Nitrous Oxide: Hazards and Proper Use

James Kaznosky
Manager, Env. & Occ. Safety
Environmental Health and Safety
What is Nitrous Oxide?

• Nitrous oxide (N2O) is nonflammable, colorless gas with pleasant, sweet odor and taste
• Also called dinitrogen monoxide or more commonly-*laughing gas.*
• When inhaled, it produces relaxation, and a reduced sensibility to pain.
 Uses

• Anesthetic agent in dental, medical and veterinary operations.
• Functions as an analgesic agent for conscious sedation in dental operatories.
• Many other applications, such as foaming agent for whipped cream, an oxidant for organic compounds, nitrating agent for alkali metals & a component of rocket fuels.
Routes of Entry & Safe Limits

**Inhalation:** Most common route of entry

**Dermal:** Potential for frostbite in liquid form

**Exposure Limits:**
- **OSHA** Not currently regulated
- **NIOSH** 25 ppm TWA for duration of use (for exposure to “waste” gas.)
- **ACGIH** 50 ppm TWA for an 8-hr use
Metabolism

• Commonly used as a single agent mixed with oxygen for surgical anesthesia
• Absorbed by diffusion through inhalation
• Eliminated through respiration
• Elimination half-life is ~ 5 minutes
• Minimally metabolized through excretion
Health Effects

The following associations have been implicated due to Nitrous Oxide exposure:

- Breathing difficulty and asphyxia, primarily from abuse by inhalation
- Potential for nausea or vomiting
- Potential for Vitamin B12 interference
- Potential for adverse reproductive effects
- Potential frostbite concerns in liquid form
How Exposure May Occur In Dental Clinics

- Inadequate Ventilation or Scavenging systems
- Equipment Malfunction
  - Equipment failure
  - Leaks due to poor connections
- Poor Technique or Use
- Uncooperative Patient

Figure 1. Sources of leaks from anesthetic delivery systems in dental operations.
Surveys performed by consultant to ensure systems are working properly:

• Nitrous oxide levels are < 5ppm
• Air changes are adequate (> 10ACH) in rooms
• All rooms are confirmed to be under negative pressure
Exposure Controls

• Engineering Controls
  • Ensure adequate room ventilation
  • Ensure delivery and scavenging systems are properly maintained
  • Supplemental local exhaust

• Administrative Controls
  • Elimination or Substitution
  • Ensure proper system maintenance.
  • Train staff to recognize hazards & minimize them
  • Ensure Proper Work Practices through effective Policy Design
  • Patient Management

• Personal Protective Equipment (PPE)
  • Use of respirator (must be in RPP Program)
General Room Ventilation

- Dilutes N\textsubscript{2}O concentration
- Provides 12 air changes per hour (ACH)
- Removes contaminated air
- Keeps ambient concentrations of N\textsubscript{2}O to <25 ppm
Exhaust and Doors

Keep Door Closed

Keep Exhaust Clear
Engineering Controls: Scavenging Systems

• To be effective, the scavenging system:
  – Must be used whenever Nitrous Oxide is used
  – Fit patient properly
  – Capture all exhaled N2O
  – Transport waste gas out of the office-flow rate of 45 lpm.
Bad FIT vs Good Fit

**Improper Fit**

**Proper Fit**
Work Practices

• Inspect delivery system prior to \( \text{N}_2\text{O} \) administration.

• Check connections, breathing bags, hoses and clamps.

• Do not fill breathing bag to capacity
  • Over inflation can cause excessive leakage from the mask
  • The bag should collapse and expand as the patient breathes

• Flush the system of \( \text{N}_2\text{O} \) after the procedure by administering \( \text{O}_2 \) to the patient for five minutes before disconnecting the gas delivery system
OSHA Permissible Exposure Limit (PEL) for N₂O is:

a) 500 ppm as an 8-hr Time
b) 50 ppm as an 8-hr Time
c) 25 ppm as an 8-hr Time a
d) No PEL
OSHA Permissible Exposure Limit (PEL) for $\text{N}_2\text{O}$ is:

d) No PEL
Quiz

Engineering controls for N2O exposure include all except:

a) Adequate room ventilation.
b) Properly functioning delivery and scavenging systems.
c) Adequate supplemental exhaust.
d) Properly blocking exhaust vents.
Quiz

Engineering controls for N2O exposure include all except:

d) Properly blocking exhaust vents.
Thank You