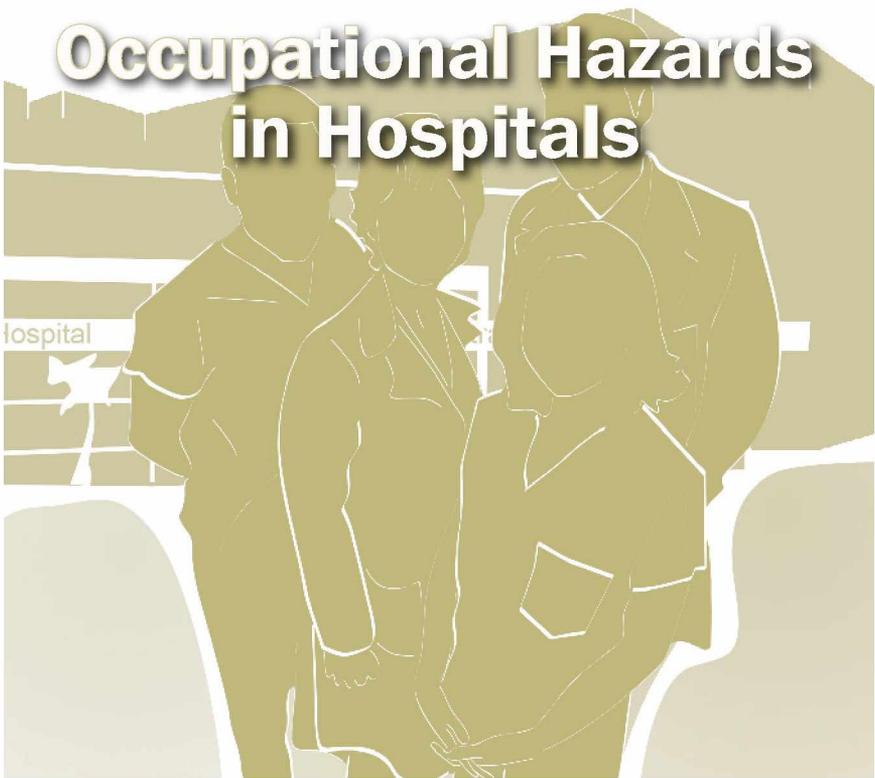




WASTE ANESTHETIC GASES

Occupational Hazards in Hospitals



DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health



NIOSH

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Waste Anesthetic Gases

Introduction

Waste anesthetic gases are small amounts of volatile anesthetic gases that leak from the patient's anesthetic breathing circuit* into the air of operating rooms during delivery of anesthesia. These gases may also be exhaled by patients recovering from anesthesia. Waste anesthetic gases include both nitrous oxide and halogenated anesthetics such as halothane, enflurane, isoflurane, desflurane, sevoflurane, and methoxyflurane (no longer used in the United States). The halogenated anesthetics are often administered in combination with nitrous oxide. Nitrous oxide and some of the halogenated anesthetics may pose a hazard to hospital workers.

The purpose of this brochure is to do the following:

- Increase awareness about the adverse health effects of waste anesthetic gases
- Describe how workers are exposed to waste anesthetic gases
- Recommend work practices to reduce these exposures
- Identify methods to minimize leakage of anesthetic gases into the work environment

*The anesthetic breathing circuit includes the mask, endotracheal tube, anesthetic gas machine, ventilator, pumps, scavenging devices, all connecting tubing, and other elements, depending on the type of anesthesia delivery system.

Who is exposed to waste anesthetic gases?

The following hospital workers may be exposed to waste anesthetic gases:

- Anesthesiologists
- Dentists
- Nurse anesthetists
- Operating-room nurses
- Operating-room technicians
- Other operating-room personnel
- Recovery-room nurses
- Other recovery-room personnel
- Surgeons

What are the health effects of exposure to waste anesthetic gases?

Effects of exposure to high concentrations

Exposure to high concentrations of waste anesthetic gases—even for a short time—may cause the following health effects:

- Headache
- Irritability
- Fatigue
- Nausea
- Drowsiness
- Difficulties with judgment and coordination
- Liver and kidney disease

Effects of exposure to low concentrations

Although some studies report no adverse health effects from long-term exposure to low concentrations of waste anesthetic gases, several studies have linked such exposure to miscarriages, genetic damage, and cancer among operating-room workers. Studies have also reported miscarriages in the spouses of exposed workers and birth defects in their offspring. Therefore, NIOSH is concerned about worker exposures to these gases and recommends controls to prevent exposures.

Where are workers most likely to be exposed to waste anesthetic gases?

Workers are most likely to be exposed to waste anesthetic gases in

- operating facilities with no automatic ventilation or scavenging systems,
- operating facilities where these systems are in poor condition, or
- recovery rooms where gases exhaled by recovering patients are not properly vented or scavenged.

Even when scavenging and venting systems are in place, workers may be exposed to these gases under the following conditions:

- When leaks occur in the anesthetic breathing circuit (which may leak gas if the connectors, tubing, and valves are not maintained and tightly connected)
- When anesthetic gases escape during hookup and disconnection of the system

- When anesthetic gas seeps over the lip of the patient's mask or from endotracheal coupling (particularly if the mask is poorly fitted—for example, during pediatric anesthesia)
- During dental operations
- During induction of anesthesia

How can employers reduce worker exposures to waste anesthetic gases?

Employers can reduce exposures to waste anesthetic gases by taking the following steps:

- Establish a hazard communication program:
 - Develop and implement a safety and health plan that includes information about exposure hazards and methods to control them.
 - Label cylinders containing anesthetic agents.
 - Make material safety data sheets (MSDSs) available.
 - Train workers as required by the Occupational Safety and Health Administration (OSHA) hazard communication standard [29 CFR[†] 1910.1200].
- Install a scavenging system with the anesthesia delivery system to remove waste anesthetic gases from the operating room. Place the exhaust in an area where waste gases will not be reintroduced into intake air for the facility.

[†]See Code of Federal Regulations under *More Information About Waste Anesthetic Gases*.

- Install a ventilation system that circulates and replenishes the air in operating rooms (at least 15 air changes per hour, with a minimum of 3 air changes of fresh air per hour).
- Install a ventilation system that circulates and replenishes the air in recovery rooms (at least 6 air changes per hour, with a minimum of 2 air changes of fresh air per hour) to prevent exposure to waste anesthetic gases exhaled by patients.
- Properly maintain anesthesia machines, breathing circuits, and waste-gas scavenging systems to minimize leaks of anesthetic gases into the operating rooms.
- Train all workers in hazard awareness, prevention, and control of exposures to waste anesthetic gases.
- Develop a monitoring program supervised by a knowledgeable person in every operating facility. Such a program should include
 - quantitatively evaluating the effectiveness of a waste-gas control system and
 - repeatedly measuring concentrations of anesthetic gas in the breathing zones of the most heavily exposed workers while they perform their usual procedures.
- Keep good records of all collected air sample results for at least 30 years.
- Keep medical records of a worker's exposure for 30 years after his or her employment has ended (see 29 CFR 1910.1020 Access to Employee Exposure and Medical Records).

- Obtain baseline liver and kidney data for operating-room personnel and monitor their liver and kidney functions periodically.
- Record medical histories for workers and their families, including occupational histories and outcomes of all pregnancies of female workers and wives of male workers (if possible).

How can operating-room personnel reduce their exposures to waste anesthetic gases?

Anesthetic gases cannot be detected by their odor until concentrations are very high. For example, halothane cannot be detected by 50% of the general population until the concentration is more than 125 times the NIOSH recommended exposure limit.

Reduce exposures to waste anesthetic gases by following these procedures before anesthesia begins:

- Inspect the anesthetic delivery system before each use. Look for irregularities or breaks.
- Check the patient's breathing circuit for negative pressure and positive pressure relief as part of the daily machine checklist.
- Turn on the room or local ventilation system.
- Make sure the scavenging equipment is properly connected.
- Connect the gas outlet to the hospital's central scavenging system.
- Start the gas flow after the laryngeal mask or endotracheal tube is installed.

- Fill vaporizers under a ceiling-mounted hood with an active evacuation system.
- Fill vaporizers before or after the anesthetic procedure.
- Make sure that uncuffed endotracheal tubes create a completely sealed airway.
- Use the lowest anesthetic gas flow rates possible for the proper functioning of the anesthesia delivery system and for patient safety.
- Avoid very high anesthetic gas flow rates to prevent leaks: high flow rates generate more waste anesthetic gases than low flow rates.
- Do not deliver anesthesia by open drop (dripping liquid, volatile anesthetic onto gauze).
- If a mask is used, make sure it fits the patient well.
- Eliminate residual gases through the scavenging system as much as possible before disconnecting a patient from a breathing system.
- Turn the gas off before turning off the breathing system.

More information about waste anesthetic gases

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