

# Nitrous Oxide: Hazards & Proper Use



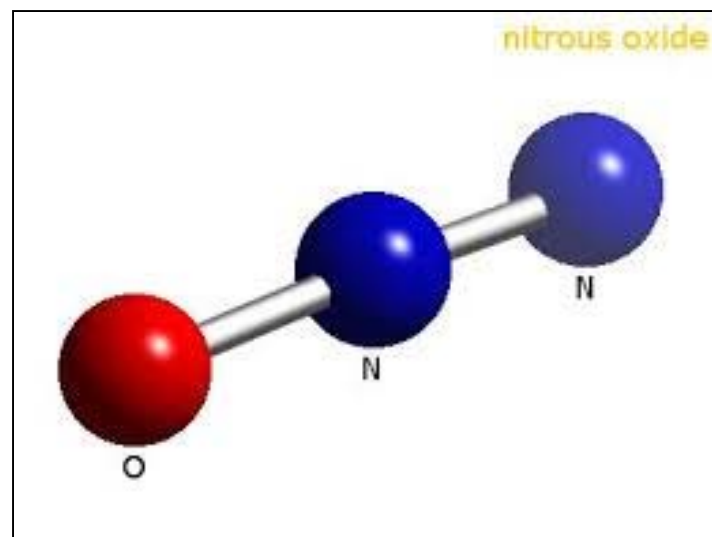
**Health and Safety Specialist**  
**Environmental Health and Safety**

# 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 (N<sub>2</sub>O, 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



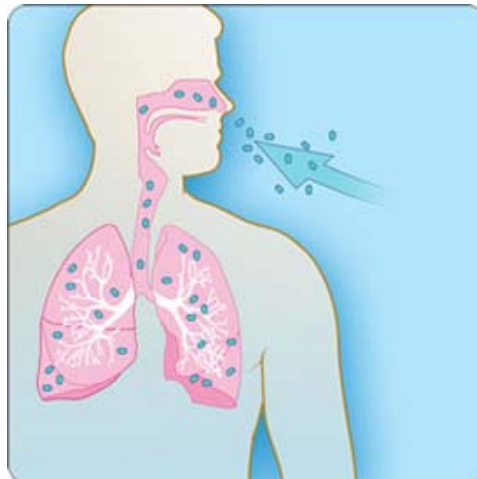
# Nitrous Oxide: Routes of Entry & Safe Limits

**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



# Quiz

OSHA Permissible Exposure Limit (PEL) for N<sub>2</sub>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  $\sim 5$  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

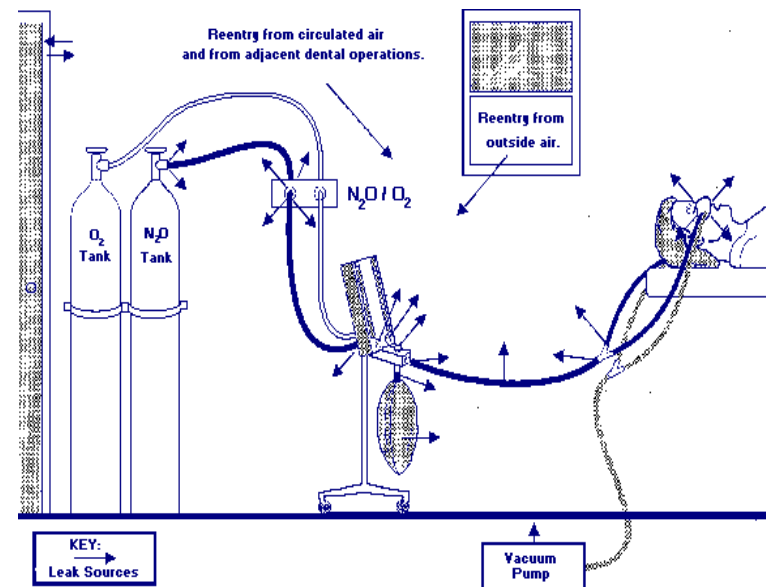


Figure 1. Sources of leaks from anesthetic delivery systems in dental operators.



# Exposure Assessment in CUMC Dental Clinics 2017

**Surveys performed by consultant to ensure systems are working properly:**

- Nitrous oxide levels are  $< 5\text{ppm}$
- Air changes are adequate ( $> 10\text{ACH}$ ) 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)

Traditional Hierarchy of Exposure Control Practices



# 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 N<sub>2</sub>O
  - Transport waste gas out of the office-flow rate of 45 lpm.



# Scavenging Systems: Bad Fit vs Good Fit

## Improper Fit



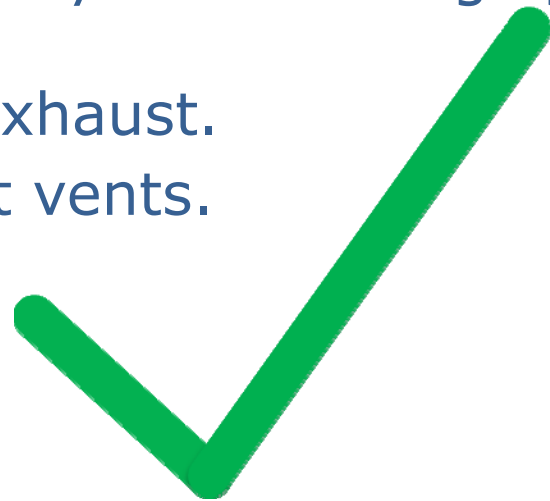
## Proper Fit



# Quiz

Engineering controls for N<sub>2</sub>O 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<sub>2</sub>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 N<sub>2</sub>O after the procedure by administering O<sub>2</sub> to the patient for five minutes before disconnecting the gas delivery system



**Thank You!**

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