Study Packet for the Correct Use of the Broselow™ Pediatric Emergency Tape 2006

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Enhancing Pediatric Patient Safety
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How to use this Study Packet

The purpose of this study packet is to introduce the learner to the Broselow tape and describe how to use the Broselow™ Tape correctly and effectively. Included in this study packet are several case-based scenarios that will test the learner's understanding of how to use the tape within the framework of several typical pediatric emergencies.

In order to use this study packet effectively, the learner should have the following items available for reference:

- The Broselow™ Pediatric Emergency Tape **Current Edition**
- A stopwatch or a watch with a second hand (optional)

Answers to any of the questions you may be asked while using this packet will be found at the end in Appendix 1.

If you need to refresh yourself on a relevant calculation, pertinent calculations are referenced in Appendix 2.

Learning Objectives

1. The learner will briefly describe the Broselow-Luten Color Coding System (B-LPS), its history and rationale for use.

2. The learner will demonstrate how to correctly place the Broselow™ Pediatric Emergency Tape using appropriate landmarks and exhibiting proper alignment with the correct (color-coded/weight) side visible

3. The learner will identify the correct color zone for the child and properly identify correct equipment sizes.

4. The learner will identify the proper dosage for several case appropriate medications.

Description of the Broselow Tape

The Broselow™ Pediatric Emergency Tape **[Figure 1]** provides a tool for determining the correct dosage of medications and equipment sizes (endotracheal tubes, suction catheters, etc.) for children, based on their length. It can help simplify some of the decision-making in an emergency by eliminating the need to estimate a child's weight, which is typically used to calculate the correct dosage for a medication. In an emergency, the estimation of a child's weight and drug dosage calculation is done under stressful conditions, increasing the likelihood of dosage errors. Research has already shown that the dosage calculation in the pediatric setting is highly prone to errors.[1,2,3,4,5,6] Additionally, patient weight in the pediatric population is critical for dosing formulas, but evidence suggests that both physician and nurse estimates of children's weights are unreliable (>15% off).[7]

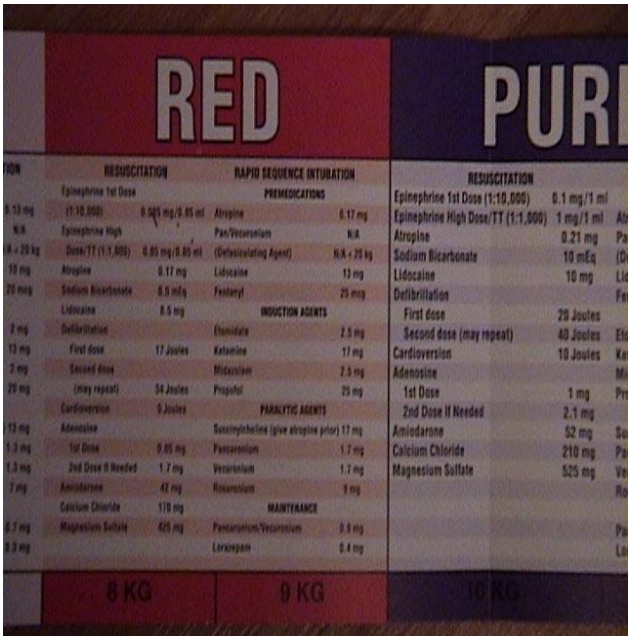

Figure 1: Section of the Broselow™ Pediatric Emergency Tape

A brief example

Jonathan, an 8 year old boy is brought to the emergency department by his father. Jonathan has had persistent vomiting and diarrhea for the past three days. Jonathan has also had almost no intake during this time frame. His father states that Jonathan has no significant previous medical history. The child has no known allergies and is not on any current medications. His father guesses the Jonathan weighs about 45 pounds (His actual scale weight on admission is 31.3 lbs).

Labs are drawn on the child and a fingerstick serum glucose level is done at the same time. Jonathan's serum glucose is 50 mg/dL. Although there are certainly additional assessment criteria and interventions that need to be addressed here, it is apparent that the child needs dextrose.

Administer Dextrose 25% IV. (If you are unfamiliar with the calculation for this, you may refer to Appendix 2 for the relevant calculation.)

(*If you are using a stopwatch or have a watch with a second, you might time yourself to see how long it actually takes to determine this calculation).*

Q1. How many kilograms does this child weigh? _____

(answers at the end of this packet in Appendix 1)

Q2. How much D25% does this child need? (cc's) _____

1. How much time do you think it would have taken to weigh the child?
2. Did you remember the calculation to determine the dose of dextrose to give to this child?
3. Did you have to convert the weight from pounds to kilograms?
4. Did you have to take in account the specific concentration of drug to be administered?
5. How long did it take to calculate the correct dosage?
6. Are you sure that particular dosage was correct?
7. How long would it take to draw up and administer the dosage?

Rationale for using a color-coded system

As you can see, medication administration to a pediatric patient involves many factors. Medication dosages typically are based upon the child's weight in kilograms. To provide the proper dosage of a medication to the child, the practitioner must know the child's weight, the dose per kilogram, and the available concentrations of the specific drug. Pediatric resuscitation drugs are not used often enough to recall the correct dosage, and valuable time is taken to look up the correct dosage by weight. Calculations required may include conversion of weight from pounds to kilograms, as well as dose by weight and concentration of the drug.

By using a length-based system tool, the practitioner is able to concentrate on more important factors of care during the emergency, such as securing the airway, maintaining circulation, making a diagnosis and securing appropriate transport. In this case, the length measurement is taken directly from the child and a color is assigned. The practitioner does not need to rely on memory or calculations to select the appropriate size equipment or drug dosage.

History of the Broselow™ Pediatric Emergency Tape

The original tape was the invention of Dr. Jim Broselow **[Figure 2]**, an emergency physician in Hickory, North Carolina. By his own admission, as a family physician he felt pretty comfortable with caring for very sick adults, but when the patient was a critically ill or injured child, he describes chaos, terror and lack of confidence on the part of emergency care providers. He was sure that there was a better way to care for these children that would provide consistency and standardization. Dr. Broselow developed a simple tool to increase the accuracy of weight estimation using height-weight correlations from the National Center for Health Statistics (NCHS)[9]. The Broselow™ Pediatric Emergency Tape has become an industry standard in pediatric emergency care. [8,9,10,11,12,13]

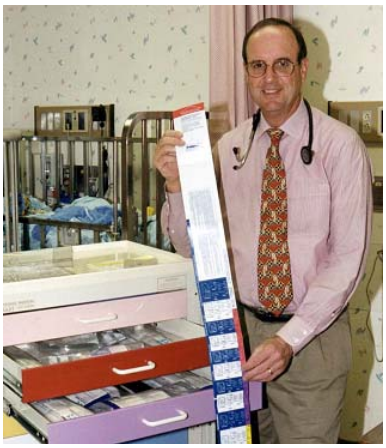

Figure 2: Dr. Jim Broselow

After the development of the original tape, Dr. Broselow teamed up with Dr. Bob Luten, a Pediatric Emergency Physician from Jacksonville, Florida. Together, with the input of other colleagues, they have developed the latest tape and other items that enhance the system. Its development is based on more than 20 years of emergency department use.

Use of the tape has been the subject of several studies that validate its use. [8,9,10,11,12] Analysis shows that mean medication dosing error severity when subjects used the B-LPS was 33.88% lower then when B-LPS was not available. [13] The tape may is recommended for use on any child under the age of 12 years old. For any child that is longer than the tape, the practitioner should use adult dosages and equipment.

In 2005, a new edition of the tape was created (2005A), eliminating the infusion section of the tape. This was done to reflect the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Patient Safety Goals, specifically Goal 3B, which requires that all hospitals move to standardized concentrations of drugs by 2008. Previous versions of the tape were calculated without a standardized concentration. JCAHO recognizes the usefulness of the tape in quickly identifying appropriate equipment sizes and doses of medications with standardized concentrations, and states that even if the organization is already using standardized concentrations, it may continue to use the tape for its other functions.
See:
(www.jointcommission.org/PatientSafety/NationalPatientSafetyGoals/06_npsg_cah.htm)

How to properly use the Broselow™ Pediatric Emergency Tape

In order for the Broselow™ Pediatric Emergency Tape to be truly effective for the calculation of drug doses and equipment size in the pediatric population, it must be used correctly. The following steps demonstrate how to use the tape correctly.

1. Place the Broselow™ Pediatric Emergency Tape on a flat surface with the color-coded/weight side visible **[Figure 3].**

Figure 3: Color-coded/Weight side Up

Weights

2. Place the red end of the tape even with the top of the patient's head **[Figure 4].**

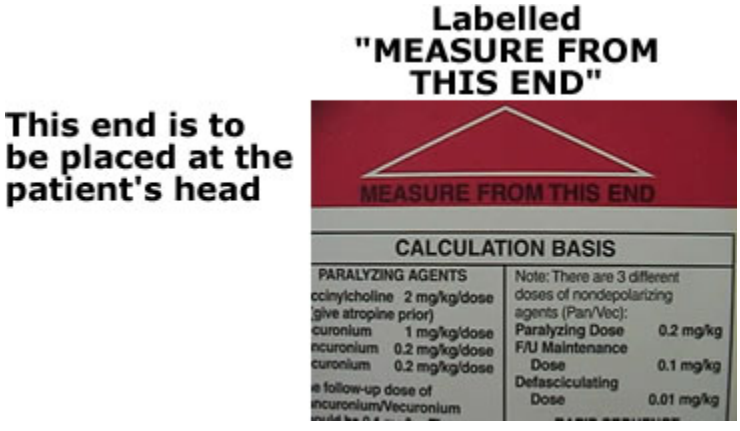

Figure 4: Red end of Broselow™ Pediatric Emergency Tape

3. The following illustrates proper placement of the tape at the head of a patient **[Figure 5]**. Remember **"RED to HEAD!"**

Figure 5: Proper placement of Red end of tape at top of head

4. Place one hand at the top, with the edge of your hand resting in the red box at the red end of the tape **[Figure 6]**.

Figure 6: Proper hand placement at head of patient

5. Run your free hand down the tape from the patient's head **[Figure 7]. It is important to maintain proper placement at the head of the patient**. You may have someone assist you if necessary. **Never measure a child in the seated position**.

Figure 7: Moving hand to find proper color zone

6. Stop free hand at the bottom of the patient's heel (**not the toes**). The edge of the free hand that lands on the tape adjacent to the patient's heels indicates the patient's approximate weight in kilograms and the patient's color zone **[Figure 8].**

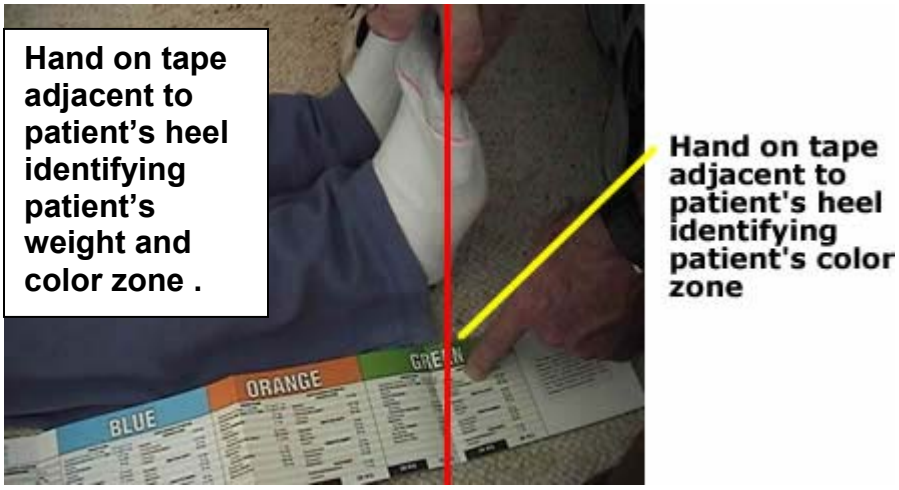

Figure 8: Identification of Color Zone and Weight

For this particular patient his heels are adjacent with this area on the tape (marked in the following illustration with a line).

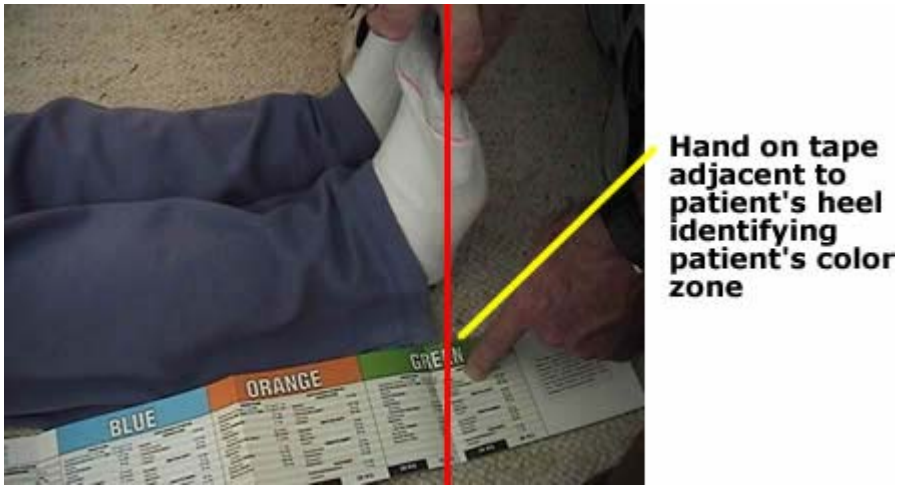

Figure 9: Identification of Color Zone and Weight

Q3. What color zone and weight group is this child in (Figure 9)**?**

_____

(answers at the end of this packet in Appendix 1)

7. If the child is longer/larger than can be measured with the tape (> 34 kgs.), stop and proceed as you would with an adult patient.

8. Be sure to verbalize and document both the color zone and the weight of the child.

Summary - Proper use of the tape

1. Place the red end of the tape even with the top of the patient's head. Remember "Red to Head". The child should be lying down. Never measure a child in a seated position.

2. Place one hand at the top, with the edge of your hand resting in the red box at the red end of the tape.

3. Run your free hand down the tape from the patient's head. It is important to maintain proper placement at the head of the patient. You

may have someone assist you if necessary.

4. Stop free hand at the bottom of the patient's heel (not the toes). The edge of the free hand that lands on the tape adjacent to the patient's heels indicates the patient's approximate weight in kilograms and the patient's color zone.

Case Studies

The following case studies are given as examples of the use of the Broselow™ Pediatric Emergency Tape. You will need your Broselow™ Pediatric Emergency Tape to complete these case studies.

Brief questions are asked throughout the case presentations. Answers to all questions follow at the end of this study guide in Appendix 1. If you need to look up a calculation relevant to these case studies, relevant calculations are found in Appendix 2.

Case Study 1:

Michael is nine month old boy whose mom has called **911** because she is having difficult "waking him up" this morning.

On initial assessment the child seems unaware of his surroundings, although his eyes are open and staring. He has decreased work of breathing, and his color is pale. He appears quite small for his stated age. PMH is significant for failure to thrive with a previous hospitalization. Mom reports no substance ingestion, no other history. Child has no allergies that she is aware of.

Vital signs are taken including the child's color zone using the Broselow™ Pediatric Emergency Tape. This particular patient's heels are adjacent with this area on the tape (marked in the following illustration with a line) **[Figure 10].**

Figure 10: Identification of Color Zone

Q4. What color zone is this child in? _____

(answers at the end of this packet in Appendix 1) This child requires immediate intervention. Your first priority should be oxygen delivery.

Q5. What delivery method? _____
Q6. If choosing mask, what size? _____

Vital signs: Color Zone – _____? . Respiratory Rate 16; heart rate 160; central pulses intact, peripheral pulses are weak. Skin is pale and cool to touch. Mom is not sure how much he weighs but he has always been "really skinny".

Cardiac monitor shows sinus tachycardia. Lungs are clear.

IV access is established and a 120cc (6kg x 20cc) fluid bolus of warm normal saline via 20 cc syringe with a 3-way stopcock.
Dextrostick=38 mg/dL.

The next intervention should be the administration of D25%.

Q7. This child is in the pink zone on the Broselow™ Tape. What would be the appropriate amount of $D_{25}W$ to administer (cc's.)? _____

(Note: The Glucose administration guidelines on the tape do NOT apply to overdose situations only. If your unit only stocks D50, you will need to dilute the D501:1 with sterile water to make D25).

After administration of $D_{25}W$ child begins to cry slightly. Heart rate after D25% and 60 cc of fluid is 150. Respiratory rate is 22 with crying. Color is still pale, skin slightly warmer to touch.

Further intervention should be to continue the fluid bolus, repeat dextrostick. Repeat reading is 60 mg/dL. Consider repeat of 2 ml/kg (12 cc) of D25%.

This child needs hospital evaluation, social services intervention and close monitoring.
Rationale:

In infants, hypoglycemia is a blood glucose level below 40. It is evidenced in inborn errors in metabolism, problems of defects in carbohydrate metabolism, organic acid disorders, and defects in fatty acid oxidation. Presenting symptoms can be lethargy, tachycardia, seizures, dysrhythmias.

An article related to this information:

- Lteif, A.& Schwenk, W. (1999). Hypoglycemia in infants and children. Endocrinology Metabolism Clinics of North America 28 (3), 619-646.

Case Study 2:

Grace is an 8 year old girl who has an allergy to peanuts. She is in the hospital cafeteria eating with her family while her mother is visiting her aunt. Her father noticed that just after Grace has bit into her cookie, she began to develop some swelling of her lips and her "breathing sounds kind of wheezy". He usually carries an epi-pen for Grace, but they left the house in a hurry when her aunt got sick and he can't recall bringing the pen. Dad calls out for help. By the time you arrive as part of an emergency response team, Grace is gasping for breath, her eyes are open and frightened, wheezing is audible and there is increased work of breathing. Her lips are pale. It appears that there are raised areas on her skin.

Vital signs are taken including the child's color zone using the Broselow™ Pediatric Emergency Tape. This particular patient's heels are adjacent with this area on the tape (marked in the following illustration with a line) **[Figure 11].**

Figure 11: Identification of Color Zone

Q8. What color zone is this child in? _____
(answers at the end of this packet in Appendix 1)

Vital signs: Color Zone – _____? ,HR 140, RR 32 with wheezing audible, BP 90/58. Cardiac monitor shows sinus tachycardia.

Q9. Oxygen delivery is a priority. According to the Broselow tape would you use an adult or Pediatric O_2 mask? _____

Her vital signs are abnormal for her age and Color Zone. Advanced Life Support equipment and medications are available. What is your next intervention?

Continue oxygen delivery. If airway compromised, employ advanced airway management as necessary. Her presentation is consistent with anaphylaxis. IV access is established and a fluid bolus of normal saline is given (560cc).

Q10. What would be the dose of intravenous epinephrine she would require (mg)? _____ (1:10,000 concentration)

PLEASE NOTE: THE SUBCUTANEOUS DOSE OF EPINEHPRINE IS NOT LISTED ON THE BROSELOW TAPE. Be aware that not all pertinent drug dosing for emergencies are included on the Tape. The 1:10,000 dose for epinephrine that is listed on the Tape is for IV/IO administration. Be aware that the 1:1000 dose is for endotracheal tube administration.

Just before you begin to administer the intravenous epinephrine, the patient becomes unresponsive. Her work of breathing is decreased; wheezing is still audible, lips and nailbeds are pale.

Heart rate is 160, RR is 20, BP is 90/58.

The patient is in shock. She requires assisted ventilation with an adult size mask and ventilation bag, and perhaps intubation.

Q11. What size of ET tube should be used for intubation? _____

After administration of IV epinephrine, patient is slightly more arousable, HR 160 RR 24, wheezing decreased, BP 100/78. She is transported to the Emergency Department for further evaluation and stabilization.

Rationale:

Anaphylaxis is an acute, generalized antigen-antibody reaction that can be rapidly fatal. An anaphylactic reaction may present as a mild to severe response: management is based upon severity. Anaphylaxis in children is unusual. As in adults, there are multiple causes of anaphylaxis: injected substances or drugs such as penicillin; other causes include food sensitivities, vaccines, insect stings.

Hypotension in children is uncommon. Shock should be assessed based on level of consciousness, work of breathing and "skin signs". Wheezing is another feature of anaphylaxis. Most reactions occur within thirty (30) minutes following allergen exposure, although the onset of symptoms can vary from several seconds to hours. As a rule, the earlier the onset of symptoms following antigenic exposure, the more severe will be the subsequent reaction. Virtually all body systems are affected in an anaphylactic reaction.

Article to read:

Pediatric Anaphylaxis: Jeffrey Linzer, MD as found at:
http://www.emedicine.com/emerg/topic360.htm

Case Study 3:

Justin is a 3 year old boy whose mother states that the child fell off of a very tall slide on the playground a few minutes ago. He didn't move "for a couple of minutes" and has been acting very sleepy since then. He is lying quietly in his mother's arms, and is breathing spontaneously. There is some dried blood on his face.

Assessment reveals that the child is unresponsive to pain, breathing is slightly decreased, and color is pale. His airway is open, no abnormal airway noises, respiratory rate is 24 and shallow, a little bluish tint is around his mouth. He has a potential C-spine injury and requires immobilization. This child is in need of emergent care. Appropriate team members are available to assist you and universal precautions are assumed.

Vital signs are taken including the child's color zone using the Broselow™ Pediatric Emergency Tape. For this particular patient his heels are adjacent with this area on the tape (marked in the following illustration with a line) **[Figure 12].**

Figure 12: Identification of Color Zone

Q12. What color zone is this child in? _____
(answers at the end of this packet)

Vital signs: Color Zone – _____? Cardiac monitor shows sinus tachycardia. Lungs are clear. Child's heart-rate is 160, BP is 98/58. Temperature is 36 C°. Respirations are assisted at 20 per minute.

Immediate oxygen delivery is required.

Q13. What delivery method would you use? _____
Q14. If choosing a mask, what size? _____

The child's clothing is removed and there are no obvious signs of bleeding. Appropriate warming measures (blankets, lights) are applied.

The mother provides additional history (no PMH, on no medications, no allergies) and is in need of additional feedback and support.

Additional assessment reveals that the only other abnormality is a swollen left thigh area. There is also a small amount of blood in each nares. He has good rectal tone with no evidence of bleeding.

IV access is obtained and a purple zone fluid bolus of warm normal saline of 200cc is administered via 20 cc syringe with 3 way stopcock.

Q15. What would be the IV catheter size for this child? _____

Peripheral IV attempts proved to be unsuccessful. The child is prepared for an intraosseous line (2 fingerbreadths below tibial tuberosity on unaffected leg). Appropriate trauma labs (CBC, Type and Cross), Appropriate trauma radiographs (XTL C-Spine, CXR, Pelvis), and a Head CT (may also order abd. CT) are ordered and complete.

The child has a gag reflex and rapid sequence intubation is ordered.

Q16. According to the patient's color zone, what size ET tube would be appropriate? _____

Q17. What size stylet? _____

After intubation, vital signs are reassessed (a little more difficult to ventilate, abdomen is slightly distended; heart rate 140, RR 24 assisted, pulse ox 96% BP 98/54).

An NG tube is ordered.

Q18. According to the Broselow™ Pediatric Emergency Tape, what size NG tube would be appropriate? _____

Child is transported to the CT scanner without incident and the mother is reassured.

Q19. If Justin were to decompensate in the CT scanner and require an infusion of dopamine, what would be the correct dose based on his weight? _____

Student resource:
http://www.tn-emsc.org/edutrain/studentfiles/pdf/trauma.pdf

Summary and Evaluation

Hopefully, you have found this information on the Broselow™ Pediatric Emergency Tape useful and interesting. There are several keypoints that you should remember:

When used correctly the Broselow™ Pediatric Emergency Tape is an excellent tool that will reduce medication and equipment errors in the pediatric population.

In order to place the tape correctly.

1. Place the red end at the top of the patient's head.
2. Rest one hand at the top of the tape and slide your other hand down the tape to the heel of the patient. Be sure to maintain the position of the hand at the top of the head.
3. Measure the patient's color zone at the heels NOT the toes.

Appendix 1

Answers:

Q1. 31.3/2.2 = 14.23 kg
Q2. 14.23 x 2 = 28.5 mL
Q3. Green
Q4. Pink
Q5. Face Mask
Q6. Infant
Q7. 12 mL
Q8. Orange
Q9. Pediatric Non-rebreather Mask
Q10. 0.3 mg
Q11. 6.0 mm cuffed
Q12. Purple
Q13. Face Mask
Q14. Pediatric
Q15. 20 – 24g catheter
Q16. 4.0mm uncuffed
Q17. 6F
Q18. 8-10F
Q19. You will need another reference to calculate this medication infusion. The 2005A version of the Tape has removed the infusion section. All previous versions of the Tape are patient specific and do not reflect the safety requirement for the use of standardized concentrations throughout an institution, thus the infusion section should not be used.

Appendix 2

Calculations:

Q1-2. The calculation for D25% is 2cc/kg
Q7. The calculation for D25% is 2cc/kg

References

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