

Monitoring nitrous oxide levels

Where inhalation sedation is used, it is recommended that nitrous oxide levels are monitored periodically, depending on the extent of usage, to ensure exposure complies with the HSE recommendation of no more than 100ppm. Sampling should be carried out in two locations: the breathing zone of the healthcare professionals managing the patient and in the area outside the breathing zone (room air).

Monitoring exposure levels can be carried out in two ways:

- Using a diffusion pen (Figure 7) will allow monitoring in the breathing zone. The pen is attached, for example, to the lapel of a clinician's uniform and worn for the length of the sedation session. It is then sent to a laboratory for analysis
- Use of a gas analyser (Figure 8), which records background and breathing zone levels of nitrous oxide in clinical settings. An example of such a device is the G200 by Geotech UK.

Summary

Chronic exposure to nitrous oxide poses a potential but minimal health risk to dental personnel involved in the administration of inhalation sedation to patients for the control of anxiety.

A maximum safe limit in the UK of 100ppm, as recommended by the HSE, is achievable provided appropriate measures are taken during its use.

All members of the dental team have a responsibility to ensure a safe working environment is maintained.

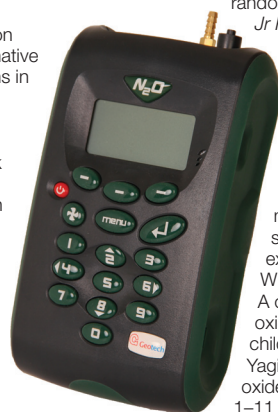
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Figure 8. The G200 gas analyser is used to record background levels of nitrous oxide



Figure 7. A diffusion pen, worn by a practitioner, can be used to monitor air in the breathing zone

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Learning outcomes

After reading this 'Guide to Inhalation Sedation Safety', you should be able to:

- Describe the biochemical effects of nitrous oxide
- List sources of nitrous oxide pollution in the dental surgery
- Describes ways to minimise excessive nitrous oxide levels in the dental surgery

GUIDE TO...



This guide is supported by an educational grant from RA Medical Services Ltd Inhalation Sedation Specialists

GUIDE TO... inhalation sedation safety

Inhalation sedation is safe, but dental care staff should avoid long-term exposure to nitrous oxide and know how to minimise its levels in the surgery

The use of conscious sedation in dentistry is well established within both primary and secondary care in the UK. It reassures and increases comfort for many patients during dental procedures.

Inhalation sedation with nitrous oxide and oxygen is a safe, effective technique for managing pain and anxiety in dentistry (Howard, 1997). It has a very good success rate and many benefits for patients (Blain and Hill, 1998; Shepherd and Hill, 2000; Wilson et al, 2002; 2003; 2006; Soldani et al, 2010).

The use of nitrous oxide in the clinical environment is subject to the Control of Substances Hazardous to Health (COSHH) Regulations 2002 (Health and Safety Executive, 2002). It is essential to control the exposure to this gas of all staff involved in its use to minimise the effects of chronic exposure.

This guide provides an overview of the potential effects of chronic exposure to nitrous oxide, possible sources of nitrous oxide pollution in the dental surgery and ways in which exposure to nitrous oxide can be reduced.

Biochemical effects of nitrous oxide

Nitrous oxide inactivates methionine synthetase, an enzyme required for the metabolism of vitamin B12 and for DNA production (Figure 1). As a result, interference with cellular proliferation may occur, particularly following chronic exposure to the gas.

The main health effects reported have been associated with reproductive, neurological and haematological disorders, and concerns have been raised regarding the exposure of healthcare personnel to nitrous oxide in the clinical workplace (Rowland et al 1992; Donaldson and Meechan, 1995).

Symptoms arising from chronic exposure

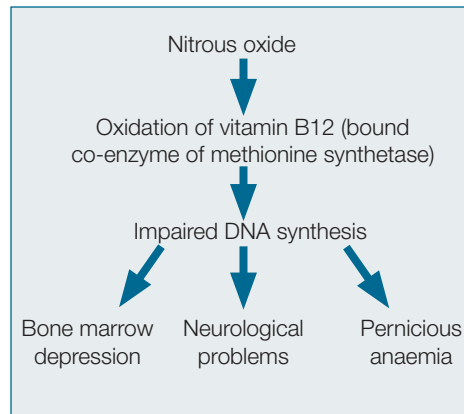


Figure 1. Mechanism of the effect of nitrous oxide

to nitrous oxide depend on several factors (Yagiela, 1991):

- Degree and pattern of exposure
- Extent to which methionine synthetase is inactivated and the time course of enzymatic recovery
- Body store and dietary intake of vitamin B12
- Tissue sensitivity.

There is no sound evidence to confirm or exclude a causal connection between reported cases of reduced fertility and exposure to nitrous oxide; however, the substance may affect bone marrow and the peripheral nervous system (British Oxygen Company, 2011).

As nitrous oxide has the potential to cause cellular changes within the body at high levels, the Health and Safety Executive in the UK has set an exposure limit of 100ppm over an eight-hour, time-weighted average (HSE, 2011). It is imperative that those involved in the use of nitrous oxide in clinical settings ensure trace levels of the gas are kept to a minimum at all times.

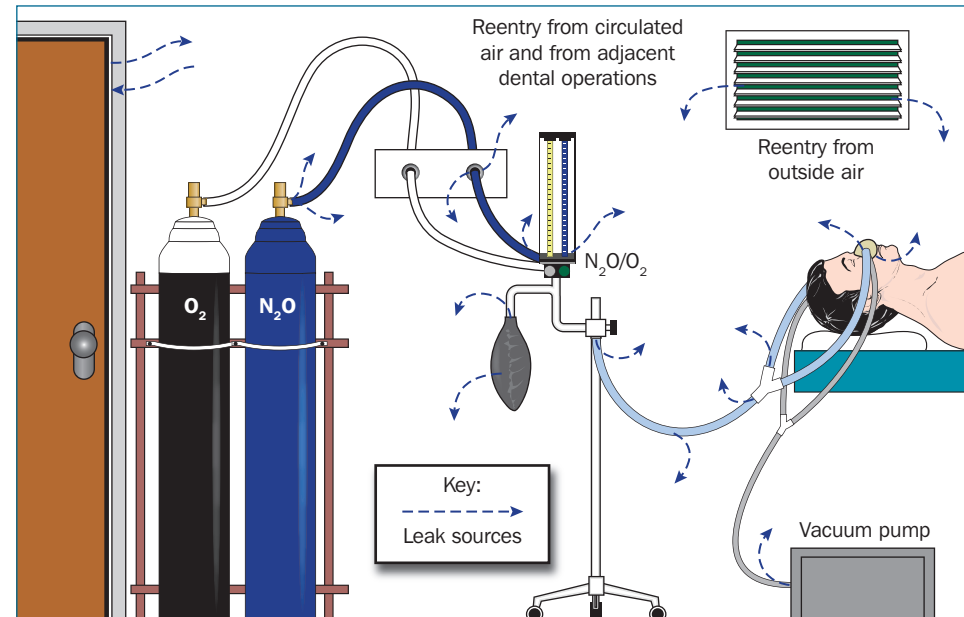


Figure 2. Sources of leaks from anaesthetic delivery systems (Adapted from Centers for Disease Control and Prevention, 2014)

Sources of nitrous oxide in the dental surgery

There are many sources by which nitrous oxide can enter the dental surgery environment (Figure 2):

- Inadequate scavenging
- Lack of ventilation in the surgery
- Leakage from the equipment
- Leakage from a poorly-fitting mask
- Exhaled gas from patients during talking or mouth breathing.

Reducing levels of nitrous oxide in the dental surgery

To minimise healthcare workers' exposure to nitrous oxide, the following recommendations should be adhered to.

1. Regular maintenance of equipment

The Department of Health guidance document *Conscious Sedation in the Provision of Dental Care* (DH, 2003) states that all inhalation sedation machines

must 'conform to British standards and be maintained according to manufacturer's guidance with regular documented servicing'. It is therefore imperative that servicing by a qualified, OEM-trained service engineer is carried out to ensure the equipment is functioning correctly and has no leaks.

Maintenance by clinical personnel on a daily or sessional basis is essential. This involves checks on the operation of the machine and inspection of the rubber tubing, reservoir bag and nose pieces to ensure there are no rips or tears. Any perished components should be replaced immediately.

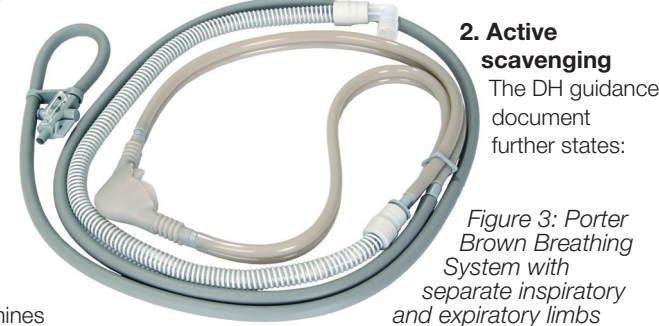


Figure 4. Patients must be able to tolerate inhalation sedation equipment and breathe comfortably through the nose

'Scavenging of waste gases must be active and sufficient to fully conform to current COSHH standards. Breathing systems should have a separate inspiratory and expiratory limb to allow proper scavenging' (Figure 3).

The use of a scavenging unit will assist in reducing the escape of waste nitrous oxide into the working zone of the dental staff. The system should be vented outside the building and away from windows.

3. Room ventilation

Keeping the dental surgery well ventilated will help to reduce ambient levels of nitrous oxide. Where possible, fresh air inlets should be located in the ceiling. This is not always possible in a general dental surgery so it is important to keep windows open where possible. Exhaust vents should be placed at floor level where possible.

4. Patient selection

It is important to ensure patients are assessed for their suitability to undergo treatment with inhalation sedation. They must be able to sit in the dental chair and cooperate to have the nose piece placed and secured (Figure 4).

Practitioners should ensure patients are able to breathe comfortably through their nose to ensure mouth breathing is kept to a minimum.



Figure 5. There should be a tight seal around the nasal hood to prevent gas from escaping

5. Nasal hood fitting

The correct size of nasal hood should be chosen for each individual patient, and there should be a tight seal to prevent leaks into the staff working area (Figure 5).

6. Patient cooperation

Throughout administration of inhalation sedation, the patient should be instructed to breathe through the nose; minimal talking should be encouraged during induction. If patient cooperation is poor, this will generally result in mouth breathing and it is important to stop the procedure if this is an issue.

7. During the dental procedure

During the procedure, the patient and the reservoir bag should be monitored visually to ensure the minimal effective dose and flow rate are used.

8. On completion of treatment

At the end of the procedure, the patient should be administered 100% oxygen for at least three minutes to assist in recovery and to flush the system of nitrous oxide (Figure 6).

Figure 6. 100% oxygen is administered at end of treatment

