WASTE ANESTHETIC GASES

Anesthetic gas and vapors that leak into the surrounding room during medical or research procedures are considered waste anesthetic gases (WAGs). Waste anesthetic gases and vapors that create health effects from over-exposure include nitrous oxide and halogenated agents such as isoflurane or halothane. University faculty, staff and students must be aware of the potential risks of WAGs and are advised to take appropriate precautions to reduce exposures.

Workers acutely exposed to excess amounts of anesthetic gas can experience symptoms of drowsiness, headache, nausea, poor judgement and loss of coordination. Chronic symptoms of over-exposure can include liver, kidney, and reproductive effects. Information on the specific health effects of each anesthetic gas can be found on the Safety Data Sheet.

To prevent unnecessary exposure to waste anesthetic gas, the following instructions help identify the potential for WAG exposure and provide guidance on leak test procedures, medical surveillance, air monitoring, worker training and waste disposal.

The principal sources of waste anesthetic gas exposure are induction chambers, leakage from anesthesia equipment or improper use of anesthetic gas scavenging systems, and recovery of large animal species (through exhalation of inspired WAG). University employees who work in hospital operating rooms, dental operators, exam rooms, and/or animal surgery or imaging areas should also take steps to reduce their exposure to WAGs.

A safe exposure concentration for any halogenated anesthetic agent is less than 2 parts per million (ppm) collected over an eight-hour period, or 25 ppm of nitrous oxide over an 8-hour time weighted average.

Below are exposure limits for WAGs. If the WAG being used does not have an exposure limit, contact EH&S for guidance.

- Isoflurane – 2 ppm as an 8-hour time weighted average (TWA)
- Nitrous Oxide – 25 ppm as an 8-hour TWA

When nitrous oxide is used in combination with halogenated gas, control of nitrous oxide to 25 ppm during anesthesia should limit concentrations of the halogenated gases to less than 0.5ppm. Charcoal filters/canisters will not work with nitrous oxide. Active scavenging is required for nitrous oxide.

1. Engineering Controls:

A scavenging system is the basic engineering control for WAGs. These systems include a collecting device (scavenging adapter) to capture gases and vapors from the anesthesia

breathing system at the site of overflow. Although some gas scavenging systems are elaborate and costly, an inexpensive system consisting of a flexible exhaust duct and Plexiglas hood, if well designed and properly installed, can dramatically reduce gas concentrations in the work area.

Animal face masks that are not tight fitting should have a sealing diaphragm to control leakage areas and must be designed for the species of animal being anesthetized. Modern anesthesia equipment is manufactured with active scavenging systems that include a scavenging nasal mask. For human subjects, select a compact double chambered mask system with a shroud large enough to capture exhausted anesthetic gas exiting from the subject's nose and mouth when possible. The inner mask is contained within a slightly larger outer mask and a slight vacuum is present in the space between the masks. Intubation reduces exposure to WAG even further.

The HVAC system for the room should not be relied upon for waste gas scavenging. While it is important to have adequate supply and exhaust ventilation (10-15 air changes per hour), active scavengers should be used to capture and exhaust gas at the point of release.

1.1 Preferred methods to capture WAGs are to work within a certified chemical fume hood or certified Class II Type B2 (hard-ducted) biosafety cabinet, work near a slotted vent exhaust, use a snorkel exhaust, or backdraft or downdraft table. If you have questions about engineering controls, contact EH&S. For humans and large animals, sealed intubation cuffs are recommended.

1.2 Other approved methods to capture WAGs are using an active scavenging device such as a house vacuum or a manufactured scavenging system that will pull the WAG away from the operator's breathing zone.

1.3 Passive scavenging via the use of charcoal canisters often results in elevated WAG exposures and should only be utilized when engineering controls and active scavenging systems are not feasible. Passive scavenging relies on the positive pressure of the aesthesia machine and the animal exhaling to push the anesthetic gas into a charcoal canister for neutralization.

1.3.1 Charcoal canisters must be dated and weighed before and after use to ensure they are within the manufacturer specifications. If the weight of the charcoal canister is out of manufactures specifications, a new canister must be used.

1.3.2 Some styles of charcoal canisters that are placed upright on the bench may not allow air to pass through; therefore:

1.3.2.1 For canisters with an exhaust port on the top, place it in an upright position.

1.3.2.2 For canisters with exhaust ports on the bottom, use a holder for charcoal canisters to avoid blocking the exhaust holes.

1.3.2.3 Do not lay the charcoal canisters on their side during use.

2. Work Practice Controls:

The anesthesia machine owner must implement a routine maintenance program to check for and fix leaking equipment and to assure that ventilation requirements are met. Steps taken before surgery to reduce gas leakage should include:

2.1 Check the vaporizer for current certification.

2.2 Fill the vaporizer inside a chemical fume hood or use an anti-spill bottle adaptor.

2.3 Make sure that waste gas disposal lines are connected, and that fittings and hoses are not defective or leaking.

2.4 Avoid turning on nitrous oxide or halogen vaporizers until the circuit is connected to the subject. Switch off the nitrous oxide and halogen vaporizer when not in use.

2.5 When using an induction chamber, open it in a chemical fume hood or Class II Type B2 biosafety cabinet, or immediately adjacent to a local exhaust device, or connect to the house vacuum system to evacuate the chamber. If a passive system is being used, turn off the vaporizer and use oxygen to push the WAG into the charcoal filter. Do not open the induction chamber until it has been flushed with oxygen. If the chamber cannot be flushed with oxygen, active scavenging is recommended.

2.6 Make sure that the mask properly fits the subject.

2.7 Use the lowest gas flow rates possible.

2.8 Maintain oxygen flow until the scavenging system is flushed.

3. Air Monitoring

Users must contact EH&S for air monitoring prior to using any active or passive scavenging setup for the first time. Monitoring must be repeated every 3 years

thereafter. Costs associated with monitoring may be charged directly to the participating Department or the Principal Investigator (PI).

Whenever there has been a change in production, controls, equipment or personnel that may result in new or additional exposure to Isoflurane, or whenever there is any other reason to suspect a change that may result in new or additional exposures to Isoflurane, please reach out to EH&S to determine if additional monitoring is necessary.

Air monitoring will be performed on both worst case and routine exposures for each job class.

Sampling results of the air monitoring along with any necessary exposure reduction measures are reported to the supervisor and should be shared with the monitored employee(s).

4. Medical Surveillance

Faculty, staff and students with symptoms of over-exposures to WAGs should be directed to promptly visit Employee Health Services for a clinical consultation.

5. Personal Protective Equipment

Personal protective equipment is required when filling the vaporizer with an anesthetic agent.

Wear nitrile gloves that provide chemical protection, safety glasses or face shield and laboratory coat.

Respiratory protection is typically not necessary or recommended if adequate controls for WAGs are in place. Respiratory protection equipment should only be utilized as an interim measure when air monitoring shows control measures are currently inadequate to limit worker exposures.

6. Training

Supervisors are responsible to assure that workers involved with waste anesthetic gases are trained to recognize, understand and reduce health and safety risks of exposure to WAGs. Training and questions can be supported by EH&S.

7. Disposal of anesthetic gas and charcoal canisters

7.1 Do not allow anesthetic gas containers to evaporate in a chemical fume hood before disposal.

7.2 Manage unused/expired anesthetic gas, used charcoal canisters, and/or carbon adsorption devices as chemical waste. Place a chemical waste label on container and dispose through the chemical waste program.

7.3 Empty anesthetic gas/isoflurane containers that are glass, deface the label and dispose in the broken glass box. Empty anesthetic gas/isoflurane containers that are not glass, deface the label and dispose in the regular trash.

7.4 Used charcoal canisters must be disposed of through the chemical waste program.