Subject: Self-Administration for Pain Management (Analgesia): Nitrous Oxide Use in the Intrapartum and Immediate Postpartum Period	
REVISION DATE: April 2015; July 2015 REPLACES:	WRITTEN: December 2014: Approved by CCBG 3/4/15; 7/8/15 SUPERSEDES DATE: April 2015

This guideline is used to assist staff when educating patients regarding the use of self-administered Nitrous Oxide (N2O) for pain management during the intrapartum period and immediate postpartum period.

Purpose: To provide N2O by self-administration through inhalation as an analgesia alternative for women in labor as well as for therapeutic use in the immediate postpartum period.

1. References:

1.1. American College of Midwives: Division of Standards and Practice. (2011, August). Position Statement: Nitrous oxide for labor analgesia.

1.2. Akerman, N., & Dresner, M. (2009). The management of breakthrough pain during labour. *CNS Drugs,* 23(8), 669-679. Doi:10.2165/00023210-200923080-00004.

1.3. Banner Health: Fairbanks Memorial Hospital. (2014, October 16). Nitrous oxide use for pain management in the intrapartum and immediate postpartum period. *Policy and Procedure*. Fairbanks, Alaska

1.4. Rooks, J.P. (2011, November-December). Safety and risks of nitrous oxide labor analgesia: A review. *Journal of Midwifery & Women's Health,* 56(6), 557-565. Doi:10.1111/j.1542-2011.2011.00122.x

1.5. Rosen, M.A. (2002). Nitrous oxide for relief of labor pain: A systematic review. *American Journal of Obstetrics and Gynecology*, 186(5 Suppl Nature), S110-S126. Doi:a121259 [pii]

1.6. Starr, S.A., & Collins, M. (2009). Nitrous oxide use in the intrapartum/immediate postpartum period. *Vanderbilt University Medical Center Policy Manual.*

1.7. Stewart, L. S., & Collins, M. (2012, October-November). Nitrous oxide as labor analgesia; Clinical implications for nurses. *Nursing for Women's Health,* 16(5), 400-409. Doi 10.1111/j.1751-486X.2012.01763x

2. Purpose and Background of Guideline:

2.1. To provide guidance for the therapeutic use of self-administered nitrous oxide (N2O) analgesia for painful or anxiety-provoking procedures that may occur in the antepartum, intrapartum, and immediate postpartum period.

2.1.1. N2O has been found to be a safe and effective alternative for pain management in these circumstances for women without contraindications.

2.1.1.1. Women using N2O remain awake and alert, with complete motor and sensory function throughout use.

2.1.1.2. The maternal laryngeal reflex is not inhibited so aspiration risk is not increased.

2.1.1.3. N2O use has not been shown to alter uterine activity or lengthen the first or active phase of labor.

2.1.1.4. N2O/O2 (50 percent to 50 percent) is associated with fewer side effects than higher doses and prevents maternal desaturation.

2.1.1.5. N2O can be initiated and discontinued quickly, with the clearance from the maternal system usually within 30-60 seconds but can take as long as 5 minutes.

2.1.1.6. An integral safety feature of N2O is that when the woman has physiologically reached her limit of N2O intake, she will no longer be able to hold the mask up to her face for more, thus self-regulating the intake

2.1.2. While N2O does cross the placenta, it causes neither central nervous system nor respiratory depression in the newborn and therefore, does not interfere with the important early period of maternal-infant bonding and early effective breastfeeding.

2.1.2.1. N2O is quickly eliminated from the newborn as respirations are initiated.

2.1.2.2. No effect on Apgar scores has been shown.

2.1.2.3. No demonstrated difference in incidence of meconium-stained fluid.

2.1.2.4. No demonstrated difference in incidence of cord blood gas results.

2.1.2.5. No effect on fetal heart rate has been documented in the literature.

2.2. Use of N2O as an analgesic for this purpose shall be standardized according to current practices and guidelines to provide safe, consistent administration for women who desire to use this modality and who are appropriate candidates.

3. Responsibilities:

3.1. Credentialed delivering provider.

3.1.1. Manages and assumes responsibility for patient care administered.

3.1.2. Responsible for counseling patient for all medical procedures and obtaining informed consent.

3.1.3. Assess patient for suitability (mother and fetus) and absence of contraindications.

3.1.4. Educates patients in use of the device for self-administration.

3.1.5. Sets up the portable gas blender which contains a scavenging system.

3.2. Nurse.

3.2.1. Provides recognized nursing standard of care to patients in coordination with provider's orders.

3.2.2. Reinforces education given regarding use of the device for self-administration.

3.2.3. Familiar with indications/contraindications for use of N2O for pain management (analgesia) during the intrapartum and immediate postpartum period.

4. Indications include, but are not limited to:

4.1. Women in active labor and throughout the second stage of labor who desire analgesia but do not desire an epidural or IV narcotics.

4.2. Women who desire analgesia but also desire, or would benefit from, increased mobility with less intervention and monitoring.

4.3. Women who want to delay use of epidural analgesia until later in labor.

4.4. When epidural analgesia is not immediately available.

4.5. When a woman arrives at the hospital too far along in labor to allow for either an epidural to be placed and take effect, or for IV narcotics.

4.6. When a woman finds epidural analgesia to be ineffective or inadequate.

4.7. Antepartum procedures such as external cephalic version.

4.8. Intrapartum procedures such as episiotomy and vaginal delivery, including forceps-assisted vaginal delivery and vacuum-assisted vaginal delivery.

4.9. Postpartum procedures such as extensive laceration/episiotomy repair, manual removal of placenta, bimanual exam for postpartum hemorrhage, or post-placental IUD placement.

4.10. Women who experience extreme anxiety with events such as starting intravenous lines, epidural placement, or pelvic exams.

5. Contraindications:

5.1. Absolute Contraindications:

5.1.1. Presence of a potential space the gas could fill, such as with pneumothorax, intraocular surgery, bowel obstruction, or middle ear surgery, trauma, or recent history of the same.

5.1.2. Present or recent history of increased intraocular pressure, increased intracranial pressure, emphysema or pulmonary hypertension.

5.1.3. Current vitamin B12 deficiency unless initiation of treatment/supplementation can be established.

5.1.4. Unable to hold the mask independently.

5.1.5. Decreased level of consciousness.

5.1.6. Intoxicated or impaired by alcohol or drugs.

5.2. Relative Contraindications/Precautions:

5.2.1. If patient has received IV opioids in the last 2 hours, the OB Provider (physician or CNM) must give approval and place an order for initiation of N2O. Patient must have continuous pulse oximetry until 2 hours have elapsed from the most recent administration of IV opioid.

5.2.2. If an epidural is in place, an anesthesia consult is required prior to self-administration of N2O.

5.2.3. Category 3 fetal heart rate tracing.

5.2.4. Hemodynamic instability and/or impaired oxygenation (O2 saturation ≤ 94%, BP < 90/40, HR >120).

5.2.5. Upper Respiratory Infection (URI), allergic rhinitis, severe sinusitis: increased risk of nausea and vomiting.

5.2.6. Side effects such as nausea, vomiting, dizziness, dysphoria are not tolerable.

5.2.7. Caution should be used in patients where magnesium sulfate is infusing. If there is a decreased level of consciousness present and/or patient is unable to hold mask to self-administer N2O, discontinue use.

6. Equipment:

6.1. Nitrous-oxygen delivery system

6.1.1. Nitrous-oxygen delivery systems not in use will be stored in the locked medication room on L&D.

6.2. N2O tank

6.2.1. N2O tanks stored on the unit, not mounted to the nitrous-oxygen delivery systems, will be kept in a locked, controlled area where badge access is required.

6.3. Oxygen tank if wall oxygen not being utilized.

6.4. Apparatus/equipment to attach to N2O tank and wall.

6.5. Blender specifically designed to deliver only a 50/50 delivery ratio of nitrous/oxygen.

6.6. Scavenger device hooked to wall suction.

6.7. Demand valve

6.7.1. Demand valve to be kept in the medication pyxis at all times when equipment not in use.

6.7.2. RN to clean and return demand valve to the medication pyxis as soon as N2O is no longer being utilized for pain management by the patient.

7. Set-up (only completed by an obstetrical provider), education and consent for self-administration of N2O:

7.1. OB Provider to assess patient (mother and fetus) for suitability and absence of contraindications.

7.2. Prior to administration of N2O, the designated OB delivery provider will obtain informed consent and prepare the patient for potential side effects of nausea, vomiting, dizziness, drowsiness, and respiratory depression.

7.3. The OB delivery provider will set up the portable gas blender which contains a scavenging system and ensure it is properly connected and operating.

7.4. Mark the outer door to the patient room with a BLUE SIGN marked with a "N" indicating N2O use is occurring within the room.

7.5. Vital signs including blood pressure, heart rate, oxygen saturation, pain level, and fetal heart rate evaluation to occur before self-administration of nitrous oxide.

7.6. OB provider to educate patient and RN to reinforce education in use of device for self-administration.

7.6.1. Educate the laboring woman to inhale deeply approximately 30-60 seconds prior to the anticipated start of a contraction and to exhale back into the mask for several breaths or for 60 seconds after the patient determines that the nitrous is no longer necessary for that contraction.

7.6.1.1. Instruct the patient that when nearing the end of the contraction, she should breathe in room air deeply and then exhale into the mask to scavenge the remaining nitrous from her system.

7.6.2. Instruct the patient to hold the mask securely over the nose and mouth to form a tight seal. This activates a second-stage regulator and opens the flow of N2O for self-administration.

7.6.2.1. If contractions are irregular, inhalation is best timed to begin at the onset of awareness of a contraction.

7.6.3. N2O can **only** be safely self-administered by the laboring woman.

7.6.3.1. Support persons to be educated that they **absolutely cannot** assist in the delivery of N2O.

7.6.3.2. Only the patient is allowed to hold the mask up to her face.

7.6.3.3. If any visitor is found to be holding the mask to assist the patient or to be using N2O for themselves, the visitor will be asked to leave the unit and the patient may have the device removed from the room.

7.7. Instruct patient they must have assistance with ambulation (either a support person in the room or nursing staff) once N2O use is initiated; may ambulate 5 minutes after last N2O inhalation.

7.8. When using labor assisting devices such as birthing balls or the Jacuzzi tub, patient must also have support person available at their side throughout the use of these devices.

7.9. Other nonpharmacologic therapies (water immersion, psychoprophylaxis (special breathing/relaxation ie. hypnobirthing), hypnosis, and acupressure) have been used as an adjunct to N2O and may potentiate the therapeutic effect.

7.10. Use of N2O is discontinued when:

7.10.1. Patient deems side effects such as nausea/vomiting/vertigo are too severe to continue.

7.10.2. The laboring woman desires/chooses to discontinue.

7.10.3. The need for analgesia is no longer present.

7.10.4. The patient is non-compliant with self-administration instructions.

7.10.5. The patient is unable/unwilling to comply with proper exhalation into the scavenger system.

8. Documentation:

8.1. Initial vital signs including blood pressure, heart rate, oxygen saturation, pain level, and fetal heart rate evaluation.

8.2. Hourly pulse oximetry spot check.

8.3. Hourly respirations.

8.4. Vital signs and pain assessment per protocol and stage of labor.

8.5. Within Interactive View (I-View) in the Electronic Health Record (EHR):

8.5.1. Document in the LABOR band under Nitrous Oxide:

8.5.1.1. Nitrous oxide initiation date/time.

8.5.1.2. Numeric pain rating.

8.5.1.3. Perception of pain control (Well Controlled, Adequate, Not Adequate).

8.5.1.4. Response to nitrous oxide (tolerated well, nausea and vomiting, vertigo, drowsiness, respiratory depression, anxiety, restlessness, other).

8.5.1.5. Nitrous oxide discontinuation date/time.

8.5.1.6. Reason nitrous oxide was discontinued (patient no longer desires, vertigo – recurrent, persistent nausea and vomiting, evidence of maternal/fetal compromise, procedure completed, non-compliant with self-administration instructions, other).

8.5.1.7. As with all nursing documentation, notes should reflect the labor analgesia efficacy.

9. Occupational Exposure Considerations:

9.1. Dose is the critical determinant of risk from occupational exposure to N2O (strongest correlation of risk being with prolonged/repetitive exposure at levels of 500-1000 parts per million and associated with use of unscavenged N2O).

9.2. Concern about potential health results from occupational exposure to inhaled anesthetics resulted in the development of national and provincial occupational exposure limits (OELs) for specific anesthetics.

9.2.1. Per the U.S. Occupational Safety and Health Administration (OSHA, n.d.), exposure limit is 25-50 parts per million (ppm), whereas the European limit is generally set at 100 ppm (American College of Nurse-Midwives, 2010).

9.3. Animal data suggest exposure limits below these levels is not supportive of reproductive risk.

9.3.1. Levels >500 ppm have been noted as a baseline to cause toxicity.

9.3.2. Facilities at lowest risk for occupational exposure with N2O use are those that utilize scavenging systems combined with good ventilation.

9.3.2.1. Patients unable/unwilling to make full use of the scavenging system by exhaling properly back into the mask should be considered **not** candidates for continued N2O use.

9.4. The underlying cause of occupational health risk is inactivation of methionine synthase (an enzyme necessary for normal cell function).

9.4.1. With very low exposures (true of occupational exposure in general), the only substantive concern is a possible effect on human reproduction (subfecundability and increased incidence of spontaneous abortions).

9.4.1.1. Concerns about reproductive toxicity from occupational exposure to N2O levels below the 25 ppm standard are not supported by the available literature.

9.4.1.2. Studies where reproductive toxicity was apparent were in facilities where unscavenged N2O use occurred combined with poor ventilation resulting in an estimated ambient air concentration of greater than 1000 ppm of N2O.

9.4.1.3. N2O induced fertility problems occur in rats at 1000 parts per million but not at 500 parts per million or less.

9.4.1.3.1. 500 parts per million is 20 times the US OEL of 25 parts per million.

9.5. If dosimeters (N2O sensitive badges) indicate environmental exposure at greater than 25 parts per million, the work environment must be changed.

9.6. Efforts to accommodate for staff members in their first trimester of pregnancy should occur if they choose not to be in the room with N2O in use.

10. Additional Considerations:

10.1. Cleaning and Return to Proper Storage:

10.1.1. After the equipment is removed from the patient room, it must be wiped appropriately with purple wipes before being returned to the medication room.

10.1.2. A bag must be placed over the top of the nitrous machine to indicate it is clean.

10.2. Tank Management:

10.2.1. Monitor tanks for empty:

10.2.1.1. Nitrous lines should never be bled (ie. Do not allow the patient to continue to breathe nitrous after the tank has been turned off).

10.2.1.2. The nitrous pressure meter should always be in the green zone.

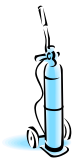
10.2.1.2.1. If not in the green zone, consider that the line has either been bled as described above, the tank is empty, or there may be a leak.

10.2.1.2.2. If there is suspicion of a leak, the tank should be removed from service, a biomed work order placed, and the nitrous delivery system taken to biomed.

Attachments:

1. N2O checklist for Providers
2. Provider Quick Set Up

Attachment 1: N2O Checklist for Providers



N2O CHECKLIST

INDICATIONS

- ☐ Antepartum: external cephalic version
- ☐ Intrapartum: active labor; prefers an alternative to IV opioid analgesia or epidural anesthesia
- ☐ Postpartum: procedures where local anesthesia may not meet all analgesic needs (e.g. manual removal of placenta; post placental IUD placement; dilation and curettage of uterine cavity; extensive perineal repair, etc.)

CONTRAINDICATIONS

- ☐ Unable to hold facemask independently
- ☐ Decreased level of consciousness
- ☐ Intoxicated or impaired by alcohol or drugs
- ☐ Documented vitamin B12 deficiency. Risk factors: chronic malnutrition; chronic alcohol abuse; anorexia nervosa; strict vegan/vegetarian diet; Crohn's disease; celiac disease; gluten intolerance; prior bariatric surgery; long-term recreational abuse of N2O (Rooks, 2011, p. 558) (Stewart & Collins, 2012, p. 404). NOTE: if B12 level is WNL from replacement therapy, N2O is not contraindicated (Stewart & Collins, 2012, p. 404)
- ☐ Impaired oxygenation, defined as O2 saturation consistently less than or equal to 94% on room air
- ☐ Category III fetal heart rate tracing
- ☐ Recent hx (within last 6 wks): trauma; pneumothorax; increased intracranial pressure; increased intraocular pressure; intraocular surgery; bowel obstruction; middle ear surgery; emphysema; pulmonary hypertension

PRECAUTIONS

- ☐ IV opioids within the last 2 hours
- ☐ Hemodynamic instability, defined as a systolic blood pressure consistently less than 100
- ☐ URI, allergic rhinitis, severe sinusitis: increased risk nausea and vomiting
- ☐ Additional/concurrent opioid may be ordered by OB provider: continuous pulse oximetry for 2 hours afterward
- ☐ Epidural in place: anesthesia consult

EQUIPMENT

- ☐ RN: Obtain demand valve and key from Pyxis
- ☐ OB provider: Attach apparatus to N2O tank and tank OR wall O2 (Nitronox)
- ☐ OB provider ensures equipment is properly connected, operating, and in good working order

EDUCATION AND CONSENT

- ☐ Informed consent signed. Possible s/e: nausea; vomiting; dizziness; drowsiness, respiratory depression
- ☐ OB provider instructs patient in use of device for self-administration. Only patient is allowed to hold mask
- ☐ Patient holds mask securely over nose and mouth. Inhale 30 to 60 seconds prior to anticipated start of contraction. Exhale back into mask
- ☐ May ambulate with assistance 5 minutes after last N2O inhalation. Water immersion, psychoprophylaxis, hypnosis, and acupressure may potentiate the therapeutic effect (Stewart & Collins, 2012, p. 402)
- ☐ Hourly pulse oximetry spot check. Vital signs per protocol

REFERENCES

American College of Nurse-Midwives: Division of Standards and Practice. (2011, August). Position Statement: Nitrous oxide for labor analgesia.

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Attachment 1: N2O Checklist for Providers (Continued)

Causes of vitamin B12 deficiency

Gastric abnormalities
Pernicious anemia
Gastrectomy/bariatric surgery
Gastritis
Autoimmune metaplastic atrophic gastritis
Small bowel disease
Malabsorption syndrome
Ileal resection or bypass
Crohn's disease
Blind loops
Diphyllobothrium latum (fish tapeworm) infestation
Pancreatitis
Pancreatic insufficiency
Diet
Strict vegans
Vegetarian diet in pregnancy
Agents that block or inhibit absorption
Neomycin
Biguanides (eg, metformin)
Proton pump inhibitors (eg, omeprazole)
Histamine 2 receptor antagonists (eg, cimetidine)
N2O anesthesia inhibits methionine synthase
Inherited transcobalamin II deficiency

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Attachment 2: Provider Quick Set Up

Provider Quick Set- Up Guide

1. Verify safety equipment is at bedside, check bags and tubing for signs of wear, crack, disconnections, and potential leakage

2. Attach suction to the wall vacuum source

3. Make sure Nitronox scavenger tube valve (black valve) is in the 6 o'clock position (9 o'clock is off) (should never be turned off unless mounted in patient room).

3. Open "in use" oxygen cylinder (check O2 line pressure gauge on Nitronox device, should be between 50-60 psi)

4. Open "in use" nitrous oxide tank (750 psi=gas in tank on E-stand regulator; if <750psi = 75% of N2O used- you have less than 5 minutes of N2O left). (Same process to check "reserve" nitrous tank- close it when done). If tank is empty, replace using a spare full tank. (Check N2O line pressure gauge on Nitronox device, should be between 50-60 psi)

4. Check O2 line gauge pressure and N2O line gauge pressure values not more than 15 psi apart
   -If more than 15 psi apart, **DO NOT USE**, send to biomed to adjust regulators

5. Check that mixed pressure gauge is in the green zone (30-35 psi)
   -if mixed pressure gauge reading more than 35 psi (or in red zone), device will whistle and should be taken out of service

6. Connect patient circuit

*To deliver 100% oxygen, disconnect or turn off N2O source and once N2O line pressure at 0, 100% O2 being delivered

*Make sure both oxygen and nitrous oxide tanks are closed after use

Troubleshooting

1. O2 line pressure and N20 line pressure more than 15 psi apart - **DO NOT USE**
   -Double check oxygen or nitrous oxide cylinder is not empty; if not,
   - Send to biomed for re-calibration

2. Mixed pressure gauge reading in the red zone (>35 psi) - **DO NOT USE**
   -Send to biomed for possible re-calibration or for them to send to manufacturer