

Evidence that Empowers!

By Rebecca Dekker, PhD, RN of EvidenceBasedBirth.com

Question: What is nitrous oxide?

Answer: Also known as “laughing gas,” nitrous oxide is a mixture of half nitrous oxide and half oxygen that is inhaled through a mask for pain management. It is a systemic drug, so it affects the whole body, but does not cause numbness or loss of muscle movement.

Question: How is nitrous oxide given during labor?

Answer: The laboring person holds the mask over their nose and mouth and inhales the tasteless, odorless gas as often as needed, taking care to exhale back into the mask. It is recommended to start taking breaths from the mask 30–45 seconds before a contraction begins, and stop breathing through the mask when the contraction ends (Richardson et al. 2017). If labor is irregular, inhalations can begin as soon as a contraction is sensed. Nitrous oxide is used for pain relief during labor in many countries, including the United Kingdom, Australia, and Canada (Hellams et al. 2018). Compared to these countries, nitrous oxide is not as commonly used in the United States, but it is becoming more widely available.

Nitrous oxide can also be used during other childbirth-related procedures including external cephalic version, manual removal of the placenta, postpartum perineal wound repair, and epidural placement (Rollins et al. 2020).

Question: How does nitrous oxide work to lessen pain during labor?

Answer: It is not clear exactly how nitrous oxide works, but researchers think the gas might have opioid-like effects in the Central Nervous System. It may also work by increasing the release of your own pain-relieving hormones. Nitrous provides a sense of pleasure and relaxation that can help you better cope with labor. Using the mask may also provide a feeling of control and help someone focus on their breathing (Hellams et al. 2018).

Question: Does nitrous oxide provide effective pain relief during labor?

Answer: Researchers published a Cochrane review and meta-analysis of randomized, controlled trials to look at the effects of inhaled medications for pain relief during labor (Klomp et al. 2012). Three studies compared 50% nitrous oxide vs. no treatment (one study, 110 participants) or vs. oxygen placebo (two studies, 709 participants). Those who received nitrous oxide were less likely to report severe pain and had lower average pain scores. People who received nitrous oxide also had more side effects such as nausea, vomiting, dizziness and drowsiness.

Another systematic review included 21 studies that looked at the effects of nitrous oxide on labor pain (Likis et al. 2014). They concluded that epidurals are more effective than nitrous oxide. However, researchers suggest that pain scores are not the best measure of effectiveness for nitrous oxide—satisfaction may be a better measurement. People who receive nitrous oxide report similar satisfaction levels as those who have epidurals, with many stating they

would choose nitrous again for a future birth (Richardson et al. 2017). Other findings suggest that nitrous oxide helps patients cope with pain and anxiety, and that it provides relaxation during childbirth (Richardson et al. 2019).

Question: What are the risks of nitrous oxide?

Answer: In the Likis et al. review, 32 studies looked at the effects of nitrous oxide on the health of the birthing person. Using best quality evidence, the authors estimated that 13% of those who receive nitrous oxide experience nausea or vomiting, 3% to 5% feel dizzy, 4% feel drowsy, 18% have a reduced sense of awareness, and about 5% feel claustrophobic because of the mask (Hellams et al. 2018). Loss of consciousness is very rare, and overdose can be avoided by having the birthing person hold the mask themselves, and not permitting anyone else to hold the mask. Respiratory depression, or slowed breathing, is a possible side effect of nitrous oxide when it is combined with injectable opioid medications, but not commonly seen when nitrous is used alone (Collins et al. 2018).

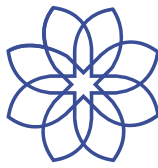
Another review looked at 140 studies of nitrous oxide for a variety of non-birth related purposes, such as surgeries, invasive screenings, and dental procedures (Collado et al. 2007). They found that, overall, bad health effects from the drug occur in about 3/10,000 individuals. The reported serious effects from the best quality study were one episode of loss of consciousness, two vomiting events, one event of slowed heartbeat, one event of dizziness (vertigo), one headache, one nightmare, one event of excessive sweating, and one event of drowsiness. There were no long-lasting side effects.

One concern with nitrous oxide is that it damages Vitamin B12 (cobalamin) in the body (Sanders et al. 2008). Vitamin B12 helps change the amino acid *homocysteine* to the amino acid *methionine*. This process is an important part of making DNA, RNA, and other products that help drive the normal function of your cells. People are at risk for Vitamin B12 deficiency if they are exposed to high doses of nitrous oxide over long periods of time. One study found that exposure to nitrous oxide during childbirth may increase the risk of B12 deficiency in infants if the pregnant person is already experiencing a B12 deficiency (Ljungblad et al. 2022).

Certain health conditions—such as Cohn’s disease, celiac disease, gluten intolerance, pernicious anemia, chronic malnutrition, significant B12 deficiency, and following a strict vegan diet—can put you at higher risk of reduced Vitamin B12 function and may be reasons to not have nitrous oxide (Collins et al. 2018, Rollins et al. 2020).

In addition, nitrous oxide can expand closed gas spaces, so it may not be safe to use in people with certain medical conditions such as bowel obstruction, retinal surgery, middle ear surgery, sinus infections, or tension pneumothorax (Richardson et al. 2017, Rollins et al. 2020). Best practice guidelines published by the American Society of Anesthesiologists recommend that the patient must be able to consent and hold the face mask without assistance (Rollins et al. 2020). The American College of Obstetricians





and Gynecologists recommends that nitrous oxide not be combined with the use of systemic opioids or sedative medications during childbirth due to concerns that this combination could lead to a state of deepened sedation, increasing the risk of respiratory depression and low-oxygen episodes (ACOG 2021).

In the Likis et al. review, 29 studies looked at the effects of nitrous oxide exposure on the health of the baby. Nitrous oxide does cross the placenta, but it does not accumulate in the baby's body and any residual gas is eliminated as soon as the baby starts breathing. Using the best quality evidence, researchers found no difference in newborn Apgar scores or the rate of neonatal intensive care admissions between babies whose birthing parents used nitrous oxide and those who did not. Klomp et al. also looked at newborn Apgar scores in two studies with 709 people and did not find a difference between those whose parents had nitrous oxide and those with no pain medication.

Benefits/Pros (ACOG 2019; Hellams et al. 2018, Vallejo and Zakowski 2019):

- Additional pain management option for those who do not have access to an epidural or do not want an epidural.
- Simple and inexpensive.
- Similar pain relief as injectable opioids but with fewer side effects.
- Similar reported levels of satisfaction as compared with people who use epidurals.
- Very flexible—it can be used in any stage of labor, started and stopped at any time, and used to supplement some other pain relief methods.
- Starts working right away, in less than a minute.
- Less invasive than an epidural or injectable opioids.
- The patient controls how often they inhale with the mask.
- No loss of strength, loss of freedom of movement, or impact on pushing and other bodily functions.
- Does not require additional monitoring.

- It might create a sense of pleasure and relaxation and ease anxiety.
- Promotes a focus on breathing.
- Has not been shown to increase the risk of bad health outcomes for birthing person or baby.

Risks/Cons (ACOG 2021; Richardson et al. 2017; Sanders et al. 2008):

- Less effective and less reliable pain relief than an epidural.
- Requires a high level of participation—you must hold your own mask. If you are exhausted, you may not want to keep holding the mask to your face for pain relief.
- Some people experience side effects such as a feeling of detachment, sleepiness, dizziness, nausea/vomiting, or claustrophobia from the mask.
- May not be appropriate for people with conditions that put them at increased risk of Vitamin B12 deficiency.
- Not recommended for use alongside opioids or sedatives.
- May require scavenging systems and ventilation to reduce health care worker exposure (exhaling into the mask helps contain the gas).
- Environmental effects—nitrous oxide is a potent greenhouse gas, 300 times greater than carbon dioxide.

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“**Bottom line: Nitrous oxide gas should be available during labor as a safe and non-invasive medical pain relief option.**”

1. American College of Obstetricians and Gynecologists (ACOG). (2019). "ACOG practice bulletin no. 209: obstetric analgesia and anesthesia." *Obstetrics and Gynecology* 133(3): e208-e225.
2. American College of Obstetricians and Gynecologists (ACOG). (2021). "Practice Advisory: Use of Nitrous Oxide in Labor and Possible Interaction with Systemic Opioids or Sedatives/Hypnotics. An update to ACOG Practice Bulletin no 209." July 2021.
3. Collado V, Nicolas E, Faulks D, Hennequin M. (2007). "A review of the safety of 50% nitrous oxide/oxygen in conscious sedation." *Expert Opin Drug Saf* 6: 559-571.
4. Collins, S., Fiore, A. T., Boudreau, J. A., et al. (2018). Nitrous Oxide for the Management of Labor Analgesia. *AANA Journal* 86(1): 72-80.
5. Hellams, A., Sprague, T., Saldanha, C., et al. (2018). Nitrous oxide for labor analgesia. *JAAPA* 31(1): 41-44.
6. Klomp, T., van Poppel, M., Jones, L., et al. (2012). Inhaled analgesia for pain management in labour. *Cochrane Database of Systematic Reviews*, Issue 9. Art. No.: CD009351.
7. Likis, F. E., Andrews, J. C., Collins, M. R., et al. (2014). Nitrous oxide for the management of labor pain: a systematic review. *Anesth Analg* 118: 153-167.
8. Richardson, M. G., Lopez, B. M. and Baysinger, C. L. (2017). Should nitrous oxide be used for laboring patients? *Anesthesiol Clin*. 35(1): 125-143.
9. Richardson, M. G., Raymond B. L., Baysinger, C. L., et al. (2019). "A qualitative analysis of parturients' experiences using nitrous oxide for labor analgesia: It is not just about pain relief." *Birth* 46: 97-104.
10. Rollins, M., Arendt, K., Carvalho, B. et al. (2020). "Nitrous oxide: ASA Committee on Obstetric Anesthesia Working Group. 2020." American Society of Anesthesiologists. Website accessed February 9, 2023.
11. Sanders, R. D., Weimann, J. and Maze, M. (2008). Biologic effects of nitrous oxide: a mechanistic and toxicologic review. *Anesthesiology* 109: 707-722.
12. Vallejo, M. C. and Zakowski, M. I. (2019). "Pro-Con Debate: nitrous oxide for labor analgesia." *Biomed Research International* 2019: 1-12.

