AirLife®

The Broselow-Luten™ System

The Broselow Reference Tape incorporates the Broselow-Luten Color Coded System. The system groups children into color-coded zones rather than assigning individual kilogram weights. The system can be accessed by using the child's weight or length. Length should be used in emergencies when the child cannot be weighed.

Recommended Concentrations

In an effort to facilitate medication preparation and administration and reduce the potential for errors associated with medication administration this edition of The Broselow Reference tape expands the medication concentrations needed to deliver the dose in milligrams, grams, micrograms, or milliequivalents to all medications on the tape. **It is critical that providers be aware of the concentration in their stock and recheck the concentration when preparing the does in mLs.** The list of recommended concentrations is provided on the tape.

Body Weight Prediction by Length

Because of concerns about the accuracy of the Broselow Reference tape to predict actual weight in an increasingly obese pediatric population, the zones for the last edition of the tape were updated and a simple weight prediction adjustment method was introduced that retains the tape's practical approach. There have been no significant changes in the prevalence of obesity in childhood since the last edition[1].

The Broselow Reference tape is based on the relationship between weight and length across all ages; each color zone estimates the 50th percentile weight for the mean length within a color zone, which for practical purposes estimates the ideal body weight (IBW) for emergency dosing. The 2011 version of the Broselow Reference tape incorporated revised length weight zones based on the most recent National Health and Nutrition Examination Survey (NHANES) data set at that time[2].

Utilizing this data set to examine Broselow Reference tape predictions of actual body weight with the revised zones reveals that approximately 65% of the time the patient's measured length places them in the correct zone for actual weight. Of the remaining 35%, ~20% fall into the heavier Broselow-Luten zone above and 13% fall into the lighter zone below, with < 1% outliers falling greater than 1 zone from predicted. If the healthcare provider incorporates a visual estimate of body habitus into the prediction, the accuracy of the estimate of actual patient weight is improved as confirmed in multiple studies. Specifically, the patient's length-based dosing zone can be adjusted up one color zone for drug dosing if the child appears overweight. Thus, incorporating a visual estimate of whether the child is overweight provides a simple method to predict actual patient weight that appears to be clinically relevant given the rise of obesity in the US.

Although some medications are best dosed by actual body weight (e.g., succinylcholine), most resuscitation medications are distributed in lean body mass (e.g., epinephrine, sodium bicarbonate, calcium, magnesium, etc.) so that IBW, rather than the actual body weight, would appear preferable for dosing. For most resuscitation medications, the optimal dose is not known and doses based on IBW or actual weight are likely equally effective.

The 2010 PALS guidelines comment on this issue[3] (below) and the 2015 PALS guidelines made no changes to the recommendations "there are no data regarding the safety or efficacy of adjusting the doses of resuscitation medications in obese patients. Therefore, regardless of the patient's habitus, use the actual body weight for calculating initial resuscitation drug doses or use a body length tape with precalculated doses (Class IIb, LOE C)."

Studies on the accuracy of predicting endotracheal tube sizes consistently demonstrate the superiority of length predictions over other methods. Unlike medication dosing, body habitus does not affect the accuracy of the prediction.

The following is the recommended use of the Broselow reference tape. Utilizing clinical judgment applied to each situation:

1.) **Measure child to identify weight/color zone.**
2.) **If a child appears overweight consider utilizing one zone higher for dosing only.**
3.) **Always use the reference tape measured length zone for equipment selection regardless of body habitus.**

For a more in depth discussion of the issue, including the theoretical dangers of dosing by actual body weight in the obese patient, the reader is referred to the following reference:

R Luten, Zaritsky A, The Sophistication of Simplicity Optimizing Emergency Dosing. Academic Emergency Medicine. 2008 May; 15 (5):461-5 18439202

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Equipment Guidelines

The following suggested guidelines are specific to each piece of equipment to assure that the appropriate size is used. If your patient's length falls at the extremes (upper or lower) of a respective color, consider the next closest color category and always follow clinical guidelines. Never use force to achieve fit.

B.V.M: The Mask of the BVM apparatus should cover the nose and mouth of the patient and form a tight seal, not allowing air leaks. the mask should cover from the bridge of the nose to the cleft of the chin. Regardless of the size of the bag or patient, one should always start with small tidal volumes, increasing in increments quickly until chest rise is obtained.

E.T. TUBES: Select one size (0.5 mm) larger and one size smaller for backup. Do not force the endotracheal tube through the vocal cords.

STYLETS/SUCTION CATHETERS: Store the appropriate size stylet and suction catheter with the ET tube for quick access. Stylets can be lubricated with a water soluble jelly to facilitate their removal. The stylet should not extend beyond the end of the ET tube.

ORAL AIRWAYS: Size can be estimated by placing the proximal end of the airway at the teeth. The correct size will have the distal end at the level of the lower border of the angle of the mandible.

B.P. CUFFS: In general, the width of the cuff should cover a minimum of two-thirds (2/3) for the child's upper arm.

N.G. TUBES: Tube length inserted can be estimated by measuring the tube length from the tip of the nose to the ear and then from the ear to just below the rib cage. Position should be confirmed by injecting a small volume of air while listening over the stomach. If needed, especially to evacuate fluid contents, the largest tube that fits easily through the nares may be used.

URINARY CATHETERS: The catheter should easily pass through the external meatus.

CHEST TUBES: Traditionally, small diameter tubes are used to evacuate air, and larger diameter tubes are used to evacuate blood. Currently, trends are moving toward the use of smaller size tubes for both the evacuation of air and blood. Pig tail catheters are also increasingly being used for uncomplicated traumatic pneumothorax instead of classic chest tubes.

VASCULAR ACCESS: For shock, the largest possible catheter should be used, and ideally two lines should be inserted. For drug administration in cardiac arrest, catheter size is less of a concern.

There are no established guidelines for the size of intraosseous needle use. Many clinicians prefer the smaller 18 Ga needle for smaller children (3, 4, 5 kg, and pink zones) and the 15 Ga needle for older children (red, purple, yellow, white, blue, orange, and green zones). The EZ IO device uses 15 Ga needle (blue) for all zones. There are currently no age restrictions on the use of intraosseous needles.

O_2 MASK: The NRB (partial non-rebreather) mask with few exceptions (some children with either ductal dependent cardiac lesions or chronic lung disease) is the preferred O_2 mask for emergency situations.

LARYNGEAL MASK APPARATUS (LMA): These guidelines are derived from the manufacturer's weight-based guidelines. Clinical judgment should be used in patients who are outliers (i.e. morbidly obese or emaciated). LMA is a registered trademark of LMA North America, Inc.

EXPIRED CO_2 COLORMETRIC END-TIDAL DETECTORS: Use the pediatric end-tidal CO_2 detector below 15 kg (3, 4, 5 kg, pink, red, purple, and yellow color zones) and the adult detector for > 15 kg (white, blue, orange, and green color zones). The pediatric detector can be used in larger children, but should be removed immediately after CO_2 detection as the small caliber of the unit may impede air flow. The adult unit will not function reliably in the smaller children as the device's dead space volume is relatively large compared with expired gas volume gas flow which is minimal.

References

1 - Ogden CL, Carroll MD, Kit BK. Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA 2014:311(8): 806-814
2 - Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey Data. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, http:/www.cdc.gov/nchs/inhanes2007-2008/nhanes07_08.htm
3 - Kleinman ME, Chameides L, Schexnayder SM, Samson RA, Hazinski MF, Atkins DL, Berg MD, de Caen AR, Fink EL, Fried EB, Hickey RW, Marino BS, Nadkarni VM, Proctor LT, Qureshi FA, Sartorelli K, Topjian A, can der Jagt EW, Zaritsky AL. Part 14: Pediatric Advanced Life Support: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122 (suppl 3):S876-S908.

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