

# NITROUS OXIDE FACT SHEET FOR THE DENTAL PROVIDER



## How does nitrous oxide work? How does it compare to Sevoflurane and Halothane?

- ◆ Nitrous oxide has multiple mechanisms of action. The analgesic effect appears to be initiated by neuronal release of endogenous opioids (e.g., enkephalins) with subsequent activation of opioid receptors, descending gamma-aminobutyric acid type A (GABAA) receptors, and noradrenergic pathways that modulate nociceptive processing at the spinal level. The anxiolytic effect involves activation of the GABAA receptor either directly or indirectly through the benzodiazepine binding site. Antagonism of the N-methyl-D-aspartate (NMDA) receptors also aids in the anesthetic, analgesic, and amnestic properties of nitrous oxide.
- ◆ Nitrous oxide is the weakest of all inhalation agents with its low tissue solubility and minimum alveolar concentration (MAC) value of 105.7

### COMPARISON CHART: NITROUS OXIDE VS. SEVOFLURANE VS. HALOTHANE

Property	Nitrous Oxide (N <sub>2</sub> O)	Sevoflurane	Halothane
<b>Strength (Potency)</b>	Weak anesthetic – used for minimal/moderate sedation only.	Strong anesthetic – produces full general anesthesia rapidly.	Strong anesthetic – very potent but slower induction/recovery than Sevoflurane.
<b>Primary Effects</b>	Anxiolysis, mild analgesia, light sedation; maintains reflexes and spontaneous breathing.	Loss of consciousness, deep anesthesia, muscle relaxation; smooth induction.	Deep anesthesia; may cause bradycardia, hypotension, arrhythmias.
<b>Typical Concentration Used (inspired gas)</b>	30–70% N <sub>2</sub> O (balance O <sub>2</sub> ). >70% may cause hypoxia.	2–8% induction; 1–3% maintenance.	2–4% induction; 0.5–1% maintenance.
<b>Onset/Recovery</b>	Very rapid onset & recovery (minutes).	Rapid onset & recovery, slightly slower than N <sub>2</sub> O.	Slow onset & recovery.
<b>Odor &amp; Tolerance</b>	Sweet, pleasant odor; well tolerated by children.	Pleasant, non-pungent; excellent for pediatric mask induction.	Distinct sweet odor; may cause mild airway irritation.
<b>Use in Pediatrics</b>	For minimal sedation and anxiety control in dental settings.	For mask induction and maintenance of general anesthesia.	Largely replaced by Sevoflurane due to slower recovery and side effects.

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## What is nitrous oxide's record of safety?

- ◆ Nitrous oxide has an excellent safety record. The most common adverse effects (occurring in 0.5-1.2 percent of patients) are nausea and vomiting. Higher incidence is noted with longer administration of nitrous oxide, fluctuations in nitrous oxide levels, lack of titration, increased concentrations of nitrous oxide, and a heavy meal prior to administration of nitrous oxide. The most commonly used concentrations are 30–50% N<sub>2</sub>O in oxygen; up to 70% N<sub>2</sub>O is safe for short procedures (<15 minutes).
- ◆ Common side effects include: oversedation, sweating, dysphoria, restlessness, panics, headache, dizziness, hallucination, diffusion hypoxia, and expansion of gas-filled spaces. Diffusion hypoxia can occur because of rapid release of nitrous oxide from the blood stream into the alveoli, thereby diluting the concentration of oxygen. This may lead to headache, disorientation, nausea, and lethargy and can be avoided by administering 100 percent oxygen for at least five minutes once the nitrous oxide flow is terminated.
- ◆ Negative outcomes associated with use of nitrous oxide are in excess of 50 percent, in longer (greater than 45 minutes) administration time, and as an anesthetic during major surgery. Use of 70 percent nitrous oxide, increase risk of laryngospasm and, although rare, silent regurgitation and aspiration. Pharyngeal-laryngeal reflexes can be maintained by not allowing the patient to go into an unconscious state.

## Does it affect IQ or the nervous system?

- ◆ Workplace exposure to volatile anesthetics including nitrous oxide reported evidence is both scarce and inconsistent regarding adverse effects. The mechanism for toxicity is thought to be the inhibition of vitamin B12 and, subsequently, myelin and DNA synthesis; the thresholds for exposure duration, concentration, and frequency to produce such harms have not been determined.

## Is it harmful for the environment?

- ◆ Nitrous oxide has been associated with environmental concerns because of its contribution to the greenhouse effect.
- ◆ Nitrous oxide is naturally emitted by bacteria in soils and oceans; humans produce it through the burning of fossil fuels and forests and the agricultural practices of soil cultivation and nitrogen fertilization. The medical use of nitrous oxide is estimated to represent **less than 1%** of global nitrous oxide pollution, most of which comes from use of nitrogenous fertilizers in agriculture along with aviation, industry, and automotive use.

## Best practices to ensure office staff are safe from occupational exposure?

- ◆ The AAPD encourages dentists and dental auxiliaries to maintain the lowest practical levels of N<sub>2</sub>O in the dental environment. The AAPD also encourages practitioners to weigh the risks and benefits of using N<sub>2</sub>O when treating pediatric patients. Adherence to the following safety practices can help minimize occupational exposure to N<sub>2</sub>O.
    - ◇ Use scavenging systems that remove N<sub>2</sub>O during patient's exhalation.
    - ◇ Ensure that exhaust systems adequately vent scavenged air and gases to the outside of the building and away from fresh air intake vents.
    - ◇ Use, where possible, clean outdoor air for dental operatory ventilation.
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- ◇ Monitor ambient N<sub>2</sub>O levels in dental operatories in accordance with local and state regulations.
  - ◇ Implement a plan for careful, regular inspection and maintenance of the nitrous oxide/oxygen delivery equipment according to manufacturer's recommendations.
  - ◇ Carefully consider patient selection criteria (e.g., tolerance of nasal hood, ability to breathe from the nose, cooperative potential, recent illnesses, indications, contraindications) prior to administering N<sub>2</sub>O.
  - ◇ Select a properly-fitted double-chambered mask size for each patient.
  - ◇ During administration, visually monitor the patient and titrate the flow/percentage to the minimal effective dose of N<sub>2</sub>O.
  - ◇ Encourage patients to minimize talking, moving, and mouth breathing during N<sub>2</sub>O administration.
  - ◇ Use high volume dental suction when possible, during N<sub>2</sub>O administration.
  - ◇ Use a rubber dam or isolation devices with suction during operative treatment.
  - ◇ Administer 100 percent oxygen to the patient for at least five minutes after terminating N<sub>2</sub>O flow to replace the N<sub>2</sub>O in the gas delivery system.
  - ◇ Educate dental personnel on minimizing occupational exposure to and potential abuse of nitrous oxide.

*NOTE: The previous recommendations are formed in collaboration between the American Dental Association (ADA), American Academy of Pediatric Dentistry (AAPD), and Council on Dental Practice (CDP)*

### TAKE AWAYS FOR CLINICAL PRACTICE

- ✓ N<sub>2</sub>O is a first-line, safe, and effective option for pediatric dental sedation.
- ✓ Adherence to proper administration protocols and patient selection is essential to minimize risk.
- ✓ Most adverse events are mild and self-limited; serious complications are rare.
- ✓ N<sub>2</sub>O can reduce the need for general anesthesia in pediatric dental patients.
- ✓ There are no known links between nitrous oxide and death

For additional information on Nitrous Oxide safety and use, please reference the AAPD Safety Toolkit: <https://www.aapd.org/resources/member/safety-toolkit/nitrous-oxide-safety/>

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