

Inhalation Sedation (Laughing Gas)

Inhalation sedation, laughing gas, relative analgesia, RA, happy gas, gas, nitrous, nitrous oxide, N₂O-O₂... this one has more names than any other sedation technique! And deservedly so. Inhalation sedation with nitrous oxide (N₂O) and oxygen (O₂) has been described as "representing the most nearly 'ideal' clinical sedative circumstance"...



What is it? And what does it do?

Nitrous oxide (N₂O) is simply a gas which you can breathe in. It has no color, smell, and doesn't irritate. It was discovered in 1772. Humphrey Davy (1778-1829), one of the pioneers of N₂O experimentation, described the effects of N₂O on himself following self-administration for a toothache and gum infection as follows:

"On the day when the inflammation was the most troublesome, I breathed three large doses of nitrous oxide. The pain always diminished after the first four or five inspirations; the thrilling came on as usual, and uneasiness was for a few minutes swallowed up in pleasure."

Sounds like fun!! The extract above pretty much summarizes the effects of nitrous oxide: it kills pain – and it induces a pleasurable feeling. After 5 minutes or so of breathing in the gas, you should feel a euphoric feeling spread throughout your body. It really kind of feels like a 'happy drunk' feeling. Some people find that there are auditory or visual effects as well. You will feel a bit light headed and often people get 'the giggles' (hence the name laughing gas!). As an interesting aside, nitrous oxide was one of the drugs of choice for young people in the late 1700s and early 1800s, when laughing gas demonstrations were a popular source of entertainment and enjoyment.

First-hand accounts of Relative Analgesia

"I started feeling warm all over. The elevator-type music they had on was starting to all sound the same and I could have sworn that they were looping the same song over and over and over. I remember somewhat the dentist coming in and telling me that this is going to be a "Three Martini Cleaning" and asked me if I preferred Strawberry Daiquiri or Pina Colada. The taste of Pina Colada filled my gums and then I saw the needle with the local anesthesia for a second, but he must have decided not to use it because I seriously didn't feel anything. I was already under a nice level buzz from the N₂O and I could feel myself relaxing into the chair — the drugs were finally kicking in. The Pina Colada taste in my mouth made me start thinking of previous Caribbean vacations..."

"I'm still smelling cherry flavor 🍒 . You start with O₂ of course and a few minutes later he asked how i was doing and basically nothing happened so he had to increase it a couple of times and finally I started to relax a bit. No real loopiness but just a sense of yeah I can get thru this. The biggest sensation was my legs felt kinda heavy as if to say maybe I want to stay here a while. Thinking like that I knew the gas was definitely working!! I WANTED TO STAY AT THE DENTIST!!!! Can you believe this."

How does nitrous oxide work?

Today, we know that nitrous oxide (N₂O) on its own can only safely be used for short periods of time (because the lack of oxygen in pure N₂O can lead to unconsciousness and even death) – but that it's safe to use for longer periods of time if you mix it with oxygen (O₂). Hence, the "laughing gas" used now is called N₂O-O₂, and contains at least 30% oxygen (that's all the machines used nowadays will permit). Usually, the mix is about 70% oxygen to 30% nitrous oxide.

In medicine, sometimes a mix of 50% oxygen to 50% nitrous oxide is used. This is known as *entnox* or, more commonly, "gas and air".

Depending on the concentration and length of administration of laughing gas, four levels of sedation can be experienced (after an initial feeling of light-headedness):

1. a tingling sensation, especially in the arms and legs, or a feeling of vibration ("parasthesia"), quickly followed by
2. warm sensations, and
3. a feeling of well-being, euphoria and/or floating. During heavier sedation, hearing may dissolve



into a constant, electronic-like throbbing.

- At a deeper level of sedation again, sleepiness, difficulty to keep one's eyes open or speak ("dream") can occur. Should nausea set in, it means you're definitely oversedated!

If you experience any unpleasant symptoms, let your dentist know so that they can adjust the percentage of N₂O. Alternatively, just take the mask off.

During relative analgesia, you should stay within the first three stages. The "dream" stage means that the N₂O concentration is too high, or that the gas has been administered for too long. This stage can be associated with side effects such as nausea and other potentially unpleasant sensations, including flashbacks. N₂O concentration should always be gradually increased ("titrated") at each visit, because people's tolerance can vary from day to day. If you've had bad experiences with laughing gas in the past, it is highly likely that these were due to improper administration and too high a concentration of N₂O.

Interestingly, the actual mechanism of action of N₂O is still unknown (it appears that there are quite a few different mechanisms at work!) However, it's been observed that N₂O depresses almost all forms of sensation – especially hearing, touch and pain, and that it seems to disinhibit some emotional centers in the brain. The ability to concentrate or perform intelligent acts is only minimally affected, as is memory.

How is nitrous oxide administered?

The equipment used for delivering "happy gas" is quite simple. It consists of a supply of compressed gases and an apparatus which delivers the gases to the client. By turning some knobs and flipping on/off switches, the administrator can produce the desired mix of N₂O-O₂ in the desired quantities. Flowmeters and pressure gauges allow the administrator to keep an eye on the flow of gases.

The desired N₂O-O₂ mix is fed through a tube to which a nasal hood or cannula is attached. This hood is put over your nose. All you have to do now is breathe normally through your nose – bingo!



In modern machines there is a sort of double mask (see photo) where the outside mask is connected to a vacuum machine to suck away the waste gas – you wouldn't want your dentist to get a face full of N₂O... The white inside mask, which is placed over your nose, comes in lots of yummy scents – such as vanilla, strawberry, and mint! The one pictured to the left is scented with vanilla (that's the one I'd go for), but Gordon likes the minty one best...

The twin tubes running to the mask are for "gas in" and "gas out". The "gas out" line is attached to the vacuum machine, while the "gas in" line is attached to the RA (short for relative analgesia) machine. The inner mask is attached to the "line in", you breathe out through a one-way valve in the inner mask, and the exhaust gas is collected inside the outer grey mask (pictured to your right) and sucked into the vacuum machine.



What are the advantages of nitrous oxide?

- Nitrous oxide works very rapidly – it reaches the brain within 20 seconds, and relaxation and pain-killing properties develop after 2 or 3 minutes.
- The depth of sedation can be altered from moment to moment, allowing the person who administers the gas to increase or decrease the depth of sedation. Other sedation techniques don't allow for this. For example, with IV sedation, it's easy to deepen the level of sedation, but difficult to lessen it. Whereas with laughing gas, the effects are almost instant.
- Other sedation techniques have a fixed duration of action (because the effects of pills or intravenous drugs last for a specific time span), whereas gas can be given for the exact time span it's needed for. It can also be switched off when not needed and then switched on again (though to avoid a roller-coaster effect, you shouldn't do this too abruptly).
- There's no "hangover" effect – the gas is eliminated from the body within 3 to 5 minutes after the gas supply is stopped. You can safely drive home and don't need an escort.
- With nitrous oxide, it's easy to give incremental doses until the desired action is obtained (this is called "titration"). So the administrator has virtually absolute control over the action of the drug, preventing the possibility of accidental overdoses. While giving incremental doses is possible with IV sedation, it's not possible with oral sedation (as a result, oral sedation can be a bit of a hit-and-miss affair).
- For certain procedures – those involving gums rather than teeth (e. g. deep cleaning) – it may be possible to use nitrous instead of local anaesthesia. N₂O acts as a painkiller on soft tissues such as gums. However, its pain-relieving effects vary a lot from person to person and can't be relied upon.
- No injection is required. In cases of very severe needle phobia, getting laughing gas first can help you feel relaxed enough to allow the needle required for IV sedation to be inserted in your arm or hand. The very deep state of sedation achievable through IV sedation will then allow you to accept local anaesthetic.
- Inhalation sedation is very safe. It has very few side effects and the drugs used have no ill effects on the heart, lungs, liver, kidneys, or brain.

- Inhalation sedation has been found to be very effective in eliminating or at least minimizing severe gagging.

Are there any disadvantages?

- Some people are not comfortable with the effects of laughing gas (either because they're afraid they might lose control or because it makes them feel nauseous – this is quite rare, though, and usually due to oversedation). If you're prone to nausea, it's a good idea to have a meal (not a huge one) about 4 hours before your appointment. If that's not possible (e. g. an early morning appointment), make sure your stomach isn't completely empty – but don't stuff yourself straight beforehand either. According to Gordon, who's a bit of an expert in the field, the normal working concentration of gases is about 70% oxygen to 30% nitrous oxide: "It's rare to go beyond that because that's what brings on the nausea, more than 45% N₂O and you're going to have the patient puke on you 😊".
- Some people will not achieve adequate sedation with permissible levels of oxygen.
- If you can't breathe through your nose (either because you're a pure mouth breather, or because your nose is blocked), or you feel too claustrophobic when something is put over your nose, it can't be used.
- Depending on where you live, a dentist who offers nitrous oxide may be hard to come by.
- Apart from that, most of the disadvantages of inhalation sedation don't affect you, but the dental team: there's training required, the equipment is quite bulky and takes up a lot of space, and there is a possibility that dental staff who are chronically exposed to nitrous oxide might develop health problems. The cost of the equipment and gases is high, so you'll have to contribute to the cost – but it's quite a bit cheaper than IV sedation.

What about bad experiences with laughing gas?

On rare occasions, people have reported a bad experience with nitrous oxide. Usually this is due to oversedation – getting too much N₂O in the mix. This is easily reversible by reducing the amount of N₂O. For example, a few people have reported auditory and "physical" hallucinations, dizziness, or vertigo.

Don't panic if you should experience this. While these symptoms are usually due to the N₂O concentration being too high for you, the machines used nowadays have built-in safety features preventing an accidental overdose. Nonetheless, these sensations can be unpleasant – let your dentist know asap about any unpleasant sensations or symptoms so that they can adjust the percentage of N₂O. Laughing, becoming giddy, crying, or uncoordinated movements are other signs that the N₂O concentration is too high, but these will easily be spotted by your dentist. Alternatively, just rip the mask off your nose! Don't confuse "dizziness" with the normal feeling of lightheadedness which many people who've never had N₂O before experience after maybe 60 or 90 seconds. The feeling of lightheadedness will pass as the concentration of N₂O is increased.

Some experts in this field (e. g. Stanley Malamed) argue that nitrous oxide should always be "titrated". This means gradually increasing the percentage of nitrous oxide in the N₂O – O₂ mix until a comfortable level is reached. The reason why titration should ideally be used every single time is because of potential adverse effects in the event of oversedation (including flashbacks of traumatic past events, as well as physical ill-effects).

However, other experts (e.g. Fred Quarnstrom) say that it's ok to use a mix based on prior experience (a concentration which a particular patient has experienced as pleasant during previous appointments). Quite a lot of dentists do this because it's quicker.

The problem with this approach is that tolerance can vary from visit to visit, depending on both psychological and physiological factors. What is experienced as pleasant varies from person to person and from day to day. And once a person has been oversedated, they may come to dislike nitrous oxide so much that they don't want to try it again.

Are there any contraindications?

There aren't any major contraindications to relative analgesia, except for M.S., emphysema and some exotic chest problems. It hasn't been proven to be safe during the first trimester of pregnancy, so you can't use it then.

Because you have to breathe it in through your nose, it's not suitable for people who have a cold or some other condition which prevents them from breathing through their nose.

You can't be allergic to N₂O. It's also safe to use if you suffer from epilepsy, liver disease, heart disease, diabetes, or cerebrovascular disease. It is also used quite successfully in many people with respiratory disease – but it depends on the exact nature of the disease, so check with your dentist!

How do I know if it's for me?

Why not ask if you can have a 5 minute 'sample' so that you know what to expect on the day of your procedure?

Many thanks to Gordon Laurie BDS for his advice and help while writing this page – and for the photos.