

Nitrous oxide, commonly known as **laughing gas**, **nitrous**, **nitro**, or **NOS**^[1] is a chemical compound with the formula N₂O. It is an oxide of nitrogen. At room temperature, it is a colourless, non-flammable gas, with a slightly sweet odor and taste. It is used in surgery and dentistry for its anaesthetic and analgesic effects. It is known as "laughing gas" due to the euphoric effects of inhaling it, a property that has led to its recreational use as a dissociative anaesthetic. It is also used as an oxidizer in rockets^[2] and in motor racing to increase the power output of engines. At elevated temperatures, nitrous oxide is a powerful oxidizer similar to molecular oxygen.

Nitrous oxide gives rise to nitric oxide (NO) on reaction with oxygen atoms, and this NO in turn reacts with ozone. As a result, it is the main naturally occurring regulator of stratospheric ozone. It is also a major greenhouse gas and air pollutant. Considered over a 100-year period, it is calculated to have between 265 and 310 times more impact per unit mass (global-warming potential) than carbon dioxide.^{[3] [4]}

It is on the WHO Model List of Essential Medicines, the most important medications needed in a health system.^[5]

Nitrous oxide has been used for anaesthesia in dentistry since December 1844, where Horace Wells made the first 12–15 dental operations with the gas in Hartford. Its debut as a generally accepted method, however, came in 1863, when Gardner Quincy Colton introduced it more broadly at all the Colton Dental Association clinics, that he founded in New Haven and New York City.^[15] The first devices used in dentistry to administer the gas, known as Nitrous Oxide inhalers, were designed in a very simple way with the gas stored and breathed through a breathing bag made of rubber cloth, without a scavenger system and flowmeter, and with no addition of oxygen/air.^[16] Today these simple and somewhat unreliable inhalers have been replaced by the more modern relative analgesia machine, which is an automated machine designed to deliver a precisely dosed and breath-actuated flow of nitrous oxide mixed with oxygen, for the patient to inhale safely. The machine used in dentistry is designed as a simplified version of the larger anaesthetic machine used by hospitals, as it doesn't feature the additional anaesthetic vaporiser and medical ventilator. The purpose of the machine allows for a simpler design, as it only delivers a mixture of nitrous oxide and oxygen for the patient to inhale, in order to depress the feeling of pain while keeping the patient in a conscious state.

Relative analgesia machines typically feature a constant-supply flowmeter, which allow the proportion of nitrous oxide and the combined gas flow rate to be individually adjusted. The gas is administered by dentists through a demand-valve inhaler over the nose, which will only release gas when the patient inhales through the nose. Because nitrous oxide is minimally metabolised in humans (with a rate of 0.004%), it retains its potency when exhaled into the room by the patient, and can pose an intoxicating and prolonged exposure hazard to the clinic staff if the room is poorly ventilated. Where nitrous oxide is administered, a continuous-flow fresh-air ventilation system or nitrous scavenger system is used to prevent a waste-gas buildup.

Hospitals administer nitrous oxide as one of the anaesthetic drugs delivered by anaesthetic machines. Nitrous oxide is a weak general anaesthetic, and so is generally not used alone in general anaesthesia. In general anaesthesia it is used as a carrier gas in a 2:1 ratio with oxygen

for more powerful general anaesthetic drugs such as sevoflurane or desflurane. It has a minimum alveolar concentration of 105% and a blood/gas partition coefficient of 0.46.

The medical grade gas tanks, with the tradename Entonox and Nitronox contain a mixture with 50%, but this will normally be diluted to a lower percentage upon the operational delivery to the patient. Inhalation of nitrous oxide is frequently used to relieve pain associated with childbirth, trauma, oral surgery, and acute coronary syndrome (includes heart attacks). Its use during labour has been shown to be a safe and effective aid for women wanting to give birth without an epidural.^[17] Its use for acute coronary syndrome is of unknown benefit.^[18]

In Britain and Canada, Entonox and Nitronox are commonly used by ambulance crews (including unregistered practitioners) as a rapid and highly effective analgesic gas.

Nitrous oxide has been shown to be effective in treating a number of addictions, including alcohol withdrawal.^[19]

Nitrous oxide is also gaining interest as a substitute gas for carbon dioxide in laparoscopic surgery. It has been found to be as safe as carbon dioxide with better pain relief.^{[20][21]}