Blood collections historically have been used in pediatrics, but this practice is increasingly attractive in adult care. Indeed, the reduced pain (12) and anxiety associated with capillary sampling has been cited as the primary motivation for founding the start-up blood testing company, Theranos. However, dependence on capillary samples may lead to inaccuracy and exaggerated variability. Twenty five years ago research demonstrated that cholesterol measurement in capillary blood is positively biased compared to venous blood (13). A recent study comparing white blood cell (WBC) counts, three-part WBC differential, and platelet counts from successive drops of capillary blood reported the average drop-to-drop coefficient-of-variation was 5 times higher than obtained with well-mixed venous blood (14).

Capillary samples are also associated with high rates of hemolysis and clotting. Proper collection technique is essential to minimize hemolysis of a sample from a finger or heel stick. “Milking” or squeezing a finger or heel is an absolute non-starter because it can result in hemolysis. In addition, exposing slow flowing capillary blood to disrupted tissue can trigger clot formation. Coagulation testing, therefore, is contraindicated on capillary specimens.

**Volumetric Challenges**

Drawing minimal volumes often increases the frequency of a lab’s quantity not sufficient (QNS) specimens. In pediatric labs, a common reason for QNS is an elevated hematocrit, which can be as high as 70% in a newborn but normalizes to adult levels by 3 months of age (15). Consequently, newborn samples can yield much less serum or plasma after centrifugation when compared to an identical volume of adult blood which has a hematocrit around 45%. In such cases, more whole blood must be provided so that sufficient plasma is available for analysis. High hematocrit in newborn samples also complicates routine coagulation tests because sodium citrate only distributes into plasma, and not blood cells. In samples with a hematocrit greater than 55%, the resulting plasma citrate concentration is higher than normal, leading to falsely prolonged clotting times. Often this can be corrected by redrawing a sample using a reduced volume of sodium citrate.

Hemolysis also is a very common problem in pediatrics. While not fully understood, this phenomenon may be related to heightened osmotic and mechanical fragility of the neonatal erythrocyte population (16,17). Regardless of mechanism, capillary sampling and the use of small gauge needles undoubtedly exacerbate the problem. Multiple studies have found that drawing blood from a 20-gauge needle or larger helps reduce hemolysis (18,19). However, in children and elderly patients the need for smaller needles is at least in part due to the small volume of sodium citrate.

In healthy residents of a newborn nursery, Total CO2 measurements over a 5 month period at St. Louis Children’s Hospital. The difference in TCO2 measurements in neonates younger than 72 hours is at least in part due to the smaller sample volumes obtained from this patient population. The 25th and 75th percentiles are indicated by the boxed area. The 10th and 90th percentile are indicated by the whiskers.

**F1**

**F2**

Small volume tubes and their larger counterparts. A) “Bullets” alongside with BD Vacutainer® counterparts. Left: green top tubes that containing lithium heparin and gel for plasma separation. Middle: blue top tubes containing sodium citrate used for coagulation studies. Right: lavender microtainer tube is a false bottom tube and looks deceivingly large. B) Blood gas syringe and capillary tubes employed for pediatric blood gas analysis.