Improper mixing of antibiotic suspensions is a source of medication errors in pediatric patients. In some cases, the problem has been caused by suspensions that weren’t reconstituted. The parents administered the drug as powder, which resulted in an overdose. It’s important that pharmacy technicians take an active role in making sure that pediatric suspensions are prepared and dispensed correctly. Here are some tips to help you.

**What information is needed BEFORE preparing a pediatric suspension prescription?**

- Verify patient allergy information for all pediatric antibiotic prescriptions.
- Note the patient’s current weight and date of birth on the prescription. This is because pediatric medications are dosed based on weight instead of age. Having the current weight handy will help the pharmacist quickly calculate the correct dose and detect a dose that is too high.

**How are pediatric antibiotic suspension prescriptions interpreted and entered into the computer?**

Pediatric antibiotic suspension Rxs are usually written to include the strength of the medication, dose in milligrams or other unit of measure (e.g., milliliters or teaspoonful), and the duration of treatment. Calculations may be necessary to determine the correct strength and amount of the medication to be dispensed. An example prescription with the calculations needed is listed below.

**Prescription reads as follows:**

![Prescription Image]

**Interpretation:**

This prescription is written for amoxicillin in the strength of 250 mg/5mL. The prescriber wants the patient to have 125 mg twice a day for 10 days.

**Calculation(s):**

Although the prescriber has written the prescription to indicate the number of milligrams the patient needs per dose, the caregiver will need to know the VOLUME of each dose to easily administer each dose and avoid confusion.

Some helpful conversion factors and abbreviations commonly used in pediatric suspension prescriptions are listed below:

- 1 teaspoon = 5 milliliters
- 1 tablespoon = 15 milliliters
- 1 cc = 1 milliliter
- 1 kilogram = 2.2 pounds
- t = teaspoon
- T = tablespoon
- mL = milliliter
- mg = milligram
- cc = cubic centimeter (Note that this abbreviation is considered to be unsafe and should not be used routinely because, when handwritten, “cc” can be misread as “00” or as “U” for units).
To calculate the volume of medicine needed per dose for this prescription, you can use a simple ratio as listed below:

\[
\frac{250 \text{ mg}}{5 \text{ mL}} = \frac{125 \text{ mg}}{X \text{ mL}} \quad (X = \text{unknown quantity})
\]

\[
X = \frac{(5 \times 125)}{250}
\]

\[
X = 2.5 \text{ mL}
\]

Alternatively, you could note that 125 mg is half of 250 mg, so the volume needed will also be half of 5 mL, or 2.5 mL.

You will then need to calculate the total volume of medicine needed to complete the prescription so that you can select the correct bottle size. The patient will be taking 125 mg (2.5 mL) twice a day for 10 days. Calculate the entire volume needed to dispense using the following method:

\[[\text{Volume/dose}] \times \text{[doses per day]} \times \text{[total number of days of therapy]} = \text{total dispensing volume}\]

For this patient, the calculation would be as follows:

\[2.5 \text{ mL} \times 2 \text{ doses per day} \times 10 \text{ days} = 50 \text{ mL suspension needed to complete therapy}\]

**Product Selection:**
Amoxicillin 250 mg/5mL is available in multiple package sizes. Make sure to choose the product size that is closest to the amount of suspension needed to complete therapy, and will provide at least that amount of drug. In this example, the patient would need at least 50 mLs of liquid to complete therapy. Amoxicillin 250 mg/5mL is stocked commonly in 80 mL or 100 mL bottles; either of these would be appropriate for this prescription. If it is necessary to prepare or dispense a volume greater than needed, pharmacies may reconstitute the entire amount and dispense the volume needed in a separate bottle, or dispense the entire amount and educate caregivers that there may be suspension left over that should be discarded after they have completed their course of therapy.

Remember to check the label on the stock bottle to make sure that the suspension will be stable for the full duration of therapy. If the stability of the reconstituted suspension is less than the duration of therapy, the prescription may need to be dispensed in two separate portions. For this example, the entire volume dispensed will need to be stable for at least 10 days. Amoxicillin suspensions are generally stable for 14 days after mixing, so this entire prescription can be dispensed at one time.

**Order Entry and Prescription Labeling:**
Although the prescription is written for the patient to take “125 mg twice a day for 10 days,” it is helpful to provide patients with specific dosing instructions on the prescription label to avoid confusion when administering a dose. In this case, it would be helpful to include a dose volume on the label along with an oral syringe to help the caregiver administer the correct dose. For example, the label may read as follows: “Take 125 mg (2.5 mL) by mouth twice a day for ten days.” Many pharmacies recommend visually demonstrating to caregivers how far medicine will need to be drawn up in the oral syringe to equal a 2.5 mL dose to reinforce appropriate dose measurement.

**What should be checked BEFORE mixing?**
- It is important to make sure that you have selected the RIGHT PRODUCT in the RIGHT CONCENTRATION and AMOUNT.
- Check the NDC number on the product you have selected from the shelf with the NDC number on the label to make sure that you are preparing to mix the right product.
- Many pharmacists prefer to verify/check the entire prescription before the suspension is reconstituted. This can help avoid wasting a reconstituted medicine if it is later found the patient needs a different product (e.g., wrong strength selected, patient allergy detected, etc).
• Check with the pharmacist if you are unsure about whether the product should be mixed immediately, or if it will be mixed later when the patient arrives to pick up the prescription.

**What kind of water should be used?**
Most pharmacies use distilled or purified water to reconstitute powders for suspension. Water from the tap has fluoride and other contaminants that may not be desirable. When measuring the amount of water to be added, be sure to use a measuring device that is the appropriate size. For example, a 250 mL graduated cylinder should not be used to measure 10 mL of water. Use the measuring device that is closest in size to the amount of water you need for the best accuracy.

**How should powders for suspension be reconstituted?**
- Tap and invert the bottle a few times so that all of the powder flows freely. Neglecting to do this may trap the powder at the bottom of the bottle.
- Add about one-half to two-thirds of the total amount of water for reconstitution. Shake the bottle vigorously to suspend the powder. Make sure to invert the bottle several times when mixing to ensure that powder adhering to the bottom of the bottle is mixed well.
- Add the remainder of the water to the bottle, and shake vigorously again.

**What auxiliary labels should be added?**
- **Shake well before using**
  All pediatric suspensions should have this auxiliary label. Usually, the powder in a reconstituted suspension will settle at the bottom of the bottle. SHAKING a suspension before it is used helps make sure that each dose contains the same amount of medication.

- **Take with food**
  Some medications should be given WITH FOOD. One reason for this is to help prevent stomach upset, which may be caused by the medication. Another reason is that food can affect the amount of medication absorbed in the gastrointestinal (GI) tract. An example of a pediatric suspension that should be taken with food is cefuroxime (*Ceftin*).

- **Take on an empty stomach**
  Other medications should be TAKEN ON AN EMPTY STOMACH. Food can change the amount of medication absorbed through the GI tract. A pediatric suspension that should be taken on an empty stomach is penicillin VK.

- **Refrigerate**
  Many antibiotic suspensions should be REFRIGERATED. Usually this is to improve stability of the suspension. Sometimes refrigeration helps improve taste. A pediatric suspension that should be refrigerated is cefprozil (*Cefzil*).

- **Do not refrigerate**
  Other suspensions SHOULD NOT BE REFRIGERATED. Typically, it’s because refrigeration makes the suspension hard to pour or affects the taste. An example of a pediatric suspension that shouldn’t be refrigerated is clarithromycin (*Biaxin*). Refrigeration causes the suspension to thicken, and the taste to become bitter.

Look at Detail-Document #231107 (U.S.) or #231122 (Canada) for a chart of “Pediatric Oral Antibiotic and Antifungal Suspensions and Liquids” which includes specific information on whether or not a suspension should be taken with food and storage requirements.

**When is flavoring added to pediatric antibiotic suspensions?**
Flavoring may be added to any liquid medication, and is commonly used with pediatric antibiotic suspensions. Many pharmacies use the “FLAVORx” flavoring system to add to or change the flavor of medications. When using any flavoring system, make sure to follow the manufacturer’s instructions. Some flavors may be specifically recommended to mask certain bad tastes. Additionally, medication stability upon addition of individual flavors may be tested by the commercial flavoring system or drug...
manufacturer. In some cases, certain flavor combinations may be known to affect or maintain stability and recommendations will be made based on this data. For example, prescribing information for Augmentin ES-600 states that the manufacturer has tested the stability of FLAVORx apple, banana cream, bubble gum, cherry, or watermelon flavors and notes that suspensions made with these flavors are stable for 10 days under refrigeration.

Keep in mind that different strengths or generic brands of the same medication may have different flavors. Look at Detail-Document #231107 (U.S.) or #231122 (Canada) for a chart of “Pediatric Oral Antibiotic and Antifungal Suspensions and Liquids” which includes information on flavors and palatability of pediatric antibiotic suspensions.

When should measuring devices be dispensed?

Most pediatric suspensions don’t come with measuring devices. So it’s a good idea to dispense a measuring device, like an oral syringe, with every pediatric suspension dispensed. If your pharmacy has these available for patients, be sure to include one with each pediatric suspension that you prepare. Some pharmacies also include a “stopper” that is inserted into the opening of the pharmacy bottle to make it easier to measure a dose with an oral syringe. These devices block the entire opening of the bottle except for a small hole in which the oral syringe can be inserted. Medication can then be drawn up directly from an inverted bottle by the caregiver.

Are there any special circumstances that should be considered?

Most antibiotic prescriptions are only stable for a few days or a week after they are reconstituted. Check the stability information on the bottle if a patient is being treated for an extended period of time to ensure that the mixed antibiotic will be good for the duration of treatment. For example, a child with a recurrent or hard to treat ear infection may need to take amoxicillin for 21 days, but the suspension is generally only stable for 14 days after mixing. In cases like these, a parent may need to pick up a partial prescription for a pediatric suspension and reconstitute it at a later time. Or, they may pick up the entire prescription in portions (e.g., one week at a time) to make sure that the mixed suspension is stable for the entire treatment time. Ask your pharmacist for direction, or if there’s a policy that dictates what you should do, when these situations come up.

What else can be done to prevent mix-ups?

If your pharmacy doesn’t reconstitute pediatric suspensions until someone comes to pick up the prescription, consider storing filled prescriptions for pediatric suspensions in a separate area and labeling them “NEED TO MIX” in large letters. Some pharmacies also add a colored sticker or highlight these letters to make them very noticeable. That way, it’s less likely that an UNRECONSTITUTED suspension will be dispensed. For one last check, when you’re ringing up a customer, take the bottle out of the bag and make sure that it’s reconstituted.