



# Lab Guide – 2019

Hematology and Coagulation Section Lab guide

## **Introduction:**

Haematology is the study of blood and its disorders and deals primarily with the cellular elements of blood and their diseases and with disorders of plasma components which may be disorganized during disorders of haemostasis.

This document aims to present a summary of tests that are currently carried out in the Haematology lab or may soon be available. Specimens are received and processed 24/day, 7days/week. Tests are carried out when suitable and correctly labeled blood specimens are combined with completed request forms are received. The tests are classified into STAT and routine depending on justified categorization by the appropriate clinician.

## **Specimen Collection and Handling**

Collection of blood for coagulation testing through intravenous lines that have been previously flushed with heparin should be avoided, if possible. If the blood must be drawn through an indwelling catheter, possible heparin contamination and specimen dilution should be considered. When obtaining specimens from indwelling lines that may contain heparin, the line should be flushed with 5 mL of saline and the first 5 mL of blood or 6-times the line volume (dead space volume of the catheter) be drawn off and discarded before the coagulation tube is filled. For those samples collected from a normal saline lock (capped off venous port) twice the dead space volume of the catheter and extension set should be discarded.

## **Rejection Criteria**

Note: No. 1, 2 & 3 applicable for Non-Cerner Clients.

1. Unlabeled or incompletely labeled specimen
2. Specimens received without a request form or improperly filled request form
3. Name on the specimen does not match that on request form
4. Broken, leaking or contaminated specimen
5. Improper specimen container
6. Clotted samples in an anticoagulant container
7. Under-filled or overfilled sample tubes. For EDTA tubes, samples <2.0 ml in macro-tubes and <0.5ml in micro-tubes will not be accepted.
8. Specimen contained in a syringe
9. Incorrect specimen submitted for the test requested
10. Insufficient volume (QNS)

11. Improper specimen transport temperature
12. Old specimen (test-dependent)
13. Hemolyzed sample (test-dependent)
14. UNLABELLED and MISLABELLED precious/irreplaceable specimen (Bone Marrow, Cerebrospinal fluid, other body fluids) this action will require the ordering physician to intercede with the sectional supervisor/designee, who will make the determination of whether any testing and reporting will be performed. Proper documentation is maintained using the form for SPECIMEN ATTESTATION

## **List of Tests**

**Activated Partial Thromboplastin Time (APTT)**

**Body Fluids Analysis (CSF, Pleural, Pericardial And Synovial)**

**Complete Blood count (CBC\_ - Coulter Profile.**

**D-Dimer**

**ESR**

**Fibrinogen**

**Malaria - Blood film for Malaria**

**Manual Differential Count**

**Microfilaria**

**Peripheral Smear**

**Platelet Estimation in Peripheral Smear**

**Prothrombin Time (PT)**

**Thrombin Time (TT)**

**Activated Partial Thromboplastin Time (APTT)**

<b>ITEM</b>	<b>PROCESS</b>
<b>Specimen</b>	<p>One tube 2.7 ml citrated blood sample filled up to the mark on the tube label. (Light blue top tube, citrated 3.2%)</p> <p>For pediatric patients below 1 year: One Tube 1.0 ml pediatric tube filled up to the mark on the tube label (Light blue top tube, citrated 3.2%)</p> <p>*In case of high hematocrit (&gt;55%) contact the lab before extracting blood for all coagulation testing because special tube(s) will be provided.</p>
<b>Transport Temperature</b>	<b>Ambient</b>
<b>Days test is performed</b>	<b>Daily</b>
<b>Turnaround time</b>	<b>STAT: 1hr                          Routine: 4hrs</b>
<b>Method</b>	<b>Automated</b>
<b>Reference Value</b>	<p>The Reference Range is reported with each patient's result. This may vary with the reagent lot and also from one hospital to the other depending on the machine/reagent combination in service.</p>
<b>Heparin therapeutic range</b>	<p>This is the APTT range in seconds corresponding to an unfractionated heparin (UFH) concentration of 0.3 to 0.7 U/mL as assessed by anti Xa assay. The test is useful to monitor patients under UFH therapy.</p>
<b>Interpretation</b>	<p>The APTT is an assessment of the intrinsic and common pathways of blood coagulation. It is prolonged in deficiency of prekallikrein, HMWK (High Molecular Weight Kininogen), factor XII, XI, IX, X, V, II and fibrinogen, or by inhibitors directed against any of these factors.</p> <p>Direct oral anticoagulant medications (non-vitamin K) should not be monitored with aPTT because the effect of this test is not predictable.</p> <p>Direct parenteral thrombin inhibitors are often monitored using the aPTT.</p>
<b>Rejection Criteria</b>	<p>See rejection criteria at the start of the section.</p> <p>See Management of Laboratory Specimen (CL 7067).</p>
<b>Performing Lab Location</b>	<b>AKH Hematology Lab : 4474-5177</b>

<b>ITEM</b>	<b>Body Fluids Analysis (CSF, Pleural, Pericardial And Synovial)</b>																																																														
<b>Specimen</b>	2-5 ml body fluids collected in glass or plastic tubes, using appropriate anticoagulant, if necessary, for analysis (as those containing EDTA or Heparin).  CSF samples preferably collected in sterile glass or plastic tubes numbered according to order of draw (preferably tube# 3) , EDTA tube can be used for bloody samples																																																														
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<b>Turnaround time</b>	4 hrs																																																														
<b>Method</b>	Macroscopic and microscopic evaluation of body fluid with total and differential cell counting.																																																														
<b>Reference Value</b>	<table border="1"> <tr> <td rowspan="3">CSF</td> <td>RBC</td> <td colspan="2">0 -2/ <math>\mu</math>l</td> </tr> <tr> <td>WBC – Adults</td> <td colspan="2">0 -5/ <math>\mu</math>l</td> </tr> <tr> <td>Neonates</td> <td colspan="2">0 -30/ <math>\mu</math>l</td> </tr> <tr> <td rowspan="2">Pleural</td> <td>RBC</td> <td colspan="2">0 -10,000/ <math>\mu</math>l</td> </tr> <tr> <td>WBC</td> <td colspan="2">&lt; 1000/ <math>\mu</math>l</td> </tr> <tr> <td rowspan="2">Peritoneal/ Pericardial</td> <td>RBC</td> <td colspan="2">0 -10,000/ <math>\mu</math>l</td> </tr> <tr> <td>WBC</td> <td colspan="2">&lt; 500/ <math>\mu</math>l</td> </tr> <tr> <td rowspan="2">Synovial</td> <td>RBC</td> <td colspan="2">0 -2000/ <math>\mu</math>l</td> </tr> <tr> <td>WBC</td> <td colspan="2">&lt; 200/ <math>\mu</math>l</td> </tr> </table> <p>Normal range for the differential cells of the body fluid</p> <table border="1"> <tr> <td rowspan="4">CSF</td> <td></td> <td>Adults</td> <td>Neonates</td> </tr> <tr> <td>Lymphocytes</td> <td>40-80%</td> <td>5-35%</td> </tr> <tr> <td>Monocytes/Macrophage</td> <td>15-45%</td> <td>50-90%</td> </tr> <tr> <td>Neutrophills</td> <td>0-6%</td> <td>0-8%</td> </tr> <tr> <td>Synovial</td> <td colspan="3">PMN (polymorphs) - Less than 25%</td> </tr> <tr> <td></td> <td colspan="3">Mononuclear cells, including lymphocytes, monocytes, macrophages and synovial lining tissue cells are the primary cells seen in normal synovial fluid.</td> </tr> <tr> <td>All other fluids</td> <td colspan="3">PMN -Less than 25%</td> </tr> <tr> <td></td> <td colspan="3">Macrophages and mesothelial cells may be present.</td> </tr> </table>			CSF	RBC	0 -2/ $\mu$ l		WBC – Adults	0 -5/ $\mu$ l		Neonates	0 -30/ $\mu$ l		Pleural	RBC	0 -10,000/ $\mu$ l		WBC	< 1000/ $\mu$ l		Peritoneal/ Pericardial	RBC	0 -10,000/ $\mu$ l		WBC	< 500/ $\mu$ l		Synovial	RBC	0 -2000/ $\mu$ l		WBC	< 200/ $\mu$ l		CSF		Adults	Neonates	Lymphocytes	40-80%	5-35%	Monocytes/Macrophage	15-45%	50-90%	Neutrophills	0-6%	0-8%	Synovial	PMN (polymorphs) - Less than 25%				Mononuclear cells, including lymphocytes, monocytes, macrophages and synovial lining tissue cells are the primary cells seen in normal synovial fluid.			All other fluids	PMN -Less than 25%				Macrophages and mesothelial cells may be present.		
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<b>Interpretation</b>	Fluid analysis is done to assist in the diagnosis or exclusion of diseases and subarachnoid hemorrhage (CSF)																																																														
<b>Rejection Criteria</b>	See Management of Laboratory Specimen (CL 7067);  See rejection criteria at the start of the section																																																														
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406																																																														

<b>ITEM</b>		<b>Complete Blood count (CBC_ - Coulter Profile.</b>
<b>Specimen</b>		Whole blood (3 ml) in EDTA Tube. Samples must reach the lab as soon as possible but not later than 2 hours after collection
<b>Transport Temperature</b>		Ambient/Refrigerated
<b>Days test is performed</b>		Daily
<b>Turnaround time</b>		STAT- 1 hr    Routine - 4 hrs
<b>Method</b>		Automated. This comprises estimation of Hemoglobin (Hb), Hematocrit (Hct), Red Blood Cells (RBC) count, White Blood Cells (WBC) count, RBC indices; platelet count ± automated differential count ± reticulocyte count.
<b>Reference Value Interpretation</b>		See table 1
<b>Rejection Criteria</b>		An essential test for the diagnosis and follow up of various haematological and non-haematological diseases. See Management of Laboratory Specimen (CL 7067); See rejection criteria at the start of the section
<b>Performing Lab Location</b>		AWH Hematology Lab : 4011-4406

	Day 0-2	Day 3-6	Day 7-13	Day 14-29	Day 30-59	Day 60-89	3-6 M	7M - 2 Yrs	2-6Y	6-12Y	Adults
RBCs	5 - 7	4 - 6.6	3.9 - 6.3	3.6 - 6.2	3 - 5.4	3.1 - 4.3	4.1 - 5.3	3.9 - 5.1	4 - 5.2	4 - 5.2	M 4.5–5.5 F 3.8–4.8
Hb	14 - 22	15 - 21	17.1 - 17.9	16.1 - 16.9	11.5 - 16.5	9.4 - 13	11.1 - 14.1	11.1 - 14.1	11 - 14	11.5 - 15.5	M 13–17 F 12–15
PCV	45 - 65	45 - 65	42 - 65	49 - 53	33 - 53	28 - 42	30 - 40	30 - 38	34 - 40	34 - 45	M 40–50 F 36–46
MCV	100 - 120	92 - 118	88 - 126	86 - 124	92 - 116	87 - 103	68 - 84	72 - 84	75 - 87	77 - 95	83–101
MCH	31 - 37	31 - 37	31 - 37	31 - 37	30 - 36	27 - 33	24 - 30	25 - 29	24 - 30	25 - 33	27–32
MCHC	30 - 36	29 - 37	28 - 38	28 - 38	29 - 37	28.5 - 35.5	30 - 36	32 - 36	31 - 37	31 - 37	31.5–34.5
Retic	120 - 400	50 - 350	50 - 100	50 - 100	20 - 60	30 - 50	40 - 100	30 - 100	30 - 100	30-100	50–100
WBCs	10 - 26	7 - 23	6 - 22	6 - 22	5 - 19	5 - 15	6 - 18	6 - 16	5 - 15	5 - 13	4–10
Neutro	4 - 14	3 - 5	3 - 6	3 - 7	3 - 9	1 - 5	1 - 6	1 - 7	1.5 - 8	2 - 8	2–7
Lympho	3 - 8	2 - 8	3 - 9	3 - 9	3 - 16	4 - 10	4 - 12	3.5 - 11	6 - 9	1 - 5	1 – 3
Mono	0.5 - 2	0.5 - 1	0.1 - 1.7	0.1 - 1.7	0.3 - 1	0.4 - 1.2	0.2 - 1.2	0.2 - 1	0.2 - 1	0.2 - 1	0.2 – 1
Eoso	0.1 - 1	0.1 - 2	0.1 - 0.8	0.1 - 0.9	0.2 - 1	0.1 - 1	0.1 - 1	0.1 - 1	0.1 - 1	0.1 - 1	0.02 – 0.5
Baso											0.02 – 0.1
Platelets	100 - 450	210 - 500	160 - 500	170 - 500	200 - 500	210 - 650	200 - 550	200 - 550	200 - 490	170 - 450	150 – 400

<b>ITEM</b>	<b>D-Dimer</b>
<b>Specimen</b>	<p>One Tube 2.7 ml citrated blood sample 3.2 % (blue top tube)</p> <p>For pediatric patients below 1 year: One Tube 1.0 ml pediatric tube filled up to the mark on the tube label (Light blue top tube, citrated 3.2%)</p> <p>*In case of high hematocrit (&gt;55%) contact the lab before extracting blood for all coagulation testing because special tube(s) will be provided.</p>
<b>Transport Temperature</b>	Ambient
<b>Days test is performed</b>	Daily
<b>Turnaround time</b>	STAT: 1hr                      Routine: 4hrs
<b>Method</b>	Automated
<b>Reference Value</b>	Normal range is reported with each patient's result. This may vary from one hospital to the other depending on the machine/reagent combination in service.
<b>Interpretation</b>	<p>D-dimer is produced by the digestion of cross-linked fibrin by plasmin. A positive test is seen in thrombosis, PE and many other situations including DIC, post-surgery, trauma, infection, malignancy, pregnancy, atherosclerosis and in the elderly.</p> <p>D-Dimer test has been cleared by the Food and Drug Administration (FDA) to exclude deep vein thrombosis (DVT) and pulmonary embolism (PE) at a cut-off of 0.50mg/L FEU* in patients where a physician's Pretest Probability assessment (PTP) indicates a non-high probability of pulmonary embolism (&lt;0.50mg/L FEU* is considered negative).</p> <p>* Cut off value may vary between labs operating different instrument/reagent. This is noted in patients' reports.</p> <p>If D-Dimer test is used for clinical conditions other than exclusion of deep vein thrombosis (DVT) or pulmonary embolism (PE), then the test should be used as an aid in the diagnosis</p>
<b>Rejection Criteria</b>	<p>See Management of Laboratory Specimen (CL 7067);</p> <p>See rejection criteria at the start of the section</p>
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406

<b>ITEM</b>	<b>ESR</b>		
<b>Specimen</b>	EDTA (LAVENDOR Top) Volume of blood needed for automated ESR is 2.0 ml. Placement of the label for patient's identification should not exceed that provided on the tube.		
<b>Transport Temperature</b>	Ambient/Ref		
<b>Days test is performed</b>	Daily		
<b>Turnaround time</b>	1 day		
<b>Method</b>	Automated		
<b>Reference Value</b>	<b>Age                      Sex                      Reference Range</b>		
	<b>0 - 14</b>	<b>W / M</b>	<b>2 – 34</b>
	<b>15 - 50</b>	<b>W</b>	<b>2 – 37</b>
	<b>15 - 50</b>	<b>M</b>	<b>2 – 28</b>
	<b>51 - 70</b>	<b>W</b>	<b>2 – 39</b>
	<b>51 - 70</b>	<b>M</b>	<b>2 – 37</b>
	<b>&gt;70</b>	<b>W / M</b>	<b>3 - 46</b>
<b>Interpretation</b>	ESR is useful in disorders associated with an increased production of acute-phase proteins. It is non-specific and will be raised in any inflammatory condition. Low normal results are obtained in cases of polycythemia		
<b>Rejection Criteria</b>	See Management of Laboratory Specimen (CL 7067);  See rejection criteria at the start of the section		
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406		



<b>ITEM</b>	<b>Fibrinogen</b>
<b>Specimen</b>	<p>One tube 2.7 ml citrated blood sample filled up to the mark on the tube label. (Light blue top tube, citrated 3.2%)</p> <p>For pediatric patients below 1 year: One Tube 1.0 ml pediatric tube filled up to the mark on the tube label (Light blue top tube, citrated 3.2%)</p> <p>*In case of high hematocrit (&gt;55%) contact the lab before extracting blood for all coagulation testing because special tube(s) will be provided.</p>
<b>Transport Temperature</b>	Ambient
<b>Days test is performed</b>	Daily
<b>Turnaround time</b>	STAT: 1hr                          Routine: 4hrs
<b>Method</b>	<p>Automated.</p> <p>Fibrinogen determination by Clauss method. An excess of thrombin converts fibrinogen to fibrin. The time taken for the clot to form is directly proportional to the concentration of fibrinogen in the sample.</p>
<b>Reference Value</b>	Normal Range: Reported with each patient's result. This may vary with the reagent lot and also from one hospital to the other depending on the machine/reagent combination in service.
<b>Interpretation</b>	Diagnosis of hypofibrinogenaemia and DIC screen
<b>Rejection Criteria</b>	<p>See Management of Laboratory Specimen (CL 7067);</p> <p>See rejection criteria at the start of the section</p>
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406

<b>ITEM</b>	<b>Malaria - Blood film for Malaria</b>
<b>Specimen</b>	1 ml whole blood in EDTA tube or as part of CBC specimen, obtained at the time of admission of the patient, irrespective of the periodicity of the fever.
<b>Transport Temperature</b>	Ambient
<b>Days test is performed</b>	Daily
<b>Turnaround time</b>	STAT: 3hrs            Routine: 1 day
<b>Method</b>	Thin and thick smears. The thick smear is used as a screening test to establish the presence of parasite and the thin smear is used to identify species.
<b>Reference Value</b>	Negative
<b>Interpretation</b>	Diagnosis of malaria infection.
<b>Rejection Criteria</b>	See Management of Laboratory Specimen (CL 7067); See rejection criteria at the start of the section
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406

<b>ITEM</b>	<b>Manual Differential count</b>
<b>Specimen</b>	3ml EDTA blood (or as part of the CBC).
<b>Transport Temperature</b>	Ambient
<b>Days test is performed</b>	Daily
<b>Turnaround time</b>	2 working days
<b>Method</b>	Examination of Wright stained smear
<b>Reference Value</b>	See table 1 in CBC Test for Differential analytes.
<b>Interpretation</b>	As a re-check of the automated count, interpreted by laboratory staff /hematopathologist.
<b>Rejection Criteria</b>	See Management of Laboratory Specimen (CL 7067); See rejection criteria at the start of the section.
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406

<b>ITEM</b>	<b>Microfilaria</b>
<b>Specimen</b>	Whole blood EDTA tube lavender top container. Sample to be collected between 10pm and 3am
<b>Transport Temperature</b>	Ambient
<b>Days test is performed</b>	Daily
<b>Turnaround time</b>	STAT: 3hrs                      Routine: 1 day
<b>Method</b>	Detection and identification of microfilaria is done by direct visualization of the parasite using slides stained with Wright stain.
<b>Reference Value</b>	Negative
<b>Interpretation</b>	Filariasis involving the lymphatics is the cause of elephantiasis. It is caused by the filarial worms <i>Brugia malayi</i> , <i>Wuchereria bancrofti</i> & <i>Brugia timor</i> , whereas filarial infection of the subcutaneous tissues is caused by <i>Loa Loa</i> . The larvae are transmitted by mosquito to humans where they can be found in the blood and where they show periodicity with fluctuating levels at different times of the day.
<b>Rejection Criteria</b>	See Management of Laboratory Specimen (CL 7067); See rejection criteria at the start of the section
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406

<b>ITEM</b>	<b>Peripheral Smear</b>
<b>Specimen</b>	Smears spread from EDTA blood.
<b>Transport Temperature</b>	Ambient
<b>Days test is performed</b>	Daily
<b>Turnaround time</b>	2 working days
<b>Method</b>	This is a thin film examined for morphological assessment of RBC, WBC and Platelets. Peripheral smears are prepared from CBC samples according to criteria set by the lab.
<b>Reference Value Interpretation</b>	-
<b>Rejection Criteria</b>	See Management of Laboratory Specimen (CL 7067); See rejection criteria at the start of the section
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406

<b>ITEM</b>	<b>Platelet Estimation in Peripheral Smear</b>
<b>Specimen</b>	Smears spread from EDTA blood.
<b>Transport Temperature</b>	Ambient
<b>Days test is performed</b>	Daily
<b>Turnaround time</b>	2 working days
<b>Method</b>	Platelets are estimated in Wright- stained peripheral smear
<b>Reference Value Interpretation</b>	See table 1 in CBC Test for platelet.
<b>Rejection Criteria</b>	Re-checking platelet count in questionable automated result See Management of Laboratory Specimen (CL 7067); See rejection criteria at the start of the section
<b>Performing Lab Location</b>	AWH Hematology Lab : 4011-4406

**Prothrombin Time (PT)**

ITEM	PROCESS
Specimen	<p>One tube 2.7ml citrated blood sample filled up to the mark on the tube label. (Light blue top tube, citrated 3.2%)</p> <p>For pediatric patients below 1 year: One Tube 1.0 ml pediatric tube filled up to the mark on the tube label (Light blue top tube, citrated 3.2%)</p> <p>*In case of high hematocrit (&gt;55%) contact the lab before extracting blood for all coagulation testing because special tube(s) will be provided.</p>
Transport Temperature	Ambient
Days test is performed	Daily
Turnaround time	STAT: 1hr                      Routine: 4hrs
Method	Automated
Reference Value	<p>The Reference Range is reported with each patient's result. This may vary with the reagent lot and also from one hospital to the other depending on the machine/reagent combination in service.</p>
Interpretation	<p>Assessment of the extrinsic and common pathways of blood coagulation. It is prolonged in deficiency of factor II, V, VII, X and fibrinogen or in presence of an inhibitor to any of these factors.</p> <p>Monitoring of Warfarin therapy.</p> <p>Rarely reagents used in different labs may show high sensitivity to lupus anticoagulant in the patient's plasma. It is recommended that such patients are monitored in the same lab.</p> <p>Direct oral anticoagulant medications (non-Vitamin K) should not be monitored with PT/INR because the effect of this test is not predictable.</p>
Rejection Criteria	<p>See Management of Laboratory Specimen (CL 7067);</p> <p>See rejection criteria at the start of the section</p>
Performing Lab Location	AKH Hematology Lab : 4474-5177

## Thrombin Time (TT)

ITEM	PROCESS
Specimen	One tube 2.7ml citrated blood sample filled up to the mark on the tube label. (Light blue top tube, citrated 3.2%) *In case of high hematocrit (>55%) contact the lab before extracting blood for all coagulation testing because special tube(s) will be provided.
Transport Temperature	Ambient
Days test is performed	Daily
Turnaround time	STAT: 1hr                      Routine: 4 hrs
Method	Automated, based on Clauss method. Thrombin is added to plasma and the clotting time recorded.
Reference Value	The Reference Range is reported with each patient's result. This may vary with the reagent lot and also from one hospital to the other depending on the machine/reagent combination in service.
Interpretation	Prolonged TT is seen in hypo- and dysfibrinogenaemia, heparin contamination and high FDPs as in DIC and liver diseases. This test may be useful to qualitatively verify the presence of direct thrombin inhibitors.
Rejection Criteria	See Management of Laboratory Specimen (CL 7067); See rejection criteria at the start of the section
Performing Lab Location	AKH Hematology Lab : 4474-5177