

# Needle Know-How

## The Art of Hemolysis

**R**ed is such a pretty color... unless it tinges the serum or plasma of the specimen you collected. Then it's ugly. It's ugly because it usually means the time you spent drawing the specimen was wasted and the draw will have to be repeated. But it's more than a time killer. Having to recollect a hemolyzed specimen that is incapable of rendering accurate and useful results to the physician delays treatment, diagnosis, and/or much-needed medications. In critical situations, time isn't just money, it can be life itself.

While hemolysis brings a splash of color to a specimen, it's the art of preventing hemolysis that is the subject of this *Needle Know-How*. Hemolysis has been reported to be the number one cause of rejected chemistry specimens. In fact, six times more specimens are rejected because of hemolysis than the second-most common reason, insufficient sample volume. But before we master the art of preventing hemolysis, we have to understand how it occurs.

"*Hemo*" means blood, of course; "*lysis*" means to rupture or the destruction of cells. So hemolysis is literally the destruction of blood cells, specifically red blood cells. When red cells rupture, they spill their contents, mostly hemoglobin, into their surroundings. Hemoglobin is a respiratory pigment that has an insatiable passion for oxygen and gloms onto every molecule of it that it can hold while passing through the lungs, then dumps it off into the tissue where it's needed for cellular functions.

Hemoglobin is also what makes blood red. So naturally, when red cells burst, it tinges the liquid portion of the blood.

If red cells burst during specimen collection, the blood being tested is not the same as the blood

circulating in the patient. It's as different as night and day. Because red blood cells contain 23 times as much potassium as the liquid portion of the blood, when red cells rupture during collection, the specimen being submitted for testing is spiked with potassium. In fact, it's spiked with so much potassium that, if tested and reported, the results can send the physician into a sheer panic, forcing him or her to react with orders that can be ultimately unfavorable to the patient. Or, if the patient's circulating potassium is actually too low, hemolysis can spike the specimen into a normal range and lead to inaction when action is necessary.

But it's not just potassium that hemolysis affects. These other tests are affected when hemolyzed specimens are submitted for testing: LDH, AST, ALT, phosphorous, magnesium, ammonia, RBC, hemoglobin and hematocrit. Not only these analytes, but virtually everything that could be tested. That's because besides hemoglobin is a liquid protein which dilutes the serum or plasma being tested. The greater the hemolysis, the greater the dilution. Suffice it to say hemolysis is just all-around nasty.

So how do those who collect specimens prevent the lab from reporting inaccurate results? Sure, the testing personnel should be rejecting hemolyzed



specimens when they receive them, but by the time hemolysis is detected, the time spent drawing the specimen is already wasted and the delay in reporting accurate results is already taking a toll on patient care. So preventing hemolysis in the first place has enormous benefits to the patient. Follow these guidelines to keep your personal specimen rejection rate to a minimum:

**Avoid line draws**—Vascular access devices (VADs) like central venous catheters and PICC lines are designed for fluids to be infused into the patient, not blood to be withdrawn from the patient. The shear forces and turbulence generated through such systems is often too much for the fragile red cells to handle, making hemolysis unavoidable. When there is a lack of alternatives, use a syringe and gentle pulling pressure on the plunger. But be prepared to perform a venipuncture anyway. Even the gentlest technique cannot prevent hemolysis during most line draws.

**Avoid vigorous mixing**—Gently invert tubes with additives instead of vigorously mixing them. Remember, red blood cells are delicate and don't handle stress too well.

**Avoid excessive pulling pressure**—When drawing into a syringe, pulling back hard on the plunger of the syringe causes too much turbulence through the needle and ruptures red cells as they pass through. Use a gentle pulling pressure instead.

**Make sure the alcohol dries**—Alcohol has a hemolytic effect on red blood cells, so make sure

the site has dried thoroughly before performing the puncture.


**Don't rim clots**—When specimens are centrifuged too soon after collection, fibrin in the serum has to be removed. Often the technique used by specimen processors is to “rim” the clot with wooden applicator sticks. This technique not only ruptures red blood cells bound up in the clot, but also exposes the processor to bloodborne pathogens. Instead, allow specimens to clot for 20-30 minutes before centrifugation.

**Place the needle properly**—Should the bevel of the needle rest half way through the wall of the vein or the vacuum of the draw partially collapse the vein, the opening of the bevel is narrowed by the obstruction. A partially obstructed needle opening results in a dramatic increase in the shear forces at the tip of the needle, hemolyzing the cells that pass through. When the blood flow appears abnormally slow, attempt to relocate the needle for a more central placement within the vein. But always follow the limits of needle relocation as defined in the NCCLS standards to prevent patient injury.

**Prewarm skin puncture sites**—Nothing hemolyzes a capillary specimen like excessive “milking” of the tissue. To prevent the necessity to milk the site, prewarm the area with a warm compress not to exceed 42 degrees Celsius. This increases the flow of blood through the area seven fold.

**Fill tubes fully**—When collection tubes with anti-coagulants are underfilled, the excessive concentra-

tion is hard on the fragile membranes of red blood cells. Make sure that all tubes are filled to their stated volume and that smaller volume tubes are available for those situations when a difficult draw is anticipated.

Using these and other techniques can minimize your potential to hemolyze specimens. Since accurate results begin with the collector, those who draw blood specimens are in the best position to make sure patients are treated according to results that are not delayed or altered because of hemolysis. The real art of hemolysis is in avoiding it in the first place. 

The Manager's Toolbox is a download with a collection of five documents including a summary of published studies on the inherent nature of hemolysis with IV starts and other line draws. Also in the Toolbox is a potassium troubleshooting checklist that lists 14 causes of hemolysis and over 40 causes of falsely elevated potassium levels. For more information on these documents and other useful tools for those who manage blood collection personnel, click below.