a 90-degree angle. The National Center for Immunization and Respiratory Diseases (2011) recommends that toddlers receive injections with a 1-inch long needle in the anterolateral thigh; the deltoid muscle could be used if the muscle size is adequate. For children 3 to 18 years old, the deltoid muscle is preferred and needle size can range from 22- to 25-gauge and from ⅝- to 1-inch long, depending on the technique used.

- The American Academy of Pediatrics (2015) recommends that injections in the anterolateral thigh be given at least 2.5 cm (1 inch) apart so that local reactions are less likely to overlap. The dorsogluteal muscle should be avoided in infants and toddlers, and perhaps even in smaller preschoolers with smaller muscle mass, because of the possibility of damaging the sciatic nerve. The anterolateral aspect of the thigh offers the greatest thickness of muscle (Ogston-Tuck, 2014b). When multiple vaccines are given, two may be given in the thigh (anterior and lateral) because of its larger size.

No research or supportive data were found regarding the amount of medication to be given at the different sites in infants and toddlers. In general, 1 ml of medication is recommended for infants younger than 12 months old; however, no data can be found to refute or support such a recommendation. Furthermore, small and preterm infants may only tolerate up to 0.5 ml in each muscle to prevent local complications.

In summary, some discrepancy remains in actual clinical practice regarding IM injection sites, amount of drug injected, and needle size in infants and toddlers. Further research is needed to address the following issues:

- What is the appropriate muscle in which an IM injection can be administered with fewest adverse effects in infants and toddlers?
- What is the appropriate needle size based on the infant or toddler's age and weight?
- What is the largest safe amount of medication that can be given to infants and toddlers based on weight and muscle size?