Introduction to pediatric pharmacy practice: Reflections of pediatric practitioners

Each year, many pharmacy students and new practitioners embark into one of the more feared rotations of the advanced pharmacy practice curriculum: pediatrics. This hesitation may stem from a fear of the unfamiliar. In fact, the mean time in doctor of pharmacy didactic curricula devoted to pediatric topics is 17 hours (range, 2.8–52.8 hours) including elective courses. Yet many pharmacists will be involved in the care of pediatric patients, regardless of their chosen practice site. Ranelli et al. found in a recent survey of pharmacists that 87% of respondents (170/195) reported filling a prescription for a pediatric patient on a daily basis. The purpose of this article is to provide the pharmacy student or new practitioner with basic principles of pediatric pharmacy practices, tips for interacting with pediatric patients, and an overview of drug information sources available for pediatric pharmacists from the perspective of four former postgraduate year 2 pediatrics pharmacy residents.

Basic principles.

There are several key points that pharmacy students and new practitioners should be aware of before beginning any pediatric pharmacy practice experience. The first and arguably most important is that a child is not a small adult. Children exhibit variations in demographics associated with pediatric practices, such as variations in rate of metabolism and clearance. The demographics associated with pediatric patients can also be misleading. While the common misconception is that pediatric patients can also be misleading. While the common misconception is that pediatric patients ends at age 18, Buck suggested that there is no absolute age at which a patient may receive pediatric doses. While there is no general rule, current practice indicates that until a patient weighs 40 kg, he or she should be given doses appropriate for pediatric patients.

Important principles govern weight-based dosing in pediatric patients. The majority of drug information sources for pediatric patient care provide dosing recommendations using weight-based dosing guidelines. Practitioners must verify that the weight used for dosage calculations is recent and is in kilograms versus pounds when provided in a written or oral format. This will help avoid errors in dosage calculations. When calculating a dosage for a child, remember that the dosage calculated should not exceed a typical adult dosage without having literature or other guidelines to support the higher dosage. This is particularly important when determining dosages for certain medications administered by continuous infusion. Such medications are frequently dosed as units per kilogram per unit of time in children. In overweight children and adolescent patients, it is often helpful to calculate how much medication a child is receiving in total and compare that dosage to the typical adult dosage.

Pharmacists should always be mindful of drug administration issues that could be encountered in pediatric patients. For example, the majority of two-year-old patients cannot swallow tablets or capsules, and many formulations cannot be opened or crushed before administration, which often requires pediatric practitioners to identify other methods of medication delivery (e.g., compounding transient preparations, obtaining other preparations or therapeutic alternatives). Product taste is also a concern. The practitioner may opt for innovative measures to ensure that children will be able to take medications, including incorporation of flavoring agents, bribery, distraction techniques, and masking techniques (e.g., applesauce). Finally, the volume of the medication administered must also be considered. Practitioners should try to use a concentration of a medication that provides the easiest measurable dose but does not exceed the volume that the child can ingest in one or two swallows, especially if the medication has poor palatability. Such administration issues may affect the use of the best medication in pediatric patients.

Patient monitoring can also be challenging while caring for pediatric patients. Many pediatric patients cannot reliably communicate complaints or effectively understand what the practitioner is asking. Practitioners should be familiar with different approaches to pa-
tient monitoring. Alternative approaches include various pediatrics pain scales, nonoral assessment of medication withdrawal, drug toxicity (e.g., hyperkalemia with digoxin), and other signs and symptoms of infection and dehydration.

The practice of pediatric pharmacy should be considered more of an art than a science. There will be many times when there is a lack of primary, evidence-based literature to support or refute an approach to a patient, a dosage used, or the appropriateness of a recommended regimen. Often, the best sources for drug information are seasoned pediatrics practitioners. Careful consideration should also be paid to the knowledge and patient-specific care that the parents or guardians of a patient bring to the discussion because they usually know their child best. Practitioners must use their best clinical judgment and be willing and prepared to defend their decisions.

**Interacting with pediatric patients.**

Pediatrics pharmacists should not be afraid to say that they do not know the answer to a question. There are few evidence-based guidelines for disease states observed in pediatric patients. It is important to use professional contacts including former or current residents, preceptors, faculty, and members of professional organizations (e.g., the Pediatric Pharmacy Advocacy Group, the Pediatric-PRN through the American College of Clinical Pharmacy). Other pediatric pharmacy professionals may often be the best source of reference and practical experience.

Pediatrics pharmacists should try to avoid routes of administration that inflict pain. They should be familiar with methods used to decrease pain associated with drug administration or blood collection (e.g., a local anesthetic cream, injection admixture with lidocaine) that can be conveyed to the medical team.

Know the opposites. In very young patients, both increased fussiness and lethargy can indicate illness, as can elevated and decreased white blood cell counts as well as fever and hypothermia. Similarly, for example, while most pneumonias in children are caused by viruses, be prepared to treat the case that is not.3

Pediatrics practitioners need to know their pharmacokinetics. A review and understanding of the basics are often key to a successful pediatrics experience. Pediatric patients have maturing rates and routes of drug metabolism and clearance. For example, thinking of infants as little sacks of water will help to explain the larger volume of distribution that is often encountered.4 Since the Cockcroft–Gault equation will not serve pediatrics practitioners in most cases, they should explore other options for estimating renal clearance (e.g., Schwartz equation). They should also keep in mind that an appropriate urine output for a pediatric patient usually exceeds 1 mL/kg/hr, though further assessment is indicated if the patient is receiving diuretic therapy.5 Pediatrics practitioners should always ask themselves when assessing serum drug levels if the level and dose make sense. If they do not, investigate why the level or dose appears incorrect.

Communicating with children is challenging. However, pharmacists should remember to counsel both the primary caregivers as well as the child. Familiarize yourself with the cognitive stages of development in children to know what types of information to provide to them.6,9

Pediatrics practitioners are advised to be knowledgeable about pediatric nutrition issues and fluid status. They should familiarize themselves with the common nutritional products utilized at their specific institution and each formula’s caloric content. They must also be familiar with calculating the amount of calories supplied by a child’s total parenteral nutrition and nutrition administration methods. It will serve the pediatrics pharmacist well to know how to calculate a child’s maintenance fluid requirements and how medication interventions affect those requirements or limits, depending on the child’s condition. The pediatrics practitioner must also be intimately familiar with any standard drip concentrations used in the institution and how to manipulate these to the patient’s advantage.

Most parents will agree that it is best not to wake a sleeping child. Accordingly, drug concentrations are usually best assessed during wakeful hours.

The pediatrics practitioner needs to know when it is okay to round doses. It is much easier for parents to administer a dose of 5 mL than the calculated dose of 5.375 mL. Pediatrics practitioners must be aware of the various product concentrations available and double-check what is being used when recommending a therapy. It also is essential to carry a calculator to confirm dosages.

Recommendations for drug therapy in pediatric patients evolve as more experience with a particular drug or drug class is gained in this patient population. For example, while many pharmacists were taught that fluoroquinolones should never be used in children because of safety concerns, the American Academy of Pediatrics released guidelines in 2006 for their use in the treatment of certain infections.10

Pediatric patients are, for the most part, extremely resilient. As is the case with all patients, though, they deserve the utmost attention to detail when evaluating medication therapy.

Regardless of the situation, if something does not seem correct (e.g., a dose, selected therapy) then there is a good chance that something is indeed wrong. Pediatric practitioners should trust their instincts and investigate further.

Pharmacists should not be afraid of children. Although not every pharmacist is a pediatrics expert, the pharmacist remains the pharmacotherapy expert. Understanding the basic differences between pediatric and adult patients and how these differences affect drug therapy will allow for a successful pediatric experience. Using knowledge and available resources will prove helpful in all situations (appendix). Also, knowing whom to call if an answer cannot be found is the ultimate key. Although pediatrics is a demanding and, at times, stressful area of pharmacy practice, it can be extremely rewarding.

Appendix—Resources commonly used in pediatrics

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<thead>
<tr>
<th>Resource</th>
<th>Citation or Contact Information</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Children’s Hospital of Philadelphia: Extemporaneous Formulations for Oral Administration</td>
<td><a href="http://www.clinicalpharmacology.com">www.clinicalpharmacology.com</a></td>
<td>Includes extemporaneous formulation data sheets for each preparation that detail: dosage form, step-by-step preparation, storage conditions, special instructions, and expiration dates. Well referenced.</td>
<td>Not updated or published since 2003; may be difficult to obtain.</td>
</tr>
<tr>
<td>Lexi-Comp's Pediatric Dosage Handbook</td>
<td><a href="http://www.lexicomp.com">www.lexicomp.com</a></td>
<td>Updated frequently; provides reference for drug dosing; available for handheld electronic devices.</td>
<td>Requires subscription; lack of access to tables available in the book format.</td>
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You can also access these resources online:

**NeoFax**
- Telephone access only
- Updated annually; may not provide dosing recommendations for medications used infrequently in neonates; provides dosing information for neonates exclusively

**Poison Control Center**
- 1-800-222-1222
- Authoritative information in toxicological emergencies
- Telephone access only

**Red Book**
- Reported by the American Academy of Pediatrics Committee on Infectious Diseases; provides disease and treatment option overviews for various pediatric infectious diseases
- Provides limited drug dosing recommendations
- Updated periodically; no electronic form available

**The Teddy Bear Book Pediatric Injectable Drugs**
- Good reference for concentrations, dosing, and rates of intermittent and continuous intravenous medications; well referenced

The authors of this article do not endorse any particular product or reference; this table is based on practice experience alone. It is always prudent to consider policies, treatments, and protocols as they pertain to the specific institution.