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Owner	Lynne Frost: Clinical Program Manager RN
Policy Area	Pediatrics
Applicability	OR - Hospitals

Pediatric Nitrous Oxide Administration

PURPOSE:

Provide a safe and effective process for management of pediatric patients receiving nitrous oxide sedation while undergoing minor medical, surgical, or dental procedures.

POLICY STATEMENT:

The use of nitrous oxide (N_2O) for minimal sedation includes administration of nitrous of ≤50% with the balance as oxygen, without any other sedative, opiod, or other depressant drug before or concurrent with N_2O to an otherwise health patient in American Society of Anesthesiology (ASA) class I or II. This is administered using fail-safe equipment to ensure the capacity to deliver 100% and never less than 25% oxygen concentration at a flow rate appropriate to the size of the patient. It is anticipated the patient will be able to maintain verbal communication throughout the procedure.

The goals of minimal sedation using N_2O include:

- Guard patient's safety and welfare
- Minimize patient's physical discomfort and pain
- Control anxiety, minimize psychological trauma, and maximize potential for amnesia for patient
- Modify patient's behavior and/or movement as to allow safe completion of procedure
- Return patient to a state in which discharge from medical and/or dental supervision is safe, as determined by objective criteria

A continuum exists between minimal, moderate, and deep sedation as well as general anesthesia. One level of sedation can quickly change to a deeper level due to unique characteristics of drugs used, as well as physical status and drug sensitivities of individual patients. The patient's age and pre-existing medical conditions may significantly alter dosing requirements needed to achieve a level of minimal sedation. Administration of sedating agents requires ongoing assessment and monitoring of the patient and ability to respond **immediately** to deviations from the norm.

Whenever N_2O is administered for minimal sedation, a minimum combination of two qualified staff (QS) [one Registered (RN) and/or licensed independent practitioner (LIP) administrator] ***AND*** one additional

person whose responsibility is to monitor appropriate physiologic parameters and assist in any supportive or resuscitation measures **must be present at patient's bedside during administration of sedation and may not leave patient unattended:**

- Both administrator and monitor have:
  - Current verified competency training in administration of N_2O
    - *Nurse Administered Nitrous Oxide Competency* (Attachment A)
    - *Respiratory Therapist Administered Nitrous Oxide Competency* (Attachment B)
  - Current PALS certification
  - Skill set to safely administer N_2O using fail-safe equipment
  - RNs complete

NOTE: If N_2O administration unintentionally progresses to a deeper level of sedation than anticipated, appropriate measures are immediately taken to return patient to intended level of minimal sedation.

A protocol for immediate access to back-up emergency services shall be clearly outlined prior to N_2O administration.

All N_2O inhalation devices will be calibrated in accordance with state and local requirements and will be compliant with the National Institute of Occupational Safety and Health Standards for the scavenging of waste gases. Delivery systems include those that provide a fixed concentration of N_2O with oxygen or wall-mounted piped N_2O and oxygen that permits increasing concentrations of N_2O from 0 to 70 percent. Essential safety features include the following:

- Automatic cutoff of N_2O if oxygen delivery fails
- Emergency oxygen override
- Maximum N_2O delivery limit of 70 percent
- Color-coded tanks with different pin assemblies to attach to the delivery system so that practitioners cannot mistake an N_2O tank for an oxygen tank
- Proportional delivery of N_2O with oxygen
- Recovery of patients with a high concentration of oxygen (oxygen washout) to prevent diffusion hypoxia
- Adequate scavenger systems to prevent excessive occupational exposure to medical personnel

POLICY INCLUSION:

This policy is effective in all care/service areas where administration of N_2O to patients ≥ 6 months to <18 years of age is authorized within the documented departmental scope of services and is equipped to manage emergency and rescue situations, as seen in the:

- Pediatric Intensive Care Unit
- In-Patient Pediatric Unit
- Emergency Departments
- Surgical Departments
- Hospital-Based Diagnostic Imaging
- Hospital-Based Procedural Areas

NOTE: Because the demand-valve mask used during administration of N_2O requires cooperation and may be difficult to activate by smaller children, N_2O is used primarily in patients older than four years of age. Continuous delivery systems (a mask strapped over the nose and/or mouth) have been used in younger children with variable success, but is more frequently associated with emesis than the demand-valve technique.

POLICY EXCLUSIONS:

Because the likelihood of progressing into moderate or deep sedation increases when N_2O is combined with other sedating medication, or if N_2O is used in concentrations >50%, the likelihood of inadvertently obtaining a deeper level of sedation increases. In these instances, moderate and/or deep sedation policies and procedures may need to be applied in place of this policy and procedure.

This policy is is not applicable to patients:

- < 6 months of age;
- with an ASA of ≥3;
- with a past medical history highly suggestive of experiencing sedation complications (such as apnea, prematurity, anatomic airway abnormalities, or moderate to severe tonsillar hypertrophy);
- Experiencing nausea and vomiting;

Absolute Contraindications Include:

- Untreated pneumothorax
- Bowel obstruction
- Air embolism
- Recent myringotomy (2 weeks)
- Severe bullous emphysema
- Maxillofacial injuries with potential trapped gas
- Penetrating injury to eye
- Intraocular surgery (involving injected gas in the last 10 weeks
- Recent air embolism (last 48 hours)
- Craniotomy in past three weeks unless imaging shows no free air
- Methylenetetrahydrofolate Reductase (MTHFR) deficiency (homocystinemia/vitamin B 12 pathway)
- Severe lung disease requiring supplemental oxygen
- Decompression sickness within last 24 hours

Relative Contraindications Include:

- Increased intracranial pressure
- Impaired level of consciousness
- Pregnancy (increased risk of pregnancy)
- Vitamin B 12 deficiency
- Treatment with bleomycin
- Intoxication with drugs or alcohol

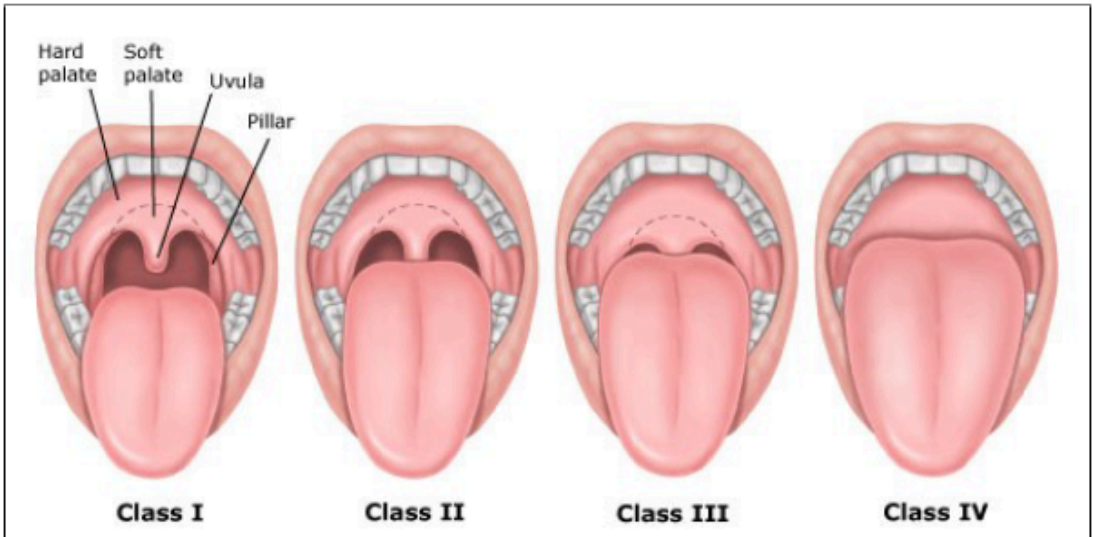
NOTE: Potentially pregnant medical personnel should be excluded from participating in N_2O administration.

DEFINITIONS:

American Society of Anesthesiologists (ASA) Classifications:

- **ASA 1:** Normal healthy patient
- **ASA 2:** Patient with mild systemic disease
- **ASA 3:** Patient with severe systemic disease
- **ASA 4:** Patient with severe systemic disease that is a constant threat to life
- **ASA 5:** Moribund patient who is not expected to survive without the operation
- **ASA 6:** Declared brain-dead patient whose organs are being removed for donor purposes

EHR - Electronic Health Record
Fail-safe equipment - A valve on the nitrous unit's flowmeter which opens to allow nitrous flow only when there is flow of oxygen to the system. Anytime the oxygen flow is less than 25%, nitrous stops flowing. This feature prevents the potential delivery of 100% nitrous oxide.
LIP - Licensed Independent Practitioner
Mallampati Classification:



- Class I : Uvula, fauces, soft palate, pillars visible.
- Class II : Uvula, Soft palate, fauces visible.
- Class III : Base of uvula visible, Soft palate, .
- Class IV : Only hard palate visible

Minimal Sedation (Anxiolysis) - A drug-induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected.
MTHFR - Methylenetetrahydrofolate Reductase
N_2O - Nitrous Oxide
PALS - Pediatric Advanced Life Support
POC - Point of Care
Qualified Staff - RN, LIPs, RTs with:

- Current verified competency training in administration of nitrous oxide

- Current PALS certification
- Knowledge and skill set to safely administer N_2O using fail-safe equipment

RN - Registered Nurse
RT - Respiratory Therapist
SOAPME: Acronym used to summarize appropriate equipment and supplies to have available to safely perform procedural sedation and analgesia which includes Suction, Oxygen, Airway, Pharmacy, Monitors, & Equipment
VS: Vital Signs include:

- Temperature
- Respiratory Rate (RR)
- Heart Rate (HR)
- Blood Pressure (BP)
- Oxygen Saturation (SpO2)

PROCEDURE:

Pre-Administration Equipment Check:

Qualified staff from sedation team:

- Reviews and completes all steps listed in the *Nitrous Oxide Machine Safety Checklist* (Attachment C). **Note:** The *Nitrous Tip Sheet with Pictures* (Attachment D) is a helpful resources which includes step-by-step photos how to complete the necessary safety check prior to administration.
- Verifies a protocol for immediate access to back-up emergency services is clearly outlined
- Verifies equipment required and/or immediately available using the "*SOAPME*" acronym including:
    - **S** = Suction - functioning suction and appropriately sized suction catheters
    - **O** = Oxygen - supplemental oxygen and appropriate delivery system (tubing, face mask, bag-valve mask, & nasal cannulas)
    - **A** = Airway - airway equipment including oral airways, nasophayrngeal and oropharyngeal airways,laryngeal mask airways, laryngoscopy blades, endotracheal tubes, & stylets
    - **P** = Pharmacy - all the basic drugs needed to support life during an emergency. Reversal agents are to be at the patient's bedside prior to beginning the procedure.
    - **M** = Monitors - pulse oximeter with appropriate sized probes, end-tidal carbon dioxide monitor, blood pressure cuffs, and other monitors as appropriate for the procedure
    - **E** = Equipment - equipment to dispense medications, including IV supplies, and any special equipment or drugs for a particular case
    - **NOTE:** Emergency Life Support Cart (Broselow Cart) with defibrillator and intubation supplies is immediately available

LIP & RN Patient Assessment, Administration, & Monitoring:

The LIP responsible for overseeing sedation will document in the electronic health record (EHR) pre-sedation/ procedure assessment, including:

A. History, including:
    1. Age
    2. Past medical history including:

a. Comorbities/abnormalities of major organ systems
b. Prematurity
c. Obstructive sleep apnea
d. Anatomical airway problems
e. Congenital syndromes
f. Respiratory disease

3. Past surgical history
4. Recent illnesses

B. Physical exam, including:
1. Vital signs (VS) taken with 30 minutes prior to the beginning administration of N_2O
2. Weight in kilograms
3. Mental status
4. Pulmonary examination
5. Cardiovascular examination
6. Airway assessment, including Mallampati Classification
7. ASA Classifications
8. **NOTE:** Patients with an ASA score of ≥ 3, special needs, anatomic airway abnormalities, or moderate to severe tonsillar hypertrophy present issues requiring additional and individual consideration for increased risk of obtaining a deeper level of sedation and/or experiencing complications, thus preparation to follow the PHS *Moderate or Deep Procedural Sedation* policies is anticipated.

C. Previous patient anesthesia experience
D. Problems pertaining to cooperation and pain tolerance
E. Family anesthesia experience
F. Medications
G. Allergies
H. Any pertinent diagnostic data
I. Pregnancy status, when applicable
J. **NOTE:** Children with developmental disabilities; younger than 6 years of age; with relevant diseases, physical abnormalities (including genetic syndromes), neurological impairments; with obesity and/or a history of snoring or obstructive sleep apnea; history of seizures; and history of prematurity are at greatest risk maintaining a patent airway or experiencing apnea during or following the sedated procedure.
K. **NOTE:** RNs may choose not to administer nitrous oxide to any patient based on their pre-assessment. The LIP is then notified. RNs may solicit LIP input at any time.
L. LIP order for nitrous oxide sedation must be obtained prior to nitrous oxide administration using the ordering code RT5024 .

Qualified Staff	Steps	Supplemental Guidance
RN, LIP	**PATIENT SELECTION CRITERIA:**	• Clinical status: ASA status I or II.

	Select patient for N_2O administration based on: • Patient's level of cooperation • Clinical status • Age • Anticipated level of anxiety • Presence of contraindications	• Age: patient is ≥ 6 months and < 18 years. • Anxiety: Patient is experiencing fear, anxiety, or distress over medical procedures or past medical procedures.
RN	Perform a pregnancy Point of Care (POC) urine dip stick on all female patients of menstruating age prior to any procedure with sedation.	If patient or legal guardian declines, consult LIP.
LIP	**INDICATIONS:** Consider N_2O for procedures which will likely cause mild-moderate pain and/or produce anxiety and distress, including but not limited to: • Urologic imaging • Foley catheterization • Intravenous (IV) insertion, PICC insertion • Wound care, suturing • Lumbar puncture • Fracture reduction • Nasogastric (NG) tube placement • Joint injection • IM/Vaccine administration • Pelvic examination • Minor laceration suturing • Abscess incision and drainage	It is acceptable to administer N_2O with a topical or injected local anesthetic.
RN, LIP	**CONTRAINDICATIONS:** **Absolute contraindications:** • Untreated pneumothorax • Bowel obstruction • Air embolism • Severe bullous emphysema • Maxillofacial injuries with potential trapped gas • Intraocular surgery (involving injected gas in the last 10 weeks) • Craniotomy in past three weeks unless imaging shows no free air	Absolute contraindications include any condition where air may be trapped in the body. Use of N_2O/oxygen combined with other sedatives falls into the category of moderate sedation. Additional monitoring and LIP presence requirements found in procedural sedation apply according to policy. If there is a question that the patient may require sedation in the moderate sedation category, consider standard hospital NPO guidelines for elective procedures to allow deeper levels of sedation if needed.

	• Methylenetetrahydrofolate Reductase (MTHFR) deficiency (homocystinemia/vitamin B 12 pathway) **Relative contraindications**: • Increased intracranial pressure • Impaired level of consciousness • Pregnancy • Vitamin B 12 deficiency • Treatment with bleomycin • Intoxication with drugs or alcohol **Single-Agent sedative**. Use N_2O as a single-sedative agent. If the influence of other sedative agents is a possibility, notify the LIP and administer N_2O under moderate sedation guidelines. **NPO considerations**. There are no fasting requirements for minimal sedation. It may be prudent to instruct families to restrict their child's oral intake to a light meal, at most, prior to a schedule procedure.	
RN, LIP, RT	**EQUIPMENT:** 1. Use fail-safe N_2O/oxygen delivery equipment which is incapable of delivering less than 25% oxygen. 2. A scavenging system must be used. 3. Use of disposable nose or face mask with sedation circuit. 4. Broselow code cart must be readily available. 5. Pulse oximeter with audible alarms	
RN, LIP	**PRE-ADMINISTRATION:** 1. Verify LIP order. 2. Initiate teaching. Utilize child life if available for teaching/preparation. Educate patient and family about the expected sedative effects and potential side effects including risks, benefits, and alternatives. 3. Obtain verbal parental consent/ patient assent and document consent was given.	Utilize the Nitrous Administration order code RT5024. Utilize teaching guide: *Nitrous Oxide Administration: A Parent's Information Guide* (Attachment E). Minimal sedation is covered under the general hospital consent for treatment an no additional written consent for nitrous oxide as a single agent is required. Check connection of hoses, tank PSIs, operational scavenging system, and fail-safe mechanism

	4. Complete checklist for contraindications. 5. Check equipment. 6. Perform a "time out" and document in the nitrous oxide flowsheet. **CAUTION**: Family members and/or caregivers who are or may be pregnant are asked to remain outside of the room to avoid environmental exposures. Do not manually collapse the bag or remove the mask during administration to achieve desired levels of anxiolysis.	
RN, LIP, RT	**ADMINISTRATION:** 1. Place child on pulse oximeter with audible alarms 2. Begin administration of 100% oxygen with appropriate volume to inflate and collapse bag with each breath. 3. Place face mask on patient to obtain good seal. 4. Begin administration of N_2O at 40-50% with oxygen as the remaining gas.	Set SpO2 alarm at 90%. Do not squeeze the bag to administer nitrous oxide, adjust dosage by using the flowmeter.
RN, LIP, RT	**ONGOING ASSESSMENT OF SEDATION:** 1. Titrate N_2O by 5-10% increments to keep the child at a level of minimal sedation and able to respond to verbal commands. If Nitrous concentrations >50%, moderate sedation guidelines may need to apply due to the increased risk of inadvertently reaching a deeper level of sedation then anticipated. 2. Continually assess by direct observation for signs of: • Adequate sedation • Over sedation • Under sedation • Minor to serious adverse events of sedation • Sedation failure	If the child becomes over-sedated or experiences adverse events of sedation, administer 100% oxygen until recovery. **Signs of adequate sedation (anxiolysis):** • Tingling sensation of hands and feet • Warm over chest, cheeks or face • Feeling of floating **Signs of over sedation:** • Agitations, excessive movement • Diaphoresis • Nausea, vomiting • Asleep, unable to respond to verbal commands **Signs of under sedation:** • Crying, combative, tense • FLACC or pain scale greater than 5

		Serious adverse events: • SpO2 less than 90% • Bradycardia • Apnea, stridor • Pulmonary aspiration • Laryngospasm, bronchospasm • Cardiovascular instability • Unplanned admission to PICU • Unplanned admission of outpatient **Minor adverse events:** • Nausea, vomiting • Diaphoresis, pallor • Crying or agitation • Dizziness, hallucinations, hiccups
	CAUTION: The possibility of reaching a deeper level of sedation than expected does exist. If a patient reaches a lever of moderate sedation, policies regarding moderate sedation apply. • HR, RR, BP, Pulse oximetry, nitrous concentration and sedation level are documented every five minutes until the patient returns to baseline Ramsey Score using the *Ramsey Scale* (Attachment F).	
RN, LIP, RT	**PATIENT MONITORING:** 1. The RN/LIP/RT administering nitrous oxide is primarily responsible for monitoring the patient. Another provider is required to perform any associated procedure(s). 2. Oxygen saturation is continuously monitored throughout the procedure. 3. Record N_2O concentration, pulse oximetry, and level of sedation at the onset of administration, and with any change in nitrous concentration throughout administration and recovery.	
RN, LIP, RT	**RECOVERY:**	Oxygen administration will quickly reverse the effects of N_2O, minimize the risk of diffusion

	1. At the completion of procedure administer 100% oxygen via face mask for 2-5 minutes following discontinuation of N_2O. 2. Continue observational monitoring and pulse oximetry until patient has achieved a level of stability appropriate for transfer to an inpatient room or discharge home.	hypoxia, and limit environmental exposure from the child exhaling into the room.
RN, LIP, RT	**DOCUMENTATION:** Document on the *Nitrous Oxide Administration Flowsheet* (Attachment G) • Location of the procedure • Type of procedure • ASA status • Record the concentration of nitrous administered and pulse oximetry and level of sedation with any change in concentration. • Beginning and end time of administration • Recovery time with 100% oxygen • Adverse events of sedation • Sedation failure	Document adverse events during the sedation period, interventions required and patient response.

SUPPLEMENTAL INFORMATION:

Equipment check - The equipment will be checked before each administration by the RN, LIP or RT administering the nitrous for leaks, tank psi, connections and functional scavenging. BioMed checks tubings, tanks, connections, potential leaks and function of equipment every 6 months.
Equipment storage - When not in use, equipment is stored in a locked and secured area.
Safety measure - Campus safety officer to do periodic dosimeter/environmental testing.
NOTE: *Nitrous Oxide Tips & Tricks* (Attachment H) is an additional resource the sedation team can reference as needed.

CROSS REFERENCES:

PHS Oregon Region *Deep Procedural Sedation for Pediatric Patients* Policy
PHS Oregon Region *Moderate Procedural Sedation for Pediatric Patients* Policy
PHS Oregon Region *Procedural Sedation Credentialing for RNs* Policy

REFERENCES:

Cote, C.J., Wilson, S., & American Academy of Pediatrics & American Academy of Pediatric Dentistry (2019). Guidelines for monitoring and management of pediatric patients before, during, and after sedation for diagnostic and therapeutic procedures. *Pediatrics*, 143(6), 1-31. Available at

https://pediatrics.aappublications.org/content/143/6/e20191000#BIBL
Cravero, J.P., & Robeck, M.G. (2019). *Pharmacologic Agents for Pediatric Procedural Sedation Outside of the Operating Room.* Available at https://www.uptodate.com/contents/pharmacologic-agents-for-pediatric-procedural-sedation-outside-of-the-operating-room?search=nitrous%20oxide%20in%20children&source=search_result&selectedTitle=3~144&usage_type=default&display_rank=2
Cravero, J.P., & Robeck, M.G. (2019). *Selection of Medications for Pediatric Procedural Sedation Outside of the Operating Room*. Available at https://www.uptodate.com/contents/selection-of-medications-for-pediatric-procedural-sedation-outside-of-the-operating-room?search=nitrous%20oxide%20in%20children&source=search_result&selectedTitle=5~144&usage_type=default&display_rank=4
Tobias, J. (2013). Applications of nitrous oxide for procedural sedation in the pediatric population. *Pediatric Emergency Medicine*, 29(2), pp. 245-65.

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REVIEWED & APPROVED BY:

Oregon Regional Children's Services Operations Council
Oregon Regional Children's Services Quality Assurance Committee
Oregon Regional Emergency Department Collaborative Committee

Attachments

Attachment A: Nurse Administered Nitrous Oxide Competency.pdf

Attachment B: Respiratory Therapist Administered Nitrous Oxide Competency.pdf

Attachment C: Nitrous Oxide Machine Safety Checklist.pdf

Attachment D: Nitrous Tip Sheet with Pictures.pdf

Attachment E: Nitrous Oxide Parent Education Guide.pdf

Attachment F: Ramsay Sedation Scale.pdf

Attachment G: Nitrous Oxide Administration Flowsheet.pdf

Attachment H: Nitrous Oxide Tips & Tricks.pdf

Approval Signatures

Step Description	Approver	Date
ONLC/Nurse Executives	Jennifer Gentry: Chief Nursing Officer PPMC	06/2020

ONLC/Nurse Executives	Jennifer Burrows: Chief Clinical & Nursing Ofcr	06/2020
ONLC/Nurse Executives	Melissa Burns: Coo/Cne	03/2020
ONLC/Nurse Executives	Rebecca Kopecky: Chief Nursing Officer	02/2020
ONLC/Nurse Executives	Patricia Heck: Chief Nursing Officer	02/2020
ONLC/Nurse Executives	Jennifer Culbertson: Chief Nsg Exec-Nsg Admin	02/2020
ONLC/Nurse Executives	Meredith Gould: Chief Nursing Offcr Pstvc Int	02/2020
ONLC/Nurse Executives	Lisa Halvorsen: Chief Nursing Officer	02/2020
Regional Director Nursing Practice Quality	Mary Waldo: Reg-Nsg Practice/ Qual Dir	02/2020
Regional Children's Executive Quality Council	Lynne Frost: Reg Prog Mgr-Clin Stand Childr	02/2020
Regional Children's Services Clinical Operations Council	Lynne Frost: Reg Prog Mgr-Clin Stand Childr	02/2020