Nitrous Oxide: Hazards & Proper Use

Health and Safety Specialist
Environmental Health and Safety

COLUMBIA UNIVERSITY
Environmental Health and Safety

Occupational Safety
www.ehs.columbia.edu
Training Outline

- Definition and Uses
- Routes of Entry & Permissible Limits
- Health Effects
- How Exposure May Occur in Dental Clinics
- CUMC Dental Clinics Exposure Assessment
- Exposure Controls
What is Nitrous Oxide?

- Nitrous oxide (N20, dinitrogen monoxide, *laughing gas*) is nonflammable, colorless gas with pleasant, sweet odor and taste
- When inhaled, it produces relaxation, and a reduced sensitivity to pain
- Anesthetic agent in dental, medical and veterinary operations
- Functions as an analgesic agent for conscious sedation in dental operatory
- 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
Nitrous Oxide: 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
OSHA Permissible Exposure Limit (PEL) for N\textsubscript{2}O 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
d) No PEL
Nitrous Oxide: 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
Nitrous Oxide: 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
Exposure Assessment in CUMC Dental Clinics 2017

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
Nitrous Oxide: 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)
Nitrous Oxide Engineering Controls: Ventilation System

General Room Ventilation

- Dilutes N₂O concentration
- Provides 12 air changes per hour (ACH)
- Removes contaminated air
- Keeps ambient concentrations of N₂O to <25 ppm
Nitrous Oxide Engineering Controls: Doors & Exhaust

Keep Door Closed  Keep Exhaust Clear
Nitrous Oxide 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.
Scavenging Systems: Bad Fit vs Good Fit

Improper Fit

Proper Fit

Occupational Safety
www.ehs.columbia.edu
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.
Nitrous Oxide: Administrative Controls

- Inspect delivery system prior to N₂O 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 N₂O after the procedure by administering O₂ to the patient for five minutes before disconnecting the gas delivery system
Thank You!