

## Blood Sample Volumes

Blood loss because of phlebotomy for diagnostic laboratory tests is a well-recognized concern for patients. The blood volume needed for laboratory testing has steadily decreased with advances in automated instrumentation and point of care testing. Most adults can easily tolerate the loss of blood volumes typically used for laboratory tests. The most commonly used vacuum tube sizes collect just less than 5ml or 10ml of blood. The 5ml size tube is equivalent to one teaspoon and therefore, a single 5 ml draw constitutes approximately only one- thousandth of the blood in the patient's circulation (0.1%).<sup>1</sup> Blood collection volumes in adults constitute a very small percentage of the total blood volume and so they should be well tolerated physiologically. Frequent blood draws for laboratory tests are a recognized risk in neonates, particularly low birth-weight infants, and critical care adult anemia patients requiring transfusions. The most significant nutritional impact of excess phlebotomy may be iron deficiency, which is detected readily by erythrocyte indices and serum iron measurements.

There are some positive effects that arise due to low blood volume. If the bone marrow is stressed by anemia, it can respond with even more new erythrocytes. The primary function of erythrocytes is to carry oxygen throughout the body; however physiologic studies have shown that the effectiveness of tissue oxygenation actually is improved when the hematocrit is substantially below the reference range. This effect is because of enhanced perfusion of small blood vessels when the viscosity of blood falls because of a drop in hematocrit. Immobilized patients run the risk of deep vein thrombosis and pulmonary embolus. Lowering the hematocrit can have the beneficial effect of reducing risk for thrombosis and embolization. An elevated or even high normal hematocrit maybe a risk factor for acute myocardial infarction.<sup>2</sup>

Specimen collection volumes are determined not only by analytic volume requirements but, by the need to standardize techniques of specimen collection, transportation, processing, and storage. All of which are important factors in specimen quality. There are convincing reasons to maintain specimen sizes at volumes above the bare minimum. Short specimens from difficult draws may be of poor quality, they may be partially hemolyzed and whole blood specimens maybe clotted. Very small specimen volumes may also allow light through thereby destroying and so falsely lowering light sensitive analytes such as bilirubin. Analyzing poor quality specimens can yield poor quality results which the physician cannot properly distinguish from truly abnormal results.

Recommendations for promoting blood conservation in adults who frequently are phlebotomized have come from two studies regarding blood loss by phlebotomy. "Smoller and Kruskall" and "Acute Physiology and Chronic Health Evaluation" studies recommend smaller collection tubes, but more importantly organizing blood draws to eliminate duplicate, and other unnecessary test requests, and consolidating multiple collections into as few as possible by scheduling them.<sup>1</sup> HHLA strives to stay abreast of emerging trends in medicine that bear on the practice of blood conservation. Our goal is to effectively utilize the volume of blood received for testing to the best benefit of the patient's care.

### Bibliography

1. "Blood Sample Volumes: Emerging Trends in Clinical Practice and Laboratory Medicine" by Richard A. McPherson, M.D.pg.3-10, copyright- Jan./Feb.2001 by Clinical Laboratory Management Association Inc.
2. Gagnon DR, ZhangT, Brand FN, Et Al. Hematocrit and the risk of cardiovascular disease-the Framingham study: a 34-year follow-up. Am Heart J, 1994; 127:674-682.