to predict, prevent, and address emerging problems that arise from dramatic changes in the 21st Century workplace and workforce.</li> <li>• NIOSH partners with diverse stakeholders to study how worker injuries, illnesses, and deaths occur and can be prevented.</li> </ul>
<p><b>Occupational Safety and Health Administration (OSHA)</b></p>	<p>The OSHA is a federal agency of the U.S. Department of Labor. <a href="http://www.osha.gov">http://www.osha.gov</a> Its mission is to "assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance". Through the Occupational Safety and Health Act, OSHA issues workplace health and safety regulations.</p> <p>These regulations include</p> <ul style="list-style-type: none"> <li>• Limits on chemical exposure,</li> <li>• Employee access to information,</li> <li>• Requirements for the use of personal protective equipment, and</li> <li>• Requirements for safety procedures.</li> </ul>
<p><b><u>U.S. Environment</u></b></p>	<p>The EPA is a federal agency created for the purpose of protecting human health and the</p>

<p><b><u>al Protection Agency (EPA)</u></b></p>	<p>environment by writing and enforcing regulations based on laws passed by Congress.  <a href="http://www.epa.gov">http://www.epa.gov</a></p> <ul style="list-style-type: none"> <li>• The agency conducts environmental assessment, research, and education.</li> <li>• It has the responsibility of maintaining and enforcing national standards under a variety of environmental laws, in consultation with state, tribal, and local governments.</li> <li>• It delegates some permitting, monitoring, and enforcement responsibility to U.S. states and the federal recognized tribes.</li> </ul> <p>EPA works with industries and all levels of government in a wide variety of voluntary pollution prevention programs and energy conservation efforts.</p>
<p><b>Additional Sources of Information</b></p>	<p>NLM's Environmental Health and Toxicology website....a "one stop shop".  <a href="http://hazmap.nlm.nih.gov/index.php">http://hazmap.nlm.nih.gov/index.php</a></p> <p>Collaborative on Health and the Environment (CHE). <a href="http://www.healthandenvironment.org/">http://www.healthandenvironment.org/</a></p> <p>Environmental Working Group.  <a href="http://www.ewg.org/">http://www.ewg.org/</a></p> <p>Healthy Child, Healthy World.  <a href="http://healthychild.org/">http://healthychild.org/</a></p> <p>University of California-San Francisco's Program on Reproductive Health and the Environment's FASTEP Program: Toxic Matters.  <a href="http://prhe.ucsf.edu/prhe/toxicmatters.html">http://prhe.ucsf.edu/prhe/toxicmatters.html</a></p>

**Safety Data Sheets (SDS) (formally known as Material Safety Data Sheets (MSDS))**

The objective of the Safety Data Sheets (SDS) (formally known as Material Safety Data Sheets (MSDS)) is to concisely educate workers about the hazards of materials they use so they can protect themselves and respond to emergency situations. The federally mandated OSHA Hazardous Communication Standard states that workers must have access to relevant SDSs and be educated on their contents and application in a format they can understand.

Some state and local “right-to-know laws” may be more comprehensive than the federal regulation.

The SDS (formally known as MSDS) is a component of the right-to-know law. Manufacturers and importers are required to provide an SDS for each hazardous chemical in a shipment. Users of the chemicals must keep copies of SDSs and make them available to workers, clinicians, and others.

SDSs contain information on the chemical properties of the substance, handling precautions, known health effects, and conditions that might worsen with exposure. The information on human health effects, however, can be vague and may have limited clinical value. The SDS may not provide information on the combined effects of multiple chemical exposures. Clinical decisions should not be based solely on information obtained from SDSs (sample MSDS; see [Appendix II !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\) \[PDF - 34 KB\]](#)). Search the Occupational Safety and Health Administration at <https://www.osha.gov/Publications/OSHA3514.html> for a more detailed description of the various required parts of the SDS (formally called MSDS).



	<p>To identify an SDS for a specific chemical, search “(name of chemical) Safety Data Sheet” using your Internet browser.</p>
<b>U.S. Poison Control Centers</b>	<p>The regional poison control centers can act as valuable resources in providing information about the toxicity and health effects of hazardous exposures involved in poisonings. The main emergency number across the country is 1-800-222-1222, although some states have other contact numbers, as well as a number for the hearing impaired. For more information, contact the American Association of Poison Control Centers at <a href="http://www.aapcc.org/">http://www.aapcc.org/</a>.</p>
<b>Clinical Resources</b>	<p>Please refer to this alphabetized sample listing of publically available clinical resources for consultation on the prevention, treatment and management of patients exposed or potentially exposed to hazardous substances. This list does not imply endorsement by the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services.</p> <ul style="list-style-type: none"><li>• American Association of Poison Control Centers <a href="http://www.aapcc.org">http://www.aapcc.org</a><ul style="list-style-type: none"><li>○ Contact the American Association of Poison Control Centers for questions about poisons and poisonings.</li><li>○ The Web site provides information about poison centers and poison prevention. AAPC does not provide information about treatment or diagnosis of poisoning or research information for student papers.</li><li>○ American Association of Poison Control Centers (1-800-222-1222)</li></ul></li></ul>

- American College of Medical Toxicology (ACMT) <http://www.acmt.net>
  - ACMT is a professional, nonprofit association of physicians with recognized expertise in medical toxicology.
  - The mission of the ACMT is to advance quality care of poisoned patients and public health through physicians who specialize in consultative, emergency, environmental, forensic, and occupational toxicology.
  
- American College of Occupational and Environmental Medicine (ACOEM) <http://www.acoem.org>
  - ACOEM is the nation's largest medical society dedicated to promoting the health of workers through preventive medicine, clinical care, research, and education.
  - Its members are a dynamic group of physicians encompassing specialists in a variety of medical practices united via the College to develop positions and policies on vital issues relevant to the practice of preventive medicine both within and outside the workplace.
  
- American College of Preventive Medicine (ACPM) <http://www.acpm.org>
  - ACPM is the national professional society for physicians committed to disease prevention and health promotion.
  - ACPM's 2,000 members are engaged in preventive medicine practice, teaching, and research.

	<ul style="list-style-type: none"> <li>▪ Association of Occupational and Environmental Clinics (AOEC) <a href="http://aoec.org">http://aoec.org</a> <ul style="list-style-type: none"> <li>○ AOEC is a network of more than 60 clinics and more than 250 individuals committed to improving the practice of occupational and environmental medicine through information sharing and collaborative research.</li> </ul> </li> <li>• Pediatric Environmental Health Specialty Units (PEHSUs) <a href="http://www.pehsu.net">http://www.pehsu.net</a> <ul style="list-style-type: none"> <li>○ PEHSU form a respected network of experts in children's environmental health.</li> <li>○ The PEHSU were created to ensure that children and communities have access to, usually at no cost, special medical knowledge and resources for children faced with a health risk due to a natural or human-made environmental hazard.</li> <li>○ Located throughout the United States, Canada, and Mexico, PEHSU professionals provide quality medical consultation for health professionals, parents, caregivers, and patients. The PEHSUs are also dedicated to increasing environmental medicine knowledge among healthcare professionals around children's environmental health by providing consultation and training.</li> </ul> </li> </ul>
<p><b>Key Points</b></p>	<ul style="list-style-type: none"> <li>• There are many publically available environmental health information and education resources designed for different audiences.</li> </ul>

	<ul style="list-style-type: none"><li>• A variety of printed and online sources are available to the clinician, including books, databases, websites, journals, and Safety Data Sheets (SDS; formally known as Material Safety Data Sheets; MSDSs).</li><li>• Publically available information on clinical consultation and referral resources enhance the role that primary health care providers have in detecting, treating, and preventing disease(s) resulting from environmental and occupational exposure(s).</li></ul>
<p><b>Progress Check Exercise(s)</b></p>	<p>12. Which of the following statements about SDS (formerly the MSDSs) is <b>INCORRECT</b>?</p> <ul style="list-style-type: none"><li>A. The SDS is a component of the right-to-know law.</li><li>B. Information contained in SDSs includes the chemical properties of the substance, handling precautions, known health effects, and conditions that might worsen with exposure.</li><li>C. Clinicians may depend on the information on human health effects from SDSs to make clinical decisions.</li><li>D. Employers must keep copies of SDSs for hazardous chemicals used in the workplace and make them available to workers, clinicians, and others.</li></ul> <p><i>To review relevant content see "Safety Data Sheets" in this section.</i></p>

## Posttest

<p><b>Posttest- Select the one best answer choice.</b></p>	<ol style="list-style-type: none"><li>1. Taking an exposure history may enable physicians to<ol style="list-style-type: none"><li>A. Make more accurate diagnoses.</li><li>B. Prevent disease or influence the course of disease by stopping exposure.</li><li>C. Stimulate workplace evaluations and the protection of workers.</li><li>D. All of the above.</li></ol></li> <li>2. Which of the following is NOT a goal of taking an exposure history?<ol style="list-style-type: none"><li>A. Reversing or slowing the progression of the patient's illness.</li><li>B. Mitigating exposure.</li><li>C. Gathering legal information about the patient.</li><li>D. Identifying the hazard.</li></ol></li> <li>3. Which of the following statements regarding the diagnosis of environmental and occupational diseases is TRUE?<ol style="list-style-type: none"><li>A. In-depth knowledge of toxicology is necessary to make the diagnosis.</li><li>B. Exposure history with attention to symptom onset and temporal pattern, physical examination, and available biological markers of exposure and effect may facilitate the diagnosis of environmental or occupational exposure related disease.</li><li>C. Extensive laboratory and environmental testing is always necessary in making the diagnosis.</li><li>D. Signs and symptoms of environmental diseases are often specific and easily</li></ol></li></ol>
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differentiated from common maladies.

4. Which of the following statements is NOT TRUE?
- A. In-depth evaluation of the exposure history form is necessary in every clinical encounter.
  - B. The completed exposure history form can be used to evaluate the patient's present complaint and also serve as a baseline for future reference.
  - C. The completed exposure history form may alert the clinician to a significant past exposure.
  - D. The exposure history forms can be self-administered.
5. All of the following statements about toxic exposure are true EXCEPT
- A. Symptoms of liver disease due to toxic exposure can mimic viral hepatitis.
  - B. Cardiovascular problems can result from exposure to noise and to chemicals such as carbon monoxide and tobacco smoke.
  - C. The respiratory system is the only portal of entry for toxicants.
  - D. Many chemicals cause mild central nervous system depression that may be misdiagnosed as inebriation.
6. Exposure to of the following hazards are best known to target the renal system?
- A. Carbon monoxide and nitrates.
  - B. Asbestos and tobacco smoke.
  - C. Organic solvents and heavy metals.
  - D. Noise and vinyl chloride.

7. Which of the following statements is correct?
- A. Generally speaking, people in developed countries spend more time outdoors than indoors.
  - B. Environmental tobacco smoke is an entirely preventable public health hazard.
  - C. Building materials used in homes are considered safe and without significant health risk.
  - D. Smoking cigarettes does not significantly impact the risk of cancer from asbestos exposure.
8. All of the following statements are true **EXCEPT**
- A. Hobbies can be a source of toxic exposure to all household members.
  - B. Labels required by law on household products are adequate in identifying product constituents.
  - C. People often do not know the names of the toxicant to which they are routinely exposed.
  - D. Family pets' health and behavior can give clues to toxic exposure in the home.
9. Which of the following statements regarding the exposure history is **NOT TRUE**?
- A. A negative response to all questions should rule out a toxic exposure etiology or significant previous exposure.
  - B. All patients should complete exposure history forms, although the form does not need extensive evaluation in every clinical situation.
  - C. An exposure history form has three components: exposure survey, work history, and environmental history.

D. Hobbies are generally a very important part of the environmental exposure history.

10. If the patient answers "yes" to one or more questions on Part 1 of an Exposure History Form, the clinician must do what?

A. Ask questions regarding the route, dose, duration, and frequency of any identified exposure.

B. Follow up by asking the patient progressively more detailed questions about the possible exposure.

C. Explore the nature and timing of symptoms in relation to reported exposure.

D. All of the above.

11. Which of the following statements regarding the exposure history process is TRUE?

A. Exploring the temporal aspects of signs and symptoms can provide clues to the source of exposure.

B. Knowing job titles is necessary when attempting to identify toxic exposures.

C. Employment handbooks are the best source of detailed information on workplace toxic exposures.

D. None of the above.

12. When eliciting an exposure history, the clinician needs to do which of the following?

A. Understand the jargon of a particular trade.

B. Take an extensive exposure history in every clinical encounter.

C. Ask the patient more detailed questions about possible exposure if the patient



answers "yes" to one or more questions on the exposure history form.

- D. Take as much time as it might take to complete the exposure history form
13. Which of the following statements is correct?
- A. Contamination in communities is a growing public health concern; affected persons usually seek care from their primary care providers first.
  - B. Household members are generally not at risk of exposure to the hazardous substances from one person's hobby.
  - C. If a group of people with similar symptoms and exposures is identified, and an environmental exposure problem is suspected, the clinician should call the EPA.
  - D. None of the above.
- 14 Which of the following statements is **NOT CORRECT**?
- A. The regional poison control centers can act as valuable resources in providing information about the toxicity and health effects of hazardous exposures involved in poisonings.
  - B. SDSs contain the information on human health effects, thus clinical decisions can be based on information obtained from SDSs
  - C. Publically available information on clinical consultation and referral resources enhance the role that primary health care providers have in detecting, treating, and preventing disease(s) resulting from environmental and occupational exposures.

	<p>D. There are many publically available environmental and occupational health information and education resources designed for different audiences..</p> <p>15. When counseling patients, health care providers should do all of the following <b>EXCEPT</b></p> <p>A. Direct patients to appropriate sources of information about chemicals.</p> <p>B. Instruct patients on steps to take to mitigate exposure.</p> <p>C. Advise patients to avoid contact with clothes that others in the household wear home if there is a potential for toxicant exposure.</p> <p>D. Advise pregnant patients that they can continue working in areas with reproductive toxicants because standard personal protective equipment adequately guards them from exposure.</p>		
<p><b>Relevant Content</b></p>	<p>To review content relevant to the posttest questions, see</p> <table border="1" data-bbox="545 1554 1365 1713"> <tr> <td data-bbox="545 1554 768 1713"> <p>Question</p> </td> <td data-bbox="768 1554 1365 1713"> <p>Location of Relevant Content</p> </td> </tr> </table>	<p>Question</p>	<p>Location of Relevant Content</p>
<p>Question</p>	<p>Location of Relevant Content</p>		

1.	<p>What Is the Purpose of Taking an Exposure History?</p> <ul style="list-style-type: none"><li>• Explain the importance of taking an exposure history.</li></ul>
2.	<p>What Is the Purpose of Taking an Exposure History?</p> <ul style="list-style-type: none"><li>• Explain the importance of taking an exposure history.</li></ul>
3.	<p>What Role Do Primary Health Care Providers Have in Detecting, Treating, and Preventing Disease Resulting from Toxic Exposures?</p> <ul style="list-style-type: none"><li>• Explain why primary health care providers should be knowledgeable about the exposure history process.</li></ul>
4.	<p>What Role Do Primary Health Care Providers Have in Detecting, Treating, and Preventing Disease Resulting from Toxic Exposures?</p>

	<ul style="list-style-type: none"> <li>• Explain why primary health care providers should be knowledgeable about the exposure history process.</li> </ul>
5.	<p>Which Organ Systems Are Affected By Toxic Exposure(s)?</p> <ul style="list-style-type: none"> <li>• Explain how organ systems may be affected by toxic exposure(s).</li> </ul>
6.	<p>Which Organ Systems Are Affected By Toxic Exposure(s)?</p> <ul style="list-style-type: none"> <li>• Explain how organ systems may be affected by toxic exposure(s).</li> </ul>
7.	<p>What Are Possible Sources of Indoor Air Pollution?</p> <ul style="list-style-type: none"> <li>• Identify possible sources of indoor air pollution.</li> </ul>
8.	<p>What Are Other Potential Sources and Pathways of</p>

	<p>Hazardous Exposure in the Home and Environment?</p> <ul style="list-style-type: none"> <li>• Identify additional potential sources of hazardous exposure in the home and environment.</li> </ul>
9.	<p>What are the Components of an Exposure History?</p> <ul style="list-style-type: none"> <li>• Describe the components of an exposure history.</li> </ul>
10.	<p>What is Included in the Exposure Survey (Part 1) of an Exposure History Form?</p> <ul style="list-style-type: none"> <li>• Explain how temporal relationships between a patient's symptoms and their non-work or work environments are identified.</li> </ul>
11.	<p>What Is Included in the Work History (Part 2) of an Exposure History Form?</p> <ul style="list-style-type: none"> <li>• Describe how a seasoned clinician reveals a</li> </ul>

	<p>possible temporal relationship between a patient's symptoms and their workplace.</p>
<p>12.</p>	<p>What Is Included in the Work History (Part 2) of an Exposure History Form?</p> <ul style="list-style-type: none"> <li>Describe how a seasoned clinician reveals a possible temporal relationship between a patient's symptoms and their workplace.</li> </ul>
<p>13.</p>	<p>What Is Included in the Environmental History (part3) of an Exposure History Form?</p> <ul style="list-style-type: none"> <li>Describe how a seasoned clinician reveals a possible temporal relationship between a patient's symptoms and their home and surrounding environment(s).</li> </ul>

	<table border="1"> <tr> <td data-bbox="545 228 766 621">14.</td> <td data-bbox="766 228 1362 621"> <p>What Are Additional Environmental Health Resources?</p> <ul style="list-style-type: none"> <li>Describe additional environmental health resources.</li> </ul> </td> </tr> <tr> <td data-bbox="545 621 766 1045">15.</td> <td data-bbox="766 621 1362 1045"> <p>What Instructions Should Be Given to Patients?</p> <ul style="list-style-type: none"> <li>Describe instructions that should be given to patients exposed or potentially exposed to hazardous substances.</li> </ul> </td> </tr> </table>	14.	<p>What Are Additional Environmental Health Resources?</p> <ul style="list-style-type: none"> <li>Describe additional environmental health resources.</li> </ul>	15.	<p>What Instructions Should Be Given to Patients?</p> <ul style="list-style-type: none"> <li>Describe instructions that should be given to patients exposed or potentially exposed to hazardous substances.</li> </ul>
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## Tables

Table of Tables

Table	Table Title
<b>Number</b>	
<b>1</b>	<b>Examples of Environmental and Occupational Causes of Medical Problems</b>
<b>2</b>	<b>Organ Systems Often Affected by Toxic Exposure</b>
<b>3</b>	<b>Commonly Used Compounds That Can Have Serious Adverse Health Effects</b>
<b>4</b>	<b>Components of an Exposure History</b>





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# Appendix I - Exposure History Form

The Exposure History Form is available at

<http://www.atsdr.cdc.gov/csem/exphistory/docs/CSEMExposHist-26-29.pdf>

Part 1. Exposure Survey    **Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

*Please select the appropriate answer*    **Birth date:** \_\_\_\_\_ **Sex (select one):**  Male     Female

1. Are you currently exposed to any of the following?

- Metals  No     Yes
- Dust or fibers  No     Yes
- Chemicals  No     Yes
- Fumes  No     Yes
- Radiation  No     Yes
- Biologic agents  No     Yes
- Loud noise, vibration, extreme heat or cold  No     Yes

2. Have you been exposed to any of the above in the past?  No     Yes

3. Do any household members have contact with metal, dust, fibers, chemicals, fumes, radiation, or biologic agents?  No     Yes

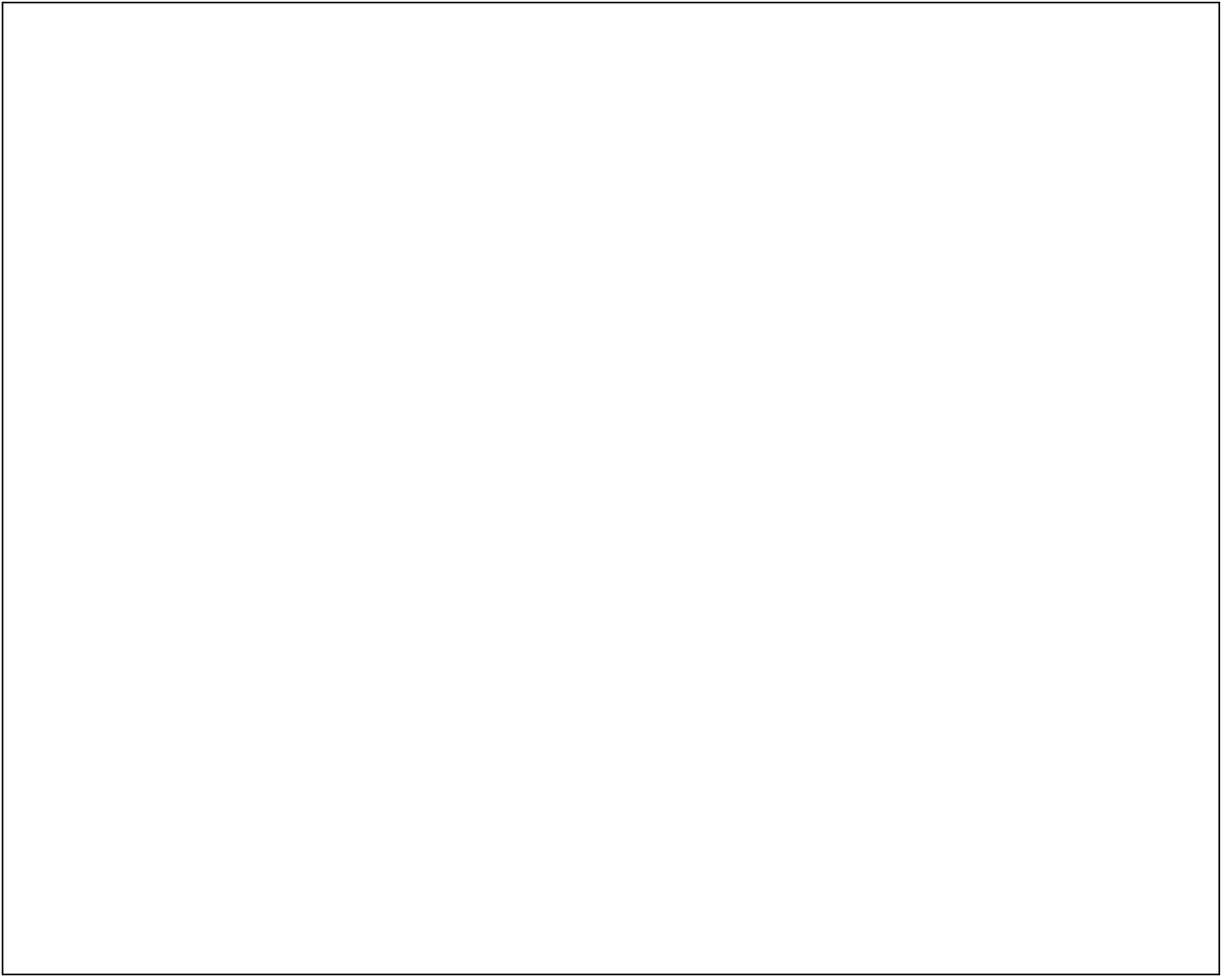
If you answered yes to any of the items above, describe your exposure in detail – how you were exposed, to what you were exposed, how much, how often, and how long you were exposed?

4. Do you know the names of the metals, dusts, fibers, chemicals, fumes, or radiation that you are/were exposed to?  No     Yes >

If yes, list them below

5.	Do you get the material on your skin or clothing?	<input type="radio"/>	No	<input type="radio"/>	Yes	
6.	Are your work clothes laundered at home?	<input type="radio"/>	No	<input type="radio"/>	Yes	
7.	Do you shower at work?	<input type="radio"/>	No	<input type="radio"/>	Yes	
8.	Can you smell the chemical or material you are working with?	<input type="radio"/>	No	<input type="radio"/>	Yes	
9.	Do you use protective equipment such as gloves, masks, respirator, or hearing protectors?	<input type="radio"/>	No	<input type="radio"/>	Yes	> If yes, list the protective equipment used
10.	Have you been advised to use protective equipment?	<input type="radio"/>	No	<input type="radio"/>	Yes	
11.	Have you been instructed in the use of protective equipment?	<input type="radio"/>	No	<input type="radio"/>	Yes	
12.	Do you wash your hands with solvents?	<input type="radio"/>	No	<input type="radio"/>	Yes	
13.	Do you smoke at the workplace?	<input type="radio"/>	No	<input type="radio"/>	Yes	
	at home?	<input type="radio"/>	No	<input type="radio"/>	Yes	
14.	Are you exposed to secondhand tobacco smoke at the workplace?	<input type="radio"/>	No	<input type="radio"/>	Yes	
	at home?	<input type="radio"/>	No	<input type="radio"/>	Yes	
15.	Do you eat at the workplace?	<input type="radio"/>	No	<input type="radio"/>	Yes	
16.	Do you know of any co-workers experiencing similar or unusual symptoms?	<input type="radio"/>	No	<input type="radio"/>	Yes	
17.	Are family members experiencing similar or unusual symptoms?	<input type="radio"/>	No	<input type="radio"/>	Yes	
18.	Has there been a change in the health or behavior of family pets?	<input type="radio"/>	No	<input type="radio"/>	Yes	
19.	Do your symptoms seem to be aggravated by a specific activity?	<input type="radio"/>	No	<input type="radio"/>	Yes	
20.	Do your symptoms get either worse or better at work?	<input type="radio"/>	No	<input type="radio"/>	Yes	
	at home?	<input type="radio"/>	No	<input type="radio"/>	Yes	
	on weekends?	<input type="radio"/>	No	<input type="radio"/>	Yes	
	on vacation?	<input type="radio"/>	No	<input type="radio"/>	Yes	
21.	Has anything about your job changed in recent months (such as duties, procedures, overtime)?	<input type="radio"/>	No	<input type="radio"/>	Yes	
22.	Do you use any (such as herbs or natural supplements) alternative medicines?	<input type="radio"/>	No	<input type="radio"/>	Yes	
23.	Have you or your child ever eaten non-food items such as paint, plaster, dirt and/or clay?	<input type="radio"/>	No	<input type="radio"/>	Yes	

If you answered yes to any of these questions, please explain.



## Part 2. Work History

### A. Occupational Profile

The following questions refer to your current or most recent job:

Job title:

Type of industry:

Name of employer:

Date job began:

Are you still working in this job?     Yes     No

If no, date job ended?

Describe this job:

Fill in the table below listing all jobs you have worked including short-term, seasonal, part-time employment, and military service. Begin with you most recent job.

Dates of Employment	Job Title and Description of Work	Exposures*	Protective Equipment

\* List the chemicals, dusts, fibers, fumes, radiation, biologic agents (i.e. molds or viruses) and physical agents (i.e., extreme heat, cold, vibration, or noise) that you were exposed to at this job.

Have you ever worked at a job or had a hobby in which you came in contact with any of the following by breathing, touching, or ingesting (swallowing)? If yes, please select beside the name.

- |   |  |   |  |
|---|--|---|--|
| <input type="checkbox"/> Acids                    | <input type="checkbox"/> Chloroprene         | <input type="checkbox"/> Methylene chloride | <input type="checkbox"/> Styrene           |
| <input type="checkbox"/> Alcohols (industrial)    | <input type="checkbox"/> Chromates           | <input type="checkbox"/> Nickel             | <input type="checkbox"/> Talc              |
| <input type="checkbox"/> Alkalies                 | <input type="checkbox"/> Coal dust           | <input type="checkbox"/> PBBs               | <input type="checkbox"/> Toluene           |
| <input type="checkbox"/> Ammonia                  | <input type="checkbox"/> Dichlorobenzene     | <input type="checkbox"/> PCBs               | <input type="checkbox"/> TDI or MDI        |
| <input type="checkbox"/> Arsenic                  | <input type="checkbox"/> Ethylene dibromide  | <input type="checkbox"/> Perchloroethylene  | <input type="checkbox"/> Trichloroethylene |
| <input type="checkbox"/> Asbestos                 | <input type="checkbox"/> Ethylene dichloride | <input type="checkbox"/> Pesticides         | <input type="checkbox"/> Trinitrotoluene   |
| <input type="checkbox"/> Benzene                  | <input type="checkbox"/> Fiberglass          | <input type="checkbox"/> Phenol             | <input type="checkbox"/> Vinyl chloride    |
| <input type="checkbox"/> Beryllium                | <input type="checkbox"/> Halothane           | <input type="checkbox"/> Phosgene           | <input type="checkbox"/> Welding fumes     |
| <input type="checkbox"/> Cadmium                  | <input type="checkbox"/> Isocyanates         | <input type="checkbox"/> Radiation          | <input type="checkbox"/> X-rays            |
| <input type="checkbox"/> Carbon tetrachloride     | <input type="checkbox"/> Ketones             | <input type="checkbox"/> Rock dust          | <input type="checkbox"/> Other (specify)   |
| <input type="checkbox"/> Chlorinated naphthalenes | <input type="checkbox"/> Lead                | <input type="checkbox"/> Silica powder      |  |

Chloroform

Mercury

Solvents



**B. Occupational Exposure Inventory***Please select the appropriate answer.*

- |    |   |   |    |   |     |
|----|---|---|----|---|-----|
| 1. | Have you ever been off work for more than 1 day because of an illness related to work?                    | 0 | No | 0 | Yes |
| 2. | Have you ever been advised to change jobs or work assignments because of any health problems or injuries? | 0 | No | 0 | Yes |
| 3. | Has your work routine changed recently?   | 0 | No | 0 | Yes |
| 4. | Is there poor ventilation in your workplace?  | 0 | No | 0 | Yes |

**Part 3. Environmental History***Please select the appropriate answers*

- |    |  |   |    |   |     |
|----|--|---|----|---|-----|
| 1. | Do you live next to or near an industrial plant, commercial business, dump site, or nonresidential property? | 0 | No | 0 | Yes |
|----|--|---|----|---|-----|

2. Which of the following do you have in your home?

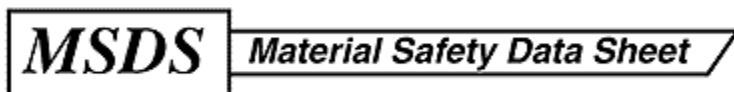
*Please select those that apply*

- |                          |  |                          |              |                          |                                  |                          |            |
|--------------------------|--|--------------------------|--------------|--------------------------|----------------------------------|--------------------------|------------|
| <input type="checkbox"/> | Air conditioner  | <input type="checkbox"/> | Air purifier | <input type="checkbox"/> | Central heating (0 Gas<br>0 Oil) | <input type="checkbox"/> | Gas stove  |
| <input type="checkbox"/> | Electric stove   | <input type="checkbox"/> | Fireplace    | <input type="checkbox"/> | Wood stove                       | <input type="checkbox"/> | Humidifier |
| 3.                       | Have you recently acquired new furniture or carpet, refinished furniture, or remodeled your home?  | 0                        | No           | 0                        | Yes                              |                          |            |
| 4.                       | Have you weatherized your home recently?   | 0                        | No           | 0                        | Yes                              |                          |            |
| 5.                       | Are pesticides or herbicides (bug or weed killers; flea and tick sprays, collars, powders, or shampoos) used in your home or garden, or on pets? | 0                        | No           | 0                        | Yes                              |                          |            |
| 6.                       | Do you (or any household member) have a hobby or craft?  | 0                        | No           | 0                        | Yes                              |                          |            |
| 7.                       | Do you work on your car?   | 0                        | No           | 0                        | Yes                              |                          |            |
| 8.                       | Have you ever changed your residence because of a health problem?  | 0                        | No           | 0                        | Yes                              |                          |            |
| 9.                       | Does your drinking water come from a private well?   | 0                        | No           | 0                        | Yes                              |                          |            |
|                          | City water supply?   | 0                        | No           | 0                        | Yes                              |                          |            |
|                          | Grocery store?   | 0                        | No           | 0                        | Yes                              |                          |            |
|                          | Other (specify)  | 0                        | No           | 0                        | Yes                              |                          |            |
| 10.                      | Approximately what year was your home built?   |                          |              |                          |                                  |                          |            |
| 11.                      | Does your food come from somewhere other than a grocery store?   | 0                        | No           | 0                        | Yes                              |                          |            |

If you answered yes to any of these questions, please explain.

# Appendix II – Material Safety Data Sheet

Please reduce your browser font size for better viewing and printing.



From: Mallinckrodt Baker, Inc.  
222 Red School Lane  
Phillipsburg, NJ 08865

MALLINCKRODT



24 Hour Emergency Telephone: 908-859-2151  
CHEMTREC: 1-800-424-9300

National Response in Canada  
CANUTEC: 613-996-6666

Outside U.S. and Canada  
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

## CARBON DISULFIDE

MSDS Number: C0957 — Effective Date: 11/17/99

### 1. Product Identification

**Synonyms:** Carbon bisulfide **CAS No.:** 75-15-0 **Molecular Weight:** 76.1 **Chemical Formula:** CS<sub>2</sub>

**Product Codes:** J.T. Baker: 9172, E350

Mallinckrodt: 8831

### 2. Composition/Information on Ingredients

Ingredient CAS No Percent Hazardous

Carbon Disulfide 75-15-0 90 - 100% Yes

### 3. Hazards Identification

**Emergency Overview: Danger! Extremely flammable liquid and vapor. Vapor may cause flash fire. May be fatal if swallowed or inhaled. Harmful if absorbed through skin. Affects the central and peripheral nervous systems. A developmental and reproductive hazard. Affects cardiovascular system, liver and kidneys.**

**J.T. Baker SAF-T-DATA<sup>(tm)</sup>** Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)

Flammability Rating: 4 - Extreme (Flammable)

Reactivity Rating: 2 - Moderate

Contact Rating: 3 - Severe (Life)

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

Storage Color Code: Red (Flammable)

### Potential Health Effects

**Inhalation:** Vapors cause irritation to the respiratory tract, followed by symptoms of headache, dizziness, fatigue, garlic breath, nausea, vomiting, and abdominal pains. Affects the central nervous system and peripheral nervous system. Overexposure may produce hallucinations, narcosis, unconsciousness, convulsions, and even death.

**Ingestion:** TOXIC! Symptoms parallel those of inhalation. May cause permanent disabilities described below in Chronic Exposure.

**Skin Contact:** May produce reddening and burning, cracking and peeling. Contact with liquid for several minutes may result in a second-degree burn. Skin absorption can occur even in the presence of vapors, with toxic effects paralleling inhalation.

**Eye Contact:** Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.

**Chronic Exposure:** Kidney and liver damage, reproductive disorders, central and peripheral nervous system damage, vision problems, psychosis, and cardiovascular effects are associated with chronic exposure to Carbon Disulfide.

**Aggravation of Pre-existing Conditions:** Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance. Affects the developing fetus.

### 4. First Aid Measures

FOLLOWING ANY ROUTE OF EXPOSURE GET MEDICAL ATTENTION IMMEDIATELY.

**Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**Ingestion:** Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

**Skin Contact:** Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

**Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

**Note to Physician:** Since effects may be delayed, keep victim under observation. The iodide-azide test is useful in detecting degree of exposure and hyposusceptibility of exposed workers. I.V. urea 0.5 to 1.5 g/kg is recommended to inactivate free carbon disulfide

in the blood. Vitamin B6 in large doses is recommended. Obtain CBC, EKG, urinalysis, and electrolyte balance.

### 5. Fire Fighting Measures

**Fire:** Flash point: -30C (-22F) CC Autoignition temperature: 90C (194F) Flammable limits in air % by volume: lel: 1.3; uel: 50 Extremely Flammable Liquid and Vapor. Contact with strong oxidizers may cause fire. May ignite on contact with hot surfaces such as light bulbs, steam pipes, or engine exhaust pipes.

**Explosion:** Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Sealed containers may rupture when heated. Sensitive to static discharge.

**Fire Extinguishing Media:** Dry chemical, foam or carbon dioxide. Fluoroprotein and protein foams are recommended over other types for carbon disulfide. Water spray may be used to keep fire exposed containers cool. Do not allow water runoff to enter sewers or waterways.

**Special Information:** In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. This highly flammable liquid must be kept from sparks, open flame, hot surfaces, and all sources of heat and ignition. Flush area with water spray to cool containers and prevent reignition.

## 6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e.g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802. J. T. Baker SOLUSORB(R) Solvent adsorbent is recommended for spills of this product.

## 7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be

acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Prepare safe grounding routes for lightning strikes in storage area. Electrical installations and heating facilities must be prohibited in or near storage areas. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:** OSHA Z-2 TWA, 8 hour 20 ppm; 30 ppm Ceiling; 100 ppm Peak Concentration; Maximum Duration 30 minutes ACGIH Threshold Limit Value (TLV): 10 ppm (TWA) (skin)

**Ventilation System:** A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne

Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A*

*Manual of Recommended Practices*, most recent edition, for details.

**Personal Respirators (NIOSH Approved):** If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.

**WARNING:** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Skin Protection:** Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

**Eye Protection:** Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

## 9. Physical and Chemical Properties

**Appearance:** Clear, colorless liquid.

**Odor:** Nearly odorless when pure, but most material has a strong garlic-type odor.

**Solubility:** 0.2 gm/100 ml water.

**Density:** 1.26

**pH:** No information found.

**% Volatiles by volume @ 21C (70F):** 100

**Boiling Point:** 46C (115F)

**Melting Point:** -100C (-148F)

**Vapor Density (Air=1):** 2.6

**Vapor Pressure (mm Hg):** 300 @ 20C (68F)

**Evaporation Rate (BuAc=1):** 22.6

## 10. Stability and Reactivity

**Stability:** Stable at room temperature in sealed containers. Heat and sunlight can contribute to instability. Containers may burst when heated.

**Hazardous Decomposition Products:** Burning may produce carbon monoxide, carbon dioxide, sulfur oxides.

**Hazardous Polymerization:** Will not occur.

**Incompatibilities:** Contact with strong oxidizers and chemically active metals (such as Potassium, Zinc), chlorine, nitrogen oxides, azides, and organic amines may cause fire and explosions.

**Conditions to Avoid:** Heat, flames, ignition sources and incompatibles.

## 11. Toxicological Information

**Toxicological Data:** Inhalation rat LC50: 25 gm/m<sup>3</sup>/2H. Investigated as a mutagen, reproductive effector.

**Reproductive Toxicity:** Carbon disulfide is a known human reproductive hazard. Menstrual disorders, spontaneous abortions and premature births are reported in cases of chronic exposure.

-----\Cancer Lists\-----

---NTP Carcinogen---

Ingredient

Known Anticipated IARC Category

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Carbon Disulfide (75-15-0)

No

No

None

## 12. Ecological Information

**Environmental Fate:** When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate.

When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life of less than 1 day. This material has an experimentally-determined bioconcentration factor (BCF) of less than 100.

This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.

**Environmental Toxicity:** No information found.

### 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

### 14. Transport Information

**Domestic (Land, D.O.T.)**

**Proper Shipping Name:** CARBON DISULFIDE

**Hazard Class:** 3, 6.1

**UN/NA:** UN1131

**Packing Group:** I

**Information reported for product/size:** 2.5L

**International (Water, I.M.O.)**

**Proper Shipping Name:** CARBON DISULPHIDE

**Hazard Class:** 3.1, 6.1

**UN/NA:** UN1131

**Packing Group:** I

**Information reported for product/size:** 2.5L

**International (Air, I.C.A.O.)**

**Proper Shipping Name:** CARBON DISULPHIDE

**Hazard Class:** 3.1, 6.1

**UN/NA:** UN1131

**Packing Group:** I

**Information reported for product/size:** 2.5L

### 15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----

Ingredient	TSCA	EC	Japan	Australia
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Carbon Disulfide (75-15-0)	Yes	Yes	Yes	Yes
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-----\Chemical Inventory Status - Part 2\-----

--Canada--

Ingredient Korea DSL NDSL Phil.

Carbon Disulfide (75-15-0) Yes Yes No Yes

-----\Federal, State & International Regulations - Part 1\-----

-SARA 302- -----SARA 313--

Ingredient RQ TPQ List Chemical Catg.

Carbon Disulfide (75-15-0) 100 10000 Yes No

-----\Federal, State & International Regulations - Part 2\-----

-RCRA- -TSCAIngredient

CERCLA 261.33 8(d)

Carbon Disulfide (75-15-0) 100 P022 Yes

Chemical Weapons Convention: No TSCA 12(b: No CDTA: No

SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No

Reactivity: No (Pure / Liquid)

**WARNING:** THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

**Australian Hazchem Code:** 3WE

**Poison Schedule:** S6

**WHMIS:** This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

## 16. Other Information

**NFPA Ratings:** Health: 3 Flammability: 4 Reactivity: 0

**Label Hazard Warning:** DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. MAY BE FATAL IF SWALLOWED OR INHALED. HARMFUL IF ABSORBED THROUGH SKIN. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS. A DEVELOPMENTAL AND REPRODUCTIVE HAZARD.

AFFECTS CARDIOVASCULAR SYSTEM, LIVER AND KIDNEYS.

**Label Precautions:** Keep away from heat, sparks and flame. Do not breathe vapor. Keep container closed. Do not get in eyes, on skin, or on clothing. Use only with adequate ventilation. Wash thoroughly after handling.

**Label First Aid:** If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

**Product Use:** Laboratory Reagent.

**Revision Information:** No changes.

### **Disclaimer:**

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**Prepared by:** Strategic Services Division

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