

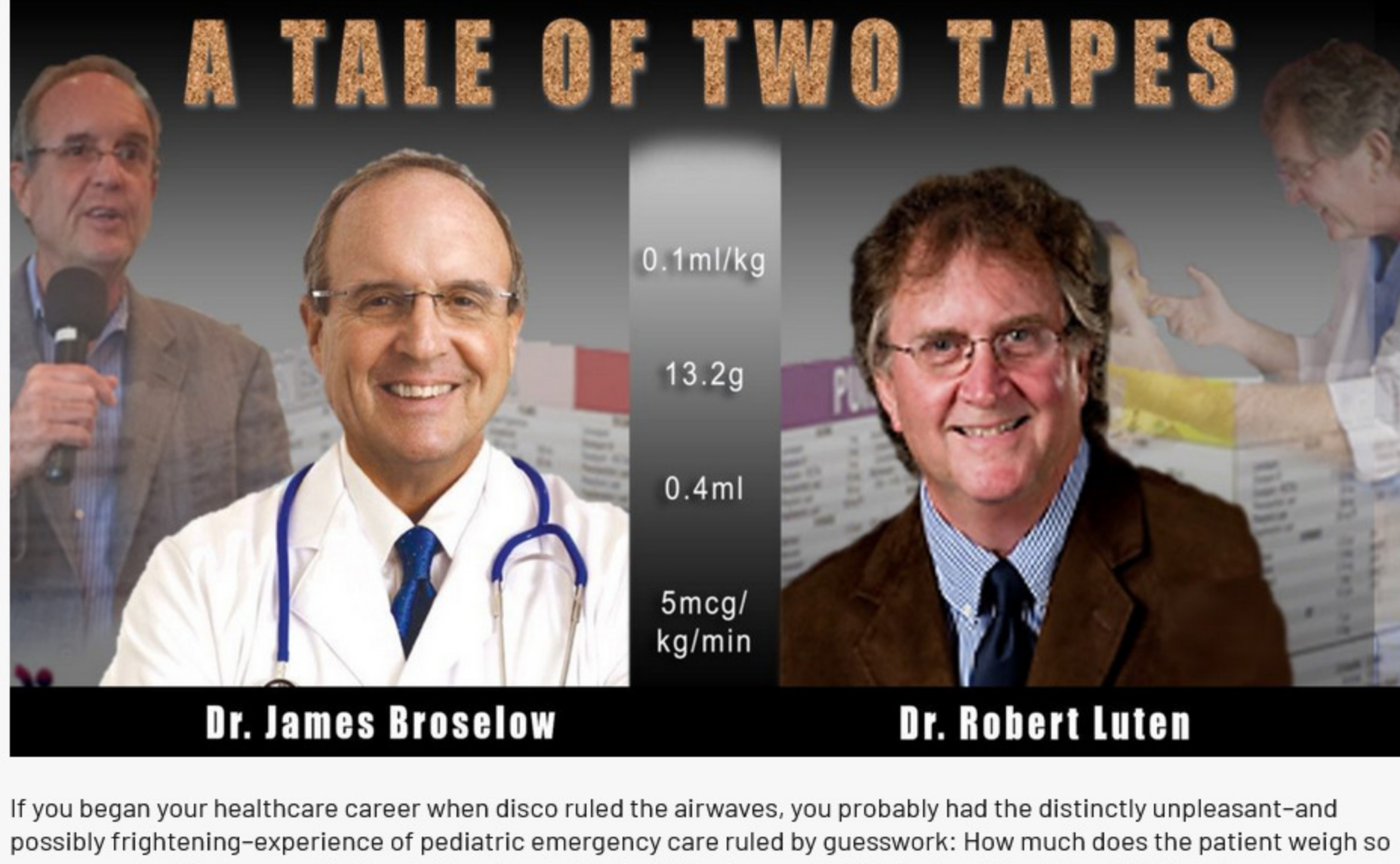
## A Tale of Two Tapes: Broselow-Luten Tapes, 2011 vs. 2017

**Review the basics, as well as tip, tricks and translations, so that you can properly use the 2017 Broselow-Luten tape during a highly stressful pediatric medical emergency.**

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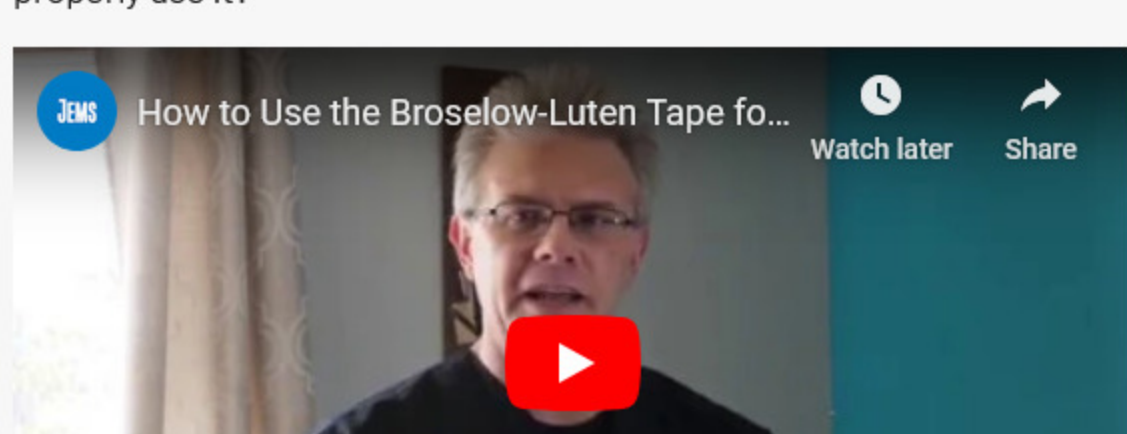
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If you began your healthcare career when disco ruled the airwaves, you probably had the distinctly unpleasant—and possibly frightening—experience of pediatric emergency care ruled by guesswork: How much does the patient weigh so you can calculate how much of each drug to administer? What amount of fluid should be infused? What size endotracheal tube is needed? There were so many questions and no easy way to find the answers. And making matters worse, there was no time to waste! We need to act now!

But that was the mid-1980s, and as our disco balls went into storage (only ever to be seen again for the occasional theme party) a revolutionary tool for pediatric care was introduced: the Broselow tape. Created by emergency medicine physician Jim Broselow, MD, and pediatric emergency medicine physician Robert Luten, MD, the Broselow tape established a worldwide standard for managing the emergency care of pediatric patients using a length-based system of color-coded zones.<sup>1</sup>

Although using the tape isn't a complex task, proficiency doesn't come automatically. Regular review and practice are needed to properly use this innovative tool in a high-stress situation. What information is on it? How do I properly use it?



### Ideal Body Weight and “What If”

We were understandably excited with the concept of length-based resuscitation guidelines, but our training and experience has taught us to question just about everything. So naturally, we wondered what to do when faced with a child whose size and body proportions fell outside of what we would typically consider average.

Pur quote bluntly, what do we do with an obese or emaciated child? Lacking specific guidance on the subject, we often made our own rules or followed the great myth of “Just bump it up a color!”

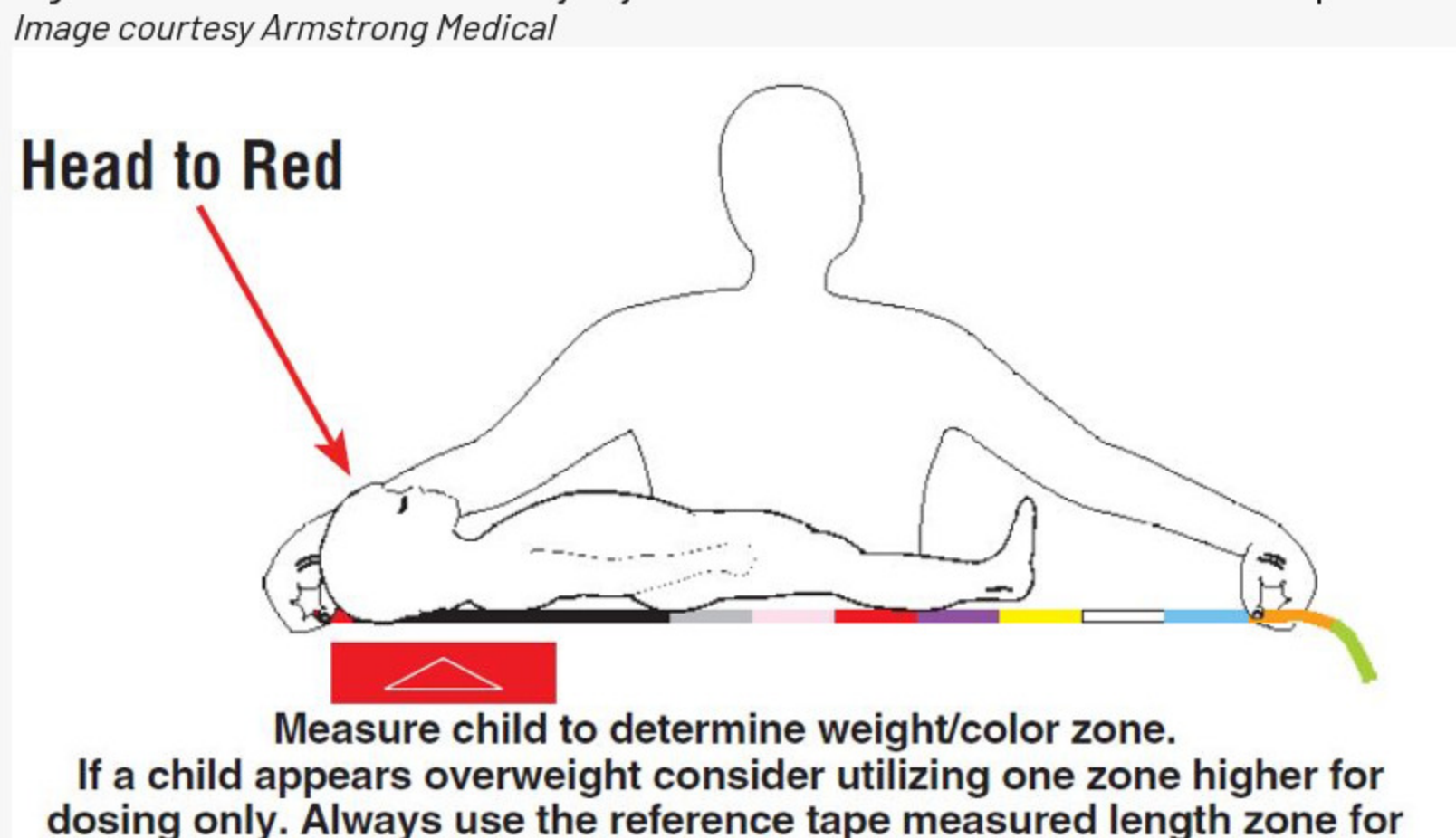
The good news, according to Luten, is that pediatric emergency drugs—with the exception of amiodarone and succinylcholine—are based on ideal body weight.<sup>2</sup> Ideal body weight is the weight that's determined from the length (i.e., height) of the child. Drugs like epinephrine, dopamine, morphine, fentanyl and ketamine are based on what a child should ideally weigh.

There are exceptions. If a child is far above any growth chart expectations, the tape reminds us to bump up a color based on what we believe is appropriate, and what protocols or orders allow.

An important consideration when exercising this exception is to only bump up one color for medication dosages, not for equipment. A child who gains weight doesn't typically increase the size of their airway; it should remain the same regardless of whether the child is skinny or husky.<sup>2,3</sup> (See Figure 1.)

Figure 1: “Head to red” and obesity adjustment reminders on Broselow-Luten tape

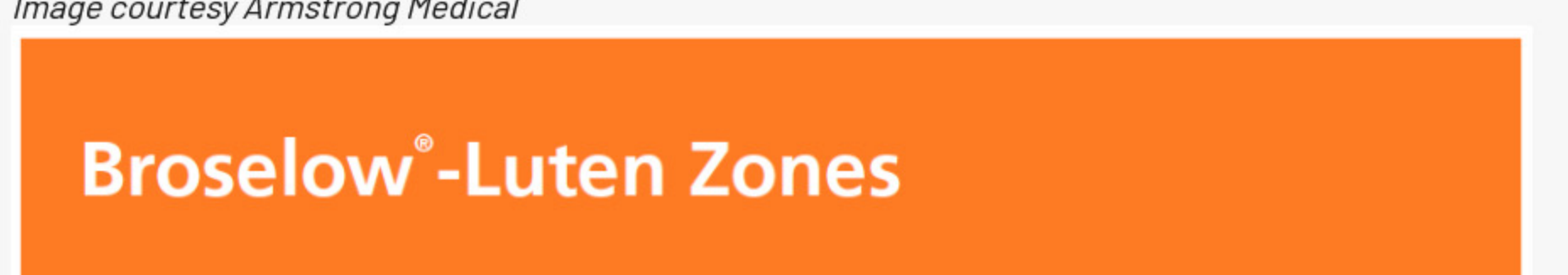
Image courtesy Armstrong Medical



What if circumstances make it either impractical or impossible to measure your pediatric patient? The tape can still be of immense value if you have an actual or approximate age. In addition to using length, age can also be used to identify the appropriate color code for medications and equipment. (See Figure 2.)

Figure 2: Broselow-Luten color zones and age/weight chart (download here)

Image courtesy Armstrong Medical



It is always preferable to measure the patient using a Broselow® Pediatric Emergency Reference Tape to determine the color zone.

For situations in which the child cannot be measured, patient age may be used to select the zone.

| Zone                       | Patient weight       | Age       |
|----------------------------|----------------------|-----------|
| 3 kg, 4 kg, and 5 kg zones | 3 kg, 4 kg, and 5 kg | < 3 mos   |
| Pink                       | 6–7 kg               | 3–5 mos   |
| Red                        | 8–9 kg               | 6–11 mos  |
| Purple                     | 10–11 kg             | 12–24 mos |
| Yellow                     | 12–14 kg             | 2 yrs     |
| White                      | 15–18 kg             | 3–4 yrs   |
| Blue                       | 19–23 kg             | 5–6 yrs   |
| Orange                     | 24–29 kg             | 7–9 yrs   |
| Green                      | 30–36 kg             | 10–11 yrs |

### Key Points: The 2017 Broselow-Luten Tape

**Friends and PALS:** The 2017 tape has been updated to reflect the 2015 American Heart Association PALS recommendations.

**Can't get an IV:** The 2017 tape has a new section labeled “No IV Quick Access Meds Chart,” which is located after the green color zone at the end of the tape. This not only addresses anaphylaxis and albuterol dosing, but provides alternative medication routes and dosing for seizures. (See Figure 3.)

Figure 3: No IV Quick Access Meds chart from 2017 Broselow-Luten tape

Image courtesy Armstrong Medical

| mLs                        | ANAPHYLAXIS |      |      |      |      |        |        | DOSE |      |      |      |  |
|----------------------------|-------------|------|------|------|------|--------|--------|------|------|------|------|--|
|                            | 3 kg        | 4 kg | 5 kg | Pink | Red  | Purple | Yellow |      |      |      |      |  |
| IM EPI (1 mg/mL)           | 0.03        | 0.04 | 0.05 | 0.07 | 0.09 | 0.1    | 0.13   | 0.17 | 0.21 | 0.27 | 0.33 | 0.01 mg/kg<br>Max 0.5 mg                       |
| Epi Auto-injector          | N/A         | N/A  | N/A  | N/A  | N/A  | N/A    | 0.15   | 0.15 | 0.15 | 0.3  | 0.3  | 10-25 kg 0.15 mg<br>>25 kg 0.3 mg              |
| SEIZURES                   |             |      |      |      |      |        |        |      |      |      |      |  |
| Rectal Diazepam 5 mg/mL    | 0.3         | 0.4  | 0.5  | 0.65 | 0.85 | 1      | 1.3    | 1.7  | 2    | 2    | 2    | 0.5 mg/kg<br>Max 10 mg                         |
| Nasal IM Midazolam 5 mg/mL | 0.12        | 0.16 | 0.2  | 0.26 | 0.34 | 0.42   | 0.52   | 0.66 | 0.84 | 1    | 1.3  | 0.2 mg/kg                                      |
| WHEEZING                   |             |      |      |      |      |        |        |      |      |      |      |  |
| Albuterol 0.83 mg/mL       | 2.5         | 2.5  | 2.5  | 2.5  | 2.5  | 5      | 5      | 5    | 5    | 5    | 5    | >10 kg 3.3 mg<br>>10 kg 5 mg                   |
| Nebulized 5 mg/mL          | 0.5         | 0.5  | 0.5  | 0.5  | 0.5  | 1      | 1      | 1    | 1    | 1    | 1    | (Use the 5 mg/mL nebulizer or saline solution) |
| DOSE in Milligrams         |             |      |      |      |      |        |        |      |      |      |      |  |
| IM EPI                     | 0.03        | 0.04 | 0.05 | 0.07 | 0.09 | 0.1    | 0.13   | 0.17 | 0.21 | 0.27 | 0.33 |  |
| Rectal Diazepam            | 1.8         | 2.4  | 3.0  | 3.9  | 5.1  | 6.5    | 8.1    | 10.5 | 13.5 | 18   | 21   |  |
| Nasal IM Midazolam         | 0.6         | 0.8  | 1    | 1.3  | 1.7  | 2.1    | 2.6    | 3.3  | 4.2  | 5    | 6.5  |  |
| Albuterol                  | 2.5         | 2.5  | 2.5  | 2.5  | 2.5  | 5      | 5      | 5    | 5    | 5    | 5    |  |

**Backup/alternate airways:** Although a variety of options for infant and pediatric emergency airway management are available, the 2017 tape only includes sizing for laryngeal mask airways (LMAs). Infant and pediatric King airways that were recently introduced have a color-coded label on their package with a supported Broselow-Luten color zone.

**Ventilator settings:** The 2017 tape includes a revised legend for initial ventilator settings section, which is located before the gray color zone at the beginning of the tape. This details suggested initial infant and pediatric ventilator settings in a color-coded format. (See Figure 4.)

Figure 4: Legend for initial ventilator settings chart from 2017 Broselow-Luten tape

Image courtesy Armstrong Medical

| LEGEND FOR INITIAL VENTILATOR SETTINGS:   |  |                 |        |              |                 |
|---|--|-----------------|--------|--------------|-----------------|
| These initial ventilator settings should be adjusted according to clinical state and arterial blood gas monitoring.                     |  |                 |        |              |                 |
| <b>Oxygen</b>   | 100%*  |                 |        |              |                 |
| <b>Tidal volume</b>   | 6-10 mL/kg   |                 |        |              |                 |
| <b>Tidal volume and Inspiratory time settings</b>   |  |                 |        |              |                 |
| zone  | Tid vol (mL)   | Insp Time (sec) | zone   | Tid vol (mL) | Insp Time (sec) |
| 3 kg  | 25-30  | 0.6             | Yellow | 85-100       | 0.7             |
| 4 kg  | 24-40  | 0.6             | White  | 100-165      | 0.7             |
| 5 kg  | 30-50  | 0.6             | Blue   | 125-210      | 0.8             |
| Pink  | 40-65  | 0.6             | Orange | 160-265      | 0.8             |
| Red   | 50-85  | 0.6             | Green  | 200-330      | 0.8             |
| Purple  | 85-105   | 0.7             |        |              |                 |
| <b>Peak inspiratory pressure</b>  | 20-30 cm H <sub>2</sub> O with normal lung compliance (lowest level that gives adequate chest expansion) |                 |        |              |                 |
| <b>Ventilator rate</b>  | Infants: 20-25 breaths/minute<br>Children: 12-25 breaths/minute  |                 |        |              |                 |
| <b>PEEP</b>   | 3-5 cm H <sub>2</sub> O  |                 |        |              |                 |
| * May mistle ventilation with 100%, but use the lowest inspired oxygen that will maintain arterial oxygenhemoglobin saturation of ≥94%. |  |                 |        |              |                 |

**More dosing by milligrams vs. milliliters:** Essential emergency medications have been updated for EMS and ED providers with precalculated doses in milligrams as well as milliliters, eliminating the need to do mental math in the middle of a pediatric emergency. This is a very welcome addition; however, it's important to ensure that milligrams are used for weight (i.e., dose of the drug) and milliliters are used for volume (i.e., how much to push).

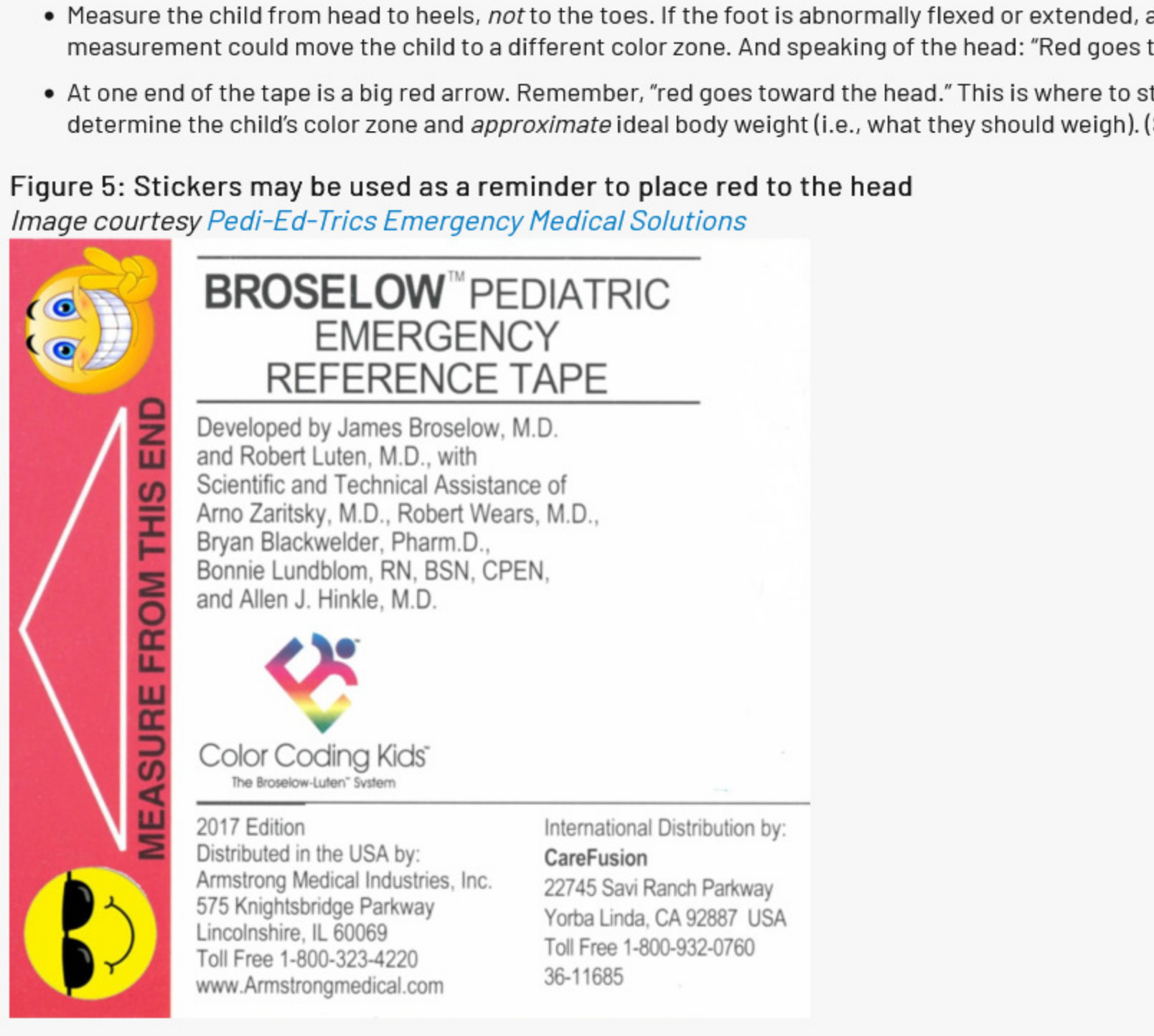
### Tips, Tricks and Translations

#### Measuring:

- Always re-measure and confirm the correct color when the child arrives at the ED.
- Measure the child from head to heels, not to the feet. If the feet is abnormally flexed or extended, an inaccurate measurement could move the child to a different color zone. And speaking of the head: “Red goes toward the head.”
- At one end of the tape is a big red arrow. Remember, “red goes toward the head.” This is where to start measuring to determine the child's color zone and approximate ideal body weight (i.e., what they should weigh). (See Figure 5.)

Figure 5: Stickers may be used as a reminder to place red to the head

Image courtesy Pedi-Ed-Trics Emergency Medical Solutions



One tape, two sides: There's vital information on both sides of the tape, so use both sides! (See Figure 6.)

- R&R: Resuscitation and rapid sequence intubation (RSI) is on one side and everything else is on the other.
- E&E: Epinephrine doses are on one side and endotracheal tube sizes on the other.
- Weights are only listed on one side of the tape.

Figure 6: Blue color zone from 2017 Broselow-Luten tape

Image courtesy Armstrong Medical

| BLUE   |  |
|--|--|
| <b>SEIZURE</b>                                 | <b>ICP</b>   |
| Lorazepam (2 mg/mL) 2 mg (1 mL)                | 3% Saline 40-100 mL  |
| Phenobarbital (20 mg/mL) 4 mg (0.2 mL)         | Mannitol 20% (0.2 g/mL) 71 (100 mL)                                |
| Phenytoin (50 mg/mL) 4 mg (0.08 mL)            | 20% (0.25 g/mL) 71 (84 mL)   |
| Propofol (100 mg/mL) 40 mg (0.4 mL)            | Fenestrol 1% (10 mg/mL) 31 mg (3.1 mL)                             |
| <b>OVERDOSE/HYPOVOLEMIA</b>                    | <b>FLUIDS</b>  |
| D <sub>5</sub> W (0.25 g/mL) 10.2 (40 mL)      | Volume Expansion Crystalloid (NS or LR) 420 mL                     |
| D <sub>5</sub> W (0.5 g/mL) 10.2 (40 mL)       | Colloid-based 210 mL   |
| Mannitol (20 mg/mL) 2 mg (0.1 mL)              | Maintenance 63 mL/hr   |
| Morphine (2 mg/mL) 2 mg (0.1 mL)               | <b>PAIN</b>  |
| Fentanyl (0.1 mg/mL) 0.2 mg (2 mL)             | Fentanyl (0.1 mg/mL) 21 mg (0.42 mL)                               |
| Flumazenil (10 mg/mL) 0.2 mg (2 mL)            | Morphine (2 mg/mL) 21 mg (1.05 mL)                                 |
| Propofol (100 mg/mL) 2 mg (0.02 mL)            | Propofol (10 mg/mL) 21 mg (2.1 mL)                                 |
| Propofol (100 mg/mL) 2 mg (0.02 mL)            | * Dilute D <sub>5</sub> W 1:1 with preservative free sterile water |
| <b>EQUIPMENT</b>                               | <b>EQUIPMENT</b>   |
| E.T. Tube 5.5 Uncoated's 0 Cathed 15.5-16.5 cm | Oxygen Mask ET/CP  |
| Stylet 18 French                               | Stetho   |
| Endotracheal Catheter 18 French                | "Urinary" Catheter 18-22 French                                    |
| Stylet 18 French                               | NG Tube 18-22 French   |
| Laryngoscope 2 Straight or Curved              | Resuscitator Access 18-20 Ga                                       |
| Stylet 18 French                               | Intracranial (IO) 15 Ga  |
| Oral Airway 7-9 mm                             | BP Cuff 15 Ga  |
| "Anatomical" Airway 2.5 French                 | * May not be included in Organizer System(s).                      |

| BLUE   |   |
|--|---|
| <b>RESUSCITATION</b>                           | <b>RSI</b>                                |
| Epinephrine (1:10,000) 0.2 (1 mL)              | Atropine 1 mg (1 mL)                      |
| Epinephrine ET (1:1,000) 2 mg (2 mL)           | <b>INDUCTION DRUGS</b>                    |
| Altophine ET (0.4 mg/mL) 1 mg (2.5 mL)         | Ethomidate (2 mg/mL) 5.3 mg (2.6 mL)      |
| Sodium Bicarbonate 8.4% 20 mg (2.4 mL)         | Ketamine (10 mg/mL) 42 mg (4.2 mL)        |
| Lidocaine 2% (20 mg/mL) 40 mg (2 mL)           | Propofol (10 mg/mL) 63 mg (6.3 mL)        |
| Etomidate 0.3 mg/mL 40 mg (13.3 mL)            |   |
| 2 <sup>nd</sup> Defibrillation 80 J            | <b>PARALYTIC DRUGS-INITIAL DOSE</b>       |
| 3 <sup>rd</sup> Defibrillation 100-200 J       | Succinylcholine (20 mg/mL) 42 mg (2.1 mL) |
| Cardioversion 100 J Dose 20-200 J              | Rocuronium (10 mg/mL) 21 mg (2.1 mL)      |
| Adenosine (3 mg/mL) 6 mg (2 mL)                | <b>PARALYTIC DRUGS-MAINTENANCE DOSE</b>   |
| 1 <sup>st</sup> Dose 2.1 mg (0.7 mL)           | Rocuronium (1 mg/mL) 21 mg (2.1 mL)       |
| 2 <sup>nd</sup> Dose 4.2 mg (1.4 mL)           | Rocuronium (10 mg/mL) 21 mg (2.1 mL)      |
| 3 <sup>rd</sup> Dose 105 mg (3.5 mL)           | <b>SEBATION DRUGS-MAINTENANCE DOSE</b>    |
| Calcium Chloride (100 mg/mL) 420 mg (4.2 mL)   | Lorazepam (2 mg/mL) 21 mg (2.1 mL)        |
| Propofol (100 mg/mL) 420 mg (4.2 mL)           | Morphine (2 mg/mL) 4 mg/mL                |
| Propofol (100 mg/mL) 420 mg (4.2 mL)           |   |
| Magnesium Sulfate (40 mg/mL) 1050 mg (26.2 mL) |   |
| Magnesium Sulfate (40 mg/mL) 1050 mg (26.2 mL) |   |

### Weight, don't tell me:

- Approximate ideal body weight is listed on the bottom of each length-based color zone.
- Color-coded weight zones range from 3 kg (i.e., not for preemies) to 36 kg.
- The name of the color is printed on the top of each zone (especially helpful for colorblind providers).

**One shade of gray:** Unlike the other color zones, the 3 to 5 kg weight zone technically doesn't have a color name. However, it's commonly referred to as the “gray zone,” not the 3 to 5 kg zone. This zone is for infants from newborn to three months—but not for preemies.

**Other means all:** In the gray color zone, equipment sizes aren't found. The note referring to other equipment implies all equipment and refers to the pink/red zone. The pink/red zones list the suggested emergency equipment sizes. Endotracheal tube insertion length is found in the gray zone, just not the size of the endotracheal tube.

**Taping the tube:** When you see the term “ET insertion length,” or “tip to tip,” this indicates the location where the endotracheal tube is secured.

**WTF (what's the Foley?)?:** Look instead for “urinary catheter—Foley is a trade name; the generic term is urinary catheter.”

**WTF #2 (what's the fluid [bolus]?)?:** What many of us would call a fluid bolus is instead listed on the tape as “volume expansion crystalloid: NS or LR.” The classic formula of 20 mL per kg is still utilized and the mL dose is listed. You just have to know what to call it in order to find it (in the fluids section). Blood is also conveniently included in the fluids section, as “colloid/blood.”

### Conclusion

As the Bob Dylan song goes, “The times, they are a changin’.” Just as popular music has changed over the years, the Broselow-Luten tape continues to evolve.

What doesn't change is the need to provide the best care we can in emergencies. When the chips are down and all bets are in, you don't want to be left guessing or stressing. You don't want to be relying on mental math if you don't need to. The tools and resources are out there. You just need to know what they are, where to find them, and how to use them!

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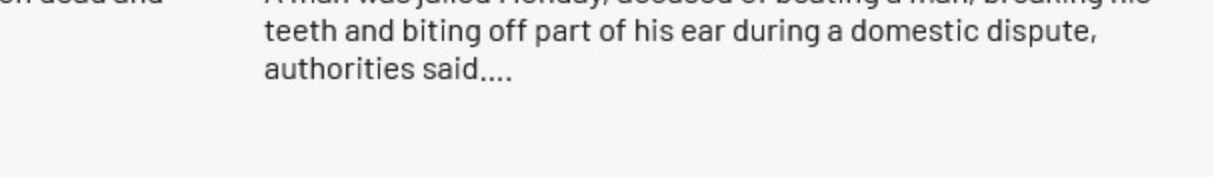
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