Nitrous Oxide for Use in Labor and Birth

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Disclaimer***

Michelle Collins has no financial relationship with any company or corporation that either has manufactured, or plans to manufacture, equipment used in the delivery of nitrous oxide.
Nitrous Oxide

- $\text{N}_2\text{O}$
- Colorless, odorless, tasteless gas
- First produced in 1772 by Joseph Priestly in Great Britain

“Nitrous Oxide 3D balls” By Ben Mills (Own work) [Public domain], via Wikimedia Commons.

“Joseph Priestley” Popular Science Monthly, Volume 5, 1873. Retrieved from Wikimedia
Current uses of nitrous oxide

- Industrial applications
- Rocket motors
- Racing engines
- Whipped cream
- Abuse

“A gas regulator attached to a nitrogen cylinder” Rifleman 82
“SpaceShipOne test pilot Mike Melvill” Renegadeaven / CC Attribution-Share Alike.
“Demi Moore” David Shankbone / CC Attribution.
Current medical uses of N2O

• Dentistry – 35% use it, commonly with children – most common exposure for those in the US
• Operating room
• Emergency medicine/field and hospital
N2O use for labor analgesia

Used commonly in numerous countries with high standards for medical care:

- United Kingdom (60%)
- Canada
- Australia (50%)
- Norway (85%)
- Finland (48%)
- New Zealand

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In the US... that we know about

- **Over 100 hospitals**
  - AK, CA, CO, CT, FL, GA, ID, IL, LA, MA, ME, MN, MT, NC, NH, NM, OH, OR, PA, SC, TN, TX, UT, VA, WA, WI

- **Over 50 birth centers**
  - AR, CA, CO, FL, ID, MD, NC, NM, NY, OR, SC, TX, UT, WA, WI
AHRQ review 2012 key questions

- What is the **effectiveness** of nitrous oxide when compared with other methods for labor pain?

- What is the **effectiveness** of nitrous oxide on women’s satisfaction with their birth experience and pain management?

- What is the **effect** of nitrous oxide on route of birth?

- What is the nature and frequency of **adverse effects** associated with the use of nitrous oxide for the management of labor pain, including but not limited to maternal adverse effects, fetal/neonatal adverse effects, childhood adverse effects, and adverse effects on health care providers and other individuals present for labor?

- What are the **health system factors** influencing the use of nitrous oxide for the management of labor pain, including but not limited to provider preferences, availability, setting, and resource utilization?
AHRQ Results

- N2O < effective than epidural for pain relief

- Studies comparing N2O w/ non-epidural methods were of poor quality, w/ inconsistent findings

- Strength of evidence was insufficient to determine the effect of N2O on route of birth

- Maternal harms reported were unpleasant side effects that affect tolerability (e.g., nausea, vomiting, dizziness, and drowsiness)

- Apgar scores were similar

- Evidence on occupational harms and exposure was limited

- No studies addressed health system factors
Final outcome of AHRQ review

Research assessing nitrous oxide is needed across all of the key questions addressed: effectiveness, women’s satisfaction, route of birth, harms, and health system factors affecting use.
50 % nitrous 50% oxygen used in labor is analgesia, not anesthesia!

- Analgesia or “minimal sedation” per American Society of Anesthesiologists (ASA)

- Minimal sedation requires:
  - No special regs or guidelines
  - “Entails minimal risk”
  - “Adverse effects are negligible”

Should allow initiation by CNM, MD, or RN with an order
Why offer nitrous oxide for labor?

- Long anecdotal history of safe use worldwide
- Few safe analgesic alternatives in US
- Women deserve to have access to all safe and effective options
- Consumer demand

“Woman using nitrous oxide during labor” Vanderbilt University Medical Center / Used with permission.
Advantages of nitrous oxide use

- Relatively simple and safe to use
- Self administered
- Rapid onset/offset

No evidence of:
- effects on progress of labor/ability to push
- adverse fetal/newborn effects

Women may be able to postpone or avoid narcotics or epidural
Limitations of nitrous oxide use

• Side effects: dizziness, nausea, drowsiness

• Mobility may be limited to proximity of apparatus

• Lack of familiarity and availability

• Not all women find it helpful

“Nitrous attached to a tub” Holly Powell Kennedy/Used with permission.
N2O - Contraindications

Women who:

- cannot hold the mask
- have impairment of consciousness/intoxication
- have documented B12 deficiency
- potential for trapped gas

Smartoon Construction Worker” ©iStock.com/TonisPan.
Who is initiating nitrous?

Recent survey of 39 hospitals/medical centers (birth centers excluded):

- 3 (7.7%) may be initiated by any of the following: ob or anesthesia provider, or nurse, with an order.

- 4 (10.3%) require anesthesia personnel to initiate; others (ob providers, nurses) may not.

- 26 (66.7%) both ob providers (midwife or physician) and bedside nurses may initiate, but largely nurse initiated w/order. Anesthesia providers not involved at all.

- 6 (15.4%) Policy still being written, but leaning towards nurse initiation.
Does initiator affect usage rates?

• In the 3 years before midwives began administration:
  ▫ 6-8% use of nitrous

• In the years since:
  ▫ 11-12% use of nitrous

Approximately 50% increase

*Per Judith Bishop CNM, MPH, UCSF
Let’s talk equipment: Entonox versus others are they different?

Yes!

“Entonox equipment” Owain.davies / CC Attribution.
“Nitronox equipment” PorterInstrument.com, used with permission.
“Pro-Nox equipment” Julie Nicholas/CAREstream American, used with permission.
“Sedara equipment “ Mark Sanda/Lifegas/Linde
“NITRONOX”

Porter Instruments

“Nitroonx equipment A” [Mike Civitello/Porter Instruments, used with permission]
“Nitroonx equipment B” [Mike Civitello/Porter Instruments, used with permission]
“PRONOX”

CAREstream America, Inc.

“Pro-Nox equipment A” Julie Nicholas/CAREstream American, used with permission.
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“SEDARA”

Lifegas/Linde
- Either mask or mouthpiece

- Flow initiated by negative pressure opening demand valve

- Same valve prevents further flow when inhalation ceases

“Labour gas mask” @iStock.com/dbleight.
Instructions for use

- Informed consent (not necessarily written)
- Only patient may hold mask
- Placement of mask
- Timed breathing for maximum effect
- Exhaling back into mask
Nitrous timing of inhalation

The Relationship between the contraction and the blood level of Nitrous Oxide. *Note:* The ‘lag’ or delay if breathing the gas is started at the time of the contraction.

“Nitrous timing of inhalation” Vanderbilt University School of Nursing, used with permission.
What should patients expect from nitrous use?

- Variable pain relief
- “I don’t care” factor
- Feeling of euphoria/bliss
- Decreased anxiety
N2O – Health and safety concerns

- Mother
- Baby
- Staff
N20 Safety for mother

- Desaturation common in labor – no evidence of increase with N2O
- Oxygen saturation should be higher in women using nitrous (breathing 50% O2)
- Does not require pulse ox, IV or continuous EFM
N₂O Safety for fetus/neonate

- Neonatal depression has not occurred
- No known effects on breastfeeding
- Not much research, but no noted ill effects after extensive use (75+ years) in other countries
Apoptosis of Fetal Brain Cells

Apoptosis happens with use of:

- Anesthetic gases including N2O
- Sedatives
- Hypnotics
- Narcotics

“Apoptosis” ©iStock.com/ttsz
• Relevance of findings from rat model studies unknown

• FDA advisory committee 2007: no changes recommended to any anesthetic practice
N2O Safety for staff

• No harm when used at analgesic levels, intermittently and with
  ▫ scavenging equipment
  ▫ demand valve
  ▫ proper instruction and use

• All of these safety practices limit exposure of others in the room

“Pregnant patient” ©iStock.com/geotrac
Environmental exposure

- NIOSH standards for exposure - suggests 25 ppm for duration of use
- ACGIH standards: 50 ppm time over 8 hour time weighted average
- UK, Finland, Germany, Sweden limit = < 100 ppm
- Dosimetry Badges
Exposure Monitoring

• Yearly evaluation if desired, or required

• Dosimeter badges from Advanced Chemical Sensors Co, Boca Raton, FL (AIHA accredited)

• Results

*Remember exposure limit ACGIH = 50 ppm, NIOSH = 25 ppm*
Nitrous use: UCSF statistics*

2007-2012 (5,987 term singleton)

- Epidural rate 76%
- Nitrous oxide initiation rate: 14%
- Conversion to epidural after initiation: 40%

*per Judith Bishop CNM, MPH
Conversion to epidural does not equate to failure of the modality!

theunnecesarean.com
Nitrous use: Vanderbilt Statistics

June 1, 2011 – present

- Epidural rate 30% NMW practice, ~85% in remaining population
- Nitrous oxide initiation rate: ~20%
- Conversion to epidural after initiation: ~40-45%
Key steps to implementing nitrous program...

1. Identify those sharing the passion
2. Have a vision statement
3. Dialogue with ALL involved initially (midwifery, Ob, MFM, anesthesia, peds, neo, nursing, nursing management, risk management)

Addressing team’s concerns

- **Anesthesia**: diversion by staff, family; monitoring of woman using nitrous
- **Neo/peds**: fetal effects
- **Nursing**: workload, role; storage of gas unit
- **Risk management**: verbiage of consent/pt ed. documents, nurse practice act issues
Implementing nitrous program

4. Be prepared
5. Expect give and take
6. Ensure visible sponsorship
7. Feedback

Lessons learned along the way...

Anesthesia and obstetric services MUST work together
Everyone needs to be on the same page
Ensure staff competency...

Nitrous Oxide for Labor Analgesia

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Nurse Midwifery Practice

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Division of Obstetric Anesthesia
Inform women in the prenatal period

“Checking in” eyeliam / CC Attribution.
“Elaine Moore at West End Women’s Center” Vanderbilt University School of Nursing / Used with permission.
Be watchful of patient positioning during use
Multi-purpose...

Laceration Repair

Bedside Surgical Procedures

“Starting IV” ©iStock.com/agentry.
“Spinal nerve block” ©iStock.com/ChaNaWiT.
“Early labor” rabble / CC Attribution-Share Alike
Be cautious in making “improvements” to delivery system

“Woman using nitrous oxide during labor” Vanderbilt University Medical Center / Used with permission.
Be cautious when instituting new “associated” practices...

Pulse oximeter” JANT Pharmacal Corp / CC Attribution.
“Butorphanol” /CC Attribution-Share Alike
Or not building upon what is standard of care ...
Keep reviewing/reinforcing the policy...

“Male Doctor Showing Okay Gesture” Freestockphotos.net/stockimages.
“Stethoscope In Doctor Hand” Freestockphotos.net/basketman.
Reminder:
Continuous Pulse Oximetry & Bedrest are **NOT** required during use of Nitrous Oxide

For more information refer to policy: AS 201111-20.19: [Nitrous Oxide Use in the Intrapartum/Immediate Postpartum Period](https://vumc.org/policies), which is available on the VUMC policy website under “Area Specific” Labor & Delivery policies
Change out the nitrous tank when it gets just below 500 psi...

“Nitronix”, used with permission.
“Scuba tanks” ©iStock.com/neokan
Keep in mind that women may use it for several hours...
Nausea and vomiting don’t seem to be a big problem...
Billing...

- Nitrous Oxide only with vaginal birth - ASA code 01960 with the base of 5 plus time (CPT Codes 59400- 59410)

- Nitrous Oxide converts to an epidural with vaginal birth– ASA code 01967 with the base of 5 plus time (CPT Codes 59610 – 59614)

- Time starts with the N20 therapy administration
Resources; don’t reinvent the wheel...

• Nitrous listserve:
  N2Oduringlabor-subscribe@yahoogroups.com

• AHRQ review (2012) available
  at www.effectivehealthcare.ahrq.gov/reports/final.cfm

• Cochrane review (2012)
Recent Papers on N2O...


- Nitrous oxide as labor analgesia; clinical implications for nurses. (2012). Nursing for Women's Health, Oct/Nov. (CE article)

- Nitrous oxide for pain relief in labor. Share with Women in Journal of Midwifery & Women’s Health, 58 (6), 2013


• In summary...

➢ safe & effective

➢ inexpensive

➢ does not require MD supervision

➢ should be as widely available in US as it is in many other countries!
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