Nitrous Oxide: Hazards & Proper Use

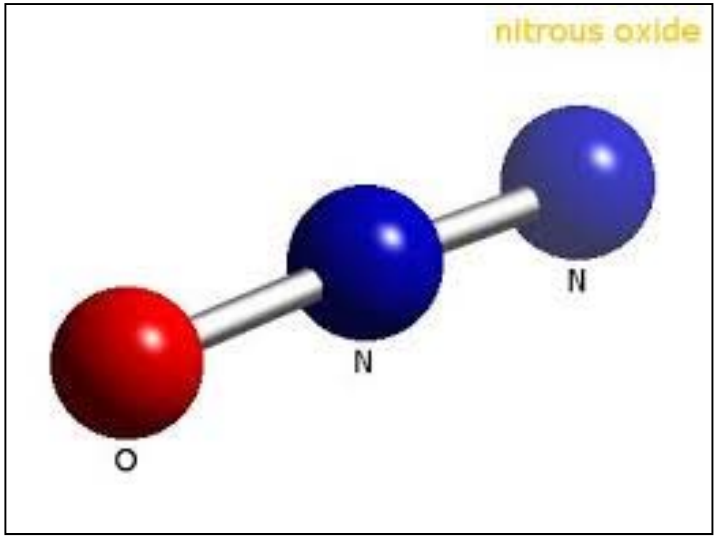
Health and Safety Specialist
Environmental Health and Safety

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) 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 sensitivity to pain



Nitrous Oxide Uses

- 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

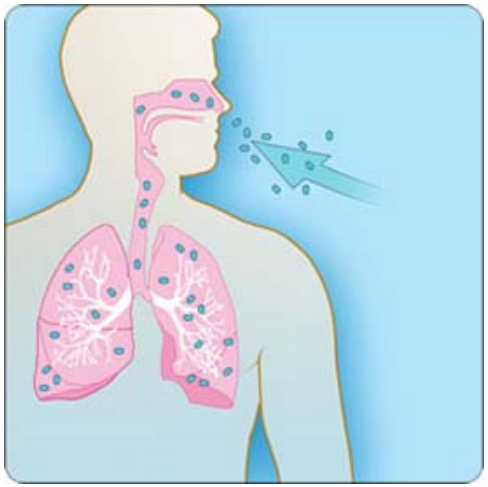
Nitrous Oxide: Routes of Entry & Safe Limits

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



Quiz

OSHA Permissible Exposure Limit (PEL) for N_2O 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

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

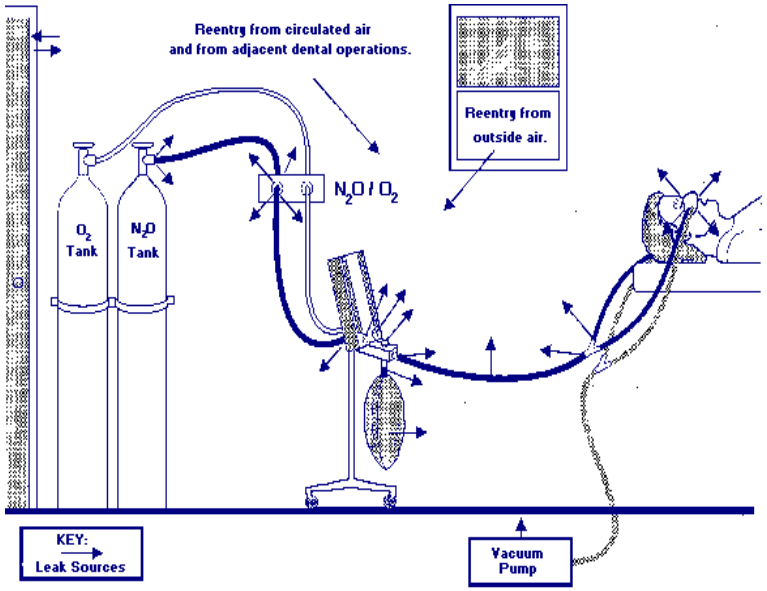


Figure 1. Sources of leaks from anesthetic delivery systems in dental operatories.

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 N_2O concentration
- Provides 12 air changes per hour (ACH)
- Removes contaminated air
- Keeps ambient concentrations of N_2O to <25 ppm

Air Supply

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

Quiz

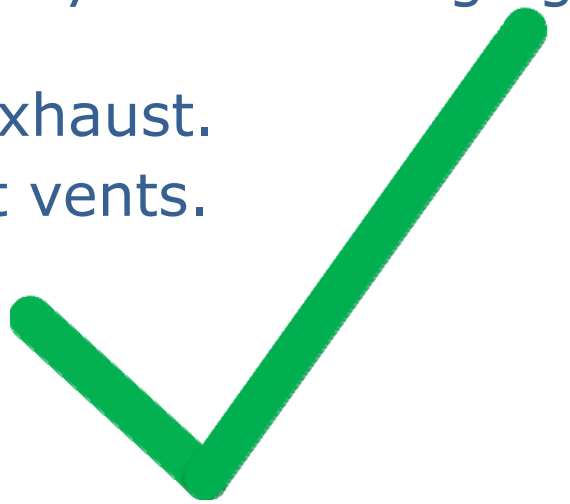
Engineering controls for N2O exposure include all EXCEPT:

a) Adequate room ventilation.

b) Properly functioning delivery and scavenging systems.

c) Adequate supplemental exhaust.

d) Properly blocking exhaust vents.



Nitrous Oxide: Administrative Controls

- Inspect delivery system prior to N_2O 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 N_2O after the procedure by administering O_2 to the patient for five minutes before disconnecting the gas delivery system

Thank You!