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AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Case Studies in Environmental Medicine

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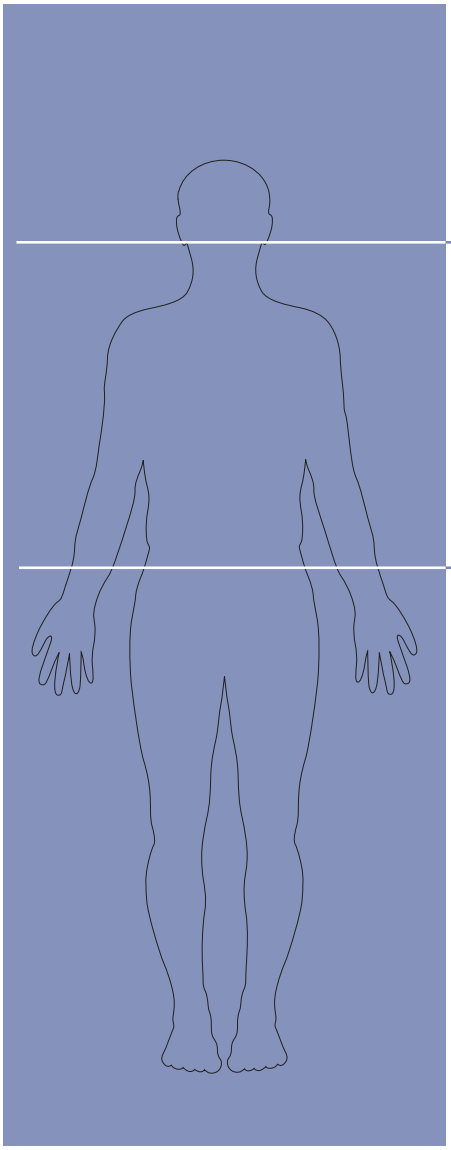

STODDARD SOLVENT TOXICITY

Environmental Alert

- Stoddard solvent is a petroleum distillate fraction containing C_7–C_{12} hydrocarbons. It consists primarily of straight-chain and branched-chain alkanes and cycloalkanes; it may contain up to 20% aromatic hydrocarbons.
- Stoddard solvent may be released to the environment during its manufacture and use as a commercial solvent. Industries that use Stoddard solvent include dry cleaning, metal degreasing, and painting.
- Human health effects from chronic exposure to low environmental levels of Stoddard solvent are not known.

This monograph is one in a series of self-instructional publications designed to increase the primary care provider's knowledge of hazardous substances in the environment and to aid in the evaluation of potentially exposed patients. This course is also available on the ATSDR Web site, www.atsdr.cdc.gov/HEC/CSEM/. See page 3 for more information about continuing medical education credits, continuing nursing education units, and continuing education units.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Education and Promotion

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Disclaimer

The state of knowledge regarding the treatment of patients potentially exposed to hazardous substances in the environment is constantly evolving and is often uncertain. In this monograph, ATSDR has made diligent effort to ensure the accuracy and currency of the information presented, but makes no claim that the document comprehensively addresses all possible situations related to this substance. This monograph is intended as an additional resource for physicians and other health professionals in assessing the condition and managing the treatment of patients potentially exposed to hazardous substances. It is not, however, a substitute for the professional judgment of a health care provider. The document must be interpreted in light of specific information regarding the patient and in conjunction with other sources of authority.

Use of trade names and commercial sources is for identification only and does not imply endorsement by the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services.

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Each content expert for this case study indicated no conflict of interest to disclose with the case study subject matter.

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Case Studies in Environmental Medicine (CSEM): Stoddard Solvent Toxicity

Goals and Objectives

The goal of the CSEM is to increase the primary care provider's knowledge of hazardous substances in the environment and to aid in the evaluation of potentially exposed patients.

After completion of this educational activity, the reader should be able to discuss the major exposure route for Stoddard solvent, describe two potential environmental and occupational sources of Stoddard solvent exposure, state two reasons why Stoddard solvent is a health hazard, describe three factors contributing to Stoddard solvent toxicity, identify evaluation and treatment protocols for persons exposed to Stoddard solvent, and list two sources of information on Stoddard solvent.

Instructions

See page 4

Accreditation

Continuing Medical Education (CME)

The Centers for Disease Control and Prevention (CDC) is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians. CDC designates this educational activity for a maximum of 2.0 hours in category 1 credit toward the American Medical Association (AMA) Physician's Recognition Award. Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

Continuing Nursing Education (CNE)

This activity for 2.2 contact hours is provided by CDC, which is accredited as a provider of continuing education in nursing by the American Nurses Credentialing Center's Commission on Accreditation.

Continuing Education Units (CEU)

CDC has been approved as an Authorized Provider of continuing education and training programs by the International Association for Continuing Education and Training and awards 0.2 continuing education units (CEUs).

The questionnaire and posttest must be completed and returned electronically, by fax, or by mail for eligibility to receive continuing education credit.

Instructions for Completing CSEM Online

1. Read this CSEM, *Stoddard Solvent Toxicity*; all answers are in the text.
2. Link to the MMWR/ATSDR Continuing Education General Information page (www.cdc.gov/atsdr/index.html).
3. Once you access this page, select the Continuing Education Opportunities link.
4. Once you access the MMWR/ATSDR site online system, select the electronic file and/or register and test for a particular ATSDR course.
   a. Under the heading "Register and Take Exam," click on the test type desired.
   b. If you have registered in this system before, please use the same login and password. This will ensure an accurate transcript.
   c. If you have not previously registered in this system, please provide the registration information requested. This allows accurate tracking for credit purposes. Please review the CDC Privacy Notice (www.cdc.gov/privacy.htm).
   d. Once you have logged in/registered, select the test and take the posttest.
5. Answer the questions presented. To receive continuing education credit, you must answer all of the questions. Some questions have more than one answer. Questions with more than one answer will instruct you to "indicate all that are true."
6. Complete the course evaluation and posttest no later than **October 17, 2003**.
7. You will be able to immediately print your continuing education certificate from your personal transcript.

Instructions for Completing CSEM on Paper

1. Read this CSEM, *Stoddard Solvent Toxicity*; all answers are in the text.
2. Complete the evaluation questionnaire and posttest, including your name, mailing address, phone number, and e-mail address, if available.
3. Circle your answers to the questions. To receive your continuing education credit, you must answer all of the questions.
4. Sign and date the posttest.
5. Return the evaluation questionnaire and posttest, no later than **September 18, 2003**, to CDC by mail or fax:

Mail
Continuing Education Coordinator
Division of Health Education and Promotion, ATSDR
1600 Clifton Road, NE (MS E-33)
Atlanta, GA 30333

or

Fax
404-498-0061
ATTN: Continuing Education Coordinator

6. You will receive an award certificate within 90 days of submitting your credit forms. No fees are charged for participating in this continuing education activity.

Case Study

A 50-year-old man has dizziness, euphoria, and chest discomfort

A 50-year-old Air Force major is referred to your office. He is concerned about a recent episode in which he felt dizzy and lightheaded, and had chest discomfort. The tightness on the left side of his chest lasted about 10 minutes. It did not radiate, and it was associated with some shortness of breath, but no diaphoresis. The patient is very concerned about possible cardiac illness because his brother died of a heart attack at the age of 54.

The episode described by the patient occurred during the previous weekend while he was alone in the vehicle maintenance shop working on his car. He denies any particularly strenuous activity and states that he simply changed the oil, cleaned the engine, and replaced some spark plugs. Because it was cold outside, he had the garage doors closed and the building exhaust system off. He did not run the vehicle for prolonged periods of time. He did no welding, but he used a degreasing solution several times to remove grease from his hands. He also used the degreasing solution to clean the engine. After he sprayed the solution over the engine, he started the engine briefly. The fumes burned his eyes, nose, and throat. He felt ill shortly thereafter, with the dizziness and light-headed feeling occurring just before the onset of chest discomfort. He has not had any similar episodes in the past.

The patient's last physical examination was about 1 year ago. At that time, his cholesterol level was within normal limits, but his blood sugar was mildly elevated. After he lost 15 pounds, his glucose level returned to normal. He quit smoking 5 years ago and is taking no medications. He drinks about a six-pack of beer a week. His major exercise is walking 2 to 3 miles with his wife, three times a week, and occasionally bicycle riding with his sons. His parents are in their 70s; his mother has diabetes, and his father has hypertension and angina. The patient is a supervisor in the vehicle maintenance shop at the Air Force base, where he oversees staff in inventory and shop repair. During working hours, he spends little time in the vehicle maintenance areas. His hobbies include fishing and home renovation. He lives in Air Force housing with his wife and two children; his younger son has asthma.

The physical examination is unremarkable, except for crusting and scaling of the skin on the volar surface of the hands and wrists, which the patient has experienced several times over the last 2 years. Results of routine laboratory screening and a 12-lead electrocardiogram (ECG) are within normal limits.

Pretest

(a) What conditions would you consider in this patient's differential diagnosis?

(b) What additional information would you seek during this visit?

(c) How will you evaluate this patient and manage the case?

Who's At Risk

The most significant exposures to Stoddard solvent occur in the workplace. The National Institute for Occupational Safety and Health (NIOSH) estimates that about 2 million U.S. workers (excluding military personnel)

- Workers in industries that produce, use, or dispose of Stoddard solvent are at the greatest risk of exposure.
- The general population can be exposed to Stoddard solvent through contact with consumer cleaning agents, paint products, or dry-cleaned fabrics.
- Although Stoddard solvent may contaminate the environment via air, water, or soil, no human health effects from chronic exposure to low environmental levels have been reported.

were potentially exposed to Stoddard solvent from 1981 to 1983. Today, Stoddard solvent is used primarily by workers in the manufacturing industry (for degreasing), paint industry, and printing industries. Exposure to Stoddard solvent is of greatest concern when it is used without skin or respiratory protection and in poorly ventilated areas.

The odor threshold for Stoddard solvent is less than 1 part per million (ppm). However, after about 6 minutes, the olfactory sense fatigues, and Stoddard solvent is no longer detected by smell. Thus, odor is not a reliable indicator of exposure and may not provide adequate warning of dangerously high concentrations. Olfactory detection of Stoddard solvent returns after breathing fresh air for about 10 minutes.

Populations susceptible to Stoddard solvent toxicity include persons who are overexposed (because of inadequate ventilation or lack of skin or respiratory protection), persons with concurrent exposures to solvents that are similarly metabolized, or persons with a lowered threshold for toxicity. Stoddard solvent is probably metabolized in the liver; thus, preexisting liver disease (e.g., hepatitis or cirrhosis) would likely decrease the rate of metabolism and increase the amount of Stoddard solvent circulating in the blood. Because excretion probably occurs through the lungs and kidneys, persons with lung impairment (e.g., chronic obstructive pulmonary disease [COPD]) or renal insufficiency may retain Stoddard solvent or its metabolites, leading to an increased risk of toxicity.

Challenge

The patient brings you a Material Safety Data Sheet (MSDS) for the degreasing solution he used on his car. The MSDS identifies the degreaser as Stoddard solvent. The patient also tells you that he has brought the solution home. He stores it in a gallon jug in the basement and uses it occasionally to help his children clean their bicycles.

(1) The patient asks you whether these exposures to Stoddard solvent could be harmful to his children. What will you tell him?

Exposure Pathways

"Stoddard solvent" is the name adopted by the National Association of Dryers and Cleaners to honor W.J. Stoddard for his work with petroleum distillates used in the dry-cleaning industry. Stoddard solvent is a distillation fraction of crude petroleum (distilling between about 300°F [149°C] and 400°F [204°C]) that contains at least 200 products, predominantly C_7 through C_{12} hydrocarbons. The mixture typically consists of 30 to 50% straight-chain and branched-chain alkanes (paraffins), 30 to 40% cycloalkanes (naphthenes), and 10 to 20% aromatic hydrocarbons.

(Benzene, toluene, and xylene each represent less than 1% of the total mixture [Figure 1].) Although the toxicity of Stoddard solvent is not attributable to any one type of constituent, the aromatic components are considered to be more toxic than the paraffin or naphthene components.

Stoddard solvent is a colorless, flammable liquid that is insoluble in water. It is volatile and has an odor similar to that of kerosene or gasoline. This description applies to a variety of other petroleum distillates including white spirits and mineral spirits, which are similar mixtures containing the same types of components as Stoddard solvent. However, the boiling ranges and ratios of hydrocarbon components of these three petroleum distillate fractions differ. Trade names for Stoddard solvent include Texsolve S and Varsol.

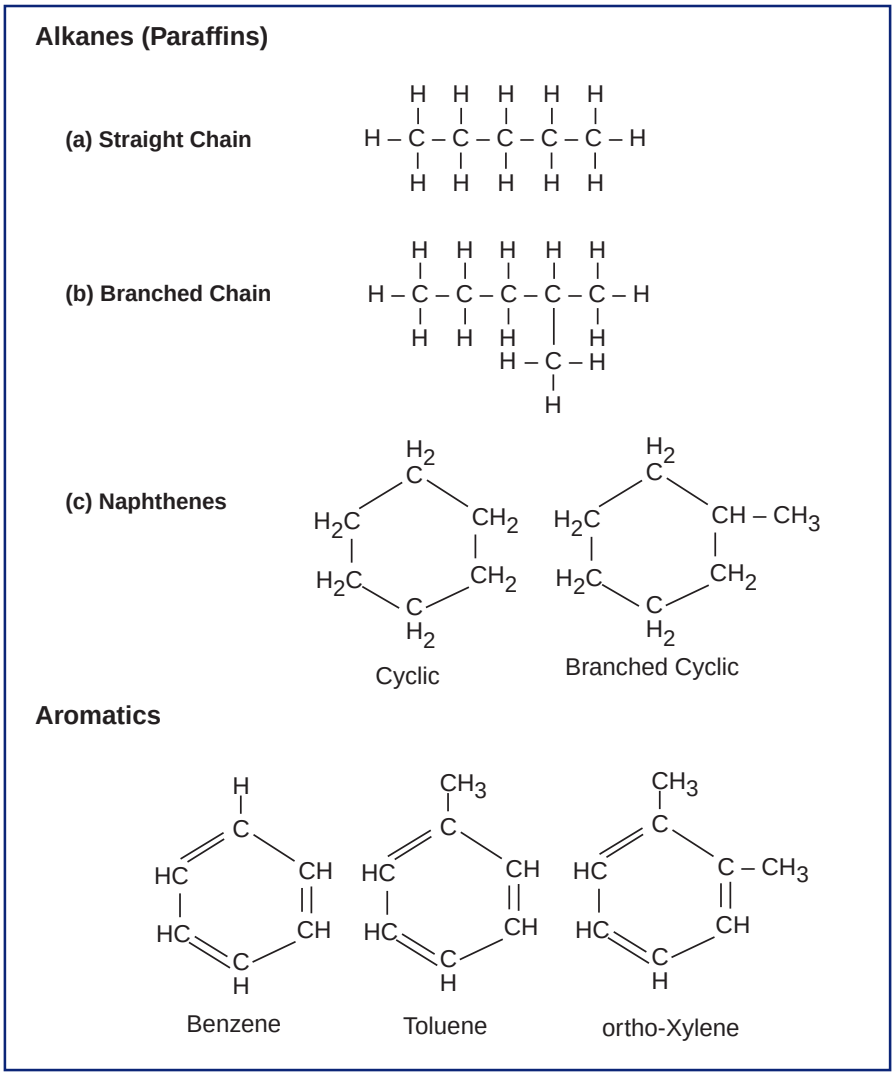

Figure 1. Structure of Major Components of Stoddard Solvent

Stoddard solvent is a multipurpose solvent used in industry primarily as a dry-cleaning solvent and a metal degreaser. Stoddard solvent is also used industrially as a thinning agent for paints, coatings, and waxes, and as a solvent for printing inks, photocopier toners, adhesives, rubber products, waxes, polishes, and pesticides.

Consumers may be exposed to Stoddard solvent through inhalation or dermal contact with cleaning products, paints, paint thinners, furniture refinishers, or pesticides. Stoddard solvent can also contaminate water and soil through industrial, consumer, or hazardous waste landfill discharges. Although the paraffin components of Stoddard solvent have low water solubility, they can adsorb to particles, and small amounts of these components may be ingested with suspended particulates in contaminated drinking water. The aromatic components of Stoddard solvent are generally more water soluble and may reach the groundwater. Both aliphatic and aromatic components rapidly undergo biodegradation by soil microorganisms, although total degradation may take years.

Biologic Fate

Data on the toxicokinetics and pathophysiology of Stoddard solvent are limited and largely extrapolated from what is known about the fate and effects of other related petroleum products such as white spirits. Inhalation is the principal route of significant exposure for most petroleum distillates. Dermal absorption is usually limited because petroleum distillates evaporate readily; however, dermal absorption is enhanced through nonintact skin or through prolonged contact with the liquid, although no systemic effects have been noted.

The main hazard from ingestion of paraffin-type petroleum products is pulmonary aspiration. Systemic toxicity is uncommon unless large volumes are ingested and absorbed. In one study of human volunteers exposed to white spirits via inhalation, the solvent was distributed by the blood to adipose tissue, with an average elimination half-life from adipose tissue of about 48 hours. Because neurologic effects are seen after exposure to white spirits, the solvent is probably distributed to the brain as well, although this has not been documented. The sites of metabolism and excretion for Stoddard solvent have not been identified. Given the composition of Stoddard solvent and its similarity to other refined petroleum solvents, some metabolism of Stoddard solvent likely occurs in the liver, and excretion occurs partially through the respiratory tract and kidneys.

Physiologic Effects

Acute Exposure

Few studies of Stoddard solvent exposure have been done in humans. In addition, the existing data can be difficult to interpret because workers in most of the studies were exposed to mixtures of solvents. Acute exposure to Stoddard solvent at air concentrations below the odor threshold produces no adverse health effects. Studies in both experimental animals and humans indicate that exposure to high levels of Stoddard solvent can produce irritation of the skin, respiratory tract, and other mucous membranes and can generally cause transient neurologic effects. Some reports indicate that exposure of hydrocarbons may cause arrhythmias, myocardial depression, or even ventricular fibrillation.

- Acute exposure to Stoddard solvent can cause respiratory tract irritation and neurologic effects.

Although case reports have been published of persons who were exposed to Stoddard solvent and subsequently suffered liver, kidney, or hematologic injury, a causal relationship has not been firmly established. Data from studies in humans and experimental animals provide inconsistent and inconclusive evidence of injury to these target organs.

Central Nervous System (CNS) Effects

The major effect associated with inhalation of paraffin-like solvents is CNS excitation, followed rapidly by CNS depression. In volunteers exposed to 100 ppm of white spirits over 6 hours, no subjective CNS symptoms were detected; however, acute exposure to 700 ppm produced prolonged reaction times. Workers exposed chronically to unknown concentrations of Stoddard solvent reported a variety of neurologic complaints including headaches, fatigue, memory deficits, inebriation, and subtle changes in color vision (dyschromatopsia). Most of these findings were reversible upon discontinuation of exposure. In experimental animal studies, inhalation exposures to high levels of Stoddard solvent produced incoordination, tremors, clonic spasms, and death.

- Exposure to high levels of Stoddard solvent can result in CNS depression.

Cardiovascular Effects

A case report described a severe myocardial depression 72 hours after ingesting paint thinner. Inhalation of hydrocarbons may cause arrhythmias, possibly from sensitization of the myocardium to circulating catecholamines. In another report, an adult woman developed ventricular fibrillation and cardiopulmonary arrest after prolonged exposure to concentrated vapors from mineral spirits.

Respiratory Effects

Acute exposure to high concentrations of Stoddard solvent can irritate mucous membranes and cause upper respiratory tract irritation. The only available human study of respiratory effects from chronic exposure involves

- Inhalation of high concentrations of Stoddard solvent causes upper respiratory-tract irritation.

house painters who were exposed to paints containing Stoddard solvent for periods ranging from 4 to 42 years. These workers had no decrease in lung vital capacity or expiratory volume compared to workers in other industries. Exposure concentrations were not recorded.

- Ingestion and attendant aspiration of hydrocarbon mixtures similar to Stoddard solvent have resulted in chemical pneumonitis.

Acute ingestion and attendant aspiration of hydrocarbon mixtures similar to Stoddard solvent have resulted in chemical pneumonitis that mimics adult respiratory distress syndrome. Typically, respiratory involvement progresses during the first day, with resolution during the second through fifth days after exposure ceases. Complications of severe overexposure by the aspiration route may also include pulmonary edema, pulmonary emphysema, pneumothorax, pleuritis, pleural effusion, empyema, and pneumatoceles.

Dermal Effects

- Stoddard solvent is a moderate skin irritant.

Stoddard solvent is a skin irritant, producing dermatitis, ulcerated and vesicular lesions, and desquamation on prolonged contact with the liquid. Dermal injury is reversible if contact with the solvent ceases. The dermal effects appear to be secondary to Stoddard solvent's ability to remove oils from the skin (defatting action). Stoddard solvent is associated with irritant contact dermatitis, and not with allergic contact dermatitis.

Carcinogenic Effects

- Carcinogenicity of Stoddard solvent has not been evaluated by the International Agency for Research on Cancer (IARC).
- Stoddard solvent is not generally regarded as a human carcinogen.

Data from studies of Stoddard solvent exposure in experimental animals (dermal exposure) and in humans (inhalation exposure) have not conclusively demonstrated that Stoddard solvent is carcinogenic. Epidemiologic studies of painters and dry-cleaning workers exposed to mixed petroleum products have not consistently found elevated cancer risks, although some of these studies have noted increased incidences of respiratory tract, bladder, and kidney cancer. IARC has not classified Stoddard solvent carcinogenicity.

Stoddard solvent was not mutagenic in the Ames test, bacterial assays, mouse bone marrow studies, or in studies of human lymphocytes in vitro.

Reproductive and Developmental Effects

- Evidence regarding reproductive effects of Stoddard solvent exposure in humans is inconclusive.

Existing data on the reproductive effects of Stoddard solvent are sparse. One study of male workers exposed chronically to mixed petroleum solvents indicated no sperm abnormalities. Because Stoddard solvent is fat soluble, it can probably cross the placenta and enter breast milk; however, this phenomenon has not been documented. Inhaled Stoddard solvent was not fetotoxic in experimental animals. The effects of Stoddard solvent on other reproductive endpoints in experimental animals have not been studied.

Challenge

(2) Are the complaints of the patient in the case study consistent with exposure to Stoddard solvent?

(3) Could the patient's skin lesions have been caused by exposure to Stoddard solvent? If so, what actions would you advise?

Clinical Evaluation

History and Physical Examination

Exposure to Stoddard solvent produces clinical signs and symptoms similar to those caused by other aliphatic solvents. Medical evaluation of a patient with Stoddard solvent exposure should initially consist of a complete history and physical examination. The medical history should include the following:

- Temporal associations between exposure and health effects
- Occupational and environmental history of the patient and relevant household members
- Hobbies or household projects; solvent use in such activities as painting, paint removal, refinishing, and automotive repair
- Residence or worksite proximity to industries and hazardous waste sites
- Dose estimates, taking into account the amount of solvent used, routes of exposure, duration of exposure, and personal protection such as gloves and respiratory apparatus
- Accentuators of effects such as social habits (e.g., cigarette smoking; drug or ethanol use), intercurrent diseases, and other exposures. Persons also exposed to other CNS depressants, such as solvent "huffing" or inhalant abuse, might be at increased risk.

(See *Case Studies in Environmental Medicine: Taking an Exposure History*.)

The physical examination should include evaluation of the skin, eyes, and mucous membranes for signs of irritation, and the CNS for signs of excitation or depression. Other organ systems that should be evaluated include the ophthalmologic (e.g., color vision testing), hematologic, hepatic, renal, and respiratory systems.

Signs and Symptoms

Acute Exposure

After aspiration of even small amounts, pulmonary aspiration of Stoddard solvent may result in serious chemical pneumonitis and pulmonary edema. Because of its aspiration hazard, Stoddard solvent is in Class 3 (may cause

- The most serious effects of acute exposure to Stoddard solvent involve the CNS and the respiratory tract.

irreversible effects that can be life-threatening). Reported symptoms of acute exposure to Stoddard solvent include lightheadedness, dizziness, visual disturbances, and drowsiness. Although Stoddard solvent has not been reported to cause respiratory depression or coma, it is chemically similar to other agents that can produce such effects with prolonged high-level exposure, such as gasoline. Irritation of the respiratory tract, mucous membranes, and skin can occur.

Chronic Exposure

- Neurologic effects associated with chronic workplace exposure are generally reversible.

Chronic exposure to Stoddard solvent has been associated with headaches, fatigue, intermittent episodes of inebriation, and memory deficits that generally resolve upon discontinuation of exposure. High-dose, chronic exposures to other volatile hydrocarbons, mainly through deliberate inhalant abuse, have been associated with memory, cognitive, and emotional disturbances.

Laboratory Tests

Direct Biologic Indicators

- There are no biomarkers for exposure to Stoddard solvent.

Because Stoddard solvent contains hydrocarbons of varying concentrations and volatility, and because formulations may vary, no specific hydrocarbon in the plasma or tissues is a reproducible index of exposure.

Indirect Biologic Indicators

- Medical surveillance for workers exposed to Stoddard solvent should include a complete blood count, urinalysis, and tests to evaluate liver, kidney, and CNS functions.

Depending on route, exposure to Stoddard solvent has been associated with neuropsychiatric disorders, hepatotoxicity, kidney damage, and changes in blood-forming capacity. NIOSH has recommended that preplacement and medical surveillance examinations for workers exposed to refined petroleum products include a complete blood count and a urinalysis, and appropriate tests for function of the liver, nervous system, and kidneys. If neurobehavioral abnormalities are suspected, consider referring the patient for neuropsychologic tests that evaluate cognitive and emotional functioning.

Challenge

You have educated your patient about the health effects of Stoddard solvent. A short time later, your patient calls to say that a neighbor who races cars and uses the vehicle maintenance shop on a regular basis is complaining of chronic fatigue, headaches, and recent memory impairment.

(4) Your patient asks you if there is a test to determine whether his neighbor's condition might be due to Stoddard solvent. What is your answer?

(5) What would you recommend for the neighbor?

Treatment and Management

Acute Exposure

In cases of acute inhalation exposure to Stoddard solvent, the person should be removed immediately from the source of exposure. After initial evaluation and treatment to maintain respiratory and cardiovascular functions, decontamination procedures should be instituted. Remove contaminated clothing and wash exposed areas with mild soap and shampoo, then rinse thoroughly with water. Direct eye splashes should be treated by irrigation with saline or water for 15 minutes or until pain resolves.

Inhalation exposure may cause respiratory, circulatory, or mental status changes. Supplemental oxygen should be administered as needed. Further evaluation, including blood gas analyses, chest radiography, ECG monitoring, and baseline liver and kidney function tests, should be considered in serious overexposures.

Because the threat of systemic toxicity is low after Stoddard solvent ingestion and because of potential for pulmonary aspiration, gastric decontamination (i.e., emesis, lavage, cathartic, activated charcoal) is not recommended in most cases. Corticosteroids and prophylactic antibiotics are not necessary to treat persons with Stoddard solvent ingestion and pulmonary aspiration. An initial chest radiograph should be obtained to determine baseline, and the patient should be observed for 6 hours. Patients who are asymptomatic after 6 hours of observation may be discharged from the hospital. Patients who develop chemical pneumonitis will require intensive supportive pulmonary care.

Acute eczematous contact dermatitis due to contact with liquid Stoddard solvent can be treated with traditional measures. Monitor for secondary infection, and treat with topical or systemic antibiotics as needed.

Chronic Exposure

Whether systemic health effects occur from low-level, chronic exposures to Stoddard solvent is uncertain. If symptoms persist, investigate other sources of exposure to Stoddard solvent or similar agents, and other etiologies. In cases of persistent neurologic symptoms, formal neuropsychologic testing may be useful for diagnostic purposes and to establish baseline functioning.

Challenge

(6) How will you treat the patient and manage the case?

- There are no known antidotes for Stoddard solvent toxicity. Treatment consists of supportive measures and prevention of further overexposure.

Standards and Regulations

Workplace

The Occupational Safety and Health Administration has established a time-weighted average (TWA) standard of 500 ppm (2,900 milligrams per cubic meter of air [mg/m^3]) for an 8-hour workday, 40-hour workweek to prevent nervous system and skin damage. NIOSH has published a recommended exposure limit of 350 mg/m^3 TWA for a 10-hour workday and a ceiling level of 1,800 mg/m^3 (15-minute sampling period). The American Conference of Governmental Industrial Hygienists has recommended a threshold limit value TWA of 100 ppm (525 mg/m^3) for an 8-hour workshift.

Environment

EPA has no current standards for Stoddard solvent in air or water.

Suggested Reading List

General Reviews

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Related Documents

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Answers to Pretest and Challenge Questions

Pretest

(a) The differential diagnosis for this patient might include coronary artery disease, acute bronchospasm, musculoskeletal injury, narcosis, anxiety, hyperventilation syndrome, solvent inhalation exposure, carbon monoxide poisoning, pulmonary embolus, and esophagitis.

(b) Although the patient's work is mainly supervisory, he may do other work intermittently (e.g., as a replacement mechanic). It is important to know not only his job classification, but also his specific duties and what occurs in his immediate work environment. Occupational exposures might include solvents, motor fuels, antifreezes, hazardous noise, paints, welding fumes, freon, carbon monoxide, and ultraviolet exposure from arc welding. Suboptimal ergonomic work stations with heavy lifting or repetitive work could contribute to symptoms. Environmental exposures of concern might include solvents, paints, welding fumes, and carbon monoxide from auto repair and inadequately vented heating units. Living near industries or hazardous waste sites that release these materials into the environment may also result in exposure.

(c) The temporal association of symptoms and use of the degreasing solution suggests a causal relationship. More information about the degreaser is needed, including its identity, ingredients, and potential health effects. The identity could be obtained from the patient or by checking with the bioenvironmental engineering officer responsible for the

auto repair shop. The health effects can be determined by talking with the manufacturer, talking with a toxicologist at a regional poison control center, or by consulting printed or electronic information sources. If the degreaser is not the most likely cause of the patient's symptoms, other etiologies must be considered. The patient should be evaluated to exclude each of the diagnoses in answer (a).

Educating the patient about engineering controls, personal protective measures, and the health effects of Stoddard solvent should help prevent future problems. Although the chest tightness may have been triggered by exposure to Stoddard or another solvent, the presence of an underlying condition requires further evaluation. Because of the patient's family history, he should be evaluated for etiologies of chest pain, including coronary artery disease or a dysrhythmia.

Challenge

(1) It is important to assess whether the children come in contact with the material and, if so, what approximate doses they receive. If the material is applied in a well-ventilated area (e.g., outdoors) and in small quantities for a limited time, most people would not suffer significant health effects. However, the younger son, who is asthmatic, could be at increased risk because the solvent may act as a nonspecific stimulus to provoke bronchoconstriction.

Flammable organic solvents such as Stoddard solvent should be used only by adults, with appropriate ventilation and skin protection. All potentially toxic substances should be kept in nonbreakable, clearly labeled containers, which should be tightly covered when not in use, and kept out of children's reach.

(2) Eye and throat irritation suggest that the patient may have been exposed to moderately high levels of Stoddard solvent, which could have also caused his CNS complaints (e.g., dizziness and euphoria) and respiratory complaints (e.g., burning sensation in the nose and throat). The overexposure could have occurred from widely applying the degreaser and heating it in an enclosed space with no ventilation.

Exposure to Stoddard solvent does not result in cardiovascular effects and is unlikely to be the cause of the patient's chest discomfort. The chest discomfort and dizziness are consistent with angina due to underlying cardiac disease or a transient dysrhythmia.

(3) The patient most likely has eczematous irritant contact dermatitis (see *Case Studies in Environmental Medicine: Skin Lesions and Environmental Exposures*). Exposure to Stoddard solvent, oils, other irritants, or allergens such as metal contaminants should be assessed, and cessation of exposure is recommended. The patient should be encouraged to use appropriate skin protection and to avoid contact when possible.

(4) There is no specific laboratory test that would prove the neighbor's complaints are due to Stoddard solvent. An industrial hygiene assessment using personal sampling could be carried out to determine whether the neighbor is exposed to Stoddard solvent. Neurobehavioral tests, which are functional tests of the CNS, could indicate whether impairment of function has occurred, but they would not indicate etiology.

(5) Advise against further unprotected exposure to known CNS toxicants such as ethanol, solvents, and certain gases (e.g., carbon monoxide).

(6) See Pretest answer (c).

Additional Sources of Information

More information on the adverse effects of Stoddard solvent and on treating cases of Stoddard solvent exposure can be obtained from the Agency for Toxic Substances and Disease Registry (ATSDR), your state and local health departments, and university medical centers. *Case Studies in Environmental Medicine: Stoddard Solvent Toxicity* is one of a series. To obtain other publications in this series, please use the order form on page 26.
For clinical inquiries, contact ATSDR, Division of Health Education and Promotion, Office of the Director, at 404-498-0101.

Notes

Case Studies in Environmental Medicine:

Stoddard Solvent Toxicity

Evaluation Questionnaire and Posttest, Course Number SS3057

Course Goal: To increase the primary care provider's knowledge of hazardous substances in the environment and to aid in evaluating potentially exposed patients.

Objectives

- Discuss the major exposure route for Stoddard solvent.
- Describe two potential environmental and occupational sources of Stoddard solvent exposure.
- State two reasons why Stoddard solvent is a health hazard.
- Describe three factors that contribute to Stoddard solvent toxicity.
- Identify evaluation and treatment protocols for persons exposed to Stoddard solvent.
- List two sources of information on Stoddard solvent.

Tell Us About Yourself

Please carefully read the questions. Provide answers on the answer sheet (page 25). Your credit will be awarded based on the type of credit you select.

1. **What type of continuing education credit do you wish to receive?**
   ****Nurses should request CNE, not CEU. See note on page 24.**
   A. CME (for physicians)
   B. CME(for non-attending)
   C. CNE (continuing nursing education)
   D. CEU (continuing education units)
   E. [Not used]
   F. [Not used]
   G. [Not used]
   H. None of the above

2. **Are you a...**
   A. Nurse
   B. Pharmacist
   C. Physician
   D. Veterinarian
   E. None of the above

3. **What is your highest level of education?**
   A. High school or equivalent
   B. Associate, 2-year degree
   C. Bachelor's degree
   D. Master's degree
   E. Doctorate
   F. Other

4. Each year, approximately how many patients with Stoddard solvent exposure do you see?
A. None
B. 1–5
C. 6–10
D. 11–15
E. More than 15

5. Which of the following best describes your current occupation?
A. Environmental Health Professional
B. Epidemiologist
C. Health Educator
D. Laboratorian
E. Physician Assistant
F. Industrial Hygienist
G. Sanitarian
H. Toxicologist
I. Other patient care provider
J. Student
K. None of the above

6. Which of the following best describes your current work setting?
A. Academic (public and private)
B. Private health care organization
C. Public health organization
D. Environmental health organization
E. Non-profit organization
F. Other work setting

7. Which of the following best describes the organization in which you work?
A. Federal government
B. State government
C. County government
D. Local government
E. Non-governmental agency
F. Other type of organization

Tell Us About the Course

8. How did you obtain this course?
A. Downloaded or printed from Web site
B. Shared materials with colleague(s)
C. By mail from ATSDR
D. Not applicable

9. How did you first learn about this course?

A. State publication (or other state-sponsored communication)
B. *MMWR*
C. ATSDR Internet site or homepage
D. PHTN source (PHTN Web site, e-mail announcement)
E. Colleague
F. Other

10. What was the most important factor in your decision to obtain this course?

A. Content
B. Continuing education credit
C. Supervisor recommended
D. Previous participation in ATSDR training
E. Previous participation in CDC and PHTN training
F. Ability to take the course at my convenience
G. Other

11. How much time did you spend completing the course, evaluation, and posttest?

A. 1 to 1.5 hours
B. More than 1.5 hours but less than 2 hours
C. 2 to 2.5 hours
D. More than 2.5 hours but less than 3 hours
E. 3 hours or more

12. Please rate your level of knowledge before completing this course.

A. Great deal of knowledge about the content
B. Fair amount of knowledge about the content
C. Limited knowledge about the content
D. No prior knowledge about the content
E. No opinion

13. Please estimate your knowledge gain after completing this course.

A. Gained a great deal of knowledge about the content
B. Gained a fair amount of knowledge about the content
C. Gained a limited amount of knowledge about the content
D. Did not gain any knowledge about the content
E. No opinion

Please use the scale below to rate your level of agreement with the following statements (questions 14–25) about this course.

A. Agree
B. No opinion
C. Disagree
D. Not applicable

14. The objectives are relevant to the goal.

15. The tables and figures are an effective learning resource.

16. The content in this course was appropriate for my training needs.

17. Participation in this course enhanced my professional effectiveness.

18. I will recommend this course to my colleagues.

19. Overall, this course enhanced my ability to understand the content.

20. I am confident I can discuss the major exposure route for Stoddard solvent.

21. I am confident I can describe two potential environmental and occupational sources of Stoddard solvent exposure.

22. I am confident I can state two reasons why Stoddard solvent is a health hazard.

23. I am confident I can describe three factors that contribute to Stoddard solvent toxicity.

24. I am confident I can identify evaluation and treatment protocols for persons exposed to Stoddard solvent.

25. I am confident I can list two sources of information on Stoddard solvent.

Posttest

If you wish to receive continuing education credit for this program, you must complete this posttest. Each question below contains four suggested answers, of which one or more is correct. Choose the answer:

A if 1, 2, and 3 are correct
B if 1 and 3 are correct
C if 2 and 4 are correct
D if 4 is correct
E if 1, 2, 3, and 4 are correct

26. Acute exposure to Stoddard solvent may adversely affect all of the following except:
(1) CNS
(2) vision and hearing
(3) mucous membranes
(4) pancreas

27. Stoddard solvent would probably be found in which of the following locations?
(1) dry-cleaning plants
(2) print shops
(3) automobile-repair stations
(4) food-processing plants

28. Recommended treatment for acute ingestion of small to moderate amounts of Stoddard solvent usually includes which of the following?
(1) steroids and hyperbaric oxygen
(2) gastric lavage
(3) prophylactic antibiotics
(4) symptomatic support

29. Which of the following are associated with exposure to Stoddard solvent?
(1) neurobehavioral changes
(2) dermatitis
(3) visual changes
(4) headaches

30. Consumers may be exposed to Stoddard solvent by which of the following?
(1) paint thinners
(2) chemical cleaning products
(3) dry-cleaned clothes
(4) pesticides

31. Which of the following statement(s) is (are) true?
(1) Stoddard solvent is a superior solvent because it readily dissolves in water
(2) benzene and other aromatic compounds make up approximately 60% of Stoddard solvent
(3) Stoddard solvent is a known developmental toxicant
(4) exposure to Stoddard solvent may cause CNS effects and defatting of the skin

32. Which of the following tests may be appropriate for monitoring a person chronically exposed to Stoddard solvent?

(1) liver function tests
(2) urinalysis
(3) complete blood count
(4) serum amylase

33. Which of the following statement(s) is (are) true?

(1) persons with increased susceptibility to Stoddard solvent toxicity include those with COPD
(2) pulmonary aspiration can be a hazard after Stoddard solvent ingestion
(3) Stoddard solvent can cause CNS toxicity
(4) significant health effects have occurred as a result of drinking Stoddard solvent -contaminated water because it is a human carcinogen

Note to Nurses

CDC is accredited by the American Nurses Credentialing Center's (ANCC) Commission on Accreditation. ANCC credit is accepted by most State Boards of Nursing.

California nurses should write in "ANCC - Self-Study" for this course when applying for relicensure. A provider number is **not** needed.

Iowa nurses must be granted special approval from the Iowa Board of Nursing. Call 515-281-4823 or e-mail marmago@bon.state.ia.us to obtain the necessary application.

Case Studies in Environmental Medicine:

Stoddard Solvent Toxicity

Answer Sheet, Course Number SS3057

Instructions for submitting hard-copy answer sheet: Circle your answers. To receive your certificate, you must answer **all** questions. Mail or fax your completed answer sheet to

Fax: 404-498-0061, ATTN: Continuing Education Coordinator

Mail: Agency for Toxic Substances and Disease Registry
ATTN: Continuing Education Coordinator
Division of Health Education and Promotion
1600 Clifton Road, NE (MS E-33)
Atlanta, GA 30333

Be sure to fill in your name and address on the back of this form.

Remember, you can access the case studies online at www.atsdr.cdc.gov/HEC/CSEM/ and complete the evaluation questionnaire and posttest online at www2.cdc.gov/atsdrce/.

Online access allows you to receive your certificate as soon as you complete the posttest.

1. A B C D E F G H
2. A B C D E
3. A B C D E F
4. A B C D E
5. A B C D E F G H I J K
6. A B C D E F
7. A B C D E F
8. A B C D
9. A B C D E F
10. A B C D E F G
11. A B C D E
12. A B C D E
13. A B C D E
14 A B C D
15. A B C D
16. A B C D
17. A B C D
18. A B C D
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20. A B C D
21. A B C D
22. A B C D
23. A B C D
24. A B C D
25. A B C D
26. A B C D E
27. A B C D E
28. A B C D E
29. A B C D E
30. A B C D E
31. A B C D E
32. A B C D E
33. A B C D E

Name: E-mail (not required):

Address:

Zip code:

○ Check here to be placed on the list to pilot test new case studies

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Access the case studies online at www.atsdr.cdc.gov/HEC/CSEM/ and complete the evaluation questionnaire and posttest online at www2.cdc.gov/atsdrce/.

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AND HUMAN SERVICES
Agency for Toxic Substances
and Disease Registry
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