Pediatric Pharmacology Study Guide

The Pediatric Pharmacology Exam is required of hospital nurses (RN, LVN) hired to the following departments: Maternal/child (3 South-The Children’s Center, Mother/Baby unit, Neonatal ICU), any of the Surgical Services (pre-op, intra-op OR, recovery, day surgery, Tyler Square) MICU, SICU, ECC, and any hospital area in Jacksonville or Winnsboro.

This study guide is provided to help you prepare and it is highly recommended you review this study guide before the test date. If you review this packet and can successfully answer the math questions you should be able to successfully complete the math on the test. The remainder of the packet will assist you in successful completion of the multiple choice section.

For Additional Copies

Contact one of the following Staff Development Educators

<table>
<thead>
<tr>
<th>Education Program Specialist</th>
<th>HealthStream Administrator</th>
<th>Pediatric Nurse Educator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patricia ‘Tish’ Cline</td>
<td>Janice Miles, MSN, RN-BC</td>
<td>Amarna O’Byrne, BSN, RN, CEN, CPN</td>
</tr>
<tr>
<td>(903) 531-5865</td>
<td>(903) 531-5134</td>
<td>(903) 606-4470</td>
</tr>
</tbody>
</table>
All nurses hired by Trinity Mother Frances Hospitals and Clinics take a general pharmacology exam. The pediatric specific pharmacology exam will assess and demonstrate basic pediatric pharmacology competency of the registered nurses and the licensed practical/vocational nurses hired into an area of the hospital that encounters pediatric patients (i.e. Jacksonville, Pediatrics, Surgical Services, Emergency Care Center, and Intensive Care Unit).

The Pediatric Pharmacology Exam

- 20 multiple choice questions on topics such as weight-based calculations, PCA calculations, intravenous pump rates, medication classes and patient safety.
- **CALCULATORS ARE ALLOWED. NOTE! You may not use calculators on cell phones or PDAs.**
- Minimum score of 80% required for passing
- You may not administer medications until the test is successfully passed.

**UNSUCCESSFUL COMPLETION:** If you are unsuccessful on your completion of the pharmacology test your manager will be notified and you will not be allowed to administer any medications. You must reschedule with your staff development educator to re-test within one week and it is highly recommended that you reschedule as soon as possible within that week. **If you are contract or agency staff, the hiring manager and Human Resource will determine whether you may retest.**

**PEDIATRIC MEDICATION ADMINISTRATION:**
When administering IM immunizations ensure your injection site is appropriate for the age group of the patient and the needle length is sufficient to reach the muscle mass itself and prevent vaccine from seeping into incorrect tissue. Use a 22–25 gauge needle. See table below available at [www.cdc.gov](http://www.cdc.gov) for recommendations. Note: There are additional recommended IM sites for non-immunizations

<table>
<thead>
<tr>
<th>Birth – 18 Years</th>
<th>Age</th>
<th>Needle Length</th>
<th>Injection Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn (first 28 days of life)</td>
<td>5/8” *</td>
<td>Anterolateral thigh (Vastus Lateralis)</td>
<td></td>
</tr>
<tr>
<td>Infant 1 – 12 months</td>
<td>1”</td>
<td>Anterolateral thigh (Vastus Lateralis)</td>
<td></td>
</tr>
<tr>
<td>Toddler 1 – 2 years</td>
<td>1” to 1 ¼”</td>
<td>Anterolateral thigh (Vastus Lateralis) – Preferred</td>
<td></td>
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<tr>
<td></td>
<td>* 5/8” – 1”</td>
<td>Deltoid muscle of the arm</td>
<td></td>
</tr>
<tr>
<td>Child/Adolescent 3 – 18 years</td>
<td>5/8” – 1”</td>
<td>Anterolateral thigh (Vastus Lateralis) – Preferred</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1” – 1 1/4”</td>
<td>Deltoid muscle of the arm</td>
<td></td>
</tr>
</tbody>
</table>

* If skin stretched tight, subcutaneous tissues not bunched.

**PEDIATRIC DOSAGE CALCULATIONS:**
Most drugs in children are dosed according to weight (mg/kg) or body surface area (BSA) (mg/m²). Be cautious in converting lbs. to kg (or avoid lbs. altogether). Dosing also varies by indication. Use caution when looking up dosing to verify pediatric not adult, and indication. Many medications are available in different concentrations; always use the manufacturer’s directions for concentrations.

**KNOW THE FOLLOWING EQUIVALENCIES:**

- 1 gm = 1000 mg
- 1 oz = 30 mL
- 1 kg = 2.2 lbs
- 1 mg = 1000 mcg
- 5 mL = 1 teaspoon(tsp)

**MAINTENANCE FLUID CALCULATIONS:**

(4-2-1 Method) To get hourly rate:

- Patients weighing (0-10kg) = 4ml/kg
- Patients weighing (11-20kg) use this formula: 40ml + (2ml/kg for each kg over 10kg)
- Patients weighing (>20kg) use this formula: 60ml + (1ml/kg for each kg over 20kg)

Multiply by 1.5 to get 1 ½ maintenance rate
MEDICATION CALCULATIONS

You may work the problems by the method you choose. If you do not currently have a formula you may wish to review the following samples.

Sample Problem: Give 100 mg. The medication vial contains 250 mg/5mL. How many mL will you give?

**IF MATH CHALLENGES YOU**
**THIS MAY BE YOUR BEST OPTION**

<table>
<thead>
<tr>
<th>Dose Ordered</th>
<th>×</th>
<th>Amount on hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose on Hand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dose ordered = 100 mg  
Dose on hand = 250 mg  
Amount on hand = 5 mL

\[
\frac{100 \text{ mg}}{250 \text{ mg}} \times 5 \text{ mL} = 0.4 \times 5 \text{ mL} = 2 \text{ mL will be amount given}
\]

Alternate way to calculate (Dimensional Analysis-Method)

Question \( (x \text{ ml}) = \text{dose ordered} \times \frac{(\text{concentration available}) \text{ mg}}{\text{Per ml}} \)

Sample Problem: Give 100 mg. The medication vial contains 250 mg/5mL. How many mL will you give?

\[
x \text{ ml} = \frac{100 \text{ mg}}{250 \text{ mg}} \times 5 \text{ mL} = \frac{500}{250} = 2 \text{ mL}
\]

Sample Problem: Infuse Gentamycin 80 mg in 100 mL D5W over 50 minutes. How many mL/hr would you program the pump for?

\[
\frac{\text{mL to Infuse}}{\text{TIME (In minutes)}} \times 60 \text{ minutes}
\]

\[
\frac{100 \text{ mL}}{50} \times 60 = \frac{6000}{50} = 120 \text{ mL/hr}
\]

Alternate way to calculate (Dimensional Analysis):

\[
\frac{100 \text{ mL}}{50 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} = \frac{6000}{50} = 120 \text{ mL/hr}
\]
You may work the IV problems by the method of your choice. If you do not currently have a formula you may wish to review the following samples.

**IV Calculations**

Sample Problem: The order reads D5W 1000mL to run over 8 hours. How many mL’s per hour and how many drops per minute should be administered? (The infusion set delivers 60 gtt per mL).

1. **To calculate mL/hr:**
   
   \[
   \frac{\text{Total Volume (i.e. total mL)}}{\text{Hours to Infuse}} = \frac{1000 \text{ mL}}{8} = 125 \text{ mL/hr}
   \]

2. **To calculate drip rate:**
   
   a. \[
   \frac{\text{mL/hr} \times \text{drop factor}}{60 \text{ minutes}} = \frac{125 \times 60}{60} = 125 \text{ gtt/min}
   \]
   
   = answer in drops per minute
   or the drip rate
   
   b. \[
   \frac{\text{mL to infuse} \times \text{drop factor}}{\text{time (in total minutes)}} = \frac{1000 \times 60}{480} = 125 \text{ gtt/min}
   \]
   
   = answer in drops per minute
   or the drip rate

Alternate way to calculate drip rate (Dimensional Analysis):

\[
\frac{1000 \text{ mL}}{8 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{60 \text{ gtt}}{1 \text{ mL}} = \frac{60,000}{480} = 125 \text{ gtt/min}
\]

These formulas will be provided in your test booklet for your reference.
Calculation Review

1. 10 mL = _______ tsp
2. 3 tsp = _______ ml
3. 0.5 Gm = _______ mg
4. 750 mg = ______ Gm
5. 1 oz = ______ mL
6. 15 mL = ______ oz
7. 25 lb = ______ kg
8. 10 kg = ______ lb

9. Methylprednisolone Sodium Succinate (SoluMEDROL) 15mg IV Q 12hrs is ordered for an asthmatic patient. The nurse has 40mg/ml vial of the medication available. How much medication will the nurse administer?

10. A subcutaneous dose of epinephrine 0.1mg/kg is ordered for a patient. The patient weighs 22lbs. To administer this drug using the available 1mg/ml ampule, what amount should the nurse give?

11. An order has been received for D10W 100 ml to run over 4 hours. The microdrip set the nurse is using has a drip factor of 60 drops/ml. Calculate the rate for this patient.

12. You have an order to administer IV fluids at 1 ½ maintenance dose. Your patient weighs 42kg. At what rate do you set your pump?

13. Determine how to set up the PCA for the following patient. Patient weighs 10kg and has the following orders: morphine PCA, Concentration 1mg/ml; Dose 10mcg/kg with a 10 minute lockout; Basal: 5mcg/kg/hr; Clinician Bolus: 40mcg/kg with a limit of 2 clinician boluses per hour.

14. A patient weighs 26kg and is placed on a continuous morphine drip with a dose of 0.1mg/kg/hr. The IV bag concentration is 1mg/ml. At what rate will the morphine run?

15. The dose of IV medication ordered for a 6kg patient is 1mg/kg. The 2ml vial is labeled as 3mg/ml. What amount of drug will be delivered?
16. A diabetic patient weighs 16kg and has an order for 1 unit/kg IV insulin bolus. The IV insulin bag has a concentration of 1 unit/ml. What will the bolus amount be?

17. The blood sugar of a patient weighing 16 kg indicates the need for her to be placed on a continuous IV insulin drip at 0.1 unit/kg/hr. The insulin bag has a concentration of 1 unit/ml. What will the continuous rate be?

18. Your pediatric patient is to receive 1 gram of Mefoxin in 50 mL of NS. To infuse this medication over 30 minutes, at what rate should it run?

19. A patient weighing 20 kg has an order for Benadryl PO QID, with a limit of 5 mg/kg/day. The nurse has 25 mg tablets available. How many tablets will the nurse administer for each dose?

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**General Pediatric Pharmacology Review**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Information to Review</th>
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<tbody>
<tr>
<td>IV fluids</td>
<td>Pediatric patients are sensitive to fluid volume overload. Pedi patients should have all IV fluids programmed into the pump with a 2 hour max volume limit. There will be certain medications in which you administer with a syringe pump and microtubing depending on drug dosage. IV fluid boluses should only consist of an isotonic fluid such as Normal Saline 0.9% or Lactated Ringers. IV Bolus (20ml/kg) can be administered with a Buretrol in the ECC, on the IV pump or in a critical situation with a syringe using rapid push.</td>
</tr>
</tbody>
</table>
| Routes         | **By mouth:** **For infants** with a suck reflex, you can place a nipple in their mouth and squirt the medication in the open side of the nipple. Just make sure you then remove the nipple when the medicine is gone so they don’t suck in air. This is more effective if the infant has not been eaten and it is nearing feeding time. Avoid mixing medicine in formula. When medication gets mixed in formula the child may associate the taste and begin refusing the formula. If necessary, mix the medicine with a small amount of non-essential fluid or a specially designed flavoring from pharmacy to help disguise the taste of the medicine. If you mix it in a bottle, make sure it is a small amount, if you mix the medicine with too large a volume of fluid and the child did not finish the bottle, then they did not get all the medicine. As an alternative to using a nipple, you can squirt the medication in the child’s mouth by placing the tip of the syringe to the side and back of the mouth and slowly depress the plunger. Re-feed what dribbles out of the mouth. **Children** are often scared of the nurses initially. If appropriate, you can give the parent the liquid to administer to the child, provided you stay in the room and make sure it was appropriately administered. Sometimes it helps to give a child an appropriate choice such as: “Would you rather squirt the medicine in your mouth with a syringe or drink from a cup?” This allows them to be involved and feel they have a choice (a choice where either option they choose is still an appropriate option). Do not make the mistake of giving a child
a choice that can be answered Yes/No with one choice being an inappropriate one such as “Are you ready to take your medicine?” inevitably the child would answer no!

**IV:**
Pediatric medications are to be used with a pump or syringe pump depending on the type and amount of medication.

**Intraosseous (IO):** When a child’s status is deteriorating and you cannot obtain immediate IV access then someone who has been trained in IO access (in the bone marrow cavity) should start an IO. The ECC has an EZ IO Drill for IO starts. Anything and everything that can go through an IV line (meds, fluids, blood) can also be infused through an IO line. Medication and fluids infused IO reaches circulation in a few seconds.

**Sites include:** (see picture below)
A & E. 1-2 cm below tibial tuberosity on the anterior medial aspect of tibia
B. distal femur
C. at the iliac crest
D. above the medial malleolus in the distal tibia

It is important to avoid the growth plate when inserting an IO needle to prevent delayed growth. An IO line cannot be placed in a bone that is broken or in a bone where an IO line was previously attempted to prevent leaking of fluid.

**Vaccines**
Ask the parents if immunizations are up to date. Most patients will have vaccines on file if they are a Trinity Clinic patient. Vaccine schedule recommendations change periodically so instead of memorizing a schedule it is more important to make sure you have a current chart available to refer to. This can be downloaded from: [http://www.cdc.gov/vaccines](http://www.cdc.gov/vaccines). During flu season between Sept and April, we must assess all patients for current flu shot status at time of admission. Core measures require us to offer the flu shot, and either administer during hospitalization or document refusal. When administering vaccines, you will find a link to the Vaccine information statement (VIS) in the MAR, you must print this and give to parents. Documentation in the MAR must also include the vaccine, lot number, expiration date, route, and site.
DRUG REVIEW

We recognize you are more familiar with drugs common to your previous work environment and your area of expertise. Therefore, to successfully complete the General Pharmacology Test we have provided the following content. Not every drug or topic will be included on your Pharmacology Test; however, we believe this will provide a good basic review. Hope you find it helpful and a good refresher.

<table>
<thead>
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<tbody>
<tr>
<td>Antibiotics</td>
<td>Blood cultures are usually drawn <em>prior</em> to antibiotic administration. Initially the patient may be put on a broad spectrum antibiotic prior to blood culture results. Once the physician has the culture result, it is sometimes necessary to change the antibiotic. It is important to teach the family that the new antibiotic is effective against the specific bacteria in your child's body.</td>
</tr>
<tr>
<td>Anaphylaxis</td>
<td>In children, anaphylaxis is commonly triggered by food allergies. Milk, eggs, wheat and soy (MEWS) as a group are the most common food allergens; but the most potent include peanuts and fish. Treatment includes adrenergic such as Epinephrine. The drug is administered IM in the anterior lateral thigh (by nurse or family) and has proven to significantly save lives.</td>
</tr>
<tr>
<td>Adenosine</td>
<td>Drug of choice for Supraventricular Tachycardia (SVT) characterized by narrow QRS complexes and heart rate of greater than 220 for infants and greater than 180 for children. This medication has an extremely short half-life (average 6 seconds) and if not administered rapidly it will not be effective. Guidelines indicate Adenosine should be given as a rapid IV push over 1-3 seconds and immediately followed by a saline flush of at least 5 mL.</td>
</tr>
<tr>
<td>EMLA</td>
<td>EMLA cream is a topical anesthetic which can be used to numb the site of an injection or IV start. Apply a thick layer to the site (or multiple sites if attempting IV access), occlude the site with the occlusive dressing (do NOT rub it in). Leave the dressing in place for at least 1 hour for optimal efficacy. If your patient needs the IV STAT, do NOT wait on EMLA. Children have a tendency to go down a vicious cycle: as they get more dehydrated the harder it is to start the IV, the longer you wait to start the IV the more dehydrated they become and hence even more difficult to start the IV. The recommendation is to use EMLA cream unless the patient’s status is likely to deteriorate within an hour.</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>When administering Gentamycin beware of nephrotoxicity and neurotoxicity including ototoxicity, muscle twitching, and convulsions.</td>
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| Hepatitis B Vaccine | People should get at least 3 doses of hepatitis B vaccine according to the following schedule. Note: do not restart series, no matter how long since previous dose.  
  - The first dose should be given prior to being discharged from the hospital at birth.  
  - The second dose at 1-2 months of age.  
  - The third dose at 6-18 months of age.  
  Due to combination injections available, the child may receive a total of 4 doses of Hep B vaccine. |
| Inhalers            | Teaching Metered Dose Inhaler (MDI):  
  1. Remove the cap and hold the inhaler upright.  
  2. Shake the inhaler.  
  3. Breathe out slowly through your mouth.  
  4. Place the mouthpiece between your lips  
  5. If you are not using a spacer, begin to breathe in slowly through your mouth. While you are breathing in, press down on your inhaler one time to release the medication. If you are using a spacer, first press down on the inhaler, then within 5 seconds, begin to breathe in slowly through your mouth.  
  6. Continue to breathe in slowly and as deeply as you can.  
  7. Hold your breath for 10 seconds if possible to allow the medication to reach deeply into your lungs, then remove mouthpiece. |
### Topic | Information to Review
--- | ---
8. Repeat steps 2 to 7 until you have inhaled the number of puffs that your doctor prescribed. If you are using a quick-relief medication (beta2 agonists), wait at least 15 to 30 seconds between puffs. There is no need to wait between puffs of other types of medication. 
9. After you use a corticosteroid inhaler, rinse your mouth thoroughly with water and then spit out the water. Do not swallow.

| Narcan (Naloxone) | Used for complete or partial reversal of narcotics, especially targeting opioid depression; can be used as adjunctive to raise blood pressure in septic shock. Usual initial dosage in children is 0.01mg/kg IV (IM and SQ can also be used). Narcan comes in 0.4mg/ml or 1mg/ml.

| Pain medication | When at all possible medication should be given PO or IV. Pain management should NOT use the IM route which causes pain when administered and has a wide range in absorption rate. Choose appropriately based on the patient’s pain rating. Mild to moderate pain can often be treated with over the counter medications such as Tylenol or Ibuprofen. Standard acetaminophen dose is 10-15mg/kg/dose every 4-6 hours, (MAX 75 mg/kg/day for infants and lesser of 100 mg/kg/day or 4000 mg/day in children). Mild to moderate pain can also be treated with a NSAID such as ibuprofen. Standard ibuprofen dosage is 5-10mg/kg/dose every 6-8 hours (MAX 4 doses/day. Motrin is not recommended for anyone under 6 months of age. Moderate to severe pain would need a stronger medication. Do not be afraid to give an opioid narcotic to a child.

| Rifampin (Rifadin) | Wide spectrum antibiotic (most commonly used with invasive bacterial infection and Tuberculosis). Educate parents that the medication will cause tears, sputum, sweat and urine to become red-orange in color. Oral suspensions may stain clothing or plastic items upon contact.

| Sublimaze (Fentanyl citrate) | Narcotic (opioid analgesic). Used commonly for sedation and analgesia. Dosage should be titrated to appropriate effects. IV onset of action 1-2 min with peak effects in 10 min and duration of action 30-60 min. Administer IV dose slowly over 10 min. Rapid infusion (faster than recommended rate) may cause respiratory depression and chest wall rigidity.

### POSITIONS OF COMFORT:
Parents should not be used as a “restraint” and the child should not have to fear that their parent is going to “hold them down while they get hurt.” When a nurse restrains a child, the next time the child comes to the hospital they have already developed a fear and will be even less cooperative. Although there are occasions when a child may need to be restrained that is typically not the case. Using the parent to hold the child in a comforting position is much more effective.

- It is important to explain to parents and children the reason for the procedure and to tell them the truth about what to expect. Uncertainty about a procedure can heighten fear, anxiety, and tension in both the parent and child. These feelings can limit a child’s ability to develop feelings of control over the procedure.
- Explain the procedure in an age-appropriate way.
- Assess the parent.
- Assign the child and parent a job during the procedure (how to sit, hold, and help with positioning).
Example images of comfort positions

- Have the child sit on a table with parent (or family or staff member) standing in front hugging the child. With the adults body in front of the child there is only one arm and one leg to worry about, the other arm and leg is on the other side of the adult out of the way. This is great for injections.

- For IVs have the child sit sideways in adult’s lap on a chair with one hand out of the way around the adult and the other hand stretched out on the treatment table or stretcher.

- Have child sit straddling the adult’s lap and facing the adult (chest to chest) with head turned away from where the procedure is occurring.

TMFHC has the privilege to have a Child Life Specialist that works in our Tyler facility. Child Life is a great asset to explaining information in a way the child can understand. The Child Life Specialist is willing to help children in any of our Tyler departments when
MEDICATION CALCULATION ANSWERS:

1) Since 5 mL = 1 tsp then $\frac{10}{5} = 2$ tsp

2) Since 5 mL = 1 tsp then $3 \times 5 = 15$ mL

3) Since 1000 mg = 1 Gm then $0.5 \times 1000 = 500$ mg

4) Since 1000 mg = 1 Gm then $\frac{750}{1000} = 0.75$ Gm

5) 1 oz = 30 mL

6) Since 1 oz = 30 mL then $\frac{15}{30} = \frac{1}{2}$ or 0.5 oz

7) Since 1 kg = 2.2 lb then $\frac{25}{2.2} = 11.36$ kg

8) Since 1 kg = 2.2 lb then $10 \times 2.2 = 22$ lb

9) $\frac{15 \text{ mg}}{1\text{ mL}} = \frac{15}{40} = 0.375 \text{ mL or } 0.38 \text{ mL}$

10) $\times \text{ mL} = \frac{0.1 \text{ mg}}{1\text{ kg}} \times 1 \text{ kg} \times \frac{22 \text{ lb}}{1 \text{ mg}} \times \frac{1 \text{ mL}}{2.2 \text{ lbs}} = 2 \text{ mL}$

11) $\times \text{ gtts/min} = \frac{100 \text{ mL}}{4 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{60 \text{ gtts}}{1 \text{ mL}} = 6000 \div 240 = 25 \text{ gtts/min}$

12) 42 kg = 60 mL + 22 (1 mL/kg for each kg over 20 kg) = $82 \times 1.5 = 123 \text{ mL/hr}$

13) PCA Dose (10 mcg x 10 kg) = $100 \text{ mcg}$ (10 min lockout) and basal rate at (5 mcg x 10 kg) = $50 \text{ mcg/hr}$

14) 0.1 mg x 26 kg/hr = $2.6 \text{ mg/hr}$

15) $X \text{ mL} = \frac{1 \text{ mg}}{1 \text{ kg}} \times \frac{1 \text{ mL}}{3 \text{ mg}} = \frac{6}{3} = 2 \text{ mL}$

16) $X \text{ mL} = 1 \text{ unit/kg} \times 16 \text{ kg} \times \frac{1 \text{ mL}}{1 \text{ unit}} = 16 \text{ mL}$

17) $50 \text{ mL} \times \frac{60 \text{ min}}{30 \text{ min}} = 100 \text{ mL/hr}$

18) $X \text{ tab} = \frac{5 \text{ mg}}{1 \text{ tablet}} \times 20 \text{ kg} \times \frac{1 \text{ tablet}}{25 \text{ mg}} = \frac{100}{25} = 4 \text{ tablet/day} = 1 \text{ tablet each dose}$