“Gas and Air”; The Utility of Nitrous Oxide in Childbirth
Presentation given 6/13/19 PAC/LAC
Excluding Images

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Disclaimer***
I have no financial relationship with any company or corporation that either has manufactured, or plans to manufacture, equipment used in the delivery of nitrous oxide.

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• Nitrous Oxide
• N₂O
• Colorless, odorless, tasteless gas
• First produced in 1772 by Joseph Priestly in Great Britain
Current non-medical use of N₂O

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

Medical use of N₂O

- Dentistry (especially in pediatrics) – most common use in the US
- Operating room
- Emergency medicine/field and hospital

Differences between use in dentistry and obstetrics

<table>
<thead>
<tr>
<th>Dentistry</th>
<th>Obstetrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous flow</td>
<td>Intermittent flow</td>
</tr>
<tr>
<td>Variable concentration up to 70/30 mix</td>
<td>Fixed 50/50 concentration</td>
</tr>
<tr>
<td>No scavenging system/exhaled gas into faces of dental personnel</td>
<td>Scavenging system; exhaled gas carried away</td>
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</table>
Current use for labor analgesia

- Common in countries with high standards for medical care:
  - United Kingdom (60%)
  - Canada
  - Australia (50%)
  - Norway (85%)
  - Finland (48%)
  - New Zealand

In the US... that we know about

- At least 1000 hospitals
  - AK, AL, AZ, CA, CO, CT, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MT, NC, ND, NH, NJ, NM, NY, OH, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI
- Approximately 100 birth centers
  - AR, AZ, CA, CO, FL, ID, MD, MN, MO, NC, ND, NH, NM, NY, OR, SC, TN, TX, UT, WA, WI

AHRQ review 2012 key questions

- What is the effectiveness of N₂O when compared with other methods for labor pain?
- What is the effectiveness of N₂O on women's satisfaction with their birth experience and pain management?
- What is the effect of N₂O on route of birth?
- What is the nature and frequency of adverse effects associated with the use of N₂O including any on maternal, fetal/neonatal, childhood health care providers and other individuals present for labor?
- What are the health system factors influencing the use of N₂O?
AHRQ Results

- $N_2O$ less effective than regional
- Studies comparing $N_2O$ w/non-epidural methods were of poor quality; inconsistent findings
- Strength of evidence was insufficient to determine effect on birth route
- Maternal harms; unpleasant side effects (N/V, dizziness, drowsiness)
- Similar Apgar scores
- Limited evidence on occupational harms/exposure
- No studies addressed health system factors

Final outcome of AHRQ review

- Research assessing $N_2O$ is needed across all of the key questions addressed:
  - Effectiveness
  - Women’s satisfaction
  - Route of birth
  - Harms
  - Health system factors affecting use

50% nitrous oxide and 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”

By definition, should allow initiation by CNM/CM, MD, or RN with an order
Advantages of N₂O use
- Relatively simple, safe to use
- Self-administered
- Rapid onset/offset
- Patient satisfaction
- Doesn’t require IV, pulse ox, or CEFM

No evidence of:
- effects on progress of labor/ability to push
- adverse fetal/newborn effects
**May be able to postpone or avoid narcotics or epidural, if desired**

Patient Satisfaction
6242 women, 34 months 2011 – 2014
- 81% w/neuraxial; 19% w/N₂O (60% of those used only N₂O)
- Efficacy: > 90% w/neuraxial "high"; N₂O users "variable" w/50% reporting "high" efficacy
- In both groups, of those reporting “poor” or “moderate” efficacy, N₂O alone users > likely to report high satisfaction than epidural alone users
- Among “high” efficacy group, satisfaction was equal.

Limitations of N₂O use
- Side effects: dizziness, nausea, drowsiness
- Mobility limited to apparatus proximity
- Lack of familiarity, availability
- Not all will find it helpful
## N₂O – Contraindications

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

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## Who is initiating N₂O at the bedside?

2015 survey of 39 hospitals/medical centers (*birth centers excluded*):
- 3 (7.7%) initiated by any of the following: ob or anesthesia provider, or nurse (with OB provider order).
- 4 (10.3%) *require* anesthesia personnel to initiate; others (ob providers, nurses) may not.
- 26 (66.7%) ob providers (midwife or physician) or bedside nurses may initiate, but largely nurse initiated w/order. *Anesthesia providers not involved in process.*
- 6 (15.4%) Policy still being written, but leaning towards nurse initiation.

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## Does bedside initiator affect usage rates?

From UCSF:
- **In the 3 years prior to midwives initiating:**
  - 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?

“NITRONOX”
Porter Instruments

“PRO-NOX”
CAREstream America, Inc
“SEDARA”
Lifegas/Linde

- Ether mask/mouthpiece
- Flow initiated by negative pressure opening demand valve
- Same valve prevents further flow when inhalation ceases

Instructions for use
- Informed consent
- Only patient may hold mask
- Placement of mask
- Timed breathing for maximum effect
- Exhaling back into mask
Timing of inhalation for maximum effect

What should patients expect from N₂O use?
- Variable pain relief
- "I don’t care" factor
- Feeling of euphoria/bliss
- Decreased anxiety

N₂O – health and safety concerns
- Mother
- Baby
- Staff
**N₂O Safety for mother**

- Desaturation – no evidence of increase
- O₂ saturation should be higher
- Safe to maintain mobility

**N₂O Safety for fetus/neonate**

- No neonatal depression
- No known effect on breastfeeding
- Paucity of adequate 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
• Relevance of findings from rat model studies unknown

• FDA advisory committee 2007: no changes recommended

N₂O Safety for staff

• No harmful exposure levels when used at 50/50, intermittently and with:
  – scavenging equipment
  – demand valve
  – proper instruction and use

Environmental exposure

• NIOSH standards for exposure: suggests 25 ppm limit for duration of use
• ACGIH standards: 50 ppm over 8 hour time weighted average limit
• 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*

N₂O use at Vanderbilt June 1, 2011 – present

• Epidural rate 30-35% NM practice, ~85 – 90% in remaining population

• Initiation rate: 15-22% overall (~26% in NM population)

• Conversion to epidural: ~ 30 - 35%

• Initiator *does* make a difference in usage

Conversion to epidural does not equate to failure of the modality!
Key steps to implementing N₂O program...

1. Identify those sharing passion
2. Have a vision statement
3. Dialogue with ALL involved initially (midwifery, Ob, MFM, anesthesia, pediatrics, 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 N₂O program

4. Be prepared
5. Expect give and take
6. Ensure visible sponsorship
7. Feedback
Lessons learned along the way...

Anesthesia/obstetric services **MUST** work together

Everyone on the same page

Ensure staff competency...
May use it for several hours…

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 N₂O therapy administration

Resources; don’t reinvent the wheel…
• Nitrous listserve: N2Oduringlabor- subscribe@yahoo groups.com
• Cochrane review (2012)
• AWHONN Practice Brief Number 6
• ACNM Position Statement on Nitrous
In summary...

- safe & effective
- inexpensive
- no anesthesia oversight req'd
- should be widely available!