The need for sedation and anesthesia care for pediatric patients in non-O.R. locations has increased significantly during the past decade.\(^1\) It is not uncommon for such children to represent anywhere from 10 to 24 percent of the daily case load, as noted by Campbell and associates.\(^1\) Without psychological and other non-pharmacological interventions, pediatric patients are unlikely to cooperate and lay still even for non-painful diagnostic MRI procedures unless the procedures are brief, as during a CT examination.\(^2,3\) Thus, procedures outside the traditional O.R. requiring anesthesia care could be simple and straightforward, like performing an MRI in an otherwise healthy child, or as complex as a CT-guided ablation of a tumor in the prone position in a child with multiple co-morbidities. Although the care delivery models for pediatric NORA can be different, this report will discuss one such model and emphasize the essentials and safety measures that need to be in place whenever anesthesia care is provided at any site.

Figure 1 provides a summary of an example of the flow of pediatric patients destined for non-O.R. procedures and the differences in resources available in a regular O.R. suite versus the pediatric procedure unit and other non-O.R. locations. The diagram also illustrates a method of flow of children requiring NORA care and lists some of the procedures commonly performed outside the O.R. Not included are procedures done at the bedside in neonatal and pediatric intensive care units (NICU/PICUs). Many pediatric NORA patients will report directly to the pediatric procedural unit (PPU); however, anesthesia care providers have to be prepared to transport pediatric patients offsite either from a regular O.R. or from a patient care unit in a hospital. This includes the PICU/NICU.

The PPU, which may also be referred to as the pediatric sedation unit (PSU), has limited human resources when compared to the regular O.R. suite, as noted in the figure. Many procedures are typically scheduled to be done in the PPU; others are scheduled either in radiological or radiation therapy and cardiac catheterization suites. Depending upon frequency and case load, the interventional radiological and cardiac catheterization suites should be equipped with anesthesia equipment, including an anesthesia delivery machine, a cupboard dedicated to anesthesia supplies and a secure portable pharmacology unit (e.g., an anesthesia Pyxis\(^®\)). Infants, children and adolescents scheduled from medical units will typically return to their units after recovery has been established, unless they are from either the PICU or NICU.

Families, and parents, including Child-Family Life specialists, play a critical role in the care of children during NORA when they report from home or medical units to the PPU. Non O.R. induction areas need to be equipped similar to induction in an O.R. A dedicated video laryngoscope and access to a difficult airway cart needs to be available. Similarly, access to a malignant hyperthermia (MH) kit to treat the rare occurrence of acute MH should be ensured. There should be the ability to treat an emergent pediatric crisis. For this,
Figure 1: Peds NORA – An Example of Patient Flow and Areas Covered

Figure 2: Peds NORA Case Example

Interventional Radiologist Schedule Otherwise Healthy 4-year-old for Sclerotherapy of Vascular Lesion Behind the Neck Area

- H&P reviewed the day before and NPO instructions provided
- Communication with radiologist indicates intralesional bleomycin will be used
- Child will require GA with endotracheal intubation – procedure in prone position
- Besides other side effects, bleomycin induces significant discoloration of skin
- Using tape and sticky electrodes increases risk of protracted discoloration in areas exposed to tape
- Be prepared to use the “IR bleomycin protocol” – tape-free care with eyes padded and a wrap around the head; minimize O₂ use
the Pedi Crisis App® – made available as a courtesy from the Society for Pediatric Anesthesia – is helpful to allow quick review and care for most pediatric commonly encountered emergency situations that may arise. The app can be easily downloaded and customized for each center.

Since the anesthesia care team is isolated from other expert anesthesia help, a special code blue button in all the non-O.R. locations needs to be available to emergently summon additional anesthesia expertise without initiating a system-wide code blue response. Caring for pediatric NORA should be no different from caring for pediatric patients requiring anesthesia care in the O.R. (see Table 1). Thus, all pediatric NORA patients need to have a comprehensive preanesthetic evaluation and a discussion with the proceduralist/diagnostician so the team can be thoroughly prepared for the upcoming anesthesia care and ensure that all needed items are available. For example (as illustrated in Figure 2), patients requiring bleomycin sclerotherapy in interventional radiology will require a low FiO₂, needle EKG electrodes, and non-adhesive methods to protect the eyes, secure an I.V. catheter, pulse oximetry probe and endotracheal tube/LMA (if employed) so as to avoid toxicity and side-effects related to bleomycin. Thus, communication and teamwork are key to successful pediatric NORA. The discussion should also include the child’s position during the procedure and whether there will be a need for controlled ventilation, breath-holds and any other specific requirements. This will all be necessary to properly plan the pediatric NORA care.

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**Table 1: The Pediatric Procedural Unit – Special Peds NORA Essentials**

| Access to ultrasound technology (for I.V. access) |
| Access to difficult airway cart |
| Dedicated video laryngoscope |
| Access to MH Rx kit |
| Access to Pedi Crisis App |
| Access to Anesthesia Code Blue |
| Access to monitored and equipped transport cart |
| Availability of Child-Family Life services |
| Other items based upon procedure |
| Access to a portable pharmacology unit (Pyxis®) |
| Availability of intraosseous needle access system |

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**Figure 3: Peds NORA - some challenges**

- Need monitored and equipped patient transport cart
- Preparedness to handle common and rare problems
- Have available:
  - self-inflating ambu® bag
- Be prepared to intubate

**Laryngospasm**

- Most common respiratory problem
- Deep extubation/LMA removal does not prevent
  - 80% handled with simple maneuvers
  - 20% require rapid response
- URI/obesity predispose
- Topical and I.V. lidocaine help
- Early Rx is best

**When sedated with a native airway:**

- Avoid light planes of anesthesia
- Ensure absence of upper airway obstruction

Be prepared to provide CPAP via face mask
As shown in Figure 2, a 4-year-old child is scheduled in the interventional radiological suite. Having received appropriate instructions, the child reports to the PPU on the day of the procedure. The Child-Family Life specialist and sedation nurses prepare the child and establish a peripheral I.V., using a needleless “J-tip system” for local anesthesia of the skin. Anesthesia induction and endotracheal intubation are done with the parents present in the interventional radiology suite. Measures to prevent bleomycin-related issues are taken during anesthesia care in the prone position. After the procedure, the child is transported to the PPU for recovery and discharge.

During pediatric NORA, anesthesiologists need to be prepared to treat rare and common problems encountered (Figure 3). One such problem is the occurrence of laryngospasm, especially when children are sedated with a native airway and being transferred from a transport bed to the procedure table. A bag, mask and positive pressure airway capability with oxygen should be available. Being prepared with the proper monitoring and equipment, like a portable Mapleson D system, is important. Thus, portable monitoring should be used at all times, and commonly used anesthesia medications should be immediately available for quick administration when required.

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In summary:
1. Evaluate your pediatric patient, be aware of the child's health care issues and have a discussion with the proceduralist so you are prepared.
2. Ensure that proper monitoring, resuscitation and transportation capabilities are available.
3. Be familiar with caring for common problems like laryngospasm, know how to use the Pedi Crisis App if needed and have quick access to additional drugs (e.g., succinylcholine and, in the rare instance, dantrolene) if needed.

References:

Figure 4 is another example of a baby requiring deep sedation in a remote radiation therapy suite. The room has piped oxygen, air, suction, ventilatory capabilities (face mask, intubation set up, self-inflating ambu bag and a portable Mapleson D system) and an induction bed with a portable monitor. The baby arrives to this suite with parents after being received, evaluated and prepared with IV. access in the PPU. After successful treatment, the baby returns to the PPU and is discharged upon meeting criteria.

Figure 4: The baby shown below is undergoing radiation therapy. The patient is on a floor bed, deeply sedated with propofol and breathing spontaneously with proper positioning of the head and neck while being continuously monitored (ETCO₂, SPO₂, EKG, BP as seen in the monitor). During the radiation application, the baby is monitored via telemetry.