



**Danbury Hospital**  
**Department of Pathology & Laboratory Medicine**  
***Technically Speaking***

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**Reference Range – Prothrombin Time (PT)**

Please be advised that the new reference range for prothrombin time went into effect November 21, 2004. The correct reference range appears on the chart and on the computer screen when viewing results.

**Reference Range – Prothrombin Time (PT) 9.7 to 12.3 seconds**

**Contaminated Blood Samples Drawn from IV Catheters: A Case History**

*S.F. Sena, Ph.D.,*

*Associate Director, Clinical Chemistry*

The integrity of a laboratory specimen is a critical component of the overall quality of test results. Inaccurate results caused by compromised sample quality can lead to errors in diagnosis and treatment, with potentially adverse clinical outcomes. One cause of compromised sample quality that is under-appreciated is contamination of blood with intravenous (IV) fluids when blood is collected from in-dwelling catheters or by venipuncture without following proper procedures. In recent months, there have been several documented incidents where the laboratory has received contaminated samples that have produced inaccurate results. The following case history illustrates the types of errors in laboratory results caused by IV fluid contamination due to improper sample collection and the potential clinical consequences if these results had been acted upon.

**Case History**

The Blood Bank received an order for one unit of uncrossmatched red blood cells for a 71-year-old male who had presented with a chief complaint of left-sided chest pain and shortness of breath. The order was based on a critically low hemoglobin of 4.7 g/dL (critical <9.0) and a hematocrit of 14.0% reported on the initial blood drawn on presentation. Minutes after releasing the blood product, the Blood Bank received a blood sample drawn from the same patient for a type and cross match. In processing this sample, the technologist noticed that its appearance was not consistent with the previously reported low results for hemoglobin and hematocrit (H&H). She contacted the Hematology section of the laboratory to question the H&H results and learned that a repeat sample had been requested to rule out sample contamination. In addition to the low H&H, the results of several blood chemistry tests were also suspicious for contamination of the sample with IV saline solution (see table). The Blood Bank immediately phoned the nursing unit; fortunately, the transfusion had not been started. A repeat blood sample was obtained by venipuncture; the hemoglobin and hematocrit results for this sample were 11.4 g/dL and 34.2%, respectively, indicating that a transfusion was not indicated. In addition, the chemistry results from the repeat sample (see table) were consistent with contamination of the first sample with IV saline. Investigation revealed that the initial sample had been drawn from the patient's IV catheter, while the second sample was drawn by venipuncture (from the arm without the IV infusion).



Test*	Result Sample #1	Result Sample #2	Reference Range	Units
Hemoglobin	<b>4.7</b>	11.4	13.5-17.0	g/dL
Hematocrit	14.0	34.2	41.0-53.0	(%)
Sodium	143	137	136-146	mmol/L
Potassium	<b>1.8</b>	3.8	3.5-4.8	mmol/L
Chloride	<b>123</b>	102	95-108	mmol/L
Bicarbonate	13	25	22-26	mmol/L
BUN	12	26	9-21	mg/dL
Creatinine	0.6	1.6	0.8-1.5	mg/dL
Glucose	61	126	70-99	mg/dL
Calcium	<b>3.1</b>	8.0	8.7-10.4	mg/dL
Magnesium	<b>0.6</b>	1.7	1.8-2.4	mg/dL

\*Critical values in **bold** font.

### Analysis of Case

Visual inspection of the sample submitted for type and cross match caused suspicion that the initial H&H results were incorrect. The very low H&H and chemistry results from the first sample are strongly suspicious for contamination with sodium chloride (NaCl) from IV saline solution. The critically high Cl<sup>-</sup> result is due to the effect of the higher-than-physiological concentration of Cl<sup>-</sup> in normal saline (145 mmol/L). Since the concentration of Na<sup>+</sup> in normal saline is very close to physiological, there is a minimal effect on this result. The very low results (many of them critical) for several other tests (K<sup>+</sup>, Ca<sup>++</sup>, Mg<sup>++</sup>, H&H) are caused by dilution of these constituents in the blood by the IV saline. This combination of a high Cl<sup>-</sup> result with very low results for several other tests is a telltale pattern that is highly suggestive of contamination of blood by IV saline.

Proper procedures must be followed whenever blood is collected from an IV or other type of catheter devices. This includes disconnecting or turning off any infusions, flushing the line, and drawing an adequate volume of blood into a “discard” tube (for details, see nursing policy and procedure on intranet for drawing blood from catheters). When performing venipuncture on a patient with an IV infusion, blood should be drawn from the arm opposite the arm with the IV infusion. If this is not possible due to poor access or other reasons and blood must be drawn from the arm with the IV infusion, a nurse must turn off the infusion and the phlebotomist must wait at least 5 minutes before performing the venipuncture.

In this case, an unnecessary transfusion was avoided and there was no adverse clinical outcome; however, this event should still be regarded as a “near miss” since uncrossmatched blood was ordered and prepared for infusion into the patient based on falsely low hemoglobin and hematocrit results. In addition, the patient was subjected to an unnecessary blood draw to obtain the second sample for repeat lab tests, there was an avoidable delay in diagnosis, treatment and disposition, and a unit of blood was wasted. All of the above could have been avoided if proper technique had been followed in drawing the initial blood sample.