

## Clinical procedure

Having checked that the inhalational sedation machine is working and that extra gas cylinders are available (or that piped gases are flowing), and that the breathing system is assembled correctly and is intact, the patient is laid supine in the chair and the procedure explained.

MDM inhalation sedation machine pre-use check sequence:

- Turn all cylinders off
- Turn on 'in use' oxygen cylinder
- Set mixture control to 100% oxygen and adjust flow control to 6L/min
- Check nitrous oxide flowmeter is still reading 'zero'
- Turn on 'in use' nitrous oxide cylinder
- Change mixture to 50% oxygen
- Check oxygen and nitrous oxide flowmeters both show flow of 3L/min
- Cover common gas outlet with palm of hand and press oxygen flush
- Ensure reservoir bag inflates and that there are no leaks (neck and seams)
- Turn off 'in use' oxygen cylinder
- Check nitrous oxide flowmeter falls to zero (takes a little time)
- Turn 'in use' oxygen cylinder back on
- Set mixture control to 100% and turn flow control to 'off'
- Machine is ready for use.

The machine is then adjusted to administer 100% oxygen at a flow rate of 6L/min and the correct size nasal mask selected. Patients often prefer to place the mask over their own nose, rather than having someone else do it. It is important to maintain a steady flow of conversation and encouragement. The oxygen flow rate (minute volume) may be checked by observing the movement of the reservoir bag. If there is under- or over-inflation, the gas flow must be increased or decreased respectively (*Figure 5*).

Ten percent nitrous oxide is then added (90% oxygen) and the patient informed that he/she may feel:

- Light-headed
- Changes in visual/auditory sensation
- Tingling of hands and feet
- Spreading warmth
- Remote from the immediate environment.

This concentration is maintained for one full minute, during which plentiful verbal



*Figure 5. Nasal mask in place*

reassurance is given. The concentration of nitrous oxide is increased by 10% for a further full minute (to a total of 20% N<sub>2</sub>O) and then in increments of 5% until the patient appears and feels sufficiently relaxed.

Nitrous oxide concentrations of between 20% and 50% commonly allow for a state of detached sedation and analgesia without any loss of consciousness or danger or obtunded laryngeal reflexes. At these levels, patients are aware of operative procedures and are co-operative without being fearful. If, after a period of relaxation, the patient becomes restless or apprehensive, it is probable that the concentration of nitrous oxide is too high.

Having carried out the dental procedure, the nitrous oxide is turned off and 100% oxygen administered for two minutes (to prevent diffusion hypoxia). Recovery is usually complete within 15–30 minutes.

Inhalational sedation should be considered as part of the management of pain and anxiety and should be available for anxious dental patients to make dental treatment more pleasant and help them achieve oral health. It is a safe effective technique and with practice is not time consuming.

Craig D, Skelly M (2004) *Practical Conscious Sedation*. Quintessence Publishing, London  
Health and Safety Executive (1998) *Occupational Exposure Limits*. HMSO, London  
NHS Information Centre (2011) Adult Dental Health Survey 2009. The Health and Social Care Information Centre  
Roberts GJ (1990a) Inhalation Sedation (Relative Analgesia) with Oxygen/Nitrous Oxide Gas Mixtures. 1. Principles. *Dental Update* **17**: 139–46  
Roberts GJ (1990b) Inhalation Sedation (Relative Analgesia) with Oxygen/Nitrous Oxide Gas Mixtures. 2. Practical Techniques. *Dental Update* **17**: 190–6

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## Learning outcomes

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

- Be aware of the indications for treatment under inhalational sedation
- Be aware of the equipment required for the provision of inhalational sedation
- Understand the clinical procedure for administering inhalational sedation
- Understand that inhalational sedation is a safe and effective way of managing anxious patients



## Inhalation Sedation

# GUIDE TO... Inhalation sedation

This guide describes the use of inhalation sedation and reviews the guidelines, training and techniques relating to administering this type of sedation

Many patients find dental treatment stressful. Reactions range from 'normal' fear, through various degrees of anxiety to phobia. Dental anxiety involves feelings of dread and apprehension and is a vague feeling that something unpleasant is going to happen. Phobia is more extreme and relates to a specific fear that is excessive or unreasonable.

The Adult Dental Health Survey 2009 found that 36% of adults had moderate dental anxiety and 12% had extreme dental anxiety. The two items most feared are having a tooth drilled and receiving local anaesthesia (NHS Information Centre, 2011).

Inhalational sedation with nitrous oxide/oxygen is a safe technique and combined with effective local anaesthesia will allow patients to accept dental care. The technique is particularly suitable for children, slightly or moderately anxious adults and gagging patients. Non-anxious patients may also benefit from sedation if the proposed dental procedure is potentially unpleasant and/or prolonged (Roberts, 1990a; 1990b).

This guide provides an introduction to inhalational sedation (IS) using nitrous oxide and oxygen. However, before administering any form of conscious sedation the dental team must have received appropriate training in accordance with contemporary professional guidance.

## Patient assessment and treatment planning

A satisfactory first visit is crucial to the success of subsequent treatment under conscious sedation. There is a great deal of information to be acquired from the patient. At the same time, it should never be forgotten, that the patient is also assessing the dental team. The first meeting should ideally be outside the surgery environment and in the nature of an informal 'chat'.

Conditions that may contraindicate inhalational sedation include nasal obstruction, poor cooperation and fear of masks. IS should not be used during the first three months of pregnancy (Craig and Skelly, 2004).

## Pharmacology of nitrous oxide

Nitrous oxide is a colourless and virtually odourless anaesthetic gas. The gas has a low blood/gas solubility and a high minimum alveolar concentration (MAC). The former determines the rate at which the gas concentration in the lungs equilibrates with that being administered which, in turn, relates to the speed of induction and of recovery. Nitrous oxide is poorly soluble in blood and so induction and recovery are rapid. MAC is related to the potency of the gas and determines the concentration needed to induce sedation. Nitrous oxide is not very potent, which means that it is a very safe gas for dental sedation. It is compressed at 800 lb per square inch (43.5 bar) to a liquid and supplied in cylinders which are coloured blue.

Nitrous oxide has very few cardiovascular or respiratory effects (*Table 1*). It is rapidly excreted via the lungs after discontinuing its administration. It has excellent anxiolytic, sedative and analgesic properties and a wide margin of safety (Craig and Skelly, 2004).

The variation between individual patients is such that, while one person may be adequately sedated with 20% nitrous oxide, another individual may require 50% or more. A titration technique of administration is employed in order to avoid the risk of under- and over-sedation.

Because of the relatively poor solubility of nitrous oxide in blood and body tissues, there is rapid outflow of nitrous oxide across the alveolar membrane, when the gas is turned off. This may dilute the percentage of alveolar oxygen available

for uptake by up to 50%. This phenomenon is called diffusion hypoxia and is prevented by giving 100% oxygen for at least two minutes at the end of the procedure.

Advantages of inhalational sedation include

- No ‘needles’
- Level of sedation easily altered
- Minimal impairment of reflexes
- Rapid induction and recovery
- Some analgesia
- An escort is not mandatory for fit adult patients.

Disadvantages of inhalational sedation include:

- Sedation depends also on good psychological support
- Mask may make oral access difficult
- Postoperative amnesia variable
- Nitrous oxide pollution.

**Nitrous oxide pollution and waste gas scavenging**

Long-term exposure to nitrous oxide may result in an increased incidence of liver, kidney and neurological disease. For this reason, the Health and Safety Executive specifies a maximum level of 100ppm nitrous oxide time-weighted over eight hours (Craig and Skelly, 2004; NHS Information Centre, 2011). To achieve this level and so keep nitrous oxide pollution to a minimum, scavenging must be employed (Health and Safety Executive, 1998).

**Equipment**

Modern inhalation sedation machines are specially designed machines to safely deliver nitrous oxide and oxygen sedation (*Figure 1*).

Nitrous oxide is supplied in a blue cylinder containing both a gas and a liquid phase. Oxygen comes as compressed gas in a black cylinder with a white collar. Most portable inhalational sedation machines are designed to operate with two nitrous oxide and two oxygen cylinders. One cylinder of each gas is ‘IN USE’, while the other is held in reserve and designated ‘FULL’. Only the ‘IN USE’ cylinders should be turned on. A Pin Index System ensures that the nitrous oxide and oxygen gas cylinders cannot be accidentally interchanged (*Figure 2*).

Nitrous oxide and oxygen pressure gauges give an indication of the contents of each

cylinder. However, while the oxygen gauge falls in a linear manner, the nitrous oxide

Table 1. Properties of nitrous oxide	
Induction characteristics	Smooth
Anxiolysis	Yes
Cardiorespiratory stability	Stable
Ease of titration	Easy
Induction and recovery rate	Rapid
Metabolism	< 1%
Ease of breathing	Non-pungent
Potency (MAC)	Weak (105%)
Blood gas solubility	Low—(0.47)
Speed of change in sedation level	Rapid
Systematic toxicity	Yes—but only with prolonged use
Environmental effects	Yes
Analgesia	Yes—mild



Figure 1. IS machine with cylinders





Figure 2. Nitrous oxide pin index system

gauge starts to fall only when the liquid phase is exhausted and pressure in the gas phase is reducing.

The popular MDM RA machine 'head' has flowmeters for nitrous oxide and oxygen, a control valve for regulating the total gas flow and a mixture dial for adjusting the percentage of oxygen and nitrous oxide (Figure 3).

All modern inhalational sedation machines are incapable of delivering a gas mixture containing less than 30% oxygen and also have a failsafe mechanism which shuts off the nitrous oxide if oxygen ceases to flow.

The mixed gases emerge at the common gas outlet to which the breathing system is connected. The reservoir bag is useful for adjusting the total gas flow to an individual patient's minute volume and also for monitoring respiration during treatment.

Scavenging of waste gases should be 'Active', the accepted definition of which is 'an air flow rate of 45 L/min at the nasal mask'. Modern scavenger systems vary slightly in tubing and mask arrangements but all require connection to a exhaust (Figure 4). This enables the optimum flow rate, proven to be most effective in reducing ambient surgery pollution and compliance with the 100ppm time-weighted average.

Fit of the nasal mask is also vital. Double masks offer a better anatomical profile than the single mask, but both types are widely used and available in autoclavable or disposable options.

Infection control and care of the breathing system is a vital component in the use of inhalation sedation. The system and connections should be included in a equipment pre-use checklist.



Figure 3. MDM machine 'head'

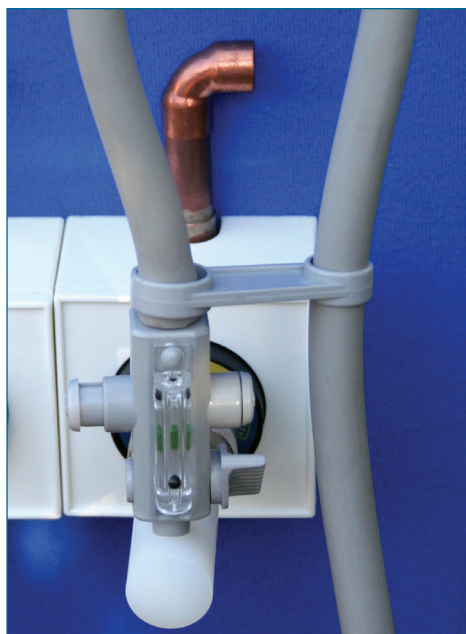


Figure 4. Scavenging