Testing Delays and Spurious Results Caused by Improper Specimen Collection

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Collecting a specimen may seem routine, but doing it properly requires a specialized knowledge base and skill set to ensure optimal patient care. Specimen collection errors delay patient care and can have devastating consequences. Labeling errors are the most serious, but errors from poor collection and handling may cause inaccurate results and patient harm. Today’s laboratory tests are much more sensitive, rapid, and accurate than in the past, but the laboratory equipment is also much more sensitive to poor quality specimens. Each day, the laboratories in the Allina Hospitals and Clinics reject a significant number of specimens that are improperly collected. Specimen rejection is, first and foremost, a safety measure to protect patients from spurious and inaccurate lab results.

Unfortunately, some specimen collection errors are not apparent on receipt in the laboratory and have the potential to cause delays, erroneous lab results, and patient harm. At Allina and in published studies, specimen problems are more common when collection is performed by staff who don’t have specialized training or expertise in best practices.

The Five Rights of Specimen Collection:

♦ Right Patient
♦ Right Test
♦ Right Time
♦ Right Container
♦ Right Handling

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Some specimen collection errors that cause erroneous results include:

<table>
<thead>
<tr>
<th>Specimen Collection Error</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mislabling</td>
<td>Results actually from another patient</td>
</tr>
<tr>
<td>Blood Draws from IV Starts</td>
<td>Hemolysis and dilution which interferes with most laboratory tests</td>
</tr>
<tr>
<td>Improper skin preparation for blood culture collection</td>
<td>False positive blood culture</td>
</tr>
<tr>
<td>Improper mixing of additive tubes</td>
<td>Spurious results for troponin and other sensitive assays</td>
</tr>
<tr>
<td>Wrong draw order or transfer between tubes</td>
<td>Unexpected or unusual laboratory results</td>
</tr>
<tr>
<td>IV fluid contamination</td>
<td>Unexpected or very abnormal laboratory results</td>
</tr>
<tr>
<td>Prolonged tourniquet time</td>
<td>Hemoconcentration, false polycythemia, masking of anemia</td>
</tr>
<tr>
<td>Line draws</td>
<td>False negative results for heparin-induced thrombocytopenia,</td>
</tr>
<tr>
<td></td>
<td>inaccurate coagulation test results.</td>
</tr>
</tbody>
</table>

Hemolysis Due to Blood Collection From an IV Start

“On arrival, the patient ... was lethargic and appeared to be in pain. .... The complete blood count was normal; other specimens could not be analyzed because of hemolysis.”


At first glance, this NEJM case report seems to be describing acute intravascular hemolysis, a serious medical emergency. However, later in the report, laboratory results are given for re-collected specimens with no evidence of hemolysis. This means that the hemolysis that delayed results the first time was artificially caused, most likely due to blood collection from an IV start.

Despite published guidelines and institutional policies against collecting specimens from IV starts, this practice still persists in some departments to “save the patient a poke”. While it might appear that this is more efficient and patient-friendly, collecting from IV starts actually results in many poor quality specimens that have to be re-collected, delaying results and patient care. Rejection rates are as high as 10-20%. In departments with specialized blood collection teams, specimens are never collected from IV starts. Experience and data at Allina show that these departments have better patient flow, faster turnaround times, and very low specimen rejection rates (0.5%). Blood collection from IV starts can no longer be justified on the basis of efficiency, turnaround time, or patient care quality. Specific exceptions for other reasons that are listed in Allina policies and published best practice guidelines include:

♦ Patients on thrombolytics such as streptokinase
♦ Critical emergencies when unable to do a standard venous blood draw
Spurious Bacteremia

Blood collection from IV starts is also responsible for a large percentage of contaminated blood cultures. This is usually because establishing the IV is the first priority and proper skin preparation for blood culture isn’t considered. After establishing the IV, blood cultures are drawn along with the rest of the specimens, forgetting that the skin wasn’t properly disinfected. A positive blood culture will trigger a critical call and initiation or escalation of antibiotic therapy for 1-2 days before additional laboratory testing reveals that the organism was a contaminant. This adds significant cost and risks to patient safety.

Spurious Troponin Results

Plasma processed from anticoagulated blood is the preferred specimen for troponin and other stat testing. This is because serum, processed from clotted specimens, requires at least 20 minutes for clotting. Another disadvantage of serum is that patients on anticoagulants have delayed clot formation – this can cause the specimen to clot during analysis and breakdown of laboratory instruments.

Plasma specimens are collected in anticoagulant tubes that must be properly mixed by inversion immediately after filling to prevent any clot formation. Although larger clots can be detected in a specimen before analysis, inadequate tube mixing at collection can allow invisible microclots to form which cannot be detected before analysis. These microclots can cause spurious results with highly sensitive assays, especially troponin. The only way to detect spurious results due to microclots is through duplicate testing of every specimen, which ties up instruments and increases turnaround time. Despite identical instrumentation and collection tubes at all Allina sites, problems due to microclots are noted to be more frequent at sites that don’t have specially trained blood collection teams.

Why is Troponin such a problem now? The need for earlier and faster detection of laboratory markers, especially Troponin, has driven manufacturers to make their test systems increasingly more sensitive and rapid. The technology is now so sensitive that delayed or inadequate tube mixing can cause problems that wouldn’t have occurred in the past.

Spurious Lab Results From Wrong Draw Order or Transfer to Another Tube Type

Every so often, the laboratory sees results a from a blood specimen that are physiologically impossible. For example:

- Potassium 20 mmol/L
- Calcium 0.5 mg/dl

What happened? Even though the specimen was submitted in the proper heparin (green top) tube, these results reveal that the blood was actually transferred from a Potassium-EDTA (lavender top) tube. This can also happen when a heparin tube is drawn after an EDTA tube (wrong draw order).

Another thing that sometimes happens is that a blue top (citrate) coagulation specimen will show a strong heparin effect in a patient who is not on heparin - indicating that the blood was transferred from a heparin tube (green top).
**Take-Home Point:** The blood collection tubes are not interchangeable. Transferring blood from one tube to another doesn’t work and should never be attempted. It will cause spurious results that will delay patient care, or worse, cause harm. Laboratory time and resources will be wasted to investigate these specimens and the patient will have to be re-drawn.

**Spurious Polycythemia Caused by Prolonged Tourniquet Time**

A 45 year old male laboratory technologist was seen by his physician for a routine visit. The patient was obese, with thick arms and deep veins that are difficult to palpate. The phlebotomist applied a tight tourniquet to distend the veins, and after a minute the sample was collected. The patient observed that the blood tubes were correctly labeled in his presence.

A CBC was ordered and showed a mildly elevated hemoglobin and hematocrit:
- Hemoglobin 18.1 g/dl
- Hematocrit 51.8%

The patient worked as a technologist in the lab where his specimen was analyzed and noted these elevated results. Remembering the prolonged tourniquet time, he asked a fellow technologist to draw a new specimen without the use of a tourniquet. Testing on the new specimen done the same day showed these results:
- Hemoglobin 13.6 g/dl
- Hematocrit 40.9%

The RBC indices on both specimens were identical and the WBC and PLT counts were similar.

**Explanation:** Prolonged tourniquet time (> 30 sec) causes hemoconcentration and can significantly raise the hemoglobin and hematocrit. This can lead to expensive investigations for polycythemia, or could mask a low hemoglobin in a patient with anemia. When a tourniquet is applied, the blood plasma flows more easily than the cells, and this leads to hemoconcentration. Since red cells far outnumber the other cell types, the red cell counts increase much more rapidly than the WBC or PLT counts.
Spurious False Negative Result for Heparin-Induced Thrombocytopenia (HIT)

A 22 year old hospitalized patient with a central venous catheter developed a sudden drop in the platelet count from 287,000/µL to 98,000/ µL.

The patient’s physician suspected heparin induced thrombocytopenia (HIT). Although the patient was not being treated with heparin, high dose heparin was used to maintain patency of the central line. Because some heparin remains in these lines even after flushing, heparin can still enter the patient’s blood stream and trigger HIT.

Antibody testing for HIT by PF4 ELISA was performed to confirm the diagnosis, but was negative. After discussion with the pathologist, the physician ordered repeat testing which was strongly positive.

What happened?
Line draws give false negative results for heparin-induced thrombocytopenia (all methods). This leads to diagnostic confusion and may trigger costly investigations for other causes of thrombocytopenia.

When heparin is used to maintain a line, there is no amount of flushing that can completely remove it. Line draws won’t affect most routine chemistry or hematology tests, but will cause false negative results for HIT and false prolongation of the PTT. These specimens must be collected by a peripheral venous draw, not through a line.

When testing for HIT, the patient must be off heparin and the specimen must be obtained by a peripheral venous draw.

Why?
HIT antibody detection systems use heparin to “smoke out” and bind to heparin antibodies. If the specimen already contains heparin, the antibodies will already be bound up with antigen and won’t react in the test system, causing a false negative.

Spurious Urinalysis Results Caused by Not Labeling Each Specimen in the Presence of the Patient

“A urine specimen arrived in the laboratory with three labels attached; one on each side and one on the lid. All three labels contained different patient names”
Consequences: Caregivers may not realize the devastating results that mislabeling a urine specimen could have for a patient. Besides giving wrong diagnostic information, a mislabeled urine could result in false evidence of infidelity or child abuse. For example, a sexually transmitted parasite, Trichomonas vaginalis, can be identified in urine and can raise suspicions of marital infidelity in adults or child abuse if the specimen was mistakenly labeled for a minor child. Also, sperm can normally be seen in the urine of males and sexually active women; but if found in a specimen that was mislabeled for a young girl, this could raise suspicion of child abuse.

Testing Delays and Labeling Errors Caused by Collecting Blood Before Orders are Placed

Some strategies used in patient care areas to get faster lab turnaround actually make it slower. One such strategy is to collect a “rainbow” of blood specimens before orders are placed. This doesn’t really work, because in turnaround time studies, the process of specimen collection isn’t the bottleneck. Typically, the biggest delay is getting the orders placed.

Instead of making things more efficient, there are two things that typically happen to blood tubes that are collected ahead of orders:

♦ Tubes are left unlabeled in the patient’s room.
  ◊ Risk: Specimen rejection due to mislabeling or worse, labeled for the wrong patient. The lab occasionally receives blood specimens that are completely unlabeled and have to be re-drawn.

♦ Tubes are labeled with station or clinic labels and sent to lab prior to receiving orders.
  ◊ Risk: Lab has tubes but orders don’t always follow and providers don’t get results. Orders not placed as “add ons” trigger a new collection, leading to confusion and delays.

In Allina’s experience, it is much safer and actually quicker to not draw blood before orders are placed.

Best Practices for Specimen Collection

It has been estimated that laboratory test results leverage 70-80% of medical decisions. The number of available laboratory tests has expanded enormously, making it harder to know the right test to order and the right specimen to collect. Instrumentation is much more powerful than in the past, but significantly more sensitive to specimen factors resulting from poor collection practices.

Data from Allina and in published reports show that specimen collection errors are more common when specimens are collected by caregivers and other staff who do not have dedicated training in blood collection best practices. This is not surprising, considering that caregivers have many priorities other than specimen collection.
Data at Allina show that specimen collection by specially trained, dedicated staff provides these benefits to patient care:

- Improved turnaround times (specialization, background knowledge, increased efficiency)
- Improved patient safety (mislabeled, unlabeled)
- Optimal blood management (experienced with minimum draw guidelines, triaging small amount of blood for the maximum possible tests)
- Decreased specimen rejection and recollection (hemolysis, clots, mislabeled, unlabeled, insufficient specimen volume, collected at wrong time, wrong container type)
- Decreased spurious results (troponin problems, false Polycythemia, missed HIT, unusual results from tube transfer, IV fluid).
- Decreased blood culture contamination rates (improper skin preparation)

Laboratory testing and specimen requirements are more complex than in the past. Specimen collection in today’s health care environment requires specialized skills and expertise to insure patient safety and optimal care.

For questions, comments, or suggestions about this newsletter or other laboratory issues, please contact Lauren Anthony, MD, Medical Director of Allina Medical Laboratories, at (612) 262-5013 or by email at Lauren.Anthony@allina.com