Policy on Minimizing Occupational Health Hazards Associated With Nitrous Oxide

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Purpose
The American Academy of Pediatric Dentistry (**AAPD**) recommends that exposure to ambient nitrous oxide be minimized to reduce occupational health hazards for dental personnel.

Methods
This document is based on current dental, medical, and public health literature regarding the potential risks of ambient nitrous oxide exposure. A MEDLINE search was conducted using the terms "nitrous oxide", "occupational exposure to nitrous oxide", and "nitrous oxide and dentistry". Guidelines and recommendations from the National Institute for Occupational Safety and Health (**NIOSH**) also were reviewed.[1-2] Expert opinions and best current practices were relied upon when sufficient scientific data were not available.

Background
Epidemiologic studies provide strong evidence that there are increased general health problems and reproductive difficulties among dental personnel chronically exposed to significant levels of ambient nitrous oxide.[3-7] Nitrous oxide acts by oxidizing vitamin B_{12} from the active, reduced cobalamin to the inactive form. In turn, this inactivates the enzyme methionine synthetase, which requires both the active cobalamin and folate as cofactors. The inactivation of methionine synthetase decreases DNA production, thereby interfering with cell proliferation.[8]

Nitrous oxide has been linked epidemiologically to reproductive, hematologic, immunologic, neurologic, hepatic, and renal disorders; symptoms are time and dose dependent.[9] Symptoms are reported most frequently in cases where scavenging has not been used or with chronic (recreational) abuse.[9] Absolute occupational effects are still uncertain.[9] Epidemiologic conclusions have been challenged.[10] Adverse reproductive outcomes are linked to B_{12} deficient individuals and those exposed to "high nitrous oxide levels".[9] A maximum safe level of ambient nitrous oxide in the dental environment has not been determined.[9-14]

Reduction of ambient nitrous oxide through system maintenance, scavenging, ventilation, use of the minimal effective dose, and patient management is critical to maintaining the lowest practical levels in the dental environment.[1,2,14,15] Frequent and regular inspection and maintenance of the nitrous oxide delivery system, together with the use of a scavenging system, can reduce ambient nitrous oxide significantly.[16,17] Using a well-fitted mask and an appropriate amount of suction via the scavenging system will minimize leakage, reducing ambient nitrous oxide levels.[17] NIOSH has recommended that the exhaust ventilation of nitrous oxide from the patient's mask be maintained at an air flow rate of 45 L/min and vented outside the building away from fresh air intakes.[2] However, scavenging at this rate has been shown to reduce the level of pyschosedation achieved with nitrous oxide inhalation.[20] Where possible, 100% clean outdoor air should be used for dental operatory ventilation.[1] Supply and exhaust vents should be well separated to allow good mixing and prevent 'short-circuiting'.[1]

Appropriate patient selection is an important consideration in reducing ambient nitrous oxide levels.[15] Patients who are unwilling or unable to tolerate the nasal hood and those with medical conditions (eg, obstructive respiratory diseases, emotional disturbances, drug dependencies) that contraindicate the use of nitrous oxide should be managed by other behavior guidance techniques.[15] In the dental environment, patient be-haviors such as talking, crying, and moving have been shown to result in significant increases in baseline ambient nitrous oxide levels despite the use of the mask-type scavenging systems.[19] Use of supplemental measures, including a rubber dam and/or a high-volume dental aspirator, placed near or within 20 cm of the patient's mouth, has been shown to reduce significantly ambient nitrous oxide levels.[21-23] During the first 3-5 minutes after terminating nitrous oxide administration, a significant amount of the gas is exhaled by the patient.[24] Once nitrous oxide administration is discontinued, the gas delivery system should be flushed by administering 100% oxygen to the patient for at least 5 minutes.[2] This post-procedural oxygenation also decreases the risk of diffusion hypoxia to the patient. Diligent use of the above practices in the pediatric dental environment has allowed for the reduction of ambient nitrous oxide to the levels recommended

by NIOSH.[14,23] Measurement of nitrous oxide levels in the dental operatory can be helpful in determining the type and extent of remediation necessary to decrease occupational exposure.

Policy statement

The AAPD recommends that dentists and dental auxiliaries minimize their exposure to nitrous oxide by maintaining the lowest practical levels in the dental environment. Adherence to the recommendations below can help minimize occupational exposure to nitrous oxide.

1. Use scavenging systems that remove nitrous oxide during patient's exhalation.
2. Ensure that exhaust systems adequately vent scavenged air and gases to the outside of the building and away from fresh air intake vents.
3. Use, where possible, 100% clean outdoor air for dental operatory ventilation.
4. Implement careful, regular inspection and maintenance of the nitrous oxide/oxygen delivery equipment.
5. Carefully consider patient selection criteria (ie, indications and contraindications) prior to administering nitrous oxide.
6. Select a properly-fitted mask size for each patient.
7. During administration, visually monitor the patient and titrate the flow/percentage to the minimal effective dose of nitrous oxide.
8. Encourage patients to minimize talking and mouth breathing during nitrous oxide administration.
9. Use rubber dam and high volume oral aspiration when possible.
10. Flush the delivery system of nitrous oxide after completion, by administering 100% oxygen to the patient for at least 5 minutes.

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