American Society of PeriAnesthesia Nurses

A Position Statement on Waste Anesthesia Gases Outside of the Operating Rooms

Developed by ASPAN and supported by the American Industrial Hygiene Association

The American Society of PeriAnesthesia Nurses (ASPAN) is the premier organization for perianesthesia nursing excellence. The purpose of ASPAN is to empower and advance the unique specialty of perianesthesia nursing. Perianesthesia registered nurses work in any space before or after patients receive anesthesia, primarily in the postanesthesia care unit (PACU) recovering patients from procedures and surgeries.

Background

Established in 1939, the American Industrial Hygiene Association (AIHA) is the association for scientists and professionals committed to preserving and ensuring occupational and environmental health and safety in the workplace and community. More than half of AIHA's 8,500 members are certified industrial hygienists. This organization supports members and those employed in private or public sectors through expertise support, comprehensive education programs, and service as a resource to help maintain the highest workplace and professional standards and for working communities.

The AIHA is composed primarily of industrial hygienists who are trained to anticipate, recognize, evaluate, and recommend controls for environmental and physical hazards that can impact the health and well-being of workers.

ASPAN practice experts believe waste anesthesia gases (WAGs) are an occupational hazard. The National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) have identified health effects from WAG exposure including nausea, dizziness, headaches, infertility, miscarriages, birth defects, cancer, liver, and kidney diseases.[1-3] The immediate postoperative patient is the source of exposure to WAGs outside of the operating rooms (ORs). Volatile anesthetic gases (e.g., nitrous oxide), and the fluorinated gases (e.g., sevoflurane, desflurane, isoflurane) undergo minimal metabolism in the body during clinical use and are primarily eliminated unchanged via exhalation (estimated equal or greater than 95%).[4,5] Few adverse effects associated with WAGs have been documented when workplace exposure limits are implemented by using measures to reduce occupational exposure.[6] The AIHA supports this ASPAN position statement and stands behind enhancing knowledge and protections to guard nurses from potential occupational hazards faced in the workplace.[7]

Position

The goals for controlling WAG exposure in hospitals are:

- To increase awareness that all areas of the hospital can have potential occupational exposure to WAGs in concentrations higher than in the operating rooms
- To prevent exposure to WAGs as an occupational hazard for nurses, patients, and their families in all areas of the institution

WAGs should be regulated with *engineering controls*[a] in the PACU including (see Figure 1):

- Application of commercially available source-control scavenging systems to patients recovering in the PACU following surgery, following the administration of inhalation anesthetic agents. Total intravenous anesthesia (TIVA) patients would only require scavenging systems for pathogens
- Increased air-exchanges to provide adequate ventilation similar to operating room air-exchanges, so that WAG levels do not increase as a result of expanding patient volumes
- Provision of fresh air exchanges in the PACU, similar to operating room air recommendations, to reduce and prevent nurse exposure to WAGs

Administrative controls for the PACU should include:

- Implementing an industrial hygiene program including routine monitoring of WAGs in the perianesthesia registered nurses' breathing zone and regular maintenance of ventilation and source-control scavenging systems at least twice per year[2,8]
- Developing and administering an education and training program for perianesthesia registered nurses exposed to WAGs that comply with NIOSH Recommended Exposure Limits (RELs), and with OSHA's Hazard Communication Standard[b]
- Defining and implementing best work practices to help reduce perianesthesia registered nurse exposure to WAGs
- Executing a medical surveillance program for all perianesthesia registered nurses exposed to WAGs
- Complying with existing federal, state, and local regulations and guidelines developed to minimize hospital personnel exposure to WAGs

Currently, these controls are not present in the PACUs in which the patients are the source of the WAG as they exhale unmetabolized anesthetic gases into the unregulated environment of the PACU and intensive care areas.

[a]Engineering controls are applied at the source of the hazard and are generally the preferred and most effective means to control and minimize occupational exposures. Administrative controls are the next best means and include implementation of best practices.[2]

[b]OSHA's Hazard Communication Standard requires that healthcare workers are provided information related to workplace chemical hazards.[2]

Relatively recent findings have shown that patients in the PACU can be significant sources of WAG exposure to nurses.[9-12]

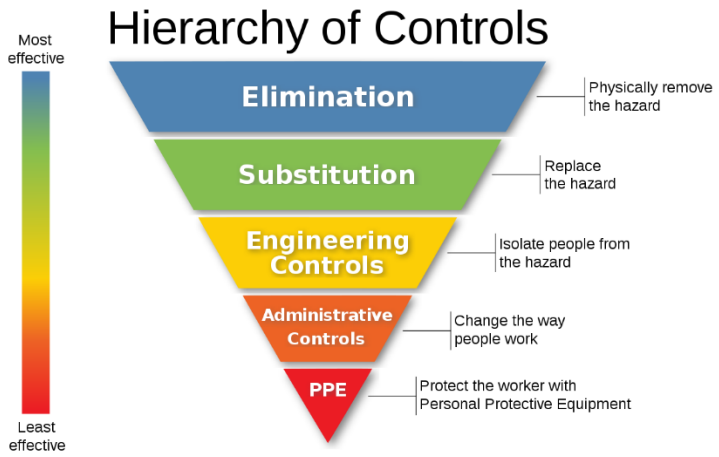

Figure 1. Hierarchy of Controls. Reprinted with permission from the National Institute of Occupational Safety & Health (NIOSH).
https://www.cdc.gov/niosh/topics/hierarchy/default.html

This position statement serves as the basis for ASPAN's action on behalf of industrial hygienists, perianesthesia registered nurses, healthcare providers in the perianesthesia environment, and those whom the organizations serve.

Comments

1. Health Outcomes Related to Waste Anesthesia Gases (WAG)

For more than 50 years, the evidence presented in the peer-reviewed literature, and by government entities such as NIOSH and OSHA, have shown that adverse occupational health outcomes are associated with WAG exposures. A recent systematic review confirmed a scarce and inconsistent evidence related to adverse effects of volatile anesthetics on exposed personnel. In addition, there is no evidence of adverse effects when environmental levels are kept within legal threshold values.[13] It is recognized that further epidemiologic and exposure assessment studies are needed to improve our knowledge and understanding of the effects of occupational exposure to WAGs. New surveillance methods that include systematic data collection, clinical signs, and biomarkers of exposure, may be helpful to formulate consistent and reproducible surveillance criteria for exposed personnel.

Based on a review of the literature, ASPAN presents the following list of potential effects.

- Health effects of exposure to WAGs may cause the following:
    - Headache[1,14,15]

- Irritability[1,14,15]
- Fatigue[14,15]
- Nausea[1,14,15]
- Drowsiness[1]
- Depression[1]
- Difficulties with judgment, audiovisual processing, and coordination[1,16-19]
- Liver disease[1,16,20]
- Kidney disease[1,16,20]
- Malignancies of the lymph or immune system[1,21,22]
- Impaired B12 metabolic status or pernicious anemia[23-25]
- Miscarriages[2,18,20,26-30]
- Congenital abnormalities[2,15,21,27]
- Low birth weights[7,20,29,30]
- Exposed spouse's miscarriages and birth defects[2,20,27]
- Reduced fertility[19,31]
- Genetic, DNA damage[20,32-35]
- Cancer[1,11,30,36]
- Bone marrow depression[17,18,20]
- Increased homocysteine levels[18]
- General health and genotoxic risks[37]
- Changes in antioxidant status[32,34,35,38]

In addition, health effects of surgical anesthetic gases in the elderly contribute to postoperative cognitive decline/dysfunction.[39-42] Health effects of repeated surgical anesthetic exposure in the very young (less than 36 months) are currently being investigated to determine if the exposure may contribute to learning disabilities and autism.[43-54]

2. Regulatory Approach

ASPAN and AIHA support the development of engineering controls to decrease exposure to WAGs reduced to the lowest feasible level in the PACU. While the use of prospective studies and carefully designed research protocols is encouraged to elucidate areas of controversy, a responsible approach to worker health and safety dictates that any exposure to waste and trace gases should be kept to the lowest practical level.[2] OSHA states, "the preferred and most effective means of protecting workers is to prevent hazards entering their breathing zone in the first place."[2,3] When workplace exposure limits are implemented by using measures to reduce occupational exposure, few adverse health effects from un-scavenged WAGs have been documented.[8]

Proposed engineering controls to include:

- Market-available source-control scavenging systems which can contain and control WAGs from the exhaled breath of patients in

the PACU. In addition, these scavenging systems may help contain and control capture pathogens, such as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the pathogen that causes COVID-19, in addition to WAGs[12,17,55-62]

- Controls for the exhaled breath of immediate postoperative patients on ventilators[10,11,55,63]
- Increased heating, ventilation, and air conditioning (HVAC) air exchanges in the PACUs from 6 air changes per hour to 15, similar to the operating rooms[10,11,19,55]
- Regular HVAC monitoring of air quality to be preferably completed during the peak of daily patient activity in the PACU and within the patient breathing zone where the nurses work closely with patients[10,11,55,57,64,68]
- Following OSHA's General Duty Clause[c] for WAGs in PACU until such time as federal standards are established and enacted
- Adherence to NIOSH Recommended Exposure Limits (RELs) for WAGs[3,11,19]
- Provision of negative airflow rooms for bi-pap and aerosol-generating procedures that induce expired and aerosolized breath/air[3,10,11,59]
- Routine maintenance of these systems[3,11]

[c]The General Duty Clause is the portion of the OSHA Act, section 5(a)(1) indicating the requirement of employers to provide a safe workplace environment that is free from hazards.[2]

3. Continued Research

There is a significant and growing body of knowledge on the relationship between the air quality in the PACU and poor health outcomes for healthcare providers in this environment. There may be moderating or predisposing factors that interact with occupational exposure.[11,43,46,59] Although exposure to WAGs in the OR has been well documented, there lacks a large body of work for the PACU. This includes the fact that there is little to no surveillance or measurement of air quality (and WAGs source) during peak times of patients' presence in the PACU.[11] The provision of information to healthcare providers to increase awareness of these risks can lead to a responsible approach for worker health and safety that keeps any exposure to WAGs to the lowest possible practical level.

Approval of Statement

This statement was endorsed by a vote of the ASPAN Board of Directors on April 6, 2022, in Philadelphia, Pennsylvania, and approved by a vote of the ASPAN Representative Assembly on April 7, 2022.

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