

Best Practice Guidelines for Nitrous Oxide/Oxygen Use in Pediatric Dentistry

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Abstract— This best practice guideline is designed to equip dental professionals with detailed recommendations for the safe and effective use of nitrous oxide/oxygen (N₂O/O₂) analgesia and anxiolysis in children. Key recommendations address the goals, general considerations, indications, and contraindications associated with this inhalation sedation technique. Before administering N₂O/O₂, dental professionals must assess various factors, including the child's physical and emotional development, medical and dental histories, and the specific procedures planned, as well as any alternative behavior management techniques available. the qualifications and training of the dental team; the adequacy of equipment and facilities; administration methods and monitoring protocols; potential adverse effects; and occupational safety concerns. Additionally, proper documentation of N₂O/O₂ usage is emphasized. When used judiciously, N₂O/O₂ can be an effective tool for managing anxiety related to dental care in children, adolescents, and individuals with special health care needs. This document has been developed collaboratively by the American Academy of Pediatric Dentistry Councils on Clinical Affairs and Scientific Affairs, aiming to provide updated information and recommendations to ensure the development of safe practices in pediatric dental sedation.

Keywords: Purpose and Scope, Assessment Prior to Administration, Mechanism of Action, Indications, Contraindications, General Considerations, Potential Risks.

I. PURPOSE

The American Academy of Pediatric Dentistry (AAPD) acknowledges the use of nitrous oxide/oxygen (N₂O/O₂) inhalation as a reliable and effective method for alleviating anxiety, providing analgesia, and improving communication between patients and healthcare providers. Through this best practice document, the AAPD aims to support the dental community in establishing safe and effective protocols for utilizing N₂O/O₂ analgesia and anxiolysis in pediatric dentistry.

II. METHODS

These guidelines were formulated by the Council on Clinical Affairs, initially adopted in 2005, and most recently updated in 2018. The revision involved a thorough review of existing dental and medical literature regarding nitrous oxide for analgesia and anxiolysis. A comprehensive search was performed using the PubMed®/MEDLINE database with the following criteria: nitrous oxide [MESH] OR nitrous oxide reductase [Supplementary Concept] AND dental [MeSH], focusing on publications from January 1, 2012, involving human subjects aged birth to 18 years. This search yielded 288 relevant articles. Selected papers for review were chosen from this dataset and additional references within those articles. In cases where the available data was insufficient or inconclusive, recommendations were formulated based on the expert consensus of seasoned researchers and clinicians.

III. BACKGROUND

Nitrous oxide and oxygen inhalation, known as N₂O/O₂ sedation, is a reliable and safe method for managing anxiety and pain in dental settings. Many parents favor this technique over more invasive methods like restraints or general anesthesia. When administered at concentrations below 50% nitrous oxide—either alone or with local anesthesia—this approach effectively diminishes pain and anxiety while keeping the patient conscious and responsive.

Patients retain their ability to follow verbal instructions and maintain their protective reflexes, and their mobility is quickly restored once the inhalation ceases. For children, N₂O/O₂ sedation can streamline the completion of procedures that may not be painful but require the child to remain still. Additionally, it can help children better tolerate discomfort by alleviating anxiety and pain. Studies have shown that this method improves reaction times and minimizes discomfort from pressure, though it does not impact pulpal sensitivity.

IV. MECHANISM OF ACTION

Nitrous oxide, a colorless and nearly odorless gas with a subtle sweet scent, serves as an effective analgesic and anxiolytic agent. It induces central nervous system (CNS) depression and feelings of euphoria while exerting minimal impact on respiratory function. The analgesic properties of nitrous oxide are thought to stem from the release of endogenous opioids, such as enkephalins, which activate opioid receptors and influence descending pathways involving gamma-aminobutyric acid type A (GABAA) receptors and noradrenergic systems that regulate pain processing in the spinal cord. Its anxiolytic effects result from direct or indirect activation of GABAA receptors through the benzodiazepine binding site.

Additionally, the antagonism of N-methyl-D-aspartate (NMDA) receptors contributes to the anesthetic, analgesic, and memory-impairing qualities of nitrous oxide. Despite being the least potent inhalational agent, characterized by low tissue solubility and a minimum alveolar concentration (MAC) value of 105, nitrous oxide is noted for its rapid onset and recovery time of approximately two to three minutes. It exists as free gas in the bloodstream, does not bind with hemoglobin, and is not metabolized by the body. Elimination occurs swiftly through the lungs, with minimal effects on renal and hepatic functions. Nitrous oxide has a negligible impact on reflexes, preserving the cough reflex, and results in slight cardiac output depression while slightly increasing peripheral resistance, thus helping to maintain blood pressure. This property is particularly beneficial for patients with cardiovascular issues.

V. GOALS

In a dental environment, N₂O/O₂ inhalation aims to achieve several key objectives:

- To alleviate or completely remove fear and anxiety.
- To improve communication between the patient and the dental team

To foster a positive perspective toward dental treatments.

- To increase the threshold for pain reactions.
- To minimize unexpected movements during procedures.
- To assist in managing an overactive gag reflex that may disrupt dental care. Candidates for N₂O/O₂ (analgesia, anxiolysis)

When deciding to use N₂O/O₂ for analgesia and anxiolysis, several factors must be taken into account. These include alternative behavioral management techniques, the specific dental requirements of the patient, the potential impact on the overall quality of dental care, as well as considerations related to the patient's emotional maturity, existing medical conditions, and physical factors. A thorough evaluation of the patient's medical history is essential before administering nitrous oxide. Generally, patients classified as American Society of Anesthesiologists (ASA) Physical Status I and II are deemed suitable for N₂O/O₂ treatment. For children categorized as ASA Class III, as well as those with special healthcare needs or anatomical airway issues, additional and tailored considerations are necessary.

VI. GENERAL CONSIDERATIONS

Nitrous oxide (N₂O), when combined with oxygen (O₂), is generally well-tolerated by children and can be easily adjusted for dosage. Many children express excitement about receiving N₂O/O₂, often describing sensations such as tingling, warmth, lightheadedness, or a floating feeling. Effective administration is indicated by relaxed limbs and jaw, drooping eyelids, a blank stare, open hands, and a decreased heart rate. However, some children may feel anxious about losing control, and those with claustrophobia might find the nasal mask uncomfortable.

The safety profile of N₂O/O₂ for analgesia and anxiolysis is strong, with acute and chronic adverse reactions being uncommon. The most frequently reported side effects, which occur in 0.5-1.2% of users, include nausea and vomiting. These effects tend to increase with prolonged exposure, fluctuations in nitrous oxide levels, inadequate titration, higher concentrations, and heavy meals before treatment. While fasting isn't necessary prior to N₂O/O₂ administration, a light meal is often recommended.

Other potential side effects can include oversedation, sweating, feelings of unease, restlessness, panic, headaches, dizziness, hallucinations, diffusion hypoxia, and gas expansion in filled spaces. Diffusion hypoxia may arise due to the rapid release of

nitrous oxide from the bloodstream into the lungs, which can dilute oxygen levels and result in symptoms such as headaches, confusion, nausea, and fatigue. This can be mitigated by administering 100% oxygen for at least five minutes after stopping nitrous oxide flow.

Research indicates risks associated with using nitrous oxide above 50% concentration, particularly with longer administration times (over 45 minutes) and its use as an anesthetic for major surgeries. A concentration of 70% nitrous oxide can pose risks like laryngospasm, and, though rare, silent regurgitation and aspiration. Maintaining pharyngeal-laryngeal reflexes is crucial, and this can be achieved by ensuring the patient does not reach unconsciousness.

Additional drawbacks to using N₂O/O₂ include its relatively low potency, possible interference from the nasal mask with treatments involving the upper jaw, costs and upkeep of the equipment, potential health risks for personnel, and environmental concerns.

Indications for Nitrous Oxide/Oxygen Analgesia/Anxiolysis Nitrous oxide/oxygen (N₂O/O₂) is indicated for:

- Patients experiencing fear or anxiety.
- Individuals with muscle tone disorders that may lead to involuntary movements.
- Patients with a strong or hypersensitive gag reflex that complicates dental procedures.
- Those for whom effective local anesthesia or pain relief is unattainable.
- Cooperative children undergoing lengthy dental treatments who may benefit from reduced fatigue.

VII. CONTRAINDICATIONS FOR NITROUS OXIDE/OXYGEN INHALATION

The use of N₂O/O₂ inhalation may be contraindicated in the following cases:

- Patients with chronic obstructive pulmonary diseases.
- Individuals currently suffering from upper respiratory infections (such as colds, coughs, or tonsillitis), sinusitis, or other conditions (like seasonal allergies) that impede nasal breathing.
- Recent episodes of middle ear issues or infections (for instance, acute otitis media).
- Individuals who have had ear, nose, or throat surgeries within the past 14 days.
- Patients with elevated intraocular pressure (such as glaucoma), particularly within three months following retinal surgery.

VIII. CONCLUSION

Nitrous oxide/oxygen inhalation is a reliable and effective sedation method in pediatric dentistry, providing significant benefits for managing anxiety and pain. Proper assessment and adherence to guidelines can ensure its safe use. Continuous evaluation of patient

conditions and monitoring during administration are critical to optimizing outcomes and minimizing risks associated with nitrous oxide use. This document serves as a comprehensive resource for dental professionals, supporting the establishment of best practices in pediatric sedation.

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