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Universiti Teknologi MARA | Hospital Al-Sultan Abdullah

CLINICAL LABORATORY HANDBOOK

DEPARTMENT OF CLINICAL DIAGNOSTICS LABORATORIES

HOSPITAL AL-SULTAN ABDULLAH
UNIVERSITI TEKNOLOGI MARA

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GENERAL OPERATING PROCEDURES

PREANALYTICAL REQUIREMENTS

TEST REQUEST

The laboratory request form is made available on the hospital information system (HIS) known as UniMEDS. All test requests shall be ordered through the UniMEDS by authorized healthcare staff, accompanied by properly collected specimens.

In the event of HIS interruption, manual test ordering will be done using the following forms which can be obtained from the Main Specimen Reception at Clinical Diagnostic Laboratories (CDL):

- Chemical Pathology (CP) & Haematology (HM) Request Form
- Medical Microbiology and Parasitology (MMP) Request Form
- Anatomic Pathology (AP) Request Form
- Pap Smear Request Form

Standard request form PER.PAT 301 Perkhidmatan Patologi (KKM) and PER-SS-BT 105 Borang Permohonan Transfusi Darah (PDN), which can be obtained from Medical Records, should be used for outsourced tests where relevant (refer to the respective units). All request forms must be legibly written. The completed forms shall be signed and stamped by a doctor. The following information must be provided for every request:

- Patient details : Name, National Registration Identification Card (NRIC) number, gender and age.
- Source: Ward, clinic and name of hospital (if relevant).
- Clinical summary: Relevant clinical information including provisional diagnosis and treatment. Abbreviations are discouraged.
- Test details: Request must specify the test required.
- Sample: Date and time of sample collection. Type of samples and anatomical site (if relevant).
- Requester details: Doctor’s name, signature and official stamp.

All personal and medical details are confidential thus, prior consent should be taken before disclosing any clinical information and family history to relevant healthcare professionals where referral is needed.

Please indicate any urgent requests by clicking the “PRIORITY” option on the UniMEDS. For manual request forms, the word "URGENT" must be clearly written or preferably stamped in red at the top right-hand corner of the request form.

PATIENT IDENTIFICATION

Proper patient identification is crucial to ensure that specimen is collected from the individual designated on the online request form in HIS. In areas where authorized healthcare personnel collect laboratory specimens, proper patient identification and specimen labelling will be the responsibility of the personnel.

Compare information from the patient with the online request form and/or the patient's identification tag/ bracelet. In the event when the patient is a minor, unconscious, has special needs or is unable to speak the language of the healthcare personnel, a nurse, next of kin or friend should be asked to identify the patient.

SPECIMEN COLLECTION

Specimens should be properly collected in appropriate containers (refer to the specific list of tests in each unit for guidelines and recommendations on the types of containers). The containers must be labelled with **at least TWO** identifiers (i.e. name of patient and patient's NRIC number) and the name of test requested (refer to Specimen Labelling section). The containers should be placed in biohazard plastic bags with the respective request forms attached outside the bag (refer to Specimen Transport section).

Collect blood samples using accepted venepuncture technique. Draw whole blood in an amount of 2.5 times the required volume of serum so that an appropriate volume can be obtained for testing.

Procedure for venepuncture:

- Verify the patient's fasting status/ dietary restrictions (as these can affect test result).
- Select a venepuncture site: median cubital is used most frequently.
- Apply the tourniquet and palpate the vein.
  NB: Prolongation of tourniquet application may produce erroneous test results. Do not leave the tourniquet on the patient's arm longer than 1 minute.
- Wash hands prior to phlebotomy and between patients.
- Wear gloves.
- Cleanse the patient's skin with an alcohol swab using a circular motion from the centre to the periphery.
- Allow the skin to air dry to avoid haemolysis of the blood and to prevent the patient from experiencing a burning sensation when the venepuncture is performed.
- Hold the patient's arm firmly using the thumb to pull the skin taut to anchor the vein.
- Puncture the vein with the needle at an angle of insertion of 30 degrees or less. Keeping the needle as stable as possible in the vein, push/connect the first tube onto the needle.
- Follow the standard **order of draw** for multiple blood samples to avoid cross-contamination from tube additives and ensure accurate test results.
- Fill the tube until blood flow ceases for correct volume of blood to anticoagulant ratios to ensure that the appropriate volume of specimen is available for analysis.
- Mix the additive tubes immediately after collection by gentle inversion 8–10 times.
- Place a cotton swab over the venepuncture site. Applying light pressure, remove the needle from the vein and activate the safety mechanism.
- Dispose needles and syringes into the sharp bin container.
- Label appropriately all tubes.

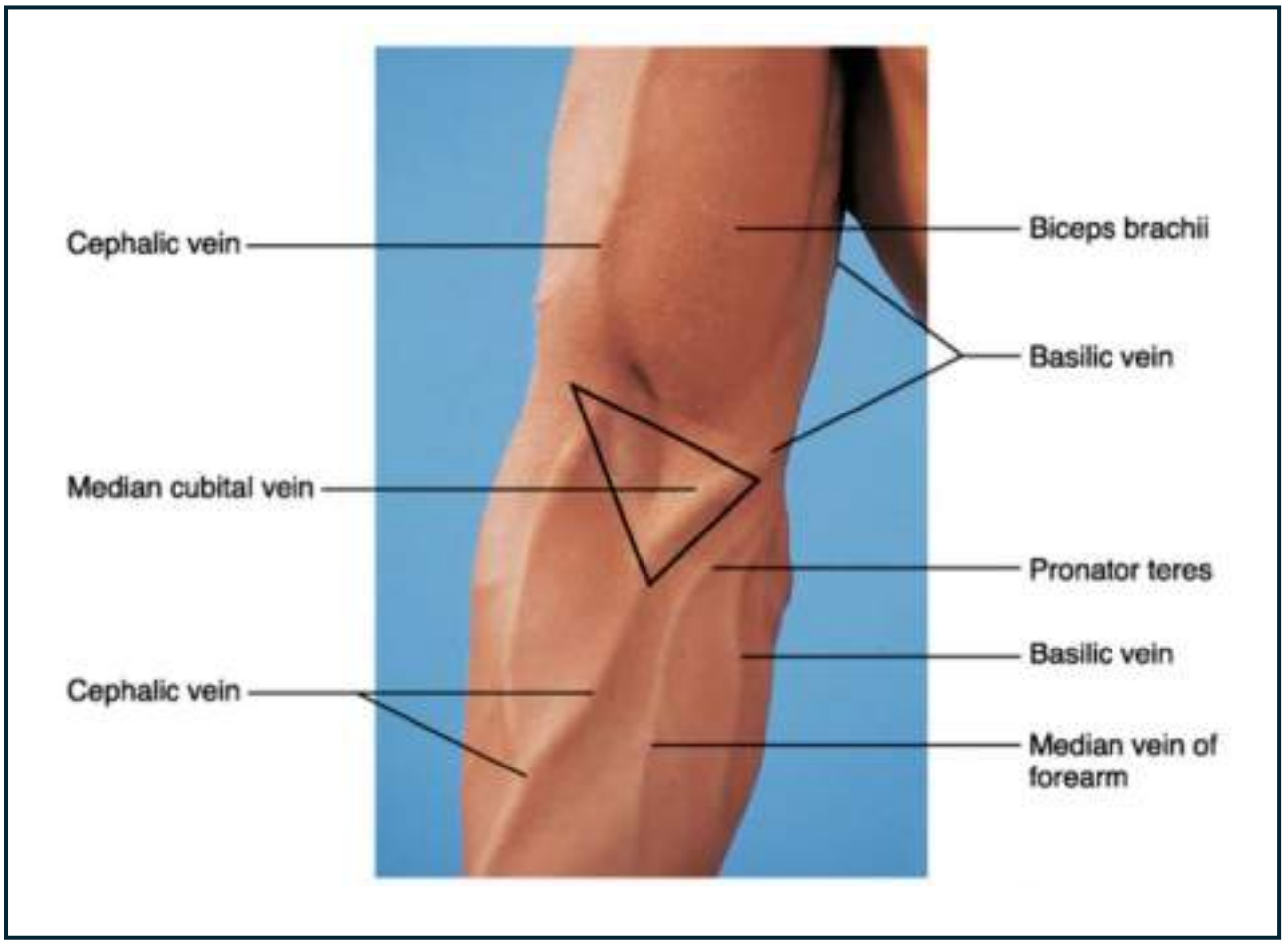
The World Health Organization (WHO) provides guidelines that cover all the steps recommended for safe phlebotomy practices and reiterates the accepted principles for blood drawing and blood collection. Please click the link for further reading: https://apps.who.int/iris/handle/10665/44294

Reference: World Health Organization 2010. WHO guidelines on drawing blood: best practices in phlebotomy

Superficial Veins of the Upper Limb for Venipuncture

The preferred site for venipuncture is the antecubital fossa of the upper extremities. Typically, the order of choice in vein selection is as follows:

1. Median cubital vein
2. Cephalic vein
3. Basilic vein



ORDER OF DRAW FOR BLOOD TUBES

The following **order of draw** is recommended when drawing several specimens during a single venepuncture:

1. Blood culture bottle(s) – aerobic and anaerobic
2. Sodium citrate/ coagulation tube (blue-top)
3. Plain/ serum tube with or without clot activator/ gel (i.e. red/ yellow- top)
4. Lithium heparin tube (green-top)
5. EDTA tube (lavender-top)
6. Fluoride oxalate/ glycolytic inhibitor tube (grey-top)

Fill only the required tubes in the specified order, as not all tubes may be necessary. It is important to fill the tubes in the correct order to avoid cross-contamination from tube additives and ensure accurate test results.

SPECIMEN LABELING

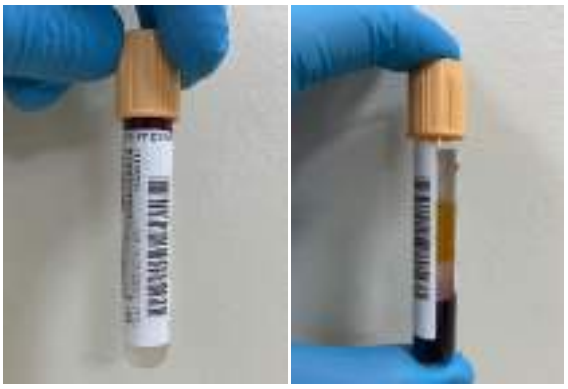
Careful labelling is important to obtain accurate and reliable results. **NEVER** label tubes/ containers prior to collection. All specimens must be labelled before leaving the patient's side.

Proper labelling includes computer-generated labels or hand-labelled tubes printed with the following information:

- Patient's full name
- National Registration Identification Card (NRIC) number
- Registration number (RN)
- Date and time of collection
- Specimen type

Specimen tubes/ containers must be labelled with **at least TWO** identifiers (i.e. name of patient and patient's NRIC number) and the name of test requested. Urgent requests must be indicated and appropriately labelled.
Note: For blood bank specimens, refer to the Transfusion Medicine section.

Refer to the instructions below on how to label patient's information on specimen tubes/ containers. Failure to comply may result in delayed analysis.

Tube	Example	Instructions
Vacutainer/ blood tube		Stick the label **horizontally** along the length of the tube, keeping the cap clear and the sample visible. Ensure that patient details and barcode on the label are not obscured.
Blood gas syringe		Stick the label **horizontally** along the syringe barrel. Ensure that patient details and barcode on the label are not obscured.
Universal container		Wrap the label around the **middle** of the container (on the side), not on the lid, ensuring it is flat and readable.
Blood culture bottles		Stick the label **horizontally** on the side of the culture bottle, avoiding the fill level and barcode.

SPECIMEN TRANSPORT

All specimens should be sent to the laboratory within an appropriate time frame, together with a dispatch book/ lists and receive acknowledgement from the laboratory staff. The time of samples received at the counter should be clocked in by the laboratory user and the samples will be subsequently attended by the laboratory staff for the tests to be carried out.

It is vital that specimens be maintained at the proper temperature to ensure specimen integrity. For tests in which no specific storage requirements are mentioned, specimens should be refrigerated until transport. The following definitions apply:

- room temperature 15 to 30°C
- refrigerated 2 to 8°C
- frozen -20 to 0°C

All collected specimens/samples from patients in the ward, operating theatre, day care or clinic should be dispatched to the laboratory in appropriate containers and then placed in a biohazard plastic bag. The specimen should be placed in the sealable compartment of the bag while the completed request form should be placed in the outer pouch to prevent contamination. Please ensure that containers and bags are properly sealed to avoid spills. Separate biohazard bags should be used for samples sent to different units and should be delivered to the appropriate specimen reception counters (refer to the test list of individual units).

If using the pneumatic tube system, ensure the specimen is suitable for transport. Do not send fragile specimens, those prone to leaking, or those requiring special handling (e.g., large-volume samples, body fluids in glass containers, or highly infectious specimens). Properly labelled specimen containers, secured in a biohazard bag with the request form, can be safely sent to the laboratory via the pneumatic tube system.

Urgent specimens/ samples must be brought to the laboratory by the ward, operating theatre, daycare or clinic staff. Frozen specimens must be transported in the frozen state. NEVER allow frozen specimens to be transported without dry ice. Specimens, when ready for transport, should be completely inserted into dry ice. Frozen specimens that have been allowed to thaw cannot be refrozen and are unacceptable for analysis.

SPECIMEN REJECTION

When test requests are received in the laboratory, they may be rejected for any one of the following reasons:

General rejection criteria

- Specimen received without a label or with improper identification
- Unlabeled/ mislabeled
- Specimen of questionable integrity (depending on tests ordered)
- Incorrect transport container
- Insufficient volume
- Haemolysis (depending on tests ordered)
- Improper handling or storage of specimen
- Clotted specimen (depending on tests ordered)
- Lipaemic samples
- Icteric samples
- No specimen received (only request form received)
- Repetitive test order/ double request
- The test is not clinically indicated
- The test is not offered

For specific rejection criteria, refer to each unit.

The requester will be notified as soon as possible via phone call and/or through the LIS/HIS system if the test request is deemed unacceptable for any of the above reasons.

SPECIMEN STORAGE/ RETENTION AND TEST ADDITIONS

Except for unstable specimens (e.g., specimen for cultures, complete blood count, urinalysis), CDL retain most specimens for several days. If a test is to be added to a specimen that has already been sent to the laboratory or if a repeat test is requested, this should be communicated via telephone at 03 – 6126 5000 (ext. 5215) for CDL PPUiTM Sg Buloh and 03 – 3396 3000 (ext. 10807) for CDL HASA UiTM Puncak Alam. A representative can arrange for additional testing if adequate specimen volume remains after the initial tests have been completed and the stability of the analyte(s) requested is acceptable. The add-on test(s) should be ordered in the HIS and a new request form should be sent to the laboratory.

POST ANALYTICAL REQUIREMENTS

REPORTING OF RESULTS

All the results of in-house tests from different units/ specialties in CDL will be validated by the Pathologist or Clinical Microbiologist on-duty/ Medical Officer/ Science Officer/ Senior MLT. Reports can be viewed through the HIS system for internal and external test requests. Clinical advice/ consultation on the interpretation of test results is available where necessary or upon request.

Critical Result Notification

Critical values will be communicated to the requester by telephone and verified through the readback policy. All notifications are documented in the LIS/ HIS system. If the responsible person or requesting doctor cannot be reached, the result will be escalated to the next responsible person.

Outsource Test

All outsourced test results will be acknowledged by the Pathologist or Clinical Microbiologist on-duty, Medical Officer, or Science Officer. The original results will be scanned and uploaded into the LIS/HIS system.

ENQUIRY, FEEDBACK & COMPLAINT

ENQUIRY

For any enquiries related to laboratory services, please feel free to contact the individual unit representatives:

CDL HASA UiTM, Puncak Alam		
Chemical Pathology	Dr. Rafezah Razali/ Pn. Nurul Iza Ismail/ En. Mohammad Shafiq Zahari	03 - 3396 3130
Hematology	Cik Halimatun Radziah Othman/ Pn. Nurul Hanini Mohd	03 - 3396 3131
Transfusion Medicine	Cik Halimatun Radziah Othman/ En. Muhammad Fakhri Sallehuddin	03 - 3396 3135
Medical Microbiology & Parasitology	Pn. Norzilawati Mohd Isa/ Cik Noor Aini Abu Bakar/ En. Abu Thalhah Abdul Aziz	03 - 3396 3128
Anatomic Pathology	En. Muhamad Idham Mohamed/ En. Khairil Idzwan Jamaludin	03 - 3396 3127
CDL PPUiTM, Sg Buloh		
Chemical Pathology	Cik Sarina Ali/ Pn. Che Wan Juliana Che Wan Jaafar	03 - 6126 5213/ 5215
Hematology	En. Mohd Nasrul Isham Mohd Jamain	03 - 6126 5209/ 5215
Transfusion Medicine	En. Hamdan Mohd Noor	

FEEDBACK

We welcome any suggestions to improve the quality of our service. The **Laboratory Customer Survey/ Kaji Selidik Pelanggan Makmal** is available for further feedback on laboratory services. Kindly click the link https://forms.office.com/r/mERR62NcdT (English/ Bahasa Melayu) or scan the QR code below to fill in the survey:

COMPLAINT

Complaints can be submitted via the link Incident Reporting System or through the Hospital Al-Sultan Abdullah UiTM (HASA) main website at https://hospital.uitm.edu.my/index.php/en/

CHEMICAL PATHOLOGY

1. INTRODUCTION

The Chemical Pathology Unit is an accredited clinical laboratory that provides comprehensive clinical biochemistry and advisory services including interpretation of results, advice on the appropriate selection of the laboratory tests, investigation and monitoring strategies for individual patients and specific diseases.

2. SERVICES

The Chemical Pathology Unit provides laboratory and consultative services in the areas of diagnostic and research as follows:

a) Urgent tests
b) 24-hour (on-call) tests
c) Routine tests
d) Specialized tests

2.1. Definition

a) Urgent tests
   - Urgent tests which require STAT analysis
     - LTAT: 45 minutes (arterial and venous blood gases)
     - LTAT: 1 hour (other urgent biochemistry tests)

b) 24- hour (on- call) tests
   - Tests are offered over 24 hours.
   - List of tests offered:
     - Renal Profile
     - Blood Gases
     - Liver Function Test
     - Bone Profile
     - Amylase
     - Aspartate aminotransferase (AST)
     - Calcium
     - Corrected Calcium
     - Creatine Kinase
     - C- reactive protein
     - Glucose
     - Magnesium
     - Phosphate
     - High-sensitivity (hs) Troponin T
     - High-sensitivity (hs) Troponin I
     - Body Fluids Biochemistry

- Bilirubin (total/direct)
- Urine FEME (dipstick only)
- Urine Pregnancy Test Beta - HCG
- Procalcitonin
- Vancomycin
- Acetaminophen
- TSH (cord blood)
- Lactate (arterial and venous)

c) Routine tests
- Tests that are offered during office hours.
- Turnaround time - 4 hours (inpatient) to 5 working days (outpatient)

d) Specialized tests
- Tests that are run in batches (e.g., endocrine tests, tumor markers, dynamic function tests and anaemia profile).
- Turnaround time - 5 working days.

2.2. In line with Malaysia Quality Society in Health (MSQH) requirement, LTAT for Chemical Pathology tests requested from all critical care units are as follows:

LTAT	**Name of tests**	**Requester**
1 hour	Urine dipsticks, BUSE, Renal Profile, calcium and lactate	CCU, ICU, CICU, NICU, PICU, HDW (including from UPSC critical care units)
3 hours	Osmolality, magnesium, phosphate and toxicology screening tests (Acetaminophen etc.)	
	Note: if the tests are requested as URGENT, the LTAT will be 1 hour.	

UPSC; UiTM Private Specialist Centre

3. REQUEST FORMS

All Chemical Pathology tests should be requested using an online ordering system via the HIS. In the event when the HIS is offline, the request should be done manually by using Chemical Pathology/Haematology Request Form (pink form). The PERPAT- 301 forms or other specified forms must be filled when ordering any outsourced tests.

Additional tests: Additional tests of primary samples can be requested but subjected to sample integrity and sufficiency. Please contact (HASA: 03- 3396 3031/3130, Sg Buloh: 03- 6126 5215/5215) prior to a request.

4. SPECIAL COLLECTION PROCEDURES

4.1. 24- hour Urine Collection

Most quantitative assays are performed on urine specimen collected over 24-hour. The 24-hour timing allows for circadian rhythmic changes in excretion at a certain time of day.

- Procedure of Collection
  - Request for the 24-hour urine container from the laboratory.
  - On the day of collection, discard the first urine voided. The time of first urine voided is the start of the timing for the 24- hour collection.
  - Collect the second and subsequent voided urine for 24 hours from the timed start into the 24-hour urine container.
  - At the end of 24 hours, collect the last urine voided. Refrigeration of the sample during the collection period is advisable. Label the urine container as directed and send it immediately to the laboratory.
  -
  - Ensure patient information on the specimen urine container is complete before they are returned to the laboratory.
  - Avoid direct urination into the 24- hour urine container to prevent skin contact with the preservatives contained in the bottle, which may cause burns or irritation.

4.2. Oral Glucose Tolerance Test (OGTT)

- Procedure of Collection
  - Check that the patient has fasted for a minimum of 8 hours.
  - Perform venepuncture and collect blood sample into fluoride oxalate tube and label with patient identification and "**fasting**" on the sample. Send the sample with the request form immediately to the laboratory.
  - Collect another blood sample in a fluoride oxalate tube for glucose measurement two hours after the glucose solution has been given.
  - Label the second blood sample must be labelled with patient details and "**2HPP**"; indicating 2 Hours Post Prandial.
  - Send the second sample immediately to the laboratory

4.3. Sample collection for Aldosterone Renin Ratio (ARR)

Patient preparation

a) Attempt to correct hypokalemia. Measure plasma potassium in blood collected slowly with a syringe and needle [preferably not a Vacutainer to minimize the risk of spuriously raising potassium]. During collection, avoid fist clenching, wait at least 5 seconds after tourniquet release (if used) to achieve insertion of needle, and ensure separation of plasma from cells within 30 minutes of collection. A plasma [K^+] of 4.0 mmol/L is the aim of supplementation.

b) Encourage patient to liberalize (rather than restrict) sodium intake.

c) Withdraw agents that markedly affect the ARR for at least 4 weeks:
   - Spironolactone, eplerenone, amiloride, and triamterene
   - Potassium- wasting diuretics
   - Products derived from licorice root (e.g., confectionary licorice, chewing tobacco)

d) If the results of ARR after discontinuation of the above agents are not diagnostic, and if hypertension can be controlled with relatively noninterfering medications, withdraw other medications that may affect the ARR (219) for at least 2 weeks, such as:
   - B-Adrenergic blockers, central-2 agonists (e.g., clonidine, - methyldopa), and nonsteroidal anti- inflammatory drugs
   - Angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, renin inhibitors, and dihydropyridine calcium channel antagonists

e) If necessary to maintain hypertension control, commence other antihypertensive medications that have lesser effects on the ARR (e.g. verapamil slow-release, hydralazine [with verapamil slow-release, to avoid reflex tachycardia], prazosin, doxazosin, terazosin).

f) Establish oral contraceptives (OC) and hormone replacement therapy (HRT) status because estrogen- containing medications may lower direct renin concentration (DRC) and cause false- positive ARR when DRC (rather than plasma renin concentration) is measured. Do not withdraw OC unless confident of alternative effective contraception.

Conditions for blood collection

a) Collect blood mid-morning, after the patient has been up (sitting, standing, or walking) for at least 2 hours and seated for 5 - 15 minutes.
b) Collect blood carefully, avoiding stasis and hemolysis.
c) Maintain sample at room temperature (and not on ice, as this will promote conversion of inactive to active renin) during delivery to laboratory and prior to centrifugation and rapid freezing of plasma component pending assay.

Factors to consider when interpreting results

a) Age: in patients aged 65 years, renin can be lowered more than aldosterone by age alone, leading to raised ARR.
b) Gender: premenstrual, ovulating females have higher ARR levels than age- matched men, especially during the luteal phase of the menstrual cycle, during which false positives can occur, but only if renin is measured as DRC and not as PRA.
c) Time of day, recent diet, posture, and length of time in that posture
d) Medications
e) Method of blood collection, including any difficulty doing so
f) Level of potassium
g) Level of creatinine (renal failure can lead to false- positive ARR)

Reference: *Funder et al, Guidelines on Primary Aldosteronism, J Clin Endocrinol Metab, May 2016, 101(5):1889 –1916*

4.4. Sample Collection Procedure for Dried Blood Spot

Preparation from blood collected by venipuncture

a) Spot the collected anti- coagulated (EDTA) whole venous blood on the filter cards as soon as possible. Do not prepare dried blood spots more than 24 hr after venipuncture.
b) Put all the information necessary for the identification of the patient on the filter card. One card should be spotted only with the blood of a single individual.
c) Put on disposable latex rubber gloves.

d) Gently invert the blood collection tube 2 - 4 times and subsequently open the stopper carefully.
e) Aspirate 50 µl of whole venous blood using a pipette with a disposable tip. Transfer the blood to the center of one circle without touching the filter paper directly with the tip of the pipette. Try to fully saturate the circle.
f) Repeat this procedure to fill all required circles of the card.

Preparation from blood collected by skin puncture

a) Wipe off the first drop of blood with a gauze pad because it may contain excess tissue fluids. Massage the finger again to increase blood flow at the puncture site. Transfer the following drop to one of the circles of a filter card without touching the surface directly with the fingertip. Allow the blood to be soaked into the texture of the filter by capillary forces only.
b) Let the next large drop of capillary blood form on the finger- tip and collect it in the next circle. Continue this procedure until all necessary circles are filled or blood flow stops.
c) Do not squeeze or "milk" the finger excessively if the blood flow is not sufficient to fill all the required circles of the filter card. If blood flow stops place a bandage on the finger- tip. Perform a second skin puncture on another finger if more blood is needed for the examination.

Drying of Blood Spots*

To dry the blood spots, put the filter cards on a clean paper towel in a biohazard safety cabinet and let them dry, preferably O/N (but for at least 4 hours), at room temperature in the absence of any external source of heat. When the drying process is complete, the blood spots have a uniformly dark brownish color, and no red areas are visible anymore.

Storage and Transportation of Dried Blood Spots (DBS)*

a) For storage, put the filter paper card in a single, gas- impermeable zipper bag, containing 1 to 2 desiccant sachets to protect the specimens from moisture. Optionally, add a humidity indicator card.
b) Transfer this bag to a freezer with a temperature of - 20 °C or lower as soon as possible. If freezers are not available under field conditions, storage at - 4 °C or even at ambient temperature is feasible for up to 14 days.
c) Transport frozen DBS specimens on dry ice. For filter cards initially kept at ambient temperature, use a triple packaging system, which consists of the zipper bag(s) as the inner container(s) as well as an inner and an outer envelope. No content markings are required on the outer envelope for shipment by regular mail, but the international biohazard symbol must be affixed to the primary inner container.
d) Exclude the filter cards from further processing if the desiccant packs and/or the additional humidity indicator card changes to a pink color.

* Reference: Grüner, N., Stambouli, O., Ross, R.S. Dried Blood Spots - Preparing and Processing for Use in Immunoassays and in Molecular Techniques. J. Vis. Exp. (97), e52619, doi:10.3791/52619 (2015)

4.5. Tumour Markers - A brief clinical practice guide

The table below is a brief guideline on clinical significance of the various tumour markers:

Tumour Marker	Malignancy	Clinical Significance *				
		S	D	P	M	R
AFP	Yolk sac tumour, Hepatoma	√	√	√	√	√
HCG	Trophoblastic tumour, choriocarcinoma		√	√	√	√
CEA	Colorectal carcinoma			√	√	√
PSA	Prostatic carcinoma		√	√	√	√
CA 125	Ovarian carcinoma		√		√	√
CA 15- 3	Breast carcinoma			√		√
CA 19- 9	Pancreatic carcinoma		√	√	√	√
hTG	Thyroid carcinoma		√	√	√	√

*S - Screening M - Monitoring and Treatment P - Prognosis
D - Diagnosis R - Reduction of recurrence

* Tumour markers should not be used for screening, the exception being AFP.

Reference: Clinical Practice Guidelines on Serum Tumour Markers, Dr. Leslie Lai. Academy of Medicine of Malaysia, Serial No. 7/2003.

5. RECEIPT OF SPECIMEN

All specimens will be received at the Specimen Reception Counter. Specimens should arrive within the stipulated time given in the table "List of Tests".

6. REPORTING OF RESULTS

All results will be verified by the Medical Laboratory Technologists (MLTs) and validated by the Science Officer and/Medical Officer/ Pathologist on duty. Critical results listed in Table 1 will be informed via phone and documented.

7. FACTORS AFFECTING LABORATORY RESULT

7.1. Specimen collection

7.1.1. Order of tube bottles

- Aim: To prevent preservatives from carrying over and contamination of the next tube.
- Lithium heparin, ammonium heparin or sodium heparin are the anticoagulants which are not appropriate to use for lithium, ammonium and sodium determinations.
- Heparin blood collection tube is unsuitable for the creatinine kinase assay.
- The thrombin evacuated blood collection tubes contain thrombin as a clot activator that causes some interferences detected for chloride, calcium, lactate dehydrogenase and potassium measurements.
- EDTA is unsuitable for iron and calcium analysis as it chelates both iron and calcium and has an effect to inhibit alkaline phosphatase, creatine kinase, sodium

and leucine aminopeptidase activities, probably by chelation of metallic cofactors. Furthermore, EDTA falsely elevates potassium due to the K2 or K3 EDTA anticoagulant content.

- Hence, the order of tube bottles for blood collection should be:
  - Blood cultures bottle > Sodium citrate tube > No additive/ clot activator tube > Lithium heparin tube > EDTA tube > Sodium fluoride tube

7.1.2. Preparation/ Pre- collection

- Prolonged tourniquet application (> 1 min) causes haemoconcentration, altered water balance and hemolysis.
- Fist clenching causes local release of potassium from cells of the forearm muscles and causes falsely elevated potassium level.
- Ethanol containing antiseptics that are not allowed to dry completely before venipuncture can enter the bloodstream and disrupt cell membranes.

7.1.3. Collection

- Probing, inappropriate needle diameter, excessive force with syringe draws either during aspiration or transfer, increased turbulence due to diameter mismatch of catheter tube adapter device and needle.
- The smaller (22- 25- gauge) needles/butterfly collection sets are reserved for difficult population e.g. geriatric, cancer, and pediatric patients more shear stress on cells risk of in- vitro hemolysis interfere with laboratory analysis (e.g. falsely elevated potassium).
- For patients on drips, the blood drawn for analytical testing should be taken from a non- IV drip arm if possible.
- Heparin water that is used to flush and keep the access of catheters can bind cation electrolytes causing low ionized calcium and magnesium.
- Flushing & discarding a small amount of blood before collecting a specimen should be discouraged as it does not guarantee that a proper sample can be obtained

7.1.4. Mixing

- Undermixing can lead to specimen clotting.
- However, overmixing can induce hemolysis.
- Avoid vigorous shaking of samples after collection and long- lasting or excessive centrifugation of samples as these processes will deleteriously impact on the integrity of erythrocytes.
- Encouraged to invert gently each tube 5- 10 times after collection.

7.2. Processing

7.2.1. Effect of delay processing

- For most chemistry analytes it is recommended for centrifugation within 30- 60 minutes of collection.
- Glucose decreases at a rate of 5 - 7% per hour in whole blood at room temperature.
- Glycolysis will continue until the serum is separated from the cellular

components of blood causing falsely low glucose.

7.2.2. Effect of improper processing

- No re- centrifugation. This causes the release of cellular components like potassium, phosphate and lactate dehydrogenase.
- Remixing plasma gel samples after centrifugation. This causes falsely increased values of 25- OH vitamin D on some assays due to resuspension of cells and platelets.
- All samples should be aliquoted and not poured over so that cell debris and particulate matter do not enter the sample and compromise the results.

7.3. Transportation

a) All specimens must be transported to the laboratory without delay.
b) The pneumatic tube system has a higher risk of hemolysis if sample is not pre-centrifuged prior to transfer.
c) Ideally, clinics and phlebotomy stations should be provided with centrifuges and equipment to process the specimens on site before transportation to the core laboratory.
d) Temperature labile analytes or with short half- life e.g. ammonia, ABG, lactate, renin, ACTH, PTH transported chilled (in ice); within 30 minutes.
e) Specimens for bilirubin should be protected from daylight and fluorescent light to avoid photodegradation. Hence, use a brown bottle or wrap a translucent bottle with brown paper.

7.4. Separation and storage

7.4.1. Separation

- Plasma or serum should be separated from cells as soon as possible, optimally within 2 hours.
- Premature separation of serum causes formation of fibrin causing obstruction of sample probes in testing equipment.
- If a separated sample is not able to be centrifuged within 2 hours, store at room temperature to reduce hemolysis.

7.4.2. Storage

- Most chemistry samples can be stored for 7 days when refrigerated (4- 80C) and up to 30 days if stored at - 200C.
- Whole blood for glycated haemoglobin A1c (HbA1c) ion exchange method is stable for ~ 14- 21days when kept at 40C, but 4–10 days at - 200C.
- Clinicians frequently “add on” tests after the initial orders have been completed. Hence, storage must be optimized.

7.5. Interfering substances

7.5.1. Hemolysis

- Rupture of red blood cells with the release of hemoglobin and the intracellular components into the plasma (leakage from cells in- vivo or in- vitro).
- Increase AST, acid phosphatase, LDH, potassium, magnesium & phosphate.
- Other analytes that can also increase are ALT, CK, Calcium, Total protein,

albumin, Iron, glucose, total cholesterol and triglycerides.

- Analytes that are falsely reduced due to hemolysis include sodium, chloride, insulin, ALP, amylase, bilirubin, bicarbonate, haptoglobin, troponin T and uric acid.

7.5.2. Icterus

- It is due to hyperbilirubinemia caused by pre- hepatic, hepatic, post- hepatic factors.
- Bilirubin ability to react with chemicals in other reagents resulting in decreased analyte values (oxidizing agent).
- Interfere with peroxidase- coupled reactions e.g. in determination of glucose, effects glucose, cholesterol, triglycerides, uric acid falsely low level.

7.5.3. Lipaemia & hyperproteinemia

- Lipaemia is caused by a rise in chylomicrons.
- The large particle causing lipaemia will interfere with instrument methods that are based on light detection or scatter.
- Causing electrolyte exclusion effect (exclusion of electrolytes from the fraction of the total blood plasma volume that is occupied by solids).
- Decrease in sodium, potassium, chloride, bicarbonate and lactate dehydrogenase.

7.6. Separation and storage

7.6.1. Separation

- Plasma or serum should be separated from cells as soon as possible, optimally within 2 hours.
- Premature separation of serum causes formation of fibrin causing obstruction of sample probes in testing equipment.
- If a separated sample is not able to be centrifuged within 2 hours, store at room temperature to reduce hemolysis

7.6.2. Storage

- Most chemistry samples can be stored for 7 days when refrigerated (4- 800C) and up to 30 days if stored at - 200C.
- Whole blood for glycated haemoglobin A1C (HbA1C) ion exchange method is stable for 3 days at room temperature, up to 7 days at 2- 80C and up to 12 months at - 700C.
- Clinicians frequently “add on” tests after the initial orders have been completed. Hence, storage must be optimized.

7.7. Interfering substances

7.7.1. Hemolysis

- Rupture of red blood cells with the release of hemoglobin and the intracellular components into the plasma (leakage from cells in- vivo or in- vitro).
- Increase AST, acid phosphatase, LDH, potassium, magnesium & phosphate.
- Other analytes that can also increase are ALT, CK, Calcium, Total protein,

albumin, Iron, glucose, total cholesterol and triglycerides.

- Analytes that are falsely reduced due to hemolysis include sodium, chloride, insulin, ALP, amylase, bilirubin, bicarbonate, haptoglobin, troponin T and uric acid.

7.7.2. Icterus

- It is due to hyperbilirubinemia caused by pre- hepatic, hepatic, post- hepatic factors.
- Bilirubin ability to react with chemicals in other reagents resulting in decreased analyte values (oxidizing agent).
- Interfere with peroxidase- coupled reactions e.g. in determination of glucose, effects glucose, cholesterol, triglycerides, uric acid → falsely low level.

7.7.3. Lipaemia & hyperproteinemia

- Lipaemia is caused by a rise in chylomicrons.
- The large particle causing lipaemia will interfere with instrument methods that are based on light detection or scatter.
- Causing electrolyte exclusion effect (exclusion of electrolytes from the fraction of the total blood plasma volume that is occupied by solids).
- Decrease in sodium, potassium, chloride, bicarbonate and lactate dehydrogenase.

CRITICAL LIMITS FOR CHEMICAL PATHOLOGY

LOWER CRITICAL LIMIT	ANALYTE	HIGHER CRITICAL LIMIT
	ADULT	
2.8 mmol/L	Potassium	6.0 mmol/L
125 mmol/L	Sodium	155 mmol/L
2.8 mmol/L	Glucose	20 mmol/L
1.5 mmol/L	Corrected Calcium	3.0 mmol/L
0.41 mmol/L	Magnesium	2.0 mmol/L
0.32 mmol/L	Phosphate	2.87 mmol/L
7.20	pH	7.55
58.65 mmHg	pO2 (arterial)	-
19 mmHg	pCO2 (arterial)	67 mmHg
-	Creatine Kinase	1000 U/L
-	NT- proBNP	10,001 pg/ml
	PAEDIATRIC	
2.8 mmol/L	Potassium	6.0 mmol/L
125 mmol/L	Sodium	155 mmol/L
1.6 mmol/L	CSF- Glucose	-
1.7 mmol/L	Corrected Calcium	3.1 mmol/:
0.5 mmol/L	Magnesium	1.8 mmol/L
0.4 mmol/L	Phosphate	2.8 mmol/L
-	pH	7.60
43.98 mmHg	pO2 (arterial)	121.8 mmHg
19.55 mmHg	pCO2 (arterial)	68.42 mmHg
-	Creatinine	330 µmol/L
-	Bilirubin (children)	257 µmol/L
-	Bilirubin (neonates)	
-	CSF- Protein	300 µmol/L
-	Urea	1.87 g/L
-	Uric Acid	19.0 mmol/L
-	TSH (Cord blood)	500 µmol/L
		21.0 mIU/L

References

a) *Critical Limit for Chemical Pathology, Quick Guide for Improving Notification of Critical Laboratory Results in MOH Hospitals, February 2010.*

b) *Critical Limits of Laboratory Results for Urgent Clinician Notification, eJIFCC vol 14 no 1: https://www.ifcc.org/media/477036/ejifcc2003vol14no1pp011-018.pdf*

c) Performance Indicators Malaysian Society for Quality in Health (MSQH) Hospital Accreditation Standards 5th Edition 2017.

LIST OF TESTS (Refer to Clinical Indications and Reference Ranges: App. 1 & 2)

(Updated 6 January 2025)

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
1.	17- hydroxy progesterone	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	Universiti Malaya Medical Centre (UMMC)	15 WD (working days)
2.	5- HIAA, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle (preservative: 10 ml of 6 mol/L HCL)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	8 WD
3.	Acetaminophen (PCM)	Serum	3 ml	Plain tube	Send the form with the sample to CDL immediately.	CDL HASA	Urgent - 1 hour Routine (from critical care units) - 3 hours Routine (from other units) - 4 hours
4.	Acetylcholine Receptor Antibody	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	31 WD
5.	Adrenocorticot-ropic Hormone (ACTH)	Plasma	3 ml	EDTA tube	BY APPOINTMENT with the laboratory (at least 1 week before blood taking). • Pre- freeze the tube & syringe overnight before use.	UMMC	6 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Complete PERPAT.301 form. • After collection, send the sample (IN ICE) and the request form immediately to the laboratory.		
6.	Alanine Trans aminase (ALT)	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
7.	Albumin	Serum	3 ml	Plain tube	Send to CDL immediately	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
8.	Albumin - Peritoneal	Peritoneal fluid	at least 5 ml	Bijou bottle	Send to CDL immediately	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
9.	Albumin CSF	CSF	at least 5 ml	Bijou bottle	Send to CDL immediately	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
10.	Alcohol /Ethanol Level	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	HKL	1 WD
11.	Aldosterone	Plasma	4 ml	EDTA tube	BY APPOINTMENT with the laboratory (at least 1 week before blood taking). • Complete PERPAT.301 form. • Sample volume must be at least 4 ml.	UMMC	15 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Samples must be sent immediately WITHOUT ice. • Record patient's posture whether supine or upright in column 'clinical history' on request form. • Aldosterone Renin Ratio (ARR) is most sensitive when used in patients from whom samples are collected in the morning, after patients have been out of bed for at least 2 hours, usually after they have been seated for 5 - 15 mins.		
12.	Alkaline Phosphatase	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
13.	Alpha- 1-antitrypsin	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	6 WD
14.	Alpha- 1-Fetoprotein	Serum	3 ml	Plain tube	Send the form with the sample to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
15.	Aluminium	Serum	6 ml	Plain tube (royal blue)	BY APPOINTMENT with the laboratory (at least 1 week before	UMMC	11 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					blood taking). • Get royal blue (plain) tubes from Chem Path laboratory. • Complete PERPAT.301 form and send the form and the sample to CDL immediately.		
16.	Amikacin	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	1 WD
17.	Aminolevulini c acid (Delta- ALA)	Random urine	at least 10 ml	Urine container (wrapped with aluminium foil)	• Get IEM Request form at CDL Specimen Reception Counter. • Get a Sterile Universal bottle (wrapped with aluminium foil) at CDL. • After collection, send the form and the sample to CDL immediately.	IMR	16 WD
18.	Ammonia	Plasma	4 ml	Lithium heparin tube (in ice)	BY APPOINTMENT with the laboratory (STRICTLY call the laboratory before sending the sample). • Complete PERPAT.301 form. • Send the sample with the form immediately to CDL (sample is	UMMC	1 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					stable only within 2 hours after collection). • Keep samples in ice after collection.		
19.	Amino Acid, Blood	Plasma	5 ml	Lithium Heparin tube	• Complete PERPAT.301 form. • Require 2ml of plasma, therefore 5ml blood is required to avoid insufficient plasma volume. • Send the form with the sample to CDL immediately.	UMMC	6 WD
20.	Amino Acid, Urine	Random urine	10 ml	Urine container	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	6 WD
21.	Amylase	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
22.	Amylase (Other Fluid)	Other fluids	At least 5 ml	Bijou bottle	Send to CDL immediately	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
23.	Amylase (Urine)	Random urine	10ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
24.	Androstene-dione	Serum	3 ml	Plain tube	BY APPOINTMENT (at least 1 week before blood taking). • Get Innoquest Pathology Request	Innoquest Pathology	15 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					Form at CDL Specimen Reception Counter and complete it. * Transportation to the USA is on Tuesday. It is advisable to send sample on Monday (AM).		
25.	Angiotensin Converting Enzyme (ACE)	Serum	3 ml	Plain tube	BY APPOINMENT (at least 1 week before blood taking). • Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. * Transportation to the USA is on every Tuesday. It is advisable to send samples by Monday (AM).	Innoquest Pathology	15 WD
26.	Anti- Mullerian Hormone	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	6 WD
27.	Apolipoprotein (a)	Serum	3 ml	Plain tube	• Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. • Send the samples with form to CDL immediately.	Innoquest Pathology	WD
28.	Apolipoprotein (b)	Serum	3 ml	Plain tube	• Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. • Send the sample with form to CDL immediately.	Innoquest Pathology	2 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
29.	Aspartate Transaminase	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
30.	Bence Jones Protein	Random urine	10 ml	Urine container	• Complete PERPAT.301 form. • Send the sample and the form to CDL immediately.	UMMC	4 WD
31.	Beta Human Chorionic Gonadotrophin (HCG)	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA	Urgent - 1 hour Routine - 4 hours
32.	Beta- 2-Glycoprotein	Serum	3 ml	Plain tube	• Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. • Send the sample to the laboratory immediately. * Transportation to Australia is on Saturday. Advisable to send the specimen by Friday (AM).	Innoquest Pathology	32 WD
33.	Beta- 2-Microglobulin	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the sample and the form to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	6 WD
34.	Bile acids	Serum	3 ml	Plain tube (red top)	• Fasting sample is preferred though not essential.	UMMC	4 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Complete PERPAT.301 form. • Send sample with completed form to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL		
35.	Bilirubin (Direct)	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
36.	Bilirubin (total)	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
37.	Bilirubin (total), CSF	CSF	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
38.	Blood Pyruvate	Plasma	2 ml	Perchloric acid tube	BY APPOINTMENT with lab (within 1 week prior to blood taking). • Get special tube at CDL. The tube contains 4 ml of perchloric acid. • Complete PERPAT.301 form. • Collect sample (2ml blood) and mix immediately and vigorously for 30 seconds. • Send the sample and the form to CDL immediately. • Keep the sample IN ICE.	UMMC	6 WD
39.	C- Peptide	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form.	UMMC	6 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.		
40.	Caeruloplasmin	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	HKL	3 WD
41.	Calcitonin	Serum	3 ml	Plain tube	BY APPOINTMENT with Lab (within 1 week prior to blood taking). • Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. • Send the sample immediately.	Innoquest Pathology	15 WD
42.	Calcium, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle (preservative: 5 mL of 6 mol/L HCL)	• Get urine 24 hours bottle collection at CDL Specimen Counter. • Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
43.	Calcium, Random urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
44.	Calprotectin (Stool)	Stool	As collected	Stool container	BY APPOINTMENT (at least 1 week before collection). • Sample must be freshly collected. * The test will be done every	Innoquest Pathology	3 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					Tuesday. Therefore, it is advisable to collect the sample by Monday.		
45.	Cancer 15- 3 (CA 15- 3)	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with a sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	4 WD
46.	Cancer AG 125 (CA 125)	Serum	3 ml	Plain tube	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
47.	Cancer AG19- 9 (CA 19- 9)	Serum	3 ml	Plain tube	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
48.	Carbamazepine	Serum	3 ml	Plain tube	Complete PERPAT.301 form. Send the form with the sample to CDL immediately.	UMMC	4 WD
49.	Carcino embryonic AG (CEA)	Serum	3 ml	Plain tube	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
50.	Chloride	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 5 WD
51.	Chloride, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
52.	Chloride, Random urine)	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
53.	Cholesterol (total)	Pleural fluid	At least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 5 WD
54.	Chromogranin A	Serum	6 ml	Plain tube	• Contact Chemical Pathologist on duty. • BY APPOINTMENT with lab (within 1 week prior to blood taking). • Please send 2 bottles on a plain tube (3ml each) to CDL. • Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. • Send the form with the sample to CDL immediately.	Innoquest Pathology	32 WD
55.	Complement 3	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the sample and the form to CDL immediately.	UMMC	4 WD
56.	Complement 4	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	4 WD
57.	Copper (blood)	Serum	3 ml	Plain tube (royal blue)	• BY APPOINTMENT (at least 1 week before taking).	UMMC	11 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Get royal blue (plain) tubes from the CDL. • Complete PERPAT.301 form. • Send the sample and the form to CDL immediately.		
58.	Copper, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle (acid-wash)	BY APPOINTMENT (at least 1 week before collecting sample). • Please get a 24- hour bottle (acid-wash bottle) from the laboratory 1 week after booking. • Complete PERPAT.301 form. • Send the form with the sample to the laboratory immediately.	UMMC	11 WD
59.	Corrected Calcium	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 1 hour
60.	Cortisol, Serum	Serum	3 ml	Plain tube	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
61.	Cortisol 0hr	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once blood is taken, send the sample to the laboratory	CDL HASA	5 WD * Run in batch analysis (unless notified)

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					immediately.		
62.	Cortisol 30min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once blood is taken, send the sample to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis (unless notified)
63.	Cortisol 60min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis (unless notified)
64.	Cortisol, 120 min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis (unless notified)
65.	Cortisol, 90 min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis (unless notified)

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
66.	Cortisol, Midnight	Serum	3 ml	Plain tube	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
67.	Cortisol, Morning	Serum	3 ml	Plain tube	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
68.	Cortisol, salivary	Saliva	As collected	Saliva Collection Kit	BY APPOINTMENT (at least 1 week before sample collection). • Get sample collection kit and Innoquest Request Form at CDL Specimen Reception Counter and complete it. • Send the sample with the form to CDL Immediately.	Innoquest Pathology	2 WD
69.	Cortisol, Urine 24 hours	Urine 24 hours	at least 500 ml	Urine 24 hours bottle	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
70.	Cotinine (Nicotine metabolite)	Random urine	10 ml	Urine container	• Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. • Send the sample with the form to CDL Immediately.	Innoquest Pathology	2 WD
71.	C- Reactive Protein	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
72.	Creatine Kinase	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
73.	Creatinine	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
74.	Creatinine PD 0 Hour	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
75.	Creatinine PD 2 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
76.	Creatinine PD 24 Hours	Peritoneal dialysis fluid	Timed collection	24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
77.	Creatinine PD 4 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
78.	Creatinine, PD Overnight	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
79.	Creatinine, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
80.	Creatinine, Random Urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
81.	Cyclosporine A	Whole blood	3 ml	EDTA tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	2 WD
82.	Dihydrotes-terone	Serum	3 ml	Plain tube	BY APPOINTMENT (at least 1 week before blood taking) • Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. * Transportation to the USA is on Tuesday. It is advisable to send sample by Monday (AM).	Innoquest Pathology	15 WD
83.	DHEAS	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	6 WD
84.	Digoxin level	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	2 WD
85.	e.g.FR	Serum	3 ml	Plain tube	• Please order Creatinine together with this test to facilitate e.g.FR	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					calculation. • The test will be rejected if no Creatinine ordered in the same request.		
86.	Everolimus	Whole blood	3 ml	EDTA tube	BY APPOINTMENT (at least 1 week before blood taking). • Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	6 WD
87.	Faecal Occult Blood (FOB)	Stool	As collected	Stool container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 5 WD * Run during office hours only.
88.	Fasting Plasma Glucose	Plasma	3 ml	Fluoride tube	• Fasting sample is required (at least 8 hours fasted). • Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
89.	Fat globules	Stool	As collected	Stool container	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * Sample must be freshly collected.	UMMC	4 WD
90.	Folate	Serum	3 ml	Plain tube	• Fasting sample required (at least 6- 8 hours fasted). • Send to the CDL immediately. • Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
91.	Free Light Chain	Serum	3 ml	Plain tube	• Complete PERPAT.301 form.	UMMC	31 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Send the form with the sample to CDL immediately.		
92.	GGT (Gamma glutamyl transferase)	Serum	3 ml	Plain tube	Send to the CDL immediately.	CDL	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
93.	Free T3	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	4 WD
94.	Free T4	Serum	3 ml	Plain tube	Send to CDL immediately. * The assay in CDL Sg Buloh is unaffected by biotin (<= 409 nmol/L OR <= 100 ng/mL).	CDL HASA & Sg Buloh	5 WD * Run in batch analysis
95.	Free Thyroxine (FT4) (Cord blood)	Serum	3 ml	Plain tube	Send to the CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
96.	Fructosamine	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	6 WD
97.	FSH	Serum	3 ml	Plain tube	Send to the CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
98.	FSH 30min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once blood is taken, send to the	CDL HASA	5 WD * Run in batch analysis

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					laboratory immediately.		
99.	FSH 60min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once blood is taken, send to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis
100.	Gastrin	Serum	3 ml	Plain tube	BY APPOINTMENT (at least 1 week before blood taking). • Get Innoquest Pathology Request Form, at CDL Specimen Reception Counter and complete it. • Fasting sample required. • Send the sample immediately. * Transportation to the USA is on Tuesday, it is advisable to send specimen to the lab by Monday (AM).	Innoquest Pathology	15 WD
101.	Gentamicin	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	2 WD
102.	Glucose (Pleural Fluid)	Pleural fluid	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
103.	Glucose 1HPP	Plasma	3 ml	Fluoride tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
							Routine (out- patient) - 5 WD
104.	Glucose 2HPP	Plasma	3 ml	Fluoride tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
105.	Glucose CSF	CSF	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
106.	Glucose, PD 0 Hour	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
107.	Glucose, PD 2 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
108.	Glucose, PD 4 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
109.	Glucose, PD Overnight	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
110.	Glucose Random	Plasma	3 ml	Fluoride tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
111.	Glycosaminoglycans (GAGs)/ Mucopolysaccharidoses (MPS)	First Morning Urine	10 ml	Urine container	BY APPOINTMENT DURING OFFICE HOURS ONLY • Collect First Morning Urine Sample	IMR	11 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Freeze immediately upon receipt in the laboratory.		
112.	Growth Hormone	Serum	3 ml	Plain tube (red top)	BY APPOINTMENT (for Insulin Tolerance Test or any dynamic function test) • Complete PERPAT.301 form. • Send the sample and the form to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	6 WD
113.	Haptoglobulin	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form a with the sample to CDL immediately.	UMMC	5 WD
114.	HbA1c	Whole blood	3 ml	EDTA tube	• Send to CDL immediately • TEST WILL BE REJECTED IF REQUESTED WITHIN 8 WEEKS AFTER PREVIOUS REQUEST. • Any special request must be discussed with the Chemical Pathologist on duty.	CDL HASA & Sg Buloh	5 WD
115.	Homocysteine	Plasma	3 ml	EDTA tube	• Complete PERPAT.301 form. • Fasting specimen preferred. • Collect blood in pre- chilled EDTA tube. • Send the form with the sample to	UMMC	6 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					the laboratory immediately on wet ice.		
116.	HS Troponin I	Serum	3 ml	Plain tube	Send to CDL immediately. * Hemolysed specimen (haemolytic index ≥400) will be rejected.	CDL HASA	1 hour
117.	HS Troponin T	Serum	3 ml	Plain tube	Send the sample to CDL immediately. * Hemolysed specimen (haemolytic index ≥100) will be rejected. * The assay is unaffected by biotin (<82 nmol/L OR < 20 ng/mL).	CDL Sg Buloh	1 hour
118.	IGF- 1	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	6 WD
119.	Inborn Error of Metabolism (IEM) Screening	Dried blood spot	3 circles of Dried Blood Spot (DBS)	Filter paper	• Collect blood from already fed baby at the age of 48- 72 hours. • Get a 903 Whatman filter paper from the lab. • Put 3 circles of Dried Blood Spot (DBS). • Ensure blood completely dried at room temperature before putting in plastic sheet. • Complete PERPAT.301 form. • Send the form with the sample to	UMMC	4 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					CDL immediately.		
120.	Intrinsic Factor Antibody	Serum	3 ml	Plain tube	BY APPOINTMENT (at least 1 week before blood taking). • Get Innoquest Pathology Request Form, at CDL Specimen Reception Counter and complete it. • Send the samples immediately. * Transportation to Australia is on Saturday. Advisable to send specimen by Friday (AM).	Innoquest Pathology	32 WD
121.	Insulin	Serum	3 ml	Plain tube	• Fasting sample should be checked in a fasting sample, during hypoglycemia or as part of a dynamic function test. • Complete PERPAT.301 form. • Send the form a with the sample to CDL immediately.	UMMC	5 WD
122.	Lactate (arterial)	Arterial heparinized blood	1 ml	Heparinized syringe	Send to CDL immediately in ice.	CDL HASA & Sg Buloh	1 hour
123.	Lactate (venous)	Venous heparinized blood	1 ml	Heparinized syringe	Send to CDL immediately in ice.	CDL HASA & Sg Buloh	1 hour
124.	LDH	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
125.	LDH (Pericardial)	Pericardial fluid	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
126.	LDH (Pleural)	Pleural fluid	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
127.	LH	Serum	3 ml	Plain tube	Send the sample to CDL immediately. * The assay is unaffected by biotin (<= 205 nmol/L OR <=50 ng/mL)	CDL HASA	5 WD * Run in batch analysis
128.	LH 0 min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis
129.	LH 30 min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis
130.	LH 60 min	Serum	3 ml	Plain tube	• Please notify the laboratory at least 2 days before the dynamic function test. • Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA	5 WD * Run in batch analysis

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
131.	Lipase	Serum	3 ml	Plain tube	• Get Innoquest Pathology Request form from CDL Specimen Reception Counter and complete it. • Send the sample and the form to CDL immediately.	Innoquest Pathology	2 WD
132.	Lipoprotein (a)	Serum	3 ml	Plain tube	• Get Innoquest Pathology Request form from CDL Specimen Reception Counter and complete it. • Send the sample and the form to CDL immediately.	Innoquest Pathology	2 WD
133.	Lithium	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the sample with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	2 WD
134.	Magnesium	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 3 hours, but if requested as urgent, LTAT is considered as 1 hour.
135.	Magnesium, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	• Get the urine 24 hours bottle at CDL Specimen Counter.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
				(Preservative: 10 mL of 6 mol/L HCL)	• Send to CDL immediately.		Routine (out- patient) - 5 WD * Run during office hours only.
136.	Magnesium, Random urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
137.	Mercury, Blood	Whole blood	6 ml	EDTA tube (royal blue)	• BY APPOINTMENT with the laboratory (at least 1 week prior to blood taking). • Get royal blue (EDTA) tube from the CDL Specimen Reception Counter. • Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	11 WD
138.	Mercury, Urine	Random urine	20 ml	Urine container (acid washed bottle)	BY APPOINTMENT with the laboratory (at least 1 week before sample collection) • Get Innoquest Pathology Request form and acid washed bottle from CDL Specimen Reception Counter. • Complete the form. • Send the sample and the form to CDL immediately.	Innoquest Pathology	11 WD
139.	Metanephrine,	Plasma	3 ml	EDTA	BY APPOINTMENT DURING OFFICE	Innoquest	15 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
	Plasma				HOURS ONLY. • Get Innoquest Request Form at Specimen Reception Counter and send it along with sample to CDL immediately. • Please provide clinical notes on medication. * Transportation to the USA is on every Tuesday. It is advisable to send samples by Monday (AM).	Pathology	
140.	Metanephrine, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	15 WD
141.	Methanol, Blood	Whole Blood	3 ml	EDTA	BY APPOINTMENT DURING OFFICE HOURS ONLY. • Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	Premier Integrated Lab	16 WD
142.	Methanol, Urine	Random urine	20 ml	Urine container	BY APPOINTMENT DURING OFFICE HOURS ONLY. • Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	Premier Integrated Lab	16 WD
143.	Myoglobin	Random urine	5 ml	Urine container	• Get Innoquest request form from CDL Specimen Reception Counter and complete it.	Innoquest Pathology	6 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					• Provide at least 5 ml of urine and send the sample and the form to CDL immediately. * Sample must be freshly collected.		
144.	NT- proBNP	Serum	3 ml	Plain tube	Send the sample to the laboratory immediately. * The assay is unaffected by biotin (<= 14326 nmol/L OR <= 3500 ng/mL).	CDL HASA and Sg Buloh	1 hour
145.	Oligoclonal band (CSF electrophoresis)	CSF and serum	≥7 drops or at least 0.5ml (CSF) 3 ml (serum)	Bijou bottle (CSF) Plain tube (serum)	BY APPOINTMENT DURING OFFICE HOURS ONLY. • Complete PERPAT.301 form. • 1- 3mL of non- hemolysed serum and at least 0.5mL of CSF in bijou bottle or sterile container. • It is recommended to collect serum and CSF at the same time. • Serum must be refrigerated immediately after collection. • No hemolysis. • Send the form with the sample to CDL immediately. * CSF sample must be SEND TOGETHER WITH serum sample. ** This test already includes Serum Protein Electrophoresis (EP). No	UMMC	16 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					need to order Serum EP.		
146.	Osmolality (serum)	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 3 hours, but if requested as urgent, LTAT is considered as 1 hour.
147.	Osmolality (urine)	Random urine	20 ml	Urine container	Send to CDL immediately.	CDL HASA	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 3 hours, but if requested as urgent, LTAT is considered as 1 hour.
148.	Parathyroid (intact)- iPTH	Plasma	3 ml	EDTA tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	5 WD
149.	pH (Pericardial Fluid)	Pericardial fluid	at least 15 ml	Bijou bottle	Send to CDL immediately	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
150.	pH (Peritoneal Fluid)	Peritoneal fluid	at least 15 ml	Bijou bottle	Send to CDL immediately	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
151.	pH (Pleural Fluid)	Pleural fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
152.	Phenobarbi-	Serum	3 ml	Plain tube (red	• Complete PERPAT.301 form.	UMMC	2 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
	tone			top)	• Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL		
153.	Phenytoin (Dilantin)	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	2 WD
154.	Phosphate	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 3 hours, but if requested as urgent, LTAT is considered as 1 hour.
155.	Phosphate, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle (preservative: 10 ml of 6 mol/L HCL)	• Get urine 24 hours bottle collection at CDL Specimen Counter. • Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
156.	Phosphate, Random Urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
157.	Phospholipase	Serum	3 ml	Plain tube	BY APPOINTMENT DURING OFFICE	Lablink	5 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
	A2 receptor Antibody (Quantitative)				HOUR ONLY. • Complete PERPAT.301 form. • Send sample and form to CDL immediately.		
158.	Phospholipase A2 receptor Antibody (Qualitative)	Serum	3 ml	Plain tube	BY APPOINTMENT DURING OFFICE HOUR ONLY. • Complete PERPAT.301 form. • Send sample and form to CDL immediately	Lablink	5 WD
159.	Porphobilinogen	Random urine	at least 10 ml	Urine container (wrapped with aluminium foil)	BY APPOINTMENT DURING OFFICE HOUR ONLY. • Complete PERPAT.301 form. • Requires at least 5 ml of fresh urine and protects it from light (wrap the bottle with aluminum foil). • Send the sample to the Laboratory immediately IN ICE.	UMMC	7 calendar days
160.	Porphyrin	Random urine	at least 10 ml	Urine container (wrapped with aluminium foil)	BY APPOINTMENT DURING OFFICE HOUR ONLY. • Complete PERPAT.301 form. • Requires at least 5 ml of fresh urine and protects it from light (wrap the bottle with aluminum foil. • Send the sample to the laboratory	UMMC	7 calendar days

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					immediately IN ICE.		
161.	Potassium	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
162	Potassium, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
163.	Potassium, Random Urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
164.	Procalcitonin	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA	Urgent - 1 hour Routine - 4 hours
165.	Prolactin	Serum	3 ml	Plain tube	Send the sample to the laboratory immediately. * Tests will be analyzed by batch once a week.	CDL HASA	5 WD * Run in batch analysis
166.	Prostate Specific Antigen (Total)	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA	5 WD * Run in batch analysis
167.	Prostate Specific Antigen (Free)	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. • Total PSA must be analyzed before the request is made.	HKL	6 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					* Total PSA result must be between 2.5 - 10 ng/ml.		
168.	Protein Electrophoresis (random urine)	Random urine	10 ml	Urine container	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	HKL	16 WD (except for sample require further tests e.g.: extended immuno- fixation or BME treatment)
169.	Protein Electrophoresis (serum)	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	HKL	16 WD (except for sample require further tests e.g.: extended immuno- fixation or BME treatment)
170.	Salicylate Acid	Serum	3 ml	Plain tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	1 WD
171.	Sex Hormone Binding Globulin	Serum	3 ml	Plain tube	• Complete PERPAT.301 form • Send the sample immediately.	UMMC	6 WD
172.	Sirolimus	Whole blood	3 ml	EDTA tube	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	6 WD
173.	Sodium	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
174.	Sodium Valproate/Valpr	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301. • Send the form with the sample to	UMMC	1 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
	oic acid				CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL		
175.	Sodium, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
176.	Sodium, Random Urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
177.	Stone Analysis	Stone	As collected	Sterile container	• Please make sure only stone specimens are in the container. NO URINE (air- dry calculi). • Complete PERPAT.301 form. • Send the sample and the form to the laboratory immediately.	Lablink	15 WD
178.	Reducing Sugar (Stool)	Stool	As collected	Stool container	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	6 WD
179.	Reducing Sugar (Urine)	Random urine	10 ml	Urine container	• Complete PERPAT 301. form. • Send the form with the sample to CDL immediately.	UMMC	6 WD
180.	Tacrolimus	Whole blood	3 ml	EDTA tube	• Complete PERPAT.301 form. • Send the form a with the sample	UMMC	1 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					to CDL immediately.		
181.	Testosterone (total)	Serum	3 ml	Plain tube	Send to CDL immediately. * Test is analyzed by batch once a week.	CDL HASA	5 WD * Run in batch analysis
182.	Theophylline/ Aminophylline	Serum	3ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL	UMMC	1 WD
183.	Thyroglobulin	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	6 WD
184.	Thyroglobulin Antibody	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	6 WD
185.	Thyroid Stimulating Immunoglobu-lin (TSI)	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	11 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
186.	Thyroperoxi-dase- Antibody - TPO	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately. * MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	UMMC	6 WD
187.	Total Protein	Pericardial fluid	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
188.	Total Protein (CSF)	CSF	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
189.	Total Protein (Peritoneal Fluid)	Peritoneal fluid	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
190.	Total Protein (Pleural Fluid)	Pleural fluid	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours
191.	Total Protein, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
192.	Total Protein, Random Urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
193.	Triglyceride (Peritoneal Fluid)	Peritoneal fluid	at least 5 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine- 4 hours

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
194.	Triglycerides	Serum	3 ml	Plain tube	• Fasting sample required. • Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
195.	TSH Cord Blood	Cord blood	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine - 4 hours
196.	TSH Receptor Antibody	Serum	3 ml	Plain tube	• Get Innoquest Pathology Request form at CDL Specimen Reception Counter and complete it. • Send the sample and the form to CDL immediately	Innoquest Pathology	6 WD
197.	TSH	Serum	3 ml	Plain tube	• Send to CDL immediately. • TEST WILL BE REJECTED IF REQUESTED WITHIN 6 WEEKS OF PREVIOUS REQUEST. * The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh	5 WD * Run in batch analysis
198.	TSH, 0 min	Serum	3 ml	Plain tube	Send to CDL immediately. * The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh	5 WD * Run in batch analysis
199.	TSH, 30 min	Serum	3 ml	Plain tube	Send to CDL immediately. * The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh	5 WD * Run in batch analysis

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
200.	TSH, 60 min	Serum	3 ml	Plain tube	Send to CDL immediately. * The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh	5 WD * Run in batch analysis
201.	TSH, 90 min	Serum	3 ml	Plain tube	Send to CDL immediately. * The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).1200 ng/mL).	CDL HASA & Sg Buloh	5 WD * Run in batch analysis
202.	Urine Albumin Creatinine Ratio (UACR)	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
203.	Urine Protein Creatinine Ratio (UPCR)	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
204.	Urea	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
205.	Urea, PD 0 Hour	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
206.	Urea, PD 2 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
207.	Urea, PD 24 Hours	Peritoneal dialysis fluid	Timed collection	24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
208.	Urea, PD 4 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
209.	Urea, Post Haemodialysis	Serum	Timed collection	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
210.	Urea, Pre-Haemodialysis	Serum	Timed collection	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
211.	Urea, PD Overnight	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD
212.	Urea, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle	• REFRIGERATE during collection. • Send to the laboratory in an ice box that contains a cold ice pack.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
213.	Urea, Random Urine	Random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
214.	Uric Acid	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
							Routine (out- patient) - 5 WD
215.	Uric acid, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle *Preservative: 10 ml of 10% NaOH (2.5N NaOH)	• DO NOT REFRIGERATE during collection. • Send the sample to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD * Run during office hours only.
216.	Urine Organic Acid	Random urine	10 ml	Urine container	• Get IEM form at CDL Specimen Reception Counter and complete it. • Send the form with the sample to CDL immediately.	IMR	16 WD
217.	Urine Orotic Acid	Random urine	10 ml	Urine container	• Get IEM form at CDL Specimen Reception Counter and complete it. • Send the form with the sample to CDL immediately.	IMR	11 WD
218.	Urine Phase Contrast	Random urine	10 ml	Urine container	• Get Innoquest Pathology Request form at CDL Specimen Reception Counter and complete it. • Send the form with the sample to CDL immediately.	Innoquest Pathology	2 WD
219.	Urine Pregnancy Test (UPT)	First morning or random urine	10 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient) - 4 hours Routine (out- patient) - 5 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
220.	Vancomycin	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (from critical care units) - 3 hours Routine (from other units) - 4 hours
221.	Vitamin B1 (Thiamine)	Whole blood	6 ml	EDTA tube (wrapped with aluminium foil)	BY APPOINTMENT (at least 1 week before blood taking). • Get the Innoquest Pathology Request Form and aluminium foil (to wrap) from the laboratory. * Transportation to Australia is on Saturday. It is advisable to send samples on Friday (AM).	Innoquest Pathology	19 WD
222.	Vitamin B12	Serum	3 ml	Plain tube	Send to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA	5 WD * Run in batch analysis
223.	Vitamin C (Ascorbic Acid)	Serum	3 ml	Lithium heparin tube (wrapped with aluminium foil)	BY APPOINTMENT (at least 1 week before blood taking). • Get the Innoquest Pathology Request Form and lithium heparin tube (which has been wrapped with aluminium foil) from the laboratory. * Transportation to the USA is on Tuesday. It is advisable to send samples on Friday (AM).	Innoquest Pathology	17 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
224.	Vitamin D	Serum	3 ml	Plain tube (red top)	• Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	5 WD * Run in batch analysis
225.	Zinc, Urine 24 hours	Urine 24 hours	As collected	Urine 24 hours bottle (acid wash)	BY APPOINTMENT (at least 1 week before sample collection). • Please get a 24- hour bottle (acid wash bottle) from the laboratory 1 week after booking. • Complete PERPAT.301 form. • Send the form with the sample to the laboratory immediately.	UMMC	11 WD
226.	Zinc (Serum)	Serum	6 ml	Plain tube (royal blue)	BY APPOINTMENT (at least 1 week before blood taking). • Get royal blue (plain) tubes from the CDL. • Complete PERPAT.301 form. • Send the form with the sample to CDL immediately.	UMMC	11 WD

PROFILE TEST

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
1.	Fasting serum lipids i. Total Cholesterol ii. Triglycerides iii. LDL- c iv. HDL- c v. Non- HDL- c	Serum	3 ml	Plain tube	• A fasting sample is required (at least an 8- hour fasting) • Send to the Chemical Pathology lab immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD
2.	Liver Function Test i. Total protein ii. Albumin iii. Total bilirubin iv. Direct bilirubin v. ALT vi. ALP vii. GGT	Serum	3 ml	Plain tube	Send to the lab immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD
3.	Renal Profile i. Urea ii. Creatinine iii. Sodium iv. Potassium v. Chloride	Serum	3 ml	Plain tube	Send to the lab immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 1 hour
4.	OGTT i. Fasting Glucose ii. Glucose- 2HPP (2 hrs. postprandial)	Plasma	3 ml	Fluoride tube	Send to the lab immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
5.	BUSE i. Urea ii. Sodium iii. Potassium iv. Chloride	Serum	3 ml	Plain tube	Send to the lab immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 1 hour
6.	Bone Profile i. Albumin ii. ALP iii. Total Calcium iv. Corrected Calcium v. Phosphate	Serum	3 ml	Plain tube	Send to the lab immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 1 hour
7.	Urine FEME i. Blood ii. Bilirubin iii. Urobilinogen iv. Ketone v. Protein vi. Nitrite vii. Glucose viii. pH ix. Specific gravity x. Leucocytes xi. Microscopy	Urine	20 ml	Urine collection container	Send to the lab immediately.	CDL HASA & Sg Buloh	Urgent - 1 hour Routine (in- patient)- 4 hours Routine (out- patient) - 5 WD * All requests from critical care units - 1 hour * Urine microscopy is not offered after office hours.
8.	Iron Profile i. Total Iron ii. TIBC	Serum	3 ml	Plain tube	Send to the lab within 2- 4 hours.	CDL HASA	5 WD * Run in batch analysis

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
	iii. UIBC iv. Ferritin						
9.	Female infertility studies i. FSH ii. LH iii. Estradiol iv. Progesterone	Serum	3 ml	Plain tube	Send to the lab within 2- 4 hours. * Tests will be analyzed by batch once a week.	CDL HASA	5 WD * Run in batch analysis
10.	Thyroid Function Test i. TSH ii. Free T4	Serum	3 ml	Plain tube	Send to the lab immediately.	CDL HASA & Sg Buloh	5 WD * Run in batch analysis
11.	Amenorrhea studies i. FSH ii. LH iii. Estradiol	Serum	3 ml	Plain tube	Send to the lab immediately. * Tests are analyzed by batch once a week.	CDL HASA	5 WD * Run in batch analysis
12.	Catecholamines i. Adrenaline ii. Noradrenaline iii. Dopamine	24- hour urine	24- hour urine collection (Urine volume must be > 750 ml).	Urine 24- hour container with 10 ml of 9 mol/L HCL acid	• Complete PERPAT.301 form. • Send to the lab within 2- 4 hours. * Refrigerate during 24- hour urine collection.	UMMC	
13.	Blood Gases (Arterial or Venous) i. pH ii. PCO2	Whole Blood	1ml	Heparin 1ml syringe	Procedure of specimen collection: 1. Indicate time of arterial or venous puncture in the request form. 2. Use a 1 ml disposable syringe	CDL HASA & Sg Buloh	45 minutes

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
	iii. PO2 iv. HCO3 v. Base Excess				3. Remove the protective cover from the ABG needle and then flush through 1000 IU/ml heparin from the syringe. 4. If using alcohol to clean the venipuncture site, allow the alcohol to dry completely. 5. Draw 1 ml of blood 6. Invert the syringe upward and expel all air bubbles. 7. Mix well by rolling between palms for 5 seconds 8. Sample should be sent immediately in ice bath. Sample need to be processed within 30 minutes of collection sample. 9. If sample was received with needle, the test request will be rejected.		
14.	Blood Gases (Cord Blood) i. pH ii. PCO2 iii. PO2 iv. HCO3 v. Base Excess	Cord Blood	1ml	Heparin 1ml syringe		CDL HASA & Sg Buloh	45 minutes
15.	Urine Drug of Abuse i. Amphetamine ii. Cannabinoids iii. Opiates iv. Barbiturates v. Benzodiazepines vi. MDMA (Ecstasy)	Urine (random)	At least ½ of a urine container.	Urine Container	• Complete PERPAT.301 form (available at the Chemical Pathology lab). • Urine must be collected in at least • ½ of the urine container. • Seal the urine container after collection. • Send to the lab immediately.	UMMC	4 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
16.	Urine Drug of Toxicology i. Amphetamine ii. Cannabinoids iii. Morphine iv. Ketamine	Urine (random)	At least ¾ of the urine container.	Urine Container	BY APPOINTMENT with the lab (at least 1 week before sample collection). • Urine must be collected at least ¾ of the urine container. • Seal the urine container after collection. • Send it to the lab immediately.	Lablink	5 WD
17.	Insulin Autoantibodies/ Diabetes Mellitus Autoimmune i. GAD ii. IA2 iii. Islet Cell Antibodies iv. Anti- insulin	Serum	8 ml x 2 tubes	Plain tubes	BY APPOINTMENT with the lab (at least 1 week before sample collection). • Complete PERPAT.301 form (available at the Chemical Pathology lab). • Send to the lab immediately. • Please send 2 separate plain tubes.	Lablink	5 WD
18.	Aldosterone Renin Ratio (ARR)	Plasma	4 ml	K2- EDTA	BY APPOINTMENT with the lab. (at least 1 week before collection). • Complete the PERPAT.301 form. • Sample volume must be at least 4 ml. • Sample must be sent immediately WITHOUT ice. • Please DO NOT pre-chilled tube and syringe before blood taking. • Record patient's posture whether supine or upright in column 'clinical history' on the request form.	UMMC	15 WD

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION	TURN AROUND TIME (TAT)
					* The Aldosterone renin ratio is most sensitive when used in patients from whom samples are collected in the morning after patients have been out of bed for at least 2 h, usually after they have been seated for 5–15 minutes.		
19.	Acylcarnitine Profile	Dried blood spot	At least 4 circles of dried blood spot	Filter Paper	By appointment with the lab (at least 1 week before collection). • Newborn must be >7 days old of life. • Get 903 Whatman filter paper from the lab. • Put at least 4 circles of Dried Blood Spot (DBS). Please put only 1 layer of blood at each circle to avoid interference of the result. • Ensure blood is completely dried at room temperature before putting in a plastic sheet. • Complete PERPAT.301 form and send it along with a sample to CDL immediately.	UMMC	6 WD

ANATOMIC PATHOLOGY

INTRODUCTION

The Anatomic Pathology specialty provides two main services:

1. HISTOPATHOLOGY

Macroscopic and microscopic examination of tissues with interpretative diagnosis. This concerns assessment of biopsies or specimens removed at surgery. Intraoperative frozen section consultation is also provided. Inclusive within the service are ancillary services such as histochemical, immunohistochemical and immunofluorescent stains.

2. CYTOPATHOLOGY

Diagnostic and screening services based on the morphologic study of cells. It is divided into two categories:

- Gynaecological- based cytology
- Non- gynaecological- based cytology - Fine needle aspiration cytology (FNAC), brushings and body fluid cytology.

In addition to diagnostic interpretation, Anatomic Pathology specialty also conducts FNAC clinics, provides in- patient FNAC and rapid on- site (ROSE) evaluation services.

HISTOPATHOLOGY

1. ROUTINE SURGICAL AND BIOPSY SPECIMENS

1.1. SPECIMEN COLLECTION AND HANDLING

1.1.1. All specimens and the accompanying request forms must be sent to the CDL Specimen Reception Counter

1.1.2. If there are multiple specimens from the same patient, these must be completely collected before arrival at the counter.

1.1.3. All specimens must be labelled with the patient's name and at least one other unique identifier (e.g. NRIC, MRN, etc.). The type of specimen must be clearly labelled on the container

1.1.4. Multiple specimens must be labelled accurately, and this must be done by the medical officer/specialist. The staff must be responsible to re-check the details on the specimen containers prior to dispatch.

1.1.5. All specimens for routine histopathology examination should be fixed in 10% formalin in a suitable leak- proof container unless stated otherwise (e.g. frozen section or biopsy for immunofluorescence studies). The volume of formalin used should be at least 10 times the volume of the specimens to be fixed.

1.1.6. Do not put large specimens in small containers as this would prevent proper fixation of the tissue and it may cause distortion to the specimens.

1.1.7. Complex specimens which require orientation must be marked or tagged accordingly by sutures/staples. The orientation must be clearly indicated in the accompanying request form.

1.1.8. If a specimen is of utmost importance, or if there is uncertainty in the method of

sampling/suitable fixation of the specimen, please communicate directly with the pathologist.

1.2. REQUEST FORM

1.2.1. All specimens must be accompanied by a request form.

1.2.2. Internal (UiTM) requests:

1.2.2.1. All requests shall be made via computerized order entry in UniMEDS. Please select the relevant test request according to the category and provide relevant clinical information, including any risk indicators (e.g. infectious risk, etc.).

1.2.2.2. For multiple specimens, please ensure that the request for each specimen is specified on the system. Requests for histopathology or cytology must be done separately.

1.2.2.3. Please indicate if an urgent result is required. In these cases, the requestor is advised to provide a contact number to ease communication.

1.2.2.4. Print the generated request form and the barcode sticker. Place the sticker onto the labelled specimen container.

1.2.3. External requests (KKM hospitals / UPSC etc.):

1.2.3.1. Requests from KKM hospitals must be accompanied by a completed Per-PAT 301 form.

1.2.3.2. Requests from other institutions (e.g. UPSC) must be accompanied by completed relevant request forms.

1.2.4. External request for a second opinion:

1.2.4.1. Please communicate directly with the specific pathologist.

1.2.4.2. Please provide a cover letter with relevant clinical information and contact information along with the referral material and previous histopathology report, if any. The pathologist shall advise on the material to be provided.

1.3. CRITERIA FOR RECTIFICATION

1.3.1. For certain requests that do not fulfil the unit's requirements, the requestor shall be contacted to rectify the request by filling in the rectification form (to be provided by the laboratory staff). The specimen will only be processed following satisfactory corrective actions.

1.3.2. Examples of cases that will require rectification include (and are not limited to):

i) Specimens with no request form, inappropriate request form, damaged, or incompletely filled request forms.
ii) Incorrectly labelled specimen container.
iii) The discrepancy between details on the request form and specimen container.
iv) Inappropriate specimen container.

2. FROZEN SECTION:

This service is ONLY offered during working hours (8 am- 4 pm), Monday - Friday (excluding public holidays).

2.1. SPECIMEN COLLECTION AND HANDLING

2.1.1. All frozen section requests must be discussed with the pathologist on- call at least 24- hour before the intended frozen section.

2.1.2. Please inform laboratory staff if a booked frozen section is cancelled.

2.1.3. All specimens for the frozen section must be sent fresh without any preservative in a closed container, accompanied by a completed request form along with the requestor's contact number.

2.1.4. The specimen should be sent immediately to the laboratory upon removal.

2.1.5. Interpretation will be verbally given to the requesting surgeon via phone call and documented.

2.1.6. High- risk infectious material will NOT be accepted for processing (e.g. tuberculosis).

2.1.7. All cases scheduled for a frozen section are best placed first in the operating list to ensure no disruption to the service.

2.2. REQUEST FORM

Refer to Histopathology section 1.2.

2.3. CRITERIA FOR RECTIFICATION

Refer to Histopathology section 1.3.

3. IMMUNOFLUORESCENCE (IF) STUDIES

3.1. SPECIMEN COLLECTION AND HANDLING

3.1.1. This service is provided for renal and skin biopsies.

3.1.2. All requests for IF studies must be discussed with the relevant pathologist on- call.

3.1.3. For pre- planned biopsies, kindly inform lab staff at least three (3) days in advance.

3.1.4. Renal biopsy:

3.1.4.1. Obtain at least a 3mm core of fresh tissue. Place sample in a clean air- tight container or phosphate buffer solution (PBS). Do not put fresh tissue on gauze.

3.1.4.2. Send specimen to the laboratory immediately. If a delay is anticipated, please transport in ice or gel ice.

3.1.4.3. Please send a separate biopsy fixed in formalin for ordinary light microscopic examination.

3.1.5. Skin biopsy:

3.1.5.1. Place skin biopsy in saline or PBS, in a clean container.

3.1.5.2. Send specimen to the laboratory immediately. If a delay is anticipated, please transport in ice or gel ice.

3.1.5.3. Please send a separate biopsy fixed in formalin for ordinary light microscopic examination.

3.2. REQUEST FORM

Refer to Histopathology section 1.2.

3.3. CRITERIA FOR RECTIFICATION

Refer to Histopathology section 1.3.

CYTOLOGY

1. GYNAECOLOGICAL CYTOLOGY

1.1. SPECIMEN COLLECTION AND HANDLING

1.1.1.Conventional smears:

1.1.1.1. Label a clean glass slide with the patient's name and at least one other unique identifier (e.g. NRIC, MRN no.).

1.1.1.2. Avoid using a lubricant on the speculum.

1.1.1.3. Obtain an adequate sample from the cervix. Smear the material onto the labelled glass slide about as thick as a blood film.

1.1.1.4. Fix the slide immediately using a spray fixative.

1.1.1.5. Air- dry the fixed slide.

1.1.1.6. Place the slide in a slide mailer and despatch along with a completed request form to the CDL reception counter.

1.1.2.Liquid- based cytology:

1.1.2.1. Avoid using a lubricant on the speculum.

1.1.2.2. Obtain an adequate sample from the cervix using an appropriate broom- like sample collection device.

1.1.2.3. Rinse the broom in the vial containing a fixative solution. Discard the collection device.

1.1.2.4. Tighten the cap. Send the vial along with a completed request form to the CDL reception counter.

1.2. REQUEST FORM

Refer to Histopathology section 1.2.

1.3. CRITERIA FOR RECTIFICATION

Refer to Histopathology section 1.3.

2. NON- GYNAECOLOGICAL CYTOLOGY

2.1. SPECIMEN COLLECTION AND HANDLING

2.1.1.Fine needle aspiration cytology (FNAC) and brushings (e.g. during Endoscopic Bronchial Ultrasound - EBUS and Endoscopic Ultrasound - EUS procedures)

2.1.1.1. Call the lab to book an appointment for FNAC clinic/inpatient FNAC. This is much preferred than FNAC performed by a clinician to reduce the incidence of insufficient/suboptimal sampling. For EBUS or EUS, please contact the lab to book for ROSE service. Please see section 3.0 below.

2.1.1.2. After obtaining the sample, spread aspirated/brushing material onto a glass slide. Label the slide using a pencil with the patient's name and one other unique identifier (e.g. NRIC, MRN no) on the frosted end of the slide.

2.1.1.3. For alcohol- fixed smears, immediately immerse slides in 95% alcohol for at least 30 minutes. The alcohol solution may be obtained from the laboratory (available during weekdays & office hours).

2.1.1.4. For air- dried smears, leave the slides to air- dry.

2.1.1.5. For cell block preparation, place the aspirated material and/or needle washings into a tube containing cytolysis solution. Place the needle in the container as well. Label the container with patient details.

2.1.1.6. Send the slides/specimen along with the completed request form to the CDL reception counter. The specific requirements (minimum number of slides +/- need for needle washing) depend on the type of specimen. The requirements are outlined in the guidelines for specimen handling below (page 57).

2.1.2. Body fluid cytology

2.1.2.1. Cerebrospinal fluid (CSF)

- Collect specimen in a sterile universal container. Label with patient details. Despatch immediately. Please call/inform the lab before sending the specimen. The specimen must arrive at the laboratory before 4 pm for same- day processing. Clinicians are advised to plan the procedure to ensure immediate transport of the specimen to the laboratory.
- If a delay is anticipated, please keep it refrigerated at 4°C and send it to the lab as soon as possible
- Ensure that specimens for microbiology/clinical chemistry are sent in separate containers. Refer to guidelines for specimen handling (page 57) for details.

2.1.2.2. Serous fluid (ascitic/peritoneal/pleural/pericardial fluid), bronchial washing and lavage, cyst fluid, synovial fluid.

- Collect specimen in a sterile universal container. Label with patient details. Despatch immediately. If a delay is anticipated, please keep refrigerated at 4°C and send it to the lab as soon as possible.
- Ensure thatspecimens for microbiology/clinical chemistry are sent in separate containers. Refer to guidelines for specimen handling (page 57) for details.

2.1.2.3. Sputum

- The specimen should be obtained first thing in the morning, before the patient eats, drinks or cleans his/her teeth. Preferably the specimen should be collected on three consecutive days. The specimen is best obtained after chest physiotherapy.
- Instruct the patient to cough deeply and collect the entire expectorated material in a sterile universal container and label it with patient details. Despatch immediately. If a delay is anticipated, please keep refrigerated at 4°C and send it to the lab as soon as possible. Refer to guidelines for specimen handling (page 57) for details.

2.1.2.4. Urine

- Collect mid- stream urine sample in a sterile universal container. Avoid submitting the first- morning urine. Label with patient details. Despatch immediately. If a delay is anticipated, please keep it refrigerated at 4°C and send it to the lab as soon as possible.
- Ensure that specimens for clinical chemistry / UFEME /microbiology are sent in separate containers. Refer to guidelines for specimen handling (page 57) for details.

2.2 **REQUEST FORM**

Refer to Histopathology section 1.2.

2.3 **RECTIFICATION CRITERIA**

Refer to Histopathology section 1.3.

3. FINE NEEDLE ASPIRATION CYTOLOGY (FNAC) SERVICES

Anatomic Pathology Unit provides three main FNAC services, which are:

a. FNAC Clinic
b. Rapid On- Site Evaluation (ROSE) service.
c. In- patient FNAC services.

FNAC services are provided in the FNAC clinic as well as in the wards. Direct involvement of the cytopathologist is much preferred compared to FNAC performed by clinicians to reduce the incidence of insufficient/suboptimal sampling.

These services are provided during working hours (please see specific sections below). If the FNAC procedure needs to be performed during the weekends or after office hours, please ensure that the person performing the procedure has been well trained in FNAC and slide smearing technique to ensure a good yield of cellularity.

3.1. FNAC Clinic

3.1.1. This is an appointment- based clinic, run by the cytopathologist and his/her team, to perform the FNAC procedure as well as to ensure the optimal amount of sample is taken for proper interpretation.

3.1.2. The FNAC clinic is held twice a month in the Radiology Department.

3.1.3. Schedule an appointment with the Cytopathology Laboratory's person- in- charge or the pathologist- in- charge at least 24 hours in advance

3.1.4. All internal requests must be made via UniMEDS. Print the generated form and barcode for the patient to bring along to the FNAC clinic.

3.1.5. Other external requests must be first referred to the in- house clinic, then subsequently arranged for an FNAC appointment.

3.1.6. UPSC requests must be accompanied by relevant request forms. Refer to Histopathology section 1.2.

3.1.7. Patients must be properly informed of the date/time and location of the FNAC clinic appointment.

3.2. Rapid On- Site Evaluation (ROSE) Service

3.2.1. This service is provided to ensure the optimal amount of sample has been taken by the radiologist/clinician.

3.2.2. This service covers the ultrasound- guided FNAC (breast/thyroid/lymph node, etc.), Endoscopic Bronchial Ultrasound FNAC (EBUS- FNAC), Endoscopic Ultrasound FNAC (EUS- FNAC for liver, pancreas, etc.) as well as Endoscopic Retrograde Cholangiopancreatography (ERCP) brushings.

3.2.3. The Cytopathology Laboratory’s person- in- charge and cytopathologist- in- charge must be informed at least 3 days before the planned procedure. The cytopathologist and

cytotechnician will be on- site on the day of the procedure to provide feedback on sample cellularity to ensure adequate sampling.

3.2.4. All internal requests are to be made via UniMEDS. Other external requests (e.g. UPSC) must be accompanied by relevant request forms. Refer to Histopathology section 1.2.

3.3. In- patient FNAC Service

3.3.1. This is the FNAC service provided for inpatients.

3.3.2. The Cytopathology Laboratory's person- in- charge and cytopathologist- in- charge must be informed at least 24- hours in advance.

3.3.3. All internal requests are to be made via UniMEDS. Other external requests (e.g. UPSC) must be accompanied by relevant request forms. Please refer to Histopathology section 1.2.

SPECIMEN REPORTING AND TURNAROUND TIME (TAT)

1. The histopathologist on duty will report all specimens and verify the reports before release.
2. All requests will be handled and reported according to the following categories:
   2.1. Urgent biopsies: Biopsies marked as "urgent" by clinicians.
   2.2. Uncomplicated urgent biopsies: Biopsies marked as "urgent" by clinicians which do not require any additional processes e.g. levels, special stains, immunohistochemistry, second opinion, etc.
   2.3. Complicated urgent biopsies: Biopsies marked as "urgent" by clinicians require additional processes e.g. levels, special stains, immunohistochemistry, second opinion, etc.
   2.4. Routine surgical specimens: All other biopsies (including excision biopsies) and excision/resection surgical specimens.
   2.5. Addendum reports: Additional report issued after an initial histopathology report has been verified. These is also known as supplementary reports, typically containing additional information not yet available at the time of initial reporting.
   2.6. Turn Around Time (TAT) is calculated from the date (or time) of arrival of the specimen to the laboratory to the date (or time) the report is verified. Table below shows the TAT for the different categories of specimens.

TAT for different categories of specimens.

CATEGORIES	TAT
Uncomplicated urgent biopsies	5 working days
Complicated urgent biopsies and routine surgical specimen	14 working days
Frozen section	30 minutes (per specimen) from time of arrival to the lab to verbal reporting
Renal / Skin biopsy with immunofluorescence	14 working days
Gynaecological / non- gynaecological cytology	14 working days

2.7. All critical results (diagnosis) will be informed via phone and documented. The list for critical results is as follows:

2.7.1. Unexpected malignancy

2.7.2. Wrong organ removed

2.7.3. Reports of the following infections

- Bacteria in the heart valves or bone marrow.
- Organisms in an immune- compromised patient such as AFB, fungi, virus, and protozoa in cerebrospinal fluid (CSF).
- Unusual organisms or organisms in unusual sites e.g. amoeba in the eye

2.7.4. Reports on critically ill patients requiring immediate therapy.

- Crescents in greater than 50% of glomeruli in a renal biopsy.
- Transplant rejections.

2.7.5. Cases that have immediate clinical consequences

- Fat in an endometrial curettage.
- Mesothelial cells in a heart biopsy.
- Fat in snare colon biopsy.

Reference: The communication of critical and unexpected pathology results, October 2017, https://www.rcpath.org/resourceLibrary/the- communication- of- critical- and- unexpected-pathology- results- pdf.html

OTHER SERVICES

1. Interdepartmental Clinicopathological Conferences (CPC)
   1.1. Anatomic Pathology Unit welcomes CPCs with the clinical departments.
   1.2. Any enquiries regarding CPCs can be directed to the medical officer or pathologist- in- charge. Once confirmed, the list of patients to be discussed is to be submitted at least one week before the scheduled CPC date.
   1.3. For cases reported in other institutions, the requestor is responsible to obtain all relevant material and histopathology/cytopathology reports for review

2. Faculty of Medicine, UiTM Clinicopathological Conferences (CPC)
   2.1. If Anatomic Pathology Unit's participation is required for the weekly Faculty of Medicine's CPC, please liaise directly with the pathologist involved in the case to be discussed. Communicate the request at least one week prior to scheduled CPC date.
   2.2. For cases reported in other institutions, please liaise with the rostered pathologist- on- call. The requestor is responsible to obtain all relevant material and histopathology/cytopathology reports for review.

3. Requests for diagnostic material / unstained sections / paraffin blocks
   3.1. Valid requests for diagnostic material including paraffin blocks, or unstained sections (e.g. patient referral to another institution, etc.) will be considered on a case- by- case basis.
   3.2. The requesting clinician must communicate directly with the pathologist in charge of the case.
   3.3. The requesting clinician must complete a request form (Request for Material from Anatomic Pathology Unit), which will be provided upon request. Please indicate the relevant details including the material required and the indication for the request made.
   3.4. Upon approval of the request, the requestor must make the arrangements to collect the material.
   3.5. All borrowed diagnostic material / stained sections/paraffin block must be returned as soon as the external review / additional tests have been completed.

4. Research
   4.1. Anatomic Pathology Unit will facilitate research from both internal and external researchers.
   4.2. Please enquire within the unit for further information.

GUIDELINES FOR SPECIMEN HANDLING - ANATOMIC PATHOLOGY UNIT

Histopathology			
Specimen type	**Container**	**Sample Volume/size**	**Remarks**
Routine HPE examination	Appropriate- sized, leak- proof container. Place in 10% formalin (at least 10x volume of sample).	-	This is to ensure proper fixation of the specimen.
Frozen section	Clean, empty air- tight container.	-	Despatch immediately.
Renal biopsy for IF	Clean, empty air- tight container or in Phosphate Buffer Solution (PBS).	At least 3mm core.	Despatch immediately. Otherwise, transport in ice/gel- ice. Please submit a separate piece of tissue in formalin for light microscopy.
Skin biopsy for IF	Tissue in saline or PBS in a clean, air- tight container.	-	
Cytopathology			
Gynae			
Specimen type	**Container**	**Sample Volume/size**	**Remarks**
Gynae smears (Conventional)	Smear onto labelled slides. Spray- fix immediately.	As collected.	Despatch immediately.
Gynae smears (liquid- based)	Collection vial containing fixative (can be collected from the lab).		
FNAC			
Specimen type	**Container**	**Sample Volume/size**	**Remarks**
FNAC of any site (smears)	Smear onto labelled slides. For alcohol fixation (wet- fixed), fix immediately by immersing in 95% alcohol. For air- dried slide, leave to air- dry.	The minimum number of slides to be submitted depends on sample types; as outlined below.	Despatch immediately.
FNAC of any site - (for cell block)	Place aspirated material and needle washing in a tube containing cytolysis solution	As collected.	Despatch immediately.

FNAC sample requirements	Sample types	Needle washings to be provided?	Minimum number of slides/smears to be submitted
	Breast	Yes	2 air- dried & 2 wet- fixed
	Thyroid	Yes	2 air- dried & 2 wet- fixed
	Nipple discharge	No	1 air- dried & 1 wet- fixed
	Cyst aspirates	No	1 air- dried & 1 wet- fixed
	Lung	Yes	2 air- dried & 2 wet- fixed
	Lymph node	Yes	2 air- dried & 2 wet- fixed
	Solid lump	Yes	2 air- dried & 2 wet- fixed
	Salivary gland	Yes	2 air- dried & 2 wet- fixed
	Liver/pancreas	Yes	2 air- dried & 2 wet- fixed

Body fluids			
Specimen type	**Container**	Sample Volume/size	**Remarks**
Bronchoalveolar lavage (BAL)	Sterile specimen container	Minimum 5mls. The optimal volume is 20mls.	Despatch immediately (on the same day) with ice packing during transportation. If a delay is anticipated, please keep it refrigerated at 4°C and send it to the lab as soon as possible.
Brushing (e.g. EBUS, EUS) - smears	Smear onto labelled slides. For alcohol fixation, fix immediately by immersing in 95% alcohol. For air- dried slide, leave to air- dry.	As collected.	ROSE service is provided for optimal sampling. Despatch immediately.

Brushing (e.g. EBUS, EUS) - for cellblock	Place in a tube containing cytolysis solution.	As collected.	Despatch immediately.
Cerebrospinal Fluid (CSF)	Sterile specimen container.	The optimal volume is 2ml.	Despatch immediately. Sample to arrive at the lab before 4 pm for same- day processing. Inform Cytopathology Laboratory's person-in- charge before sending the specimen. If a delay is anticipated, please keep it refrigerated at 4°C and send it to the lab as soon as possible. Please ensure specimens for microbiology/clinical chemistry are sent in separate containers and dispatch immediately
Cyst fluid	Sterile specimen container.	As collected. The maximum volume is 25mls.	If a delay is anticipated, please keep it refrigerated at 4°C and send it to the lab as soon as possible.
Nipple discharge	Smear onto labelled slides. For alcohol fixation, fix immediately by immersing in 95% alcohol. For air- dried slide, leave to air- dry.	At least 1 air-dried and 1 alcohol- fixed slide.	-
Serous fluid (e.g. Pericardial, Peritoneal, Pleural)	Sterile specimen container.	The minimum volume of 75mls (for large volume collection and washings)	Adequate amount of CSF should be sent for evaluation.

Sputum	Sterile specimen container.	As collected. The entire amount of expectorated sample should be submitted. Multiple samples (x3) may be needed, but they should be taken on 3 separate days.	Should only be taken where patients are unfit for bronchoscopy. For best results obtain sputum following chest physiotherapy, with an early morning sample before the patient has eaten or brushed teeth.
Synovial fluid	Sterile specimen container.	The minimum volume of 5mls.	Despatch immediately. If a delay is anticipated, please keep refrigerated at 4°C and send it to the lab as soon as possible. Please ensure specimen for microbiology is sent in a separate container.
Urine	Sterile specimen container.	As collected. The maximum volume is 20mls.	Despatch immediately. If a delay is anticipated, please keep refrigerated at 4°C and send it to the lab as soon as possible. Avoid morning void samples. Please ensure specimens for clinical/chemistry/ UFEME/ microbiology are sent in separate containers.

HAEMATOLOGY AND TRANSFUSION MEDICINE

INTRODUCTION

The Haematology and Transfusion Medicine specialty provides diagnostic and consultative services. It also receives specimens for research purposes. Two main services are operating in our unit are:

1. Haematology
2. Transfusion Medicine

Operating in HASA, UiTM Puncak Alam and PPUiTM Sungai Buloh, both laboratories perform haematology and transfusion medicine services and operate 24 hours daily including weekends and public holidays. In HASA UiTM Puncak Alam, the laboratory shares the Specimen Reception Counter with the Chemical Pathology Unit, Anatomic Pathology Unit and Medical Microbiology Unit. In PPUiTM Sg Buloh, the laboratory shares the Specimen Reception Counter with the Chemical Pathology Unit. When specimens are received at the counter, the laboratory staff will acknowledge the receipt of the specimen through UniMEDS or LIS. The specimens are divided into units and processed accordingly.

HAEMATOLOGY

1. Services

   The diagnostic services are divided into:

   1.1. Routine tests - These tests are offered during office hours (please refer to the test list in **Table 1**). The following is the routine request during and after office hours:

ROUTINE REQUEST			
No.	**Tests**	**TAT**	
		Inpatient	**Outpatient**
1.	Complete Blood Count (CBC)	4 hours	5 working days
2.	Complete Blood Count + Differential Count (CBC+DIFF)	4 hours	5 working days
3.	Reticulocytes	4 hours	5 working days
4.	Coagulation Screen	4 hours	5 working days
5.	Glucose- 6- Phosphate Dehydrogenase (G6PD)	24 hours	
6.	Peripheral Blood Film	5 working days	

1.2. Urgent tests - These are short TAT tests for immediate patient management as indicated by the clinician on the request form. Urgent tests are offered 24 hours. The following list is urgent requests during and after office hours:

No.	Test	TAT	Remarks
1.	Complete Blood Count (CBC) and Complete Blood Count + Differential Count (CBC+DIFF)	ED: 45 minutes	TAT may be delayed if a blood film review is required.
2.		Other than ED: 60 minutes	
3.	Reticulocytes	60 minutes	-
4.	Coagulation Screen	90 minutes	-
5.	Peripheral Blood Film	Urgent request is subjected to communication between pathologist and requesting clinician.	Urgent request is subjected to communication between pathologist and requesting clinician.

* ED - Emergency Department

1.3. Outsourced tests - These are the tests that are not performed in- house but are outsourced to referral laboratories.

No.	Test	TAT	Remarks
1.	Specialized test	Most of specialized tests are outsourced to referral laboratory. TAT depends on the TAT of the referral laboratory.	These tests are run in batches (refer to Table 2).

2. Request forms

2.1. All haematology tests shall be requested through UniMEDS. The specimen shall arrive in the laboratory with UniMEDS form.

2.2. An additional test to the primary sample can be requested in a new request form. However, the request is subjected to the analyte's stability. Please contact the laboratory before request.

2.3. Specimen for haematology tests i.e., CBC or CBC+DIFF can **ONLY** be shared with HbA1c. The labelling must be done appropriately and separate forms for haematology and chemical pathology tests are needed. Failure to do so may lead to tests being missed out.

2.4. For tests that are run in outsourced laboratories, they shall be requested through UniMEDS. The specimen shall arrive in the laboratory with UniMEDS form together with the respective form of the outsourced laboratory.

3. Special Collection Procedures
   Several in- house and outsourced tests require special collection procedures. Refer to Table 1 and Table 2 for instructions. Failure to adhere to a specific procedure may cause specimen rejection.

4. Receipt of Specimen
   All specimens will be received at the Specimen Reception Counter either by a porter or pneumatic tube. The timely arrival of specimens in the right condition is vital as failure to keep to the appropriate arrival time may cause erroneous results and misinterpretation.

5. Rejection of Specimen
   The common errors in specimen collection that can cause rejection are:
   a) Incomplete request form
   b) Misidentification of a patient.
   c) Mislabeling of the specimen.
   d) Inadequate specimen volume
      For e.g. Inadequate blood volume in citrate tube will result in the wrong ratio of blood: anticoagulant. This may affect test results.
   e) Improper mixing that results in clotted sample.
   f) Wrong tube/wrong anticoagulant.
   g) Haemolysis/lipaemia
      - Common causes of haemolysed specimen include the needle being too large or too small), vigorous mixing of the filled collection tube, prolonged tourniquet pressure and difficult blood taking.
   h) Exposure to light and/or extreme temperatures. This can affect the analyte's stability.
   i) Improper time specimen/delayed delivery to the laboratory. This can affect the analyte's stability.
   j) Improper storage prior to specimen despatch. This can affect the analyte's stability.
   k) Improper collection of specimens
      - Heparin contaminated specimens may result in falsely prolonged APTT.
      - Specimens collected from the intravenous line may cause a dilutional effect leading to falsely low counts for HGB, WBC, RBC and PLT.

   Several outsourced tests need to be despatched as soon as possible to the respective laboratory. Therefore, the requestor must make an appointment with the laboratory prior to specimen collection.
   Rejection of specimen will be informed through a phone call by laboratory staff and must be acknowledged by ward/clinic staff.

6. Reporting of Results

Test results during office hours will be verified and/or validated by a senior medical laboratory technologist (MLT), scientific officer, medical officer and pathologist. Results after office hours will be verified and validated by a trained MLT. If there is any uncertainty, the MLT will consult the pathologist on- call.

All haematology test reports are available in UniMEDS. Results reaching critical values will be informed via phone by laboratory staff (Refer to Table CRITICAL VALUE IN HAEMATOLOGY RESULT). The ward/clinic must acknowledge the notification of the result and laboratory action is documented.

CRITICAL VALUE IN HAEMATOLOGY RESULT

ADULT					
No	Analyte	Unit	Low Critical Limit	Upper Critical Limit	Remark/Action
1.	Haemoglobin	g/dL	≤6.0	≥19.0	Clotted specimen will be rejected.
2.	Haematocrit	%	≤20	≥60	
3.	Platelet	10^9/L	≤20	≥1000	
4.	Fibrinogen	g/dL	≤1	-	
5.	Total WBC	10^9/L	≤1.0	-	
6.	INR		-	>5	
7.	PT	sec	-	>2.5 upper limit	
8.	APTT	sec	-	80 secs >2X upper reference range	
9.	Blast	%	First time or previous result no blast is reported.		
PAEDIATRIC					
No	Analyte	Unit	Low Critical Limit	Upper Critical Limit	Remark/Action
1.	Haemoglobin (Paeds)	g/dL	≤7.0	≥20.0	Clotted specimen will be rejected.
2.	Haemoglobin (Neonate)	g/dL	≤8.0	≥22.0	Clotted specimen will be rejected.
3.	Haematocrit (Paeds)	%	≤20	≥40	
4.	Haematocrit (Neonate)	%	≤25	≥70	
5.	Platelet	10^9/L	≤50	≥1000	
6.	Fibrinogen	g/dL	≤0.7	-	
7.	Total WBC	10^9/L	≤2.0	≥50	

Reference: Quick Guide List Critical Result, Ministry of Health, Malaysia 2010

7. Enquiry for Laboratory Services

   Enquiries regarding the laboratory services can be made via the following directories:

	HASA UiTM Puncak Alam Contact No./Extension	PPUiTM Sungai Buloh Contact No./Extension
Enquiry	10807	5215
Result and analytical issue	3131	5209
Medical officer and pathologist on-call	Refer to the monthly on- call roster for the contact numbers	

TRANSFUSION MEDICINE

1. Services

   The laboratory provides diagnostic tests related to the use of blood and blood products to all clinical departments in HASA, UiTM Puncak Alam and PPUiTM, Sg Buloh. Apart from diagnostic tests, the laboratory also provides blood (packed cells, typed blood, etc.) and blood products for patients. All blood and blood products are obtained from the Pusat Darah Negara (PDN). This handbook outlines the blood request and transfusion procedures, storage, adverse transfusion reaction report and haemovigilance.

   The following are the list of tests performed by the transfusion medicine unit:

   1.1. Pre- transfusion testing
   - ABO and Rh(D) Grouping
   - Group, Screen & Hold (GSH) - tests include ABO and Rh(D) grouping and antibody screening/indirect Coombs test.
   - Group & Crossmatch - tests include ABO and Rh(D) grouping, antibody screening/indirect Coombs test and the compatibility test.
   - Crossmatching/Compatibility test
   - Rh(D) Phenotyping for all Rhesus (D) negative patients

   1.2. Post- transfusion testing
   - Investigation of transfusion reaction

   1.3. Anti- Human Globulin (AHG) test/Coombs test
   - Direct Coombs Test
   - Extended Coombs Test
   - Indirect Coombs Test / Antibody Screening

   Some tests will be outsourced to the referral laboratories e.g. PDN. The PDN will perform extended antibody panels to identify new red cell antibody/antibodies following a positive antibody screening test.

   Please refer to **Table 1** and **Table 2** for a list of tests that are offered in- house and outsourced. The appendices also contain details of test preparation and request forms needed for the respective tests

2. Request forms

   2.1. All diagnostic tests shall be requested through the UniMEDS, and specimens shall arrive at the laboratory along with the UniMEDS form. Additional tests to the primary sample can be requested in a separate request form, however, the request is subjected to the analyte's stability. Please contact the laboratory before requesting an additional test.

   2.2. All outsourced test requests shall be requested through the UniMEDS. The specimen shall arrive in the laboratory with the UniMEDS form and respective forms of the outsourced laboratory.

   2.3. Prescription of blood and blood products should be made by the attending physician. The pathologist and medical officer on- call is available for consultation and advice on the appropriate type of blood products to be ordered, quantity, duration of transfusion, precautions and any other related issues if required.

   2.4. All requests for blood and blood products (packed cells, platelet, fresh frozen plasma and

cryoprecipitate) must be made using the PER- SS- BT 105 form and for HASA, an additional step of filling up the Blood Product Request Menu in the UniMEDS is required. The PER- SS- BT 105 form shall be filled up with legible handwriting, clear and complete by the attending doctor to avoid delay or rejection of blood or blood product requests.

Information for PER- SS- BT 105 form

	Information	**Remarks**
1.	Name	These three are **unique identifiers** in blood sampling/blood supply.
2.	Identity card/passport number	
3.	Registration number	
4.	Sex	If known
5.	Age	If known
6.	Blood Group	If known
7	Haemoglobin result	If known
8.	Reason for transfusion	Mandatory
9.	Time the blood/product required	Please tick the appropriate box available. Do not give vague statements e.g. "as soon as possible" or "PRN"- this would assist the laboratory staff in prioritising the blood request. The maximum time to hold cross- matched blood is within two days. However, the duration for keeping the crossmatched blood may be extended upon request. Please communicate with the laboratory staff for enquiry.
10.	Quantity of blood/product required	Number of bags or volume in mL
11.	Date and time of specimen collection	Mandatory
12.	Name of person taking and labelling the sample	Must be clearly written or stamped and signed
13.	Name of requesting doctor	Must be clearly written or stamped and signed
14.	Other relevant information	Previous history of transfusion reaction

3. Specimen Collection

Refer to **Table 1** and **Table 2** for specimen collection.

A good practice during specimen collection is important for safe transfusion as most transfusion errors are due to taking samples from a wrong patient, labelling specimens using another patient's ID and administering blood to the wrong patient. Thus, practical precautions given in this section must be followed:

3.1. **Positive** patient identification and blood sampling for compatibility testing: The process of taking and labelling specimens must be done in one process at the bedside, **one patient at one time**. The process shall be carried out by one person at the bedside. The doctor or ward staff (nurse) who performs this must ensure:

3.1.1. A patient must be correctly identified by checking the patient's wristband. If possible, ask the patient to state his/her name and IC number. The information must be checked

against the case note or pre- printed patient identification label.

3.1.2. For an unconscious patient, the identification is done through the patient's wristband and confirmed by the patient's relative.

3.1.3. A wristband with a unique number is given for an unidentified patient with an emergency casualty. The number will be used to identify the patient until essential details of the patient are available.

3.2. Labelling of specimen

3.2.1. The person who withdraws the blood and the person who labels the specimen **must** be the same individual. The person must acknowledge his/her duty by signing the respective section in PER- SS- BT 105 form.

3.2.2. The specimen must be labeled clearly and accurately at the patient's bedside immediately after blood taking.

3.2.3. The label must contain three patient identifiers: name, RN and IC number.

3.2.4. The label should be preferably handwritten. However, pre- printed labels are acceptable.

3.2.5. The doctor's name, signature and stamp on the request form will indicate that the sample has been accurately identified.

3.2.6. **NEVER** label specimens from two or more patients at the same time.

3.3. Specimen requirement for elective surgery or correction of symptomatic anaemia.

3.3.1. The specimen should be sent to the laboratory at least 24 hours before the blood is required.

3.3.2. GSH work- up is recommended during pre-operation assessment.

3.4. Specimens for patients with known RhD negative or red cell antibody (antibody- positive cases), must be sent to the laboratory **at least ONE WEEK** before the procedure. Ample time is needed for PDN to provide the appropriate blood and blood products such as platelet, fresh frozen plasma and cryoprecipitate (where applicable).

3.4.1. A new patient will require a fresh blood sample and a request form.

3.4.2. Each request for blood product requires a separate request form.

3.4.3. A new patient's sample is required for every new admission if blood products were to be requested.

4. Special Collection Procedures

4.1. The GXM for an infant less than 4 months of age **MUST** be accompanied by the mother's blood sample. Both samples **MUST** be distinctively labelled and sent together using one request form.

4.2. Request for antibody identification must be done during office hours. Please refer to **Table 1** for the collection procedure. For urgent cases, please consult the medical officer or pathologist on- call.

4.3. Certain outsourced tests may require special requirements procedures e.g. Anti- A and Anti- B titre and HLA Typing. Refer to **Table 2** for further instructions.

5. Receipt of Specimen

   All specimens for diagnostic tests and tests that are related to the use of blood and blood products will be received either by a porter or pneumatic tube. A timely arrival of correct specimens in the right condition is vital as failure to adhere to these requirements may cause a delay in the release of blood and blood products. Refer to **Table 1** and **Table 2** for details.

6. Rejection of Specimen

   Blood specimens sent for compatibility testing shall meet the suggested minimum requirement (please refer to section 3.0). An exception is given only in a life- threatening situation after consulting and obtaining approval from the medical officer/pathologist- on- call. The reasons for specimen rejection in haematology & transfusion medicine are similar.

   A specimen can be rejected due to the following reasons:

   6.1. Inadequate labelling. There should be three patient identifiers e.g. name, IC number and RN. The label should be preferably handwritten. However, pre-printed labels are acceptable.

   6.2. The PER- SS- BT 105 form is inadequately filled up. The form shall also contain three patient's identifiers and other important information (Refer to Information for PER- SS- BT 105 form).

   6.3. Any discrepancy between patient's label and request form.

7. Reporting of Results

   For the GXM request, a copy of the form will be handed to the ward personnel who comes to collect the blood or blood product for transfusion. Another copy is maintained in the transfusion laboratory. For PPUiTM Sungai Buloh, all GXM and GSH forms will be scanned and kept in patient's respective file in UniMEDS.

8. Issuing, Storage and Transport of Blood and Blood Products to the Ward

   8.1. Issuing

   Blood and blood product will be ready at the time they are required. However, approximately about half an hour is needed to thaw the blood products (FFP and cryoprecipitate) and they will not be available immediately. The shelf life of thawed blood products is 24 hours. If the thawed product were not used within the stipulated time, it shall be discarded.

   8.2. Collection

   Upon collection of blood/blood products, at least two personnel (SO/MLT and staff nurse or PPK) are involved in checking and ensuring the information on the request form and transfusion tag are matched. Information that needs to be checked are:

   - Blood/blood product number
   - Type of blood/blood product
   - Blood group (ABO & Rh(D)
   - Name of the patient receiving the blood/blood product
   - I/C number of the patient
   - RN of the patient
   - The expiry date of the blood/blood product

   The patient's label and name of ward personnel who collect the blood/blood product shall be recorded by the laboratory staff in the blood collection book.

8.3. Storage and Transport

Blood and blood product should be kept in the laboratory until it is collected and transfused. Upon collection, the ward staff shall transport the issued blood to the ward or return the blood to the laboratory without delay. Transportation shall be carried out at an appropriate temperature. The issued blood/blood product must be transfused without delay.

However, in the event where the delay is inevitable, the ward shall keep the blood at the appropriate temperature and condition, or the ward shall return the blood to the laboratory as soon as possible. If the blood/blood products are not kept at the appropriate temperature, the quality of blood/blood products will be affected and shall be discarded.

Any movement of issued blood and blood products to other facilities shall be informed to the laboratory.

9. Administration of Blood and Blood Products

9.1. Administration of blood and blood products

9.1.1. Issued blood shall be transfused without delay. Packed cells and whole blood should be transfused within 30 minutes of removal from the refrigerator and the process of each unit shall not exceed 4 hours.

9.1.2. Platelet should be transfused as soon as it is received from the laboratory and the transfusion process should not exceed more than 30 minutes.

9.1.3. FFP and cryoprecipitate should be transfused as soon as it is received from the laboratory and the transfusion process should be carried out at a rate that the patient can tolerate.

9.2. Discontinued transfusion

9.2.1. Any blood/blood product remaining from a discontinued transfusion **SHALL NOT** be used.

9.2.2. The remainder of blood shall be clearly labeled as **USED BLOOD** and returned to the transfusion laboratory immediately.

9.2.3. Details and reasons for discontinuation shall be documented in the patient's case note and a memo should be sent to the transfusion laboratory.

9.3. Return of used blood bags

9.3.1. For PPUiTM - The ward shall be responsible to return used blood bags and transfusion tag which has been filled up to the transfusion laboratory within 48 hours.

9.3.2. For HASA - The ward staff is required to fill up the transfusion log menu in UniMEDS within 48 hours and used blood bags shall no longer be returned to transfusion laboratory.

9.4. Return of unused blood products

9.4.1. The ward shall return all unused blood products immediately to the transfusion laboratory. The unused blood product that is returned to the blood bank shall be discarded unless it is kept at an appropriate temperature.

9.4.2. The ward shall inform the laboratory if any of the unused blood product returned to the laboratory has not complied with the storage or transportation temperature.

10. Group, Screen and Hold (GSH) Protocol
    10.1. A Group, Screen and Hold (GSH) protocol consists of (ABO) and Rh(D) grouping and an antibody screening on the patient's plasma. The laboratory has the GSH protocol that adhered to a locally established Maximum Surgical Blood Ordering Schedule (MSBOS) where appropriate.
    10.2. The conversion of GSH to GXM can be made within three (3) days of sample collection. After three (3) days, a new blood sample is needed for crossmatching.
    10.3. If the likelihood of blood usage is minimal, a GSH protocol is recommended in the first place. If the blood is required urgently, an emergency crossmatched blood should be available for issue after 30 minutes of the request. However, if blood requirement is not urgent, the crossmatched blood will be ready within four (4) hours or at the time indicated by the requestor.

11. Group & Crossmatch (GXM) Protocol
    11.1. Group & Crossmatch (GXM) consists of (ABO) and Rh(D) grouping, antibody screening of patient's plasma and crossmatching patient and donor unit for compatibility.
    11.2. GXM shall be requested for cases with a high possibility for transfusion at the time it is requested.
    11.3. In the event of incompatible crossmatch and positive antibody cases which are not able to be resolved in-house, a new specimen will be requested and sent to PDN for further investigations e.g. for antibody identification and supply of compatible blood.
    11.4. The clinician is advised to communicate with the medical officer or pathologist on- call regarding the urgency of the transfusion requirement.

12. Emergency Request
    12.1. An emergency crossmatch only involves the first phase of crossmatching procedure (immediate spin) with a specific blood group. This process takes about 15 minutes, and blood can be supplied within 30 minutes.
    12.2. The following second and third phases will be continued, and if there is any incompatibility detected during these phases, the staff will immediately contact the ward or the requesting doctor for discontinuation of the transfusion.
    12.3. Releasing blood for an emergency requires a signed statement of the requesting doctor (including IC number) indicating that the clinical situation is urgent to issue blood.
    12.4. The emergency- crossmatch (and release of blood) can only be performed in a life-threatening situation and requires careful clinical judgment as the test for compatibility has not been completed at the time of issue.
    12.5. Safe- O blood is also available for use should the need arises. However, the timely release of safe-O blood requires communication and coordination with the medical officer or pathologist-on-call. The attending specialist must directly consult the medical officer or pathologist-on-call. A **pre-transfusion sample** and **complete request form** are **MANDATORY**. A full crossmatch procedure will be performed after the release of safe-O blood. Any incompatibility during the procedure will be informed to the physician and transfusion must be stopped immediately.

13. List of tests and their estimated turnaround time (TAT)

Tests		Estimated turnaround time (TAT)
Urgent	Full GXM (Urgent)	1 hour
	GSH convert to GXM (Urgent)	1 hour
	Emergency crossmatch	30 minutes
	Safe O	15 minutes
Non- urgent	Full GXM (Non- urgent)	4 hours
	GSH convert to GXM (Non- urgent)	4 hours
	GSH	4 hours
	ABO and RhD Grouping	4 hours

* For URGENT Request, please inform medical officer/pathologist on duty and transfusion laboratory.

14. Maximum Surgical Blood Ordering Schedule (MSBOS)

The MSBOS is a table of elective surgical procedures which lists the number of units of red cells routinely pre- operatively crossmatched and then transfused for each procedure. For procedures in which blood transfusion is not likely to be needed, GSH should be ordered.

A GXM should be requested for procedures that would likely require a blood transfusion (refer to the current MSBOS which is updated annually).

15. Adverse Transfusion Event

Investigation of a transfusion reaction is performed when there is an alleged reaction after transfusion of blood or blood product. If an adverse transfusion reaction is suspected, the transfusion shall be stopped immediately. A doctor shall immediately assess and stabilise the patient. Further management depends on the type and severity of the reaction.

15.1. For a suspected case of acute transfusion reaction (before 24 hours), the following samples for the respective tests are taken:

Test name	**Specimen type**	**Container**	**Volume**	**Remark**
* Investigation of transfusion reaction	Whole blood	EDTA tube	4ml	Compulsory to send sample for investigation of transfusion reaction
* Renal profile	Serum	Plain tube (with gel)	4ml	Other haemolytic marker(s) may be needed when necessary
* Bilirubin	Serum			
* Haemoglobin	Urine	Universal container	10ml	Sample is only taken when it is indicated.
* Bacterial culture	Remainder blood from transfused blood bag	Blood culture bottle	5 - 10 ml for adult / 1 - 2 ml for paediatric	Sample is taken when it is indicated (raise in body temperature >37^{o}C).
	Whole blood from patient	Blood culture bottle	5 - 10 ml for adult /	

			1 - 2 ml for paediatric	

* Tests are ordered separately in UniMEDS.

15.2. For a suspected case of delayed transfusion reaction, a second sample is recommended after 24 hours. The following samples for the respective tests are taken:

Test name	Specimen type	Container	Volume	Remark
* Investigation of transfusion reaction	Whole blood	EDTA tube	4ml	Compulsory to send sample for investigation of transfusion reaction
		Plain tube (without gel)	8ml	Compulsory to send sample for suspected haemolytic transfusion reaction due to development of red cells antibody.
* Renal profile	Serum	Plain tube (with gel)	4ml	Another haemolytic marker may be needed when necessary
* Bilirubin	Serum			
* Haemoglobin	Urine	Universal container	10ml	Sample is only taken when it is indicated.

* Tests are ordered separately in UniMEDs

15.3. The doctor in charge shall withdraw the required blood samples and complete the Request Form for Transfusion Reaction Investigation (Blood and Blood Products) (refer to **Appendix 7**) and include INVESTIGATION OF TRANSFUSION REACTION as part of clinical history in other request forms.

16. Enquiry for Laboratory Services

Any enquiries regarding the laboratory services please contact the following phone numbers:

	HASA UiTM Puncak Alam Contact No./Extension	PPUiTM Sungai Buloh Contact No./Extension
Enquiry	10807	5215
Blood and blood product request	3135	5209
Medical officer and pathologist on- call	Refer to the monthly on- call roster for the contact numbers	

Table 1: LIST OF IN-HOUSE TESTS FOR HAEMATOLOGY AND TRANSFUSION MEDICINE

* Refer to Clinical Indications and Reference Ranges: Appendix 4 and 5.

NO	TEST	SPECIMEN TYPE	SPECIMEN CONTAINER	VOLUME REQUIRED	INSTRUCTION	TAT
LIST OF SINGLE TESTS FOR HAEMATOLOGY SECTION						
1.	Complete Blood Count (CBC)	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent ED - 45 minutes Urgent in- patient - 1 hour Routine - 5 days
2.	Complete Blood Count + Differential Count (CBC+Diff)	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent ED - 45 minutes Urgent in- patient - 1 hour Routine - 5 days
3.	Reticulocytes	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent ED - 45 minutes Urgent in- patient - 1 hour Routine - 5 days
4.	Erythrocyte Sedimentation Rate	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent - 90 minutes Routine - 5 days
5.	Prothrombin Time (PT)/International Normalised Ratio (INR)	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent - 90 minutes Routine - 5 days
6.	Activated Partial Thromboplastin Time (APTT)	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent - 90 minutes Routine - 5 days
7.	Fibrinogen	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent - 90 minutes Routine - 5 days
8.	Thrombin Time (TT)	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent - 90 minutes Routine - 5 days
9.	Quantitative D- Dimer	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible.	Urgent - 90 minutes

NO	TEST	SPECIMEN TYPE	SPECIMEN CONTAINER	VOLUME REQUIRED	INSTRUCTION	TAT
					Sample integrity is within 4 hours.	Routine - 5 days
10.	G6PD	Whole Blood/ Cord Blood	EDTA Tube	1- 2 mL	To reach the laboratory as soon as possible.	24 hours
LIST OF SINGLE TESTS FOR TRANSFUSION MEDICINE SECTION						
11.	ABO and Rh(D) Grouping	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	6 hours
12.	Direct Coombs Test	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	4 hours
13.	Indirect Coombs Test/ Antibody Screening	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	4 hours
14.	Rh(D) Phenotyping	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	8 hours
LIST OF PROFILE TESTS FOR HAEMATOLOGY SECTION						
15	Coagulation Screen					
	Prothrombin Time (PT)	Plasma	Citrate tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent - 90 minutes Routine - 5 days
	INR					
	Activated Partial Thromboplastin Time (APTT)					
16.	Mixing Test for APTT					
	Activated Partial Thrombo-plastin Time (APTT) for patient	Plasma	Citrate tube	2 mL	Must be clinically indicated and another anticoagulant use has been ruled out.	24 hours
	Activated Partial Thrombo-plastin Time (APTT) for Normal					

NO	TEST	SPECIMEN TYPE	SPECIMEN CONTAINER	VOLUME REQUIRED	INSTRUCTION	TAT
	Pool					
	Activated Partial Thromboplastin Time					
	(APTT) for Immediate Mixing					
	Activated Partial Thromboplastin Time (APTT) for 2- hour Incubation					
17.	Mixing Test for PT					
	Prothrombin Time (PT) for patient	Plasma	Citrate tube	2 mL	Must be clinically indicated and other anticoagulant use has been ruled out.	24 hours
	Prothrombin Time (PT) for Normal pool					
	Prothrombin Time (PT) for Immediate Mixing					
	Prothrombin Time (PT) for 2-hour Incubation					
18	DIVC					
	Prothrombin Time (PT)	Plasma	Citrate tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Urgent - 90 minutes Routine - 5 days
	INR					
	Activated Partial Thromboplastin Time (APTT)					
	Fibrinogen					
	D- Dimer					

NO	TEST	SPECIMEN TYPE	SPECIMEN CONTAINER	VOLUME REQUIRED	INSTRUCTION	TAT
19.	Peripheral Blood Film					
	Complete Blood Count + Differential Count Peripheral Blood Film Comment	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	Routine - 5 days Communicate with pathologist for URGENT request
20.	Bone marrow Examination					
	Complete Blood Count + Differential Count Peripheral Blood Film Comment	Whole Blood	EDTA Tube	2 - 3mL	By appointment only and discussion with pathologist- on- call.	14 days Communicate with pathologist for URGENT request
	Bone marrow staining	Bone marrow aspiration and trephine aspirate	EDTA tube, glass slides, a container with 10% formalin as a fixative.	5 - 6 ml of BMA aspirate. 1 - 2 cm of trephine tissue.		
21.	Hb Analysis					
	Complete Blood Count + Differential Count Peripheral Blood Film (PBF) Comment	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity at room temperature is within 4 hours.	30 working days
	Hb Analysis (HPLC) Hb Analysis (CE)					

NO	TEST	SPECIMEN TYPE	SPECIMEN CONTAINER	VOLUME REQUIRED	INSTRUCTION	TAT
LIST OF PROFILE TESTS FOR TRANSFUSION MEDICINE SECTION						
22.	Group, Screen & Hold (GSH)					
	ABO and Rh(D) Grouping	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	4 hours
	Indirect Coombs Test/ Antibody screening					
23.	Group & Crossmatch (GXM)					
	ABO and Rh(D) Grouping	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.	URGENT: Full GXM - 1 hour GSH Convert to GXM - 1 hr Emergency crossmatch - 30 mins Safe 'O' - 15 mins NON- URGENT: Full GXM - 4 hours GSH Convert to GXM - 4 hrs
	Indirect Coombs Test/ Antibody screening					
	Crossmatch (depends on number of units being requested)					
24.	Investigation of Transfusion Reaction					
	ABO and Rh(D) Grouping (Post transfusion sample)	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours. To fill up the request form for Transfusion Reaction Investigation (Blood and Blood Products). Other related tests depending on the clinician's judgement i.e., haemoglobin urine test, PBF, liver function test and blood culture. The test must be requested in	5 days
	Indirect Coombs Test / Antibody screening (Post transfusion sample)					
	Crossmatch (post-transfusion sample)					

NO	TEST	SPECIMEN TYPE	SPECIMEN CONTAINER	VOLUME REQUIRED	INSTRUCTION	TAT
	Indirect Coombs Test/ Antibody screening (Post transfusion sample)				separate forms.	
	Crossmatch (post-transfusion sample)					

Table 2: LIST OF OUTSOURCED TESTS FOR HAEMATOLOGY & TRANSFUSION MEDICINE

(Refer to Clinical Indications and Reference Ranges: Appendix 4 and 5)

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
1.	ALL screen (E2A- PBX1, ETV6- RUNX1, MLL-AF4, BCR- ABL e1a2, SIL- TAL1)	Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14
2.	AML screen (RUNX1-RUNX1T1, CBFB-MYH11)	Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14
3.	BCR- ABL1 quantitation (e13a2, e14a2)	Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	21
4.	CD4/CD8	Whole Blood	EDTA Tube	3 mL	PERPAT.301	By appointment only. Sample can only be sent on Tuesday and Friday morning ONLY.	UMMC	7 working days, verbal report - 24 hours
5.	DNA Analysis for Alpha Thalassaemia	Whole Blood	EDTA tube	3 mL	DNA Analysis for Thalassemia Syndrome (IMR/CaRC/H AEM/22/2203/ 03(1) REQForm	Hb Analysis must be done before requesting. The test must be requested together with CBC+DIFF. This test strictly requires written informed consent from the patient/guardian.	HKL	90

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
6.	DNA Analysis for Beta Thalassaemia	Whole Blood	EDTA tube	3 mL	Borang Permohonan Ujian Molekular Genetik (PPUKM)	Hb Analysis must be done before requesting. The test must be requested together with CBC+DIFF. This test strictly requires written informed consent from the patient/guardian.	PPUKM	21
7.	DNA analysis Thalassaemia - common mutation (Alpha & Beta)	Whole Blood	EDTA tube	3 mL	IMR/CaRC/HAEM/22/2203/03(1)/REQForm - DNA Analysis for Thalassaemia Syndromes	Hb Analysis must be done before requesting. The test must be requested together with CBC+DIFF. This test strictly requires written informed consent from the patient/guardian.	IMR	30
8.	DNA analysis thalassaemia - uncommon mutation (IMR)	Whole Blood	EDTA tube	3 mL	IMR/CaRC/HAEM/22/2203/03(1)/REQForm - DNA Analysis for Thalassaemia Syndromes	Hb Analysis must be done before requesting. The test must be requested together with CBC+DIFF. This test strictly requires written informed consent from the patient/guardian.	IMR	30
9.	DNA analysis Hb Variant (IMR)	Whole Blood	EDTA tube	3 mL	IMR/CaRC/HAEM/22/2203/03(1)/REQForm - DNA Analysis for Thalassaemia Syndromes	Hb Analysis must be done before requesting. The test must be requested together with CBC+DIFF. This test strictly requires written informed consent from the patient/guardian.	IMR	30

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
10.	Erythropoietin	Whole Blood	Plain tube (without gel)	3 mL	PERPAT.301	NA	UMMC	14
11.	Factor VIII Assay (Haemophilia A)	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PERPAT.301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
12.	Factor VIII Inhibitor	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PERPAT.301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
13.	Factor IX Assay (Haemophilia B)	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PERPAT.301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
14.	Factor XIII Assay (Screen)	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PERPAT.301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
15.	Factor XIII	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PERPAT.301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	HOSPITAL AMPANG	Urgent - 1 day Routine - 14 days
16.	FLTT3- ITD/D835 mutation	Bone marrow/ Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form,	By appointment. To request CBC+DIFF separately.	UMMC	30

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
					UMMC form			
17.	JAK2 V617F	Bone marrow/ Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14
18.	JAK2 ex12	Bone marrow/ Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	60
19.	PML- RARA detection (bcr1, bcr2, bcr3)	Whole Blood	EDTA Tube	4 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	30
20.	Lupus Anti- coagulant	Plasma	Citrate tube	6 mL (in 3 citrate bottles)	PERPAT.301	Requests shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	14
21.	von Willebrand Study	Plasma	Citrate tube	6 mL (in 3 citrate bottles)	PERPAT.301	Requests shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	14
22.	Antithrombin Estimation	Plasma	CITRATE	6 mL (in 3 citrate bottles)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected by PDN. By appointment from Monday to Thursday only.	UMMC	14
23.	Hb Analysis	Whole blood	EDTA	3 mL	PERPAT.301	Send to laboratory within 4 hours (preferably on Monday to Tuesday	HKL	30

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
						only, sample is run by batch).		
24.	Factor II Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
25.	Factor II Inhibitor	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
26.	Factor V Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
27.	Factor V Inhibitor	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified	UMMC	7

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
						prior to blood collection.		
28.	Factor VII Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
29.	Factor VII Inhibitor	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
30.	Factor IX Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
31.	Factor IX Inhibitor	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified	UMMC	7

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
						prior to blood collection.		
32.	Factor X Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
33.	Factor XI Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
34.	Factor XI Inhibitor	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
35.	Factor XII Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified	UMMC	7

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
						prior to blood collection.		
36.	Factor XII Inhibitor	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
37.	Factor XIII Screen	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
38.	Haemophilia Screen (APTT, F8, F9)	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	7
39.	Factor Xa Assay	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified	HOSPITAL AMPANG	Urgent - 1 day Routine - 7 days

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
						prior to blood collection.		
40.	G6PD Enzyme Level	Whole blood	EDTA	3 mL	PERPAT.301	Strictly by appointment and case shall be discussed with pathologist-on- call. Sample shall reach outsourced lab by 12.00 PM.	PREMIER	5
41.	Lymphocyte Subset - Full (B & T Cell)	Whole blood	EDTA	3 mL	PERPAT.301	Strictly by appointment and must be clinically indicated. Case shall be discussed with pathologist- on- call. Specimen shall be sent on Tuesday, Wednesday, and Friday morning only.	UMMC	14
42.	NPM1 mutation	Whole blood	EDTA	3 mL	PPUM - Molecular and Genetic Analysis Laboratory	By appointment. To request CBC+DIFF separately.	UMMC	14
43.	Osmotic Fragility	Whole blood	HEPBTL (Special bottle from UMMC)	3 bottles	PERPAT.301	By appointment only. To request CBC+DIFF separately. To request for special heparinised bottle (20ml). Post transfusion sample is strictly prohibited.	UMMC	7
44.	Protein C	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected.	UMMC	14
45.	Protein S	Plasma	CITRATE	6 mL (in 3 Citrate	PERPAT.301	Must be clinically relevant prior to request otherwise request will be	UMMC	14

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
				tubes)		rejected.		
46.	Thrombophilia Profile (Protein C, Protein S & Antithrombin)	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. Request shall be discussed with pathologist- on- call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	14
47.	Activated Protein C Resistance	Plasma	CITRATE	6 mL (in 3 Citrate tubes)	PERPAT.301	Must be clinically relevant prior to request otherwise request will be rejected. By appointment from Monday to Thursday only.	UMMC	14
48.	Platelet Function Test	Whole blood	1 EDTA + 5 CITRATE	10 mL	PERPAT.301	Strictly by appointment. Discussion between pathologists. Bleeding Test must be performed first.	UMMC	5
49.	Anti- PF4	Whole blood	PLAIN	6 mL	Hospital Ampang Special Haematology Requisition Form	Strictly ordered upon discussion between haematopathologist.	HOSPITAL AMPANG	42 - 56
50.	HLAB1502	Whole blood	EDTA	3 mL	PERPAT.301	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only.	UMMC	14
51.	Flow Cytometry (Immuno	Bone marrow	EDTA	6 mL	PERPAT.301	Strictly by appointment and case shall be discussed with pathologist-	UMMC	5

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
	phenotyping) - BONE MARROW					on- call. The specimen must reach the outsourced lab by 11:00 AM; therefore, early collection is required		
52.	Flow Cytometry (Immuno phenotyping) - WHOLE BLOOD	Whole blood	EDTA	6 mL	PERPAT.301	Strictly by appointment and case shall be discussed with pathologist-on- call. The specimen must reach the outsourced lab by 11:00 AM; therefore, early collection is required	UMMC	5
53.	Flow Cytometry (Immuno phenotyping) - CSF	CSF	EDTA	6 mL	PERPAT.301	Strictly by appointment and case shall be discussed with pathologist-on- call. The specimen must reach the outsourced lab by 11:00 AM; therefore, early collection is required	UMMC	5
54.	Cryoglobulin	Whole blood	PLAIN (RED)	10 mL	PERPAT.301	Strictly by appointment and case shall be discussed with pathologist-on- call. Appointment only on Monday to Wednesday. Patient needs to fast 6 hours before blood taking, and sample requires special preparation (sample must clot at 37°C).	UMMC	7

LIST OF TESTS FOR HAEMATOLOGY SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
55.	PNH Studies	Whole blood	EDTA	6 mL	PERPAT.301	Only fresh sample is accepted. Strictly by appointment and case shall be discussed between haematopathologist of HASA & HUKM. Samples should reach HUKM before 10am.	HUKM	5
56.	Acute Myeloid Leukemia NGS	Whole blood	EDTA	21 mL	Request Form for AGTC	Order must be done through clinical haematologist only. Laboratory shall be informed prior to sample delivery. Request CBC DIFF on the same day.	AGTC	14
57.	Acute Lymphoblastic Leukemia NGS	Whole blood	EDTA	21 mL	Request Form for AGTC	Order must be done through clinical haematologist only. Laboratory shall be informed prior to sample delivery. Request CBC DIFF on the same day.	AGTC	14
58.	Myelodysplastic Syndromes NGS	Whole blood	EDTA	21 mL	Request Form for AGTC	Order must be done through clinical haematologist only. Laboratory shall be informed prior to sample delivery. Request CBC DIFF on the same day.	AGTC	14
59.	HLA 5 LOCI High Resolution	Whole blood	EDTA	6 mL		Order must be done through clinical haematologist only. Lab shall be informed prior to sample delivery. Request CBC DIFF on the same day	GEMSUM	14

LIST OF TESTS FOR TRANSFUSION MEDICINE SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
1.	Anti- A and Anti- B titre (PPUM)	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN- Immunohematology Test Request form PDN/IH/QP- 05/01 (filled by lab)	Strictly by appointment only.	UMMC	The official report is ready in 14 working days.
2.	Anti- A and Anti- B titre	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PDN- Immunohematology Test Request form PDN/IH/QP- 05/01 (filled by lab)	Strictly by appointment only.	PDN	The official report is ready in 14 working days.
3.	Antibody Identification	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN- Immunohematology Test Request form PDN/IH/QP- 05/01 (filled by lab)	Only performed when the patient has a positive antibody. Urgent request is entertained for a patient that requires transfusion. Antibody identification is also sent for the patient who is incidentally found to be positive antibody screening for GSH request. The request is initiated by the lab, and it is important to identify the antibody for a future emergency.	PDN	The official report is ready in 14 working days. Complex case requires more days. Packed cells requested will be ready once the investigation is completed.

LIST OF TESTS FOR TRANSFUSION MEDICINE SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
4.	Antibody Identification (Extended)	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN-Immunohematology Test Request form PDN/IH/QP- 05/01 (filled by lab)	Only performed when the patient has a positive antibody. Urgent request is entertained for a patient that requires transfusion. Antibody identification is also sent for the patient who is incidentally found to be positive antibody screening for GSH request. The request is initiated by the lab, and it is important to identify the antibody for a future emergency.	PDN	The official report is ready in 14 working days. Complex case requires more days. Packed cells requested will be ready once the investigation is completed.
5.	Anti- D titre	Serum & Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN-Immunohematology Test Request form PDN/IH/QP- 05/01 (filled by lab)	Strictly by appointment only.	PDN	The official report is ready in 14 working days.
6.	RBC Phenotype	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN-Immunohematology Test Request form PDN/IH/QP- 05/01	Strictly by appointment only.	PDN	The official report is ready in 14 working days.

LIST OF TESTS FOR TRANSFUSION MEDICINE SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
					(filled by lab)			
7.	Cold Agglutinin Titre	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN-Immunohematology Test Request form PDN/IH/QP- 05/01 (filled by lab)	Strictly by appointment only.	PDN	The official report is ready in14 working days.
8.	Platelet Antibody (Adult)	Serum & Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & Platelet Immunology Test Request (PDN) (filled up by lab)	Strictly by appointment only.	PDN	The official report is ready in 14 working days.
9.	Platelet Antibody (Neonate)	Serum & Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & Platelet Immunology Test Request (PDN) (filled up by lab)	Strictly by appointment only.	PDN	The official report is ready in 14 working days.
10.	RBC Genotype	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN-Immunohematology Test Request form	Strictly by appointment only.	PDN	The official report is ready in 14 working days.

LIST OF TESTS FOR TRANSFUSION MEDICINE SECTION								
NO	**TEST**	**SPECIMEN TYPE**	**SPECIMEN CONTAINER**	**VOLUME REQUIRED**	**FORM**	**INSTRUCTION**	**DESTINATION**	**TAT (WORKING DAYS)**
					PDN/IH/QP- 05/01 (filled up by lab)			
7.	Cold Agglutinin Titre	Whole Blood	EDTA Tube & Plain Tube (Red)	6 mL each	PER- SS- BT 105 (GSH/GXM Form) & PDN- Immunohematology Test Request form PDN/IH/QP- 05/01 (filled by lab)	Strictly by appointment only.	PDN	The official report is ready in14 working days.

* For updated tests list and procedures, refer to UniMEDS - Healthcare Information System (CDL > Report > List of Test). Tests are added based on request by clinicians.

MEDICAL MICROBIOLOGY & PARASITOLOGY

1. INTRODUCTION

   Medical microbiology plays a major role in the infectious disease discipline and knowledge in this field is essential to the clinical management of infections. Medical Microbiology & Parasitology specialty is particularly involved in the detection and identification of the causative organism, management of the patient including screening, treatment monitoring and research development.

2. SERVICES

   The microbiology unit provides the following services:

   - Diagnostic and research services comprise bacteriology, virology, mycology, immunology, and parasitology.
   - Participation in hospital infection control activities related to antibiotic stewardship and surveillance, as well as control and prevention of hospital-acquired infections.

3. REQUEST

   - All Microbiology and Parasitology tests should be requested through the UniMEDS, and hardcopy laboratory forms shall be used in the event of off-line.
   - Outsource tests
     - A communication shall take place between the requestor and the laboratory before transportation and sending out the specimen.
     - Request for urgent test MUST involve communication between the requesting clinician and the Clinical Microbiologist on duty.

4. SPECIAL/PROCEDURES OF SPECIMEN COLLECTION & TRANSPORT

   - Blood
     - All blood culture & sensitivity (C&S) specimens should be collected before antibiotic administration.
     - Skin decontamination with 70% alcohol followed by povidone- iodine should be carried out prior to venipuncture.
     - In the event delay is inevitable, keep the bottle of C&S at room temperature.
   - Cerebrospinal Fluid (CSF)
     - The CSF specimens should be collected prior to antimicrobial therapy.
     - Place CSF into sterile leak- proof container.
     - Collect a sufficient volume of fluid. Suggested volumes are:
       - 2 ml for bacterial culture
       - 2 ml for fungal culture
       - 2 ml for mycobacterial culture
     - Transport CSF to the laboratory immediately.

       *NB: **DO NOT** refrigerate CSF unless viral studies are requested.*
   - Sputum for acid fast bacilli (AFB)
     - Three (3) consecutives morning sputum should be collected as the specimen of choice.
     - Sputum is expectorated directly into a sterile container.

       NB: Specimen that is grossly salivary is unsatisfactory/unsuitable for examination and

will be rejected

- Urine
  - The first morning voided urine should be collected as the specimen of choice. If this is not possible, the urine should be allowed to incubate in the bladder for a minimum of 2 hours before collection. This is an important point to remember for patients with indwelling catheters.
  - Midstream urine (MSU): The periurethral area (tip of penis in male, labial folds and vulva in female) is cleansed well with water. The first portion of the voiding urine is not collected. At least 5ml of the midstream portion of the early morning is voided directly into a sterile container.
  - Catheterised urine: These specimens are obtained by aspirating urine from the proximal lumen of the catheter with a syringe (DO NOT collect specimen from the urine bag).
  - Suprapubic aspiration: Direct the needle into the urinary bladder just above the symphysis pubis after the suprapubic skin decontamination done. Aspirate the urine with a syringe and transfer to a sterile container
  - Immediate despatch (1 to 2 hours) is expected. If this is not possible, specimen should be kept in the refrigerator (no longer than 18 hours). Therefore, it is important that the time of specimen collection is marked on the patient's request.

- Detection of other organisms causing e.g. diphteria, pertussis, peptic ulcer due to H. pylori etc.
  - Swab from nose, throat or wound for C&S: Transport the swab using Amies or Stuart medium for suspected cases of C. diphtheriae or C. ulcerans infection.
  - Tissue from pseudo- membrane for C&S: The specimen should be placed in the container containing sterile saline and NOT formalin. The specimen should be sent immediately to the laboratory without any delay. If delay is inevitable the specimen should be kept in the refrigerator.
  - Tissue biopsy for H. pylori detection: The tissue is a specimen of choice as patients may not receive antibiotics or anti secretory drugs especially proton pump inhibitors (PPI).
    NB: Pre- treatment of the tissue biopsy with saline may improve the recovery of H.pylori.
    - Detection of Mycobacterium tuberculosis Complex (MTBC)/Non - tuberculous Mycobaterium (NTM)
    - TB culture & TB PCR: fresh specimen in sterile container with correct labelling should be sent immediately to the laboratory. Specimen received after 48 hours of collection will be rejected.
    - Other molecular test (e.g. respiratory sample PCR, HIV PCR, Hep C PCR, HBV DNA, etc.: appointment is encouraged due to requirement of special preparation. Please contact the laboratory for further assistance.

      *NB**: All specimen for C&S: Specimen should be placed in a proper container with correct labelling and **immediately** reached laboratory **within 2 hours** of collection. In the event of transportation delay, specimen should be kept in **refrigerator** (**except for CSF**).*

5. RECEIPT OF SPECIMEN

   All specimens will be received at the Specimen Reception Counter, CDL HASA.

6. REPORTING OF RESULTS

   - A preliminary report of positive sterile body fluids results will be informed to clinic/ward via phone by Clinical Microbiologist on duty/Medical Officer/Science Officer/MLT and documented.
   - Results will be validated by Clinical Microbiologist/Medical officer/Science Officer and the report will be issued via UniMEDS.
   - Critical results as listed below will be informed via phone to the requestor by the laboratory staff and documented.
     - A positive result of Gram stain from sterile clinical specimen.
     - A positive blood film for malarial parasite (BFMP).
     - Infectious screening (HbsAg, anti- HBs, anti- HCV and HIV combo) from sharp/needle stick injury (NSI) and urgent haemodialysis cases.
     - A positive acid- fast bacilli (AFB) positive.

7. SERVICE AFTER OFFICE HOURS AND DURING PUBLIC HOLIDAYS

   - Specimens sent for bacteriology, mycology, virology etc. and will be processed as usual on weekends and public holidays from 8.00 am to 5.00 pm.
   - There is one (1) MLT working after office hour to process urgent (e.g.: NSI) specimen.

8. SUPPLIES

   The supply of containers relevant to medical microbiology &parasitology examination can be obtained from the central store of Clinical Training Centre, PPUiTM Sg. Buloh and HASA respectively.

9. RESEARCH

   The MMP Unit is supporting the research work and activities by facilitating research from both internal and external research.

10. ENQUIRY OF LABORATORY SERVICES

    Enquiries regarding the laboratory services can be made at 03- 3396 3128/3129.

LIST OF TESTS
IN-HOUSE & OUTSOURCED TESTS IN MEDICAL MICROBIOLOGY & PARASITOLOGY

BACTERIOLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	AFB stain	Sputum & Other clinical specimens	3ml	Sterile	Collect 3 consecutive early mornings (fresh) sputum (NOT SALIVA). Send within 2-4 hours.	CDL	24 hours
2.	TB Culture & Sensitivity	All specimens	3ml	Sterile	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	42 days
3.	*Burkholderia pseudomallei* antibody (Meliodosis)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	14 working days
4.	*Chlamydophila pneumoniae/ C.trachomatis/ C.psittaci* antibody	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	INNOQUEST	10 working days
5.	*Clostridium difficile* Combo Test (Gdh+ Toxin A+B)	Stool (fresh)	Not applicable	Stool container	Send to the lab immediately.	CDL	24 hours
6.	Culture and Sensitivity	Blood	5ml-10ml (adult) 2-3 ml (paediatric)	Blood culture (aerobic, anaerobic, Myco F lytic) bottle Blood culture (paediatric) bottle	Inoculate blood collected with aseptic technique. If the sample is not sent immediately, please do not refrigerate it. Please leave it at room temperature.	CDL	5 Days for negative blood culture 2-5 days for positive blood culture 42 days for MTB

BACTERIOLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
7.	Culture and Sensitivity	Sputum	Not applicable	Sterile	Sample should not be saliva. Send within 2-4 hours.	CDL	2 – 5 days
8.	Culture and Sensitivity	Tracheal aspirates/ BAL/NPA	3ml	Sterile	The sample should not be saliva. Send within 2-4 hours	CDL	2 – 5 days
9.	Culture and Sensitivity	Fluid Pleural/ Peritoneal/ Pericardial/ Synovial/ ascites/ Other sterile body fluid	5ml	Sterile	Send within 2-4 hours. Send immediately	CDL	2 – 5 days
10.	Culture and Sensitivity	Nasal / Per nasal/ Throat swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL	2 – 5 days
11.	Culture and Sensitivity	CSF	1- 3ml	Sterile	Send to the lab immediately.	CDL	2 – 5 days
12.	Culture and Sensitivity	Ear discharge/ Ear swab	Not applicable	Sterile	Send within 2-4 hours.	CDL	2 – 5 days
13.	Culture and Sensitivity	Vitreous and aqueous fluid	1-3ml	Sterile	Send to the lab immediately.	CDL	2 – 5 days
14.	Culture and Sensitivity	Eye discharge	Not applicable	Sterile	Send within 2-4 hours.	CDL	2 – 5 days

BACTERIOLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
15.	Culture and Sensitivity	Contact lens	Not applicable	Sterile	Send within 2-4 hours.	CDL	2 – 5 days
16.	Culture and Sensitivity	Corneal Scrapping	Not applicable	Sterile	Send within 2-4 hours.	CDL	2 – 5 days
17.	Culture and Sensitivity	HVS/ Endocervical swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL	2 – 5 days
18.	Culture and Sensitivity	LVS	Not applicable	Amies Transport Medium	Only for medicolegal case investigation. Send to the lab immediately.	CDL	2 – 5 days
19.	Culture and Sensitivity	Urethral swab/ Penile swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL	2 – 5 days
20.	Culture and Sensitivity	Urine	5ml	Sterile	Please collect morning midstream urine and send it within 2-4 hours.	CDL	2 – 5 days
21.	Culture and Sensitivity	Stool	Not applicable	Stool container	Send within 2-4 hours.	CDL	2 – 5 days
22.	Culture and Sensitivity	Rectal swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL	2 – 5 days
23.	Culture and Sensitivity	Pus	Not applicable	Sterile	Please specify the site of collection. Send within 2-4 hours.	CDL	2 – 5 days
24.	Culture and Sensitivity	Wound swab/ulcer	Not applicable	Amies Transport	Please specify the site of collection. within 2-4 hours.	CDL	2 – 5 days

BACTERIOLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
		swab		Medium			
25.	Culture and Sensitivity	Tissue/ Bone	Not applicable	Sterile	Please specify the site of collection. within 2-4 hours.	CDL	2 – 5 days
26.	Culture and Sensitivity	Throat swab	Not applicable	Amies Transport Medium	Send within 2 -4 hours.	CDL	2 – 5 days
27.	Culture and Sensitivity	Intra-Uterine Contraceptive Device (IUCD)	Not applicable	Sterile	Send within 2 -4 hours.	CDL	2 – 5 days
28.	Culture and Sensitivity	Biopsy	Not applicable	Sterile	Send within 2-4 hours	CDL	2 – 5 days
29.	Culture and Sensitivity	Bile	Not applicable	Sterile	Send within 2 -4 hours.	CDL	2 – 5 days
30.	Culture and Sensitivity	TIPS	Not applicable	Sterile	Send within 2 -4 hours.	CDL	2 – 5 days
31.	Culture and Sensitivity	Placenta swab	Not applicable	Sterile	Send within 2 -4 hours.	CDL	2 – 5 days
32.	Culture and Sensitivity	Gastric lavage	Not applicable	Sterile	Send within 2 -4 hours.	CDL	2 – 5 days
33.	MRSA Screening	Nasal/axilla/ groin swab	Not applicable	Amies Transport Medium	Please specify the site of collection. Send within 2-4 hours.	CDL	2 – 5 days
34.	Culture and Sensitivity	Bone marrow	5-10ml (adult)	Blood culture bottle	Inoculate bone marrow collected with aseptic technique. If the sample is not	CDL	2 – 5 days

BACTERIOLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
			2-3ml (paediatric)		sent immediately, please do not refrigerate it. Please leave it at room temperature.		
35.	*Legionella* Antigen	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
36.	*Legionella* Antibody	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours	LABLINK	10 working days
37.	*Leptospira* IgM	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
38.	*Leptospira:* Microscopic agglutination test (MAT)	Blood	5ml	Plain tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	IMR	10 working days
39.	*Rickettsia* antibody	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	10 working days
40.	Treponema Pallidum Antibody	Blood	5ml	Gel tube	Send within 2-4 hours.	CDL	5 days
41.	FEME (Fluids)	Sterile body fluids	3ml	Sterile	Send within 2-4 hours.	CDL	24 hours
42.	Line Probe Assay	Sputum/ Tracheal	2 ml	Sterile container	Complete PER PAT.301 form and send it along with the sample to CDL within	MKAK	14 working days

BACTERIOLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
		aspirate/ BAL			2-4 hours.		

NB:

- *All sterile specimens should **NOT** be refrigerated. It should be sent immediately to the laboratory.*
- *All specimens for C&S should be sent before antibiotic administration.*

MOLECULAR BACTERIOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	Gene Xpert Ultra MTB RIF	Sputum/ BAL	Not applicable	Sterile	Send to the lab immediately.	CDL	48 hours
2.	Respiratory Bacterial PCR	Nasophryngeal swab/ NPA/ Sputum	2 ml	VTM/ Sterile container	Send the sample to CDL within 2-4 hours.	CDL	24 – 72 hours
3.	Rickettsia PCR	Blood	6 ml	2 tubes of EDTA	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	IMR	14 working days
4.	TB PCR	Sputum/ BAL/ Tissue/ Fluid/Pus/ Bone/Biopsy	Not applicable	Sterile	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	3 working days
5.	Gene Xpert MRSA Screening	MRSA swab	Not applicable	MRSA Dual Eswab	Please contact Microbiology lab for swab.	CDL	48 hours
6.	Meliodosis PCR	Blood	6 ml	EDTA	Complete IMR form and sent it along with sample to CDL within 2-4 hours	IMR	3 working days

VIROLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	Cytomegalovirus IgM	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	3 working days
2.	Cytomegalovirus IgG	Blood	5ml	Sterile	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	3 working days
3.	Dengue Test (NS1, IgG, IgM)	Blood	5ml	Gel tube	Send to the lab immediately.	CDL	1 hours
4.	Epstein Barr Virus IgM	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	7 working days
7.	Epstein Barr Virus IgG	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	7 working days
8.	Epstein Barr Virus IgA	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	7 working days
9.	Hepatitis A Virus IgM	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	10 working days
10.	Hepatitis B surface antigen (HBsAg)	Blood	5ml	Gel tube	Send the sample within 2-4 hours.	CDL	5 days
11.	Hepatitis B surface antibody) (HBsAb)	Blood	5ml	Gel tube	Send the sample within 2- 4 hours.	CDL	5 days
12.	Hepatitis B core IgM (HBc IgM)	Blood	5ml	Gel tube	Complete LABLINK form and send it	LABLINK	10 working days

VIROLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
					along with the sample to CDL within 2-4 hours.		
13.	Hepatitis B core total antibody (HBc total Ab)	Blood	5ml	Gel tube	Complete-LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	10 working days
14.	Hepatitis B e Antigen (HBeAg)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	10 working days
15.	Hepatitis B e Antibody (HBeAb)	Blood	5ml	Gel tube	Complete-LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	10 working days
16.	Hepatitis C Antibody (Anti HCV)	Blood	5ml	Gel tube	Send the sample within 2- 4 hours.	CDL	5 working days
17.	Herpes simplex Type 1 & 2 Antibody (IgM)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
18.	Herpes simplex Type 1 & 2 Antibody (IgG)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
19.	HIV 1 & 2 Antigen/antibody COMBO	Blood	5ml	Gel tube	Send sample within 2- 4 hours. The patient's consent is to be obtained and documented on the request form before blood collection.	CDL	5 days
20.	HIV 1 &2	Blood	5ml	Gel tube	This is confirmation test.	CDL	5 days

VIROLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
	(Particle agglutination)				Automatically added if screening positive		
21.	Japanese encephalitis Antibody (IgM)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
22.	Japanese encephalitis Antibody (IgG)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
23.	Japanese encephalitis Antibody (IgM)	CSF	1-3ml	Sterile	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
24.	Measles Virus Antibody (IgM)	Blood	5ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	MKAK	7 working days
25.	Measles Virus Antibody (IgG)	Blood	5ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	MKAK	7 working days
26.	Mumps Virus Antibody (IgM)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	7 working days
27.	Mumps Virus Antibody (IgG)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	7 working days
28.	Rubella IgM	Blood	5ml	Gel tube	Complete LABLINK form and send it	LABLINK	3 working days

VIROLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
					along with the sample within 2-4 hours		
29.	Rubella IgG	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours	LABLINK	3 working days
30.	SARS COV 2 Rapid Test kit Antigen (RTK Ag)	Nasopharyn geal swab	Not applicable	Dry swab	Transportation with triple packaging/ ice pack. Sample must reach within 4 hours upon collection	CDL	1 hours
31.	Mycoplasma Antibody	Blood	5 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours	LABLINK	3 working days
32.	Coxiella Burnetti Antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours	INNOQUEST	10 working days
33.	Brucella Antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours	IMR	10 working days
34.	Bartonella antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with sample within 2-4 hours	INNOQUEST	10 working days
35.	Salmonella Antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with sample within 2-	INNOQUEST	10 working days
36.	Anti Streptolysin O (ASOT) Titre	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with sample within 2-4 hours.	LABLINK	3 working days

VIROLOGY AND SEROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
37.	Rotavirus Ag	Stool	-	Sterile container	Send sample within 2- 4 hours.	CDL	24 hours
38.	TB QuantiFERON	Blood	1 ml	4 units TB QuantiFERON container	Collect container from CDL Microbiology lab	CDL	3 working days
39.	TORCHES Antibody	Blood	5 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	10 working days
40.	Varicella-Zoster Antibody IgM	Blood	5 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	7 working days
41.	Varicella-Zoster Antibody IgG	Blood	5 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	7 working days
42.	Toxoplasma Antibody IgM	Blood	5 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	3 working days
43.	Toxoplasma Antibody IgG	Blood	5 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	3 working days
44.	Chikungunya IgM	Blood	4 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	10 working days
45.	Chikungunya IgG	Blood	4 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	10 working days
46.	Parvovirus IgM	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	10 working days
47.	Parvovirus IgM & IgG	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with sample within 2 – 4 hours	LABLINK	10 working days

MOLECULAR VIROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	SARS CoV2 RNA	Nasopharyngeal/ Oropharyngeal swab	Not applicable	VTM	Transportation with triple packaging/ice pack.	CDL	24 – 72 hours
2.	CMV PCR	Blood	3-5ml	EDTA	Transported on ice.	Geneflux	3 working days
		Urine Eye vitreous fluid Tissue biopsy BAL Amniotic fluid CSF/Saliva Semen	3 ml 0.2-3 ml min 2cm 1-3ml 1-3ml 1-3ml 1-3ml	Sterile			
3.	BK & JC PCR	Blood	3-5ml	EDTA	Transported on ice.	Geneflux	3 working days
		Serum CSF Urine	3-5ml 0.5-1 ml 1-3ml	Sterile			
4.	HBV DNA	Blood	3-5ml	EDTA	Transported on ice.	Geneflux	3 working days
5.	HCV RNA	Blood	3-5ml	EDTA	Transported on ice.	Geneflux	3 working days
6.	HIV RNA (Qualitative)	Blood	3-5ml	EDTA	Transported on ice.	LABLINK	5 working days
7.	HIV viral load	Blood	3-5ml	EDTA	Transported on ice.	LABLINK	5 working days
8.	Gene Xpert – Xpert Xpres SARS-CoV-2	Nasopharyngeal swab/ Nasal swab/ Nasal wash/ Nasal aspirate	Not applicable	Viral Transport Medium (VTM)	Specimen should be in triple packaging and transported with ice pack to the laboratory.	CDL	3 hours

MOLECULAR VIROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
9.	Respiratory Virus PCR	Nasopharyngeal swab/ Nasal swab/ NPA/Sputum	2 ml	VTM/ Sterile container	Send to the lab immediately.	CDL	24 – 72 hours
10.	MERS-CoV PCR	Nasopharyngeal swab	2 ml	VTM	Transported on ice.	Geneflux	3 working days
11.	Meningitis Viral Pathogen Panel	CSF /Blood	2 ml	Sterile con-tainer/ EDTA	Complete LABLINK form and send it along with sample within 2-4 hours.	LABLINK	10 working days
12.	Viral Culture	CSF	2 ml	Sterile container	Complete PPUM form and send along with sample within 2-4 hours.	UMMC	14 working days
13.	Epstein Barr Virus PCR	Blood/ CSF/ BAL	3-5 ml	EDTA/ Plain tube/ Sterile container	Complete PER PAT.301 form and send it along with sample within 2-4 hours.	Geneflux	3 working days
14.	Herpes Simplex Virus PCR	Blood/ CSF/ Vesicle swab	3-5 ml	EDTA/ Plain tube/ Sterile container	Complete PER PAT.301 form and send it along with sample within 2-4 hours.	Geneflux	3 working days
15.	Varicella-zoster Virus PCR	Blood/CSF Vesicle swab	3-5 ml	EDTA/ Plain tube/ Sterile container	Complete PER PAT.301 form and send it along with sample within 2-4 hours.	Geneflux	3 working days
16.	STI 7	Urine	Not applicable	Sterile container	Complete GENEFLUX form and send it along with sample within 2-4 hours	Geneflux	3 working days

MOLECULAR VIROLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
		Urethral swab Lymph node aspirate Endocervical swab HVS		Amies transport media			
17.	MPOX PCR	Lesion Fluid Swab Lesion Fluid Aspirate Lesion Roof Crust Tonsillar Tissue Swab Nasopharyngeal Swab	Not Applicable	Sterile container without any media	Please contact microbiology lab before taking the sample	IMR	5 working days

MYCOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	*Cryptococcal* Antigen	CSF/Blood	5ml	Sterile/Gel tube	Send to the lab immediately.	CDL	24 hours
2.	Fungal Culture and Sensitivity	Blood	5-10ml (adult) 2-3ml (paediatric)	Blood Myco F lytic or aerob bottle	Inoculate blood collected with aseptic technique. If the sample is not sent immediately, please do not	CDL	14 days

MYCOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
					refrigerate it. Please leave it at room temperature.		
3.	Fungal Culture and Sensitivity	CSF	1-3ml	Sterile	Send to the lab immediately.	CDL	14 days
4.	Fungal Culture and Sensitivity	Pleural fluid	5ml	Sterile	Send to the lab immediately.	CDL	14 days
5.	Fungal Culture and Sensitivity	Peritoneal fluid	5-10ml	Sterile	Send to the lab immediately.	CDL	14 days
6.	Fungal Culture and Sensitivity	Pus	Not applicable	Sterile	Send sample within 2-4 hours.	CDL	14 days
7.	Fungal Culture and Sensitivity	Vitreous/Aqueous Fluid	3ml	Sterile	Send to the lab immediately.	CDL	14 days
8.	Fungal Culture and Sensitivity	Hair / Nail	Not applicable	Wrap with filter paper	Send sample within 2-4 hours.	CDL	14 days
9.	Fungal Culture and Sensitivity	Tissue	Not applicable	Sterile	Please specify the site of collection. Send sample within 2-4 hours.	CDL	14 days
10.	Galactomannan Antigen	Blood BAL	3ml 3ml	Sterile Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours	LABLINK	10 working days

MOLECULAR MYCOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	*Pneumocystis jirovecii molecular*	BAL	1-3ml	Sterile	Transport in Ice.	Geneflux	10 working days
2.	Fungal PCR	BAL/Tissue/Fluid Blood (EDTA) Others	3 ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	IMR	5 working days

IMMUNOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	Anti-nuclear antibody (ANA)	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL	5 working days
2.	Anti - double-stranded DNA antibody (anti-dsDNA)	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL	5 working days
3.	Anti- mitochondrial antibody (AMA)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours.	LABLINK	3 working days
4.	Anti-cardiolipin	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample to CDL within 2-4 hours	LABLINK	10 working days
5.	Extractable Nuclear antibody (ENA)	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL	5 working days
6.	Anti -Neutrophil Cytoplasmic antibody (ANCA)	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
7.	Rheumatoid factor (RF)	Blood	5ml	Gel tube	Send sample within 2- 4 hours.	CDL	5 working days

IMMUNOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
8.	Immunoglobulin A	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
9.	Immunoglobulin G	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
10.	Immunoglobulin M	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
11.	Total IgE	Blood	5ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
12.	HLA B 27	Blood	10 ml	EDTA tube	By appointment ONLY.	IMR	10 working days
13.	Anti-CCP	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL	5 working days
14.	Anti GBM	Blood	5 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days

IMMUNOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
15.	Anti Smooth Muscle Antibody (ASMA)	Blood	5 ml	Gel Tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	3 working days
16.	Anti Centromere Antibody	Blood	5 ml	Gel Tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
17.	Anti Endomysial Antibody	Blood	5 ml	Gel Tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
18.	Allergic Test – 54 Allergens	Blood	3ml	Gel Tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
19.	Anti NMDAR	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
20.	Tryptase	Blood	3ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	IMR	10 working days
21.	Anti-Ganglioside Panel	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days

IMMUNOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
22.	Adenosine Deaminase (ADA)	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
23.	Anti-Muscle Specific Kinase (Anti- MUSK)	Blood	4 ml	Gel Tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
24.	Myositis Profile	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
25.	FX5	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
26.	Anti LKM	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
27.	COELIAC Antibody (anti TTG, anti-Gliadin, Endomysium)	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	IMR	10 working days
28.	Encephalitis Receptor Autoimmune Profile	Blood/ CSF	3 ml/ 2 ml	Gel tube/ Sterile container	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days

IMMUNOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
29.	Primary Immuno-deficiency (PID) - TBNK	Blood	2 ml/ 3 ml	EDTA (2ml) & Gel tube (5 ml)	Please contact CDL Microbiology for appointment and fill in IMR form.	IMR	5 working days
30.	Neuromyelitis Optica Autoimmune Profile	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
31.	Aquaporin 4	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
32.	Paraneoplastic Antigen Autoimmune Profile	CSF/ Blood	3 ml	Sterile container/Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days
33.	Myelin Oligodendrocyte Glycoprotein	Blood	3 ml	Gel tube	Complete LABLINK form and send it along with the sample within 2-4 hours.	LABLINK	10 working days

PARASITOLOGY							
NO.	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**	**TURN AROUND TIME (TAT)**
1.	Malaria Microscopy (BFMP)- Thin & Thick Blood Smears	Blood	2ml	EDTA	Send to the lab immediately.	CDL	3 hours (preliminary) 24 hours full report
2.	Microfilaria Microscopy – Thin & Thick Blood Smear	Blood	2ml	EDTA	Send the sample during operational hours.	CDL	24 hours
3.	Ova & Cysts – Microscopy (Direct Smear)	Stool	20-50 gm	Stool container	Send sample within 2-4 hours.	CDL	24 hours
4.	Intestinal Protozoa (Cryptosporidium spp, Cyclospora spp, Isospora spp, Microsporidium spp	Stool	6 gm	Stool container	Complete IMR form and sent it along with the sample within 2-4 hours	IMR	10 working days

APPENDIX

Appendix 1: Chemical Pathology Tests & Clinical Indications

TEST	INDICATIONS
Acetaminophen (PCM)	It is used to find out any abuse/overdose of acetaminophen.
Alpha-1-feto protein (AFP)	• To help confirm or rule out a cancer diagnosis when used with other examinations and tests. • To predict how cancer may behave over time. • To monitor cancer treatment response. AFP levels often go up if cancer is growing and go down when treatment is working.
Albumin	The determination of albumin allows monitoring of a controlled patient dietary supplementation and serves also as an excellent test of liver function.
ALP	• To screen for or monitor treatment for a liver or bone disorder. • A rise of the ALP occurs with all forms of cholestasis, particularly with obstructive jaundice. It is also elevated in diseases of the skeletal system, such as Paget's disease, hyperparathyroidism, rickets and osteomalacia, as well as with fractures and malignant tumors.
ALT	To evaluate the function of the liver. Elevated ALT level is found in hepatitis, cirrhosis, obstructive jaundice, carcinoma of the liver and chronic alcohol abuse.
Amylase	Suitable for the diagnosis and monitoring of acute pancreatitis and acute attacks during chronic pancreatitis.
AST	• To detect liver damage and/or to help diagnose liver disease. • Elevated serum levels are found in hepatobiliary diseases, such as cirrhosis, metastatic carcinoma, viral hepatitis, myocardial infarction. • Decreased AST levels are found in patients undergoing renal dialysis or those with vitamin B6 deficiency.
Blood Gases	• To determine oxygen and carbon dioxide saturation in patient blood. It also determines the acidity (pH) of the blood. • The test is used to evaluate respiratory diseases and conditions that affect the lungs. It helps determine the effectiveness of oxygen therapy. The test also provides information about the body's acid/base balance, which can reveal important clues about lung and kidney function and the body's general metabolic state.
AST	• To detect liver damage and/or to help diagnose liver disease. • Elevated serum levels are found in hepatobiliary diseases, such as cirrhosis, metastatic carcinoma, viral hepatitis, myocardial infarction. • Decreased AST levels are found in patients undergoing renal dialysis or those with vitamin B6 deficiency.

TEST	INDICATIONS
Beta Human chorionic gonadotropin (HCG)	• HCG appears in the blood of pregnant women as early as 10 days after conception. • Quantitative HCG measurement helps determine the exact age of the fetus. • It can also assist in the diagnosis of abnormal pregnancies, such as ectopic pregnancies, molar pregnancies, and possible miscarriages. • It is also used as part of a screening test for Down syndrome. This test is also done to diagnose abnormal conditions not related to pregnancy that can raise HCG level.
Bilirubin	• To screen for or monitor liver disorders or haemolytic anemia. • Elevated serum bilirubin is found in haemolytic anaemia (unconjugated), liver disorders and biliary obstruction.
Calcium	• To evaluate calcium levels in the body. • Increases in serum PTH or Vitamin D are usually associated with hypercalcemia. Increased serum calcium levels may also be observed in multiple myeloma and other neoplastic diseases. • Hypocalcemia may be observed in a patient with hypoparathyroidism, nephrosis or pancreatitis.
Chloride	• To evaluate electrolyte imbalance. • Decreased chloride includes reduced dietary intake, prolonged vomiting, reduced renal reabsorption as well as some forms of acidosis and alkalosis. • Increased chloride values are found in dehydration, kidney failure, some forms of acidosis, high dietary or parenteral chloride intake, and salicylate poisoning.
Creatine Kinase	• Elevated CK serum levels are found in skeletal muscle disease, particularly muscular dystrophy. • Serum CK activity is also increased after cerebral ischaemia, acute cerebrovascular disease and head injury.
Creatinine	The most common test used to assess renal function.
C- reactive protein	• To identify the presence of inflammation and to monitor response to treatment for an inflammatory disorder. • Elevated CRP is found in patients with a tissue- damaging process such as infection, inflammatory diseases and malignant neoplasms.
Cortisol	• The cortisol status of a patient is used to diagnose the function or malfunction of the adrenal gland, the pituitary, and the hypothalamus. e.g.: a. Overproduction (e.g. Cushing's syndrome) b. Underproduction (e.g. Addison's disease)
Oestradiol	• The determination of oestradiol is utilized clinically in the elucidation of fertility disorders in the hypothalamus- pituitary- gonad axis, gynecomastia, oestrogen-producing ovarian and testicular tumors

TEST	INDICATIONS
	and in hyperplasia of the adrenal cortex. • Further clinical indications are the monitoring of fertility therapy and determining the time of ovulation within the framework of in vitro fertilization.
Ferritin	To determine total iron storage capacity; to help diagnose iron deficiency or iron overload.
FSH	• Determination of the FSH concentration is used in the elucidation of dysfunctions within the hypothalamus- pituitary- gonads system. • The determination of FSH in conjunction with LH is utilized for the following indications: congenital diseases with chromosome aberrations, polycystic ovaries (PCO), amenorrhoea (causes), and menopausal syndrome.
Free T4	• To evaluate thyroid gland function. • To help in the diagnosis of hyperthyroidism or hypothyroidism.
Free T3	• Determination of this hormone concentration is important for the diagnostic differentiation of euthyroid, hyperthyroid, and hypothyroid states.
Folate	Aids in the detection of folate deficiency.
GGT	To assist in the diagnosis and monitoring of hepatobiliary diseases.
Glucose	To be used in the diagnosis and treatment of carbohydrate metabolism disorders including diabetes mellitus and hypoglycemia.
HDL- C	• To determine the risk of atherosclerotic disease. • Elevated HDL- cholesterol concentrations are protective against coronary heart disease, while reduced HDL- cholesterol concentrations, particularly in conjunction with elevated triglycerides, increase the cardiovascular risk.
Haemoglobin A1c	• To monitor blood glucose control in individuals with diabetes mellitus (Indicate the mean blood glucose level in 8- 12 weeks). • HbA1c predicts the development of diabetic complications in diabetes patients and can be used for the diagnosis of diabetes mellitus.
Iron (total)	Aids in the diagnosis of iron deficiency anaemia and iron overload.
LDH	• Elevated serum levels of LDH have been observed in a variety of disease states. The highest levels are seen in patients with megaloblastic anemia, disseminated carcinoma, leukemias and trauma. • Mild increases in LDH activity have been reported in cases of haemolytic anemias, muscular dystrophy, pulmonary infarction, hepatitis, nephrotic syndrome and cirrhosis.
LDL- cholesterol	• To determine the risk of atherosclerotic disease. • Strong predictor for coronary atherosclerosis.

TEST	INDICATIONS
Luteinizing Hormone	• Determination of the LH concentration is used in the elucidation of dysfunctions within the hypothalamus- pituitary- gonads system. • The determination of LH in conjunction with FSH is utilized for the following indications: congenital diseases with chromosome aberrations (e.g. Turner's syndrome), polycystic ovaries (PCO), clarifying the causes of amenorrhea, menopausal syndrome, and suspected Leydig cell insufficiency.
Magnesium	• To evaluate electrolyte imbalance. • Increased serum magnesium concentrations occur in renal failure, acute diabetic acidosis, dehydration, or Addison's disease. • Hypomagnesemia may be observed in chronic alcoholism, malabsorption, severe diarrhoea, acute pancreatitis, diuretic therapy, prolonged parenteral fluid therapy without magnesium supplementation, and kidney disorders such as glomerulonephritis and tubular reabsorption defects.
Microalbumin (urine)	It is considered an important marker for glomerular dysfunction. Slightly elevated albumin excretion in urine, called microalbuminuria, is of particular importance in the early diagnosis of diabetic nephropathy.
Non- HDL- c	• To determine the risk of atherosclerotic disease. • Strong predictor for coronary atherosclerosis.
Osmolality	• To determine the balance between water and certain chemicals in the blood. • Provision of diagnostic guide for dehydration and overhydration. • To help diagnose diabetes insipidus
Phosphorus	To evaluate the level of phosphorus and as a marker to evaluate an abnormal calcium level.
Potassium	• To evaluate an electrolyte imbalance. • Hypokalaemia can be found in reduced intake of dietary potassium or excessive loss of potassium from the body by prolonged vomiting, diarrhoea or increased kidney excretion. • Hyperkalaemia may be caused by dehydration or shock, severe burns, diabetic ketoacidosis, and retention of potassium by the kidney.
Procalcitonin	• To diagnose or rule out a bacterial infection. • To determine the severity of sepsis. • To guide treatment decisions. • To monitor treatment response • To guide the diagnosis of kidney infections in children
Progesterone	The determination of progesterone is utilized in a fertility diagnosis for the detection of ovulation and assessment of the luteal phase.
Prolactin	Evaluation of anterior pituitary tumour hyper- or hypofunction.

TEST	INDICATIONS
Total Prostate Cancer Antigen (PSA)	• To screen for prostate carcinoma. • To guide diagnosis of prostate conditions that are non- cancerous/ malignant. • To monitor treatment response.
Sodium	• To evaluate electrolyte imbalance. • Decreased levels of sodium include prolonged vomiting or diarrhoea, diminished reabsorption in the kidney and excessive fluid retention. • Increased sodium includes excessive fluid loss, high salt intake, and increased kidney reabsorption.
TiBC	Aid in the diagnosis of iron deficiency anaemia and iron overload.
Testosterone	• The determination of testosterone in women is helpful in the diagnosis of an androgenic syndrome (AGS), polycystic ovaries (Stein-Leventhal syndrome) and when an ovarian tumor, adrenal tumor, adrenal hyperplasia or ovarian insufficiency is suspected. • Testosterone is determined in men when reduced testosterone production is suspected, e.g. hypogonadism, oestrogen therapy, chromosome aberrations (as in the Klinefelter's syndrome) and liver cirrhosis.
Total protein	Total protein measurements are used in the diagnosis and treatment of a variety of diseases involving the liver, kidney, or bone marrow, as well as other metabolic or nutritional disorders.
Triglycerides	The determination of triglycerides is utilized in the diagnosis and treatment of patients having diabetes mellitus, nephrosis, liver obstruction, lipid metabolism disorders and numerous other endocrine diseases.
Troponin T	Cardiac troponin T (cTnT) is a biomarker of myocardial injury. A major utility is for diagnosis, risk stratification and management of the acute coronary syndrome.
TSH	TSH is a very sensitive and specific parameter for assessing thyroid function and is particularly suitable for early detection or exclusion of disorders in the central regulating circuit between the hypothalamus, pituitary and thyroid. It is also used to screen for congenital hypothyroidism in newborns.
Urea	Urea is one of the most widely used tests for renal function apart from creatinine.
Uric acid	Uric acid measurements are used in the diagnosis and treatment of numerous renal and metabolic disorders, including renal failure, gout, leukemia, psoriasis, starvation or other wasting conditions, and of patients receiving cytotoxic drugs.
Vancomycin	Vancomycin test is used to monitor the amount of drug in the blood to ensure that it is adequate but not excessive. The effectiveness of vancomycin depends on keeping blood levels at a therapeutic level

TEST	INDICATIONS
	(minimum effective concentration), for the duration of therapy. Excessive concentrations of vancomycin must be avoided because high levels can result in toxicity, specifically ototoxicity (hearing damage) and nephrotoxicity (kidney damage).
Vitamin B12	Aids in the detection of vitamin B12 deficiency in individuals with macrocytic or unexplained anaemia, or unexplained neurologic disease.

Appendix 2: Chemical Pathology Tests & Reference Ranges

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
Acetaminophen (PCM)	Homogeneous enzyme immunoassay	Serum	Adult: 10 - 30 µg/ml
Alanine Aminotransferase (ALT)	IFCC Modified (no pyridox. phosphate)	Serum	Men: <41.0 U/L Women: <33.0 U/L
Albumin	BCG- Citrate Buffer	Serum	Adults: 35- 52 g/L Paediatric range: Newborns: 0- 4d: 28- 44 g/L Children 4d- 14d: 38- 54 g/L Children 14- 18yr: 32- 45 g/L
	Immunoturbidimetric	2nd morning Urine	Adults: <20.0 mg/L
		Urine 24 hour	<30 mg/24h
Alpha-1- fetoprotein	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 9.0
Alkaline Phosphatase (ALP)	AMP Buffer- rate (IFCC)	Serum	Adults: - Men: 40- 129 U/L Women: 35- 104 U/L Children: - - Males: 0d - 14d: 83- 248 U/L 15d - 1y: 122- 469 U/L 1y - 9y: 142- 335 U/L 10y - 12y: 129- 417 U/L 13y - 14y: 116- 468 U/L 15y - 16y: 82- 331 U/L 17y - 18y: 55- 149 U/L - Females: 0d - 14d: 83- 248 U/L 15d - 1y: 122 - 469 U/L 1y - 9y: 142- 335 U/L 10y - 12y: 129- 417 U/L 13y - 14y: 57- 254 U/L 15y - 16yr: 50- 117 U/L 17y - 18yr: 45- 87 U/L
Amylase	IFCC Based - EPS	Serum	Adults: 28- 100 U/L
		Urine (random)	Men: 16 - 491 U/L Women: 21 - 447 U/L
Aspartate Amino-transferase (AST)	IFCC Modified (no pyridox. phosphate)	Serum	Men: ≤50.0 U/L Women: ≤35.0 U/L

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
Beta HCG	Chemi luminescent Immunoassay (CLIA) - Sandwich	Serum	Men/Women: ≥ 18y and < 40y :0 - 0.6 IU/L ≥ 40y: 0 - 3.1 IU/L Female, post- menopause: 0.1 - 11.6 IU/L
Bilirubin (direct)	Diazonium salt	Serum	Adult: ≤ 5.0 µmol/L
Bilirubin (total)	Diazonium salt	Serum	Adults: ≤21.0 µmol/L Newborn & Paediatrics 1d: <137µmol/L 2d: <222 µmol/L 3d - 4d: <290 µmol/L 5d - 17y: ≤ 17 µmol/L
Calcium	5- nitro- 5'- methyl- BAPTA	Serum	Serum: 0 - 10d: 1.90 - 2.60 mmol/L 10d - 2y :2.25 - 2.75 mmol/L 2 - 12y:2.20 - 2.70 mmol/L 12 - 18y: 2.10 - 2.55 mmol/L 18 - 60y: 2.15 - 2.50 mmol/L 60 - 90y: 2.20 - 2.55 mmol/L > 90y: 2.05 - 2.40 mmol/L
		Urine 24 hrs	2.5 - 7.5 mmol/24h
Cancer AG 19- 9 (CA 19- 9)	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 35.0
Cancer AG 125 (CA 125)	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 35.0
Carcinoembryonic AG (CEA)	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 3.0
Corrected calcium	Calculated	Serum	Serum: 0 - 10d: 1.90 - 2.60 mmol/L 10d - 2y: 2.25 - 2.75 mmol/L 2 - 12y: 2.20 - 2.70 mmol/L 12 - 18y: 2.10 - 2.55 mmol/L 18 - 60y: 2.15 - 2.50 mmol/L 60 - 90y: 2.20 - 2.55 mmol/L > 90y: 2.05 - 2.40 mmol/L
Creatinine	Jaffe (Alk. Picrate- rate, compensated)	Serum	Adults: Men: 62 - 106 µmol/L Women: 44 – 80 µmol/L Children: Neonates (premature): 25 - 91 µmol/L

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
			Neonates (full term): 21 - 75 µmol/L 2 - 12m: 15 - 37 µmol/L 1 - <3y: 21 - 36 µmol/L 3 - <5y: 27 - 42 µmol/L 5 - <7y: 28 - 52 µmol/L 7 - <9y: 35 - 53 µmol/L 9 - <11y: 34 - 65 µmol/L 11 - <13y: 46 - 70 µmol/L 13 - <15y: 50 - 77 µmol/L
		Urine (1st morning urine)	Men: 3.45–22.9 mmol/L Women: 2.47 - 19.2 mmol/L
		Urine 24 Hr	Men: 9- 21 mmol/24h Women: 7- 14 mmol/24h Creatinine clearance Adults: 71-151 mL/min
Cholesterol	Cholesterol Oxidase/Peroxidase	Serum	Adults: <5.2 mmol/L
Creatine Kinase	Catalytic CK activity (340nm)	Serum	Men: <190.0 U/L Women: <170.0 U/L
Cortisol	CLIA (Competitive)	Serum	Morning hours (6- 10 am): 185 - 624 nmol/L Afternoon hours (4 - 8 pm): < 276 nmol/L
C- Reactive Protein (Latex)	Particle enhanced turbidimetric assay	Serum	Adults: < 5.0 mg/L
Ferritin	CLIA (Sandwich)	Serum	Male and Female 0d - 14d: 39.8 - 540.0 ug/L 15d - 5m: 15.3 - 375.0 ug/L 6m - 11m: 13.3 - 192.0 ug/L 1y - 15y: 10.3 - 55.8 ug/L 16y - 17y: 18.7 - 102.0 ug/L (Male) 3.20 - 75.1 ug/L (Female) 18y - 200y: 23.9 - 336.2 ug/L (Male) 11.0 - 306.8 ug/L (Female)
Folate	CLIA (Competitive)	Serum	Men/Women (≥18y): 7.0 - 45.1 nmol/L
Follicle Stimulating	CLIA (Sandwich)	Serum	Men >= 18y: 1.27 - 19.26 IU/L

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
Hormone (FSH)			Women: Mid- Follicular Phase: 3.85 - 8.78 IU/L Mid - Cycle Peak: 4.54 - 22.51 IU/L Mid - Luteal Phase: 1.79 - 5.12 IU/L Post - Menopausal: 16.74 - 113.59 IU/L
Free Thyroxine (FT4) * Reported by CDL HASA	CLIA (Competitive)	Serum	Male and Female (Serum) 0 - 19 days: 17.4 - 57.7 pmol/L 20 days - 2y: 9.52 - 17.8 pmol/L 3y - 17y: 7.85 - 13.6 pmol/L 18y - 60y: 7.86 - 14.41 pmol/L Male and Female (Cord Blood) 0d - 1 month: > 15 pmol/L
Gamma- Glutamyl transferase (GGT)	Enzymatic colorimetric assay other g-Glut-3-carboxy-nitro	Serum	Men: <60 U/L Women: <40 U/L
Glucose	Hexokinase	Plasma	**Based on 2006 WHO criteria** **Fasting Plasma Glucose:** 3.5 - 6.0 mmol/L (Normal) 6.1- 6.9 mmol/L (Impaired fasting glucose) ≥7.0 mmol/L (Diabetes mellitus) Random Plasma Glucose: < 7.8 mmol/L (Normal) 7.8–11.0 mmol/L (Impaired glucose tolerance) > 11.0 mmol/L (Diabetes mellitus)
		Urine (random) Urine 24 hrs	Random urine: 0.06- 0.83 mmol/L 24- hour urine: <2.78mmol/24H
		CSF	Children: 3.33- 4.44 mmol/L Adults: 2.22- 3.89 mmol/L
HbA1c	High performance liquid chromatography (HPLC)	Plasma	**According to the American Diabetes Association (ADA)** ≥6.3% or 45 mmol/mol (Diabetic) 5.7- 6.2% or 39 - 44 mmol/mol (Pre - Diabetic) ≤5.6% or 38 mmol/mol (non-diabetic)

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
HDL- Cholesterol	Non- separation method (Cholesterol esterase/oxidase)	Serum	**<u>According to * NCEP ATP III Guidelines</u>** Men: ≥ 1.0 mmol/L Women: ≥1.3 mmol/L ** Adult Treatment Panel (ATP), National Cholesterol Education Program (NCEP)*
Iron (total)	Colorimetric assay	Serum	Adults: 5.83 - 34.5 µmol/L
ISE (Na, K, Cl)	ISE- Indirect (diluted)	Serum	Sodium: 136- 145 mmol/L Potassium: 3.5- 5.1 mmol/L Chloride: 98- 107 mmol/L
		Urine (24-hour)	Sodium: 40 - 220 mmol/24 hrs Potassium: 25 - 125 mmol/24 hrs
			Chloride: 110 - 250 mmol/24 hrs
Lactate Dehydrogenase (LDH)	UV assay (Lactate to Pyruvate)	Serum	Women: 135 - 214 U/L Men: 135 - 225 U/L Children (2–15 years): 120 - 300 U/L Newborn (4 - 20 days): 225 - 600 U/L
LDL- Cholesterol	According to Friedewald formula	Serum	**<u>Target LDL- c based on cardiovascular risk</u>** Low risk: < 3.0 mmol/L Moderate risk: < 2.6 mmol/L High risk: ≤ 1.8 mmol/L and a reduction of > 50% from baseline Very high risk: ≤ 1.4 mmol/L and a reduction of > 50% from baseline
Luteinizing Hormone (LH)	CLIA (Sandwich)	Serum	Men (≥18y): 1.24 - 8.62 IU/L Women: Mid- Follicular Phase: 2.12- 10.89 IU/L Mid- Cycle Peak: 19.18- 103.03 IU/L Mid- Luteal Phase: 1.20- 12.86 IU/L Post- Menopausal: 10.87- 58.64 IU/L

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
Magnesium	Xylidyl Blue	Serum	Newborn: 0.62 - 0.91 mmol/L 5m - 6y: 0.70 - 0.86 mmol/L 6Y - 12y: 0.70 - 0.86 mmol/L 12Y - 20y: 0.70 - 0.91 mmol/L 20Y - 60y: 0.66 - 1.07 mmol/L 60Y - 90y: 0.66 - 0.99 mmol/L >90y: 0.70 - 0.95 mmol/L
		Urine 24 hrs	3.0 - 5.0 mmol/24hrs
Non- HDL- c	Calculation	Serum	**Target non- HDL- c based on cardiovascular risk** Low risk: < 3.8 mmol/L Moderate risk: < 3.4 mmol/L High risk: ≤ 2.6 mmol/L and a reduction of > 50% from baseline Very high risk: ≤ 2.2 mmol/L and a reduction of > 50% from baseline
Oestradiol	CLIA (Competitive)	Serum	Follicular: 91.8 - 422.2 pmol/L Ovulation: 117.9 - 1898.1 pmol/L Luteal: 134.0 - 903.2 pmol/L Post Menopause: < 55.1 - 91.8 pmol/L
Phosphate	Phosphomolybdate formation	Serum	Men 1D- 30D :1.25 - 2.25 mmol/L 1M- 12M :1.15 - 2.15 mmol/L 1Y- 3Y :1.00 - 1.95 mmol/L 4Y- 6Y :1.05 - 1.80 mmol/L 7Y- 9Y :0.95 - 1.75 mmol/L 10Y- 12Y :1.05 - 1.85 mmol/L 13Y- 15Y :0.95 - 1.65 mmol/L 16Y- 18Y :0.85 - 1.60 mmol/L Adults :0.80 - 1.45 mmol/L Women 1D- 30D :1.40 - 2.50 mmol/L 1M- 12M :1.20 - 2.10 mmol/L 1Y- 3Y :1.10 - 1.95 mmol/L 4Y- 6Y :1.05 - 1.80 mmol/L 7Y- 9Y :1.00 - 1.80 mmol/L 10Y- 12Y :1.05 - 1.70 mmol/L 13Y- 15Y :0.90 - 1.55 mmol/L 16Y- 18Y :0.80 - 1.55 mmol/L Adults :0.81 - 1.45 mmol/L

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
		Urine (1st morning) Urine 24 Hrs	Urine 1st morning urine: 13- 44 mmol/L 24- hour urine: 13- 42 mmol/24H
Procalcitonin	CLIA (Sandwich)	Serum	< 0.5 ng/mL: Low risk of severe sepsis and/or septic shock ≥ 0.5 to ≤ 2.0 ng/mL: Moderate risk of progression to severe sepsis and/or septic shock > 2.0 ng/mL: High risk of severe sepsis and/or septic shock
Progesterone	Electro-chemiluminescence (Competitive)	Serum	Women Follicular Phase: 0.181 - 2.84 nmol/L Ovulation Phase: 0.385 - 38.1 nmol/L Luteal Phase: 5.82 - 75.9 nmol/L Post- menopause: < 0.401 nmol/L Men: < 0.5 nmol/L
Prolactin	Electro-chemiluminescence (Sandwich)	Serum	Women (not pregnant): 102- 496 mIU/L Men: 86- 324 mIU/L
Prolactin	CLIA (Sandwich)	Serum	Men: 55.97 - 278.36 mIU/L Women: < 50y (pre- menopausal): 70.81 - 566.46 mIU/L ≥ 50y (post- menopausal): 58.01 - 416.37 mIU/L
Prostate Specific Antigen (Total)	CLIA (Sandwich)	Serum	Men/Women (≥18y): ≤ 4.0
Total Protein	Biuret/endpoint (with blank)	Serum	**<u>According to * Tietz Textbook</u>** Newborn: 46- 70 g/L 1W: 44- 76 g/L 7M- 1Y: 5 - 73 g/L 1Y- 2Y: 56- 75 g/L >3Y: 60- 80 g/L Adults: 64- 83 g/L ** Lopez, J. (2015). Carl A. Burtis and David E. Bruns: Tietz fundamentals of clinical chemistry and molecular diagnostics.*

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
Total Protein Urine/CSF	Turbidimetric	Urine (random)	Adults: <0.15 g/L
		Urine 24Hrs	Adults: <0.14 g/24h
		CSF	Adults: 0.15- 0.45 g/L
Testosterone	CLIA (Competitive)	Serum	Men 18y - 66y: 6.07 - 27.10 nmol/L Women 21y - 73y: <0.35 - 2.60 nmol/L
Thyroid Stimulating Hormone (TSH) * Reported by CDL Sg Buloh	Electro-chemiluminescence (Sandwich)	Serum	Adults: 0.270 - 4.20 mIU/L Newborn: 0.70 - 15.2 mIU/L 6 days - 3 mths: 0.72 - 11.0 mIU/L 4 - 12 mths: 0.73 - 8.35 mIU/L 1 - 6 years: 0.70 - 5.97 mIU/L 7 - 11 years: 0.60 - 4.84 mIU/L 12 - 20 years: 0.51 - 4.30 mIU/L
Triglycerides	Lipase/Glycerol kinase/GPO- PAP	Serum	**According to * NCEP ATP III Guidelines** Adults: <1.7 mmol/L ** Adult Treatment Panel (ATP), National Cholesterol Education Program (NCEP).*
hs Troponin T	Electro-chemiluminescence (Sandwich)	Serum	Adults: ≤14 ng/L
hs Troponin I	CLIA (Sandwich)	Serum	Men: ≤19.8 ng/L Women: ≤ 11.6 ng/L
Unsaturated Iron Binding Capacity	Direct determination with Ferrozine	Serum	Men: 22.3 - 61.7 µmol/L Women: 24.2 - 70.1 µmol/L
Urea	Urease- Kinetic (340nm)	Serum	Adults: 2.78 - 8.07 mmol/L Men: 202.3 - 416.5 µmol/L Women: 142.8 - 339.2 µmol/L
		Urine (24 h)	Adults: 428- 714 mmol/24 h
Uric acid	Uricase/peroxidase	Serum	Men: 142.8 - 339.2 µmol/L Women: 202.3 - 416.5 µmol/L
		Urine 24hrs	1200 - 5900 µmol/24H
Vancomycin	Kinetic interaction of microparticles in a solution (KIMS)	Serum	Trough: 10.0 - 20.0 mg/L Peak: 20.0 - 40.0 mg/L
Vitamin B12	CLIA (Competitive)	Serum	Men/Women (≥18y): 133.0 - 675.0 pmol/L

Blood Gases

TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
pH	Potentiometric electrodes	Whole Blood	ABG: 0d- 28d: 7.10 - 7.38 29d- 200 y: 7.35 - 7.45 VBG: 0 d- 28 d: 7.17 - 7.45 29d- 200 y: 7.32 - 7.43
pCO2	Potentiometry		ABG: 0d- 28d: 27- 40 mmHg 29d- 12m: 27- 41 mmHg 1y - 200 y: Male: 35- 48 mmHg Female: 35- 45mmHg VBG: 40.0 - 61.0 mmHg
pO2	Optical		ABG: 0d- 40y: 83- 108 mmHg 41y- 200 y: 72- 103 mmHg VBG: 18 - 59 mmHg
HCO3	Calculated test		ABG: 21.0 - 29.0 mmol/L VBG: 20.0 - 28.0 mmol/L
SpO2	Calculated test		ABG: 94.0 - 98.0 % VBG: 70 - 80 %
BE	Calculated test		ABG: - 7.0 to 2.0 VBG: - 6.0 to 2.0
Lactate	Amperometry		ABG: 0.4 - 0.8 mmol/L VBG: 0.6 - 1.4 mmol/L

NB: *ABG - Arterial blood gases, VBG - Venous blood gases*

Urine Full Examination Microscopy Examination (FEME)

A) Macroscopic Examination

(reported in CDL, HASA)

TESTS	METHOD	REFERENCE RANGE/UNIT
Bilirubin	Diazonium salt	<8.5 µmol/L
Erythrocytes	Peroxidase- like activity of Hb	0.3 mg/L
Glucose	Glucose oxidase/peroxidase reaction	<2.8 mmol/L
Ketone	Legal's test	<0.5 mmol/L
Leucocytes	Indoxyl ester with diazonium salt	<25 Leu/µL
Nitrite	Griess test	Negative
pH	pH indicator	5.0 - 9.0
Protein	Protein error of a pH indicator	<0.1 g/L

(reported in CDL, PPUiTM Sg Buloh)

TESTS	METHOD	REFERENCE RANGE/UNIT
Bilirubin	Diazonium salt	Negative
Erythrocytes	Peroxidase- like activity of Hb	<18 Ery/µL
Glucose	Glucose oxidase/peroxidase reaction	<1.4 mmol/L
Ketone	Legal's test	<0.34 mmol/L
Leucocytes	Indoxyl ester with diazonium salt	<10 Leu/µL
Nitrite	Griess test	Negative
pH	Hydrogen ions concentration	5.0 - 9.0
Protein	Protein error of a pH indicator	<0.3 g/L
Specific gravity	Detection of ion concentration (Presence of cation, protons are released and produce color change)	1.003 - 1.035
Urobilinogen	Ehrlich's Test	< 17 µmol/L

B) Microscopic Examination

TYPE OF SEDIMENTS	NORMAL FINDINGS
Erythrocytes	< 5 cells/µL
Leucocytes	<10 cells/µL
Epithelial cells	Renal tubular - negative Other epithelial cells < 10
Hyaline cast	Occasional (1 - 5 casts)
Epithelial cast	Negative
Erythrocyte cast	Negative
Granulated cast	Negative
Leucocyte cast	Negative
Crystals	Negative
Bacteria	Negative
Yeast cells	Negative

Appendix 3: Additional Rejection Criteria, Chemical Pathology

1. HbA1c request is less than 8 weeks from the previous testing.
2. TSH request is less than 6 weeks from the previous testing.
3. Hs troponin T will be rejected when sample is haemolyzed (haemolytic index≥100).
4. Hs troponin I will be rejected when sample is haemolyzed (haemolytic index≥400).
5. Insufficient amount of urine:
    a. Urine drug of toxicology - less than ¾ universal urine container.
    b. Urine drug of abuse - less than ½ universal urine container.
    c. Urine 24- hour cortisol and catecholamines - less than 750ml.
6. Renin test is requested without aldosterone.
7. Renin and aldosterone samples are collected at different sampling times.
8. Free PSA is rejected when total PSA result is not within 2.5 - 10 ng/ml.

Appendix 4: Clinical Indication for Haematology and Transfusion Medicine Requests

Tests	Clinical Indications
CBC	Enquiry of general haematology status. Suspected anaemia, polycythaemia, thrombocytosis, thrombocytopenia, leucocytosis, leucopoenia, leukaemia.
CBC+DIFF	Enquiry of general haematology status. Suspected anaemia, polycythaemia, thrombocytosis, thrombocytopenia, leucocytosis, leucopoenia, leukaemia. All subsets of leucocytes can be investigated.
Reticulocytes	To differentiate acute from chronic anaemia.
ESR	Inflammation marker which is a non- specific test used to help diagnose conditions associated with acute and chronic inflammation, including infections, cancers, and autoimmune diseases.
PBF	General enquiry of haematology status, validation of blood count results and monitoring haematological abnormalities or haematological responses to disease or inflammation/infection.
PT/INR	General haemostasis test monitors clotting function when treated with warfarin (anticoagulant/anticlotting) therapy.
APTT	General haemostasis test monitors clotting function when treated with heparin (anticoagulant/anticlotting) therapy. Suspected haemophilia or inhibitors.
Fibrinogen	Suspected dysfibrinogenaemia, hypofibrinogenaemia.
Thrombin Time	Enquiry of clotting mechanism of the blood. Suspected haemostatic disorder, disseminated intravascular disorder (DIC), heparin contamination.
D- Dimer	D- dimer concentration is determined by a blood test to help diagnose thrombosis. Suspected thrombotic disorders, e.g. Deep vein thrombosis (DVT) or pulmonary embolism (PE). In patients suspected of disseminated intravascular coagulation (DIC), D- dimers may aid in the diagnosis. Its main use is to exclude thromboembolic disease where the probability is low.
GSH	A test that is requested where patient's blood sample will be typed for ABO and Rh(D) grouping and screened for the unexpected antibody. It is ordered when there is any chance that the patient may require blood during admission. A GSH protocol should be used in accordance with the locally established Maximum Surgical Blood Order Schedule (MSBOS).
GXM	GXM shall be requested for cases with high possibility for blood transfusion. Indications for transfusion are (1) active bleeding/blood loss, (2) low haemoglobin level, (3) comorbidities (i.e. CAD), (4) symptomatic anaemia and (5) age.
DCT	A screening test to check for the presence of antibodies (and/or complement proteins) that are bound to the surface of red blood cells (RBCs). This test is used to determine whether the cause of red cell haemolysis is due to antibodies/complements that are attached to RBCs.

Appendix 5: Routine Haematology Test & Reference Range

	Unit	Men (Adult)	Women (Adult)	Children (7M - 12M)	Children (2Y - 6 Y)	Children (6Y - 12Y)
WBC	*x109/L*	*4 - 10*	*4 - 10*	*6 - 16*	*5 - 15*	*5 - 13*
RBC	*x1012/L*	*4.5 - 5.5*	*3.8 - 4.8*	*3.9 - 5.1*	*4.0 - 5.2*	*4.0 - 5.2*
HGB	*g/dL*	*13.0 - 17.0*	*12.0 - 15.0*	*11.1 - 14.1*	*11.0 - 14.0*	*11.5 - 15.5*
HCT	*%*	*40 - 50*	*36 - 46*	*30 - 38*	*34 - 40*	*35 - 45*
MCV	*fL*	*83 - 101*	*83 - 101*	*72 - 84*	*75 - 87*	*77 - 95*
MCH	*pg*	*27 - 32*	*27 - 32*	*25 - 29*	*24 - 30*	*25 - 33*
MCHC	*g/dL*	*31.5 - 34.5*	*31.5 - 34.5*	*32.0 - 36.0*	*31.0 - 37.0*	*31.0 - 37.0*
PLT	*x109/L*	*150 - 410*	*150 - 410*	*200 - 550*	*200 - 490*	*170 - 450*
NEUT	*%*	*40 - 80*	*40 - 80*	*-*	*-*	*-*
LYMP	*%*	*20 - 40*	*20 - 40*	*-*	*-*	*-*
MONO	*%*	*2 - 10*	*2 - 10*	*-*	*-*	*-*
EOS	*%*	*1 - 6*	*1 - 6*	*-*	*-*	*-*
BAS	*%*	*0 - 2*	*0 - 2*	*-*	*-*	*-*
NEUT	*x109/L*	*2.0 - 7.0*	*2.0 - 7.0*	*1.0 - 7.0*	*1.5 - 8.0*	*2.0 - 8.0*
LYMP	*x109/L*	*1.0 - 3.0*	*1.0 - 3.0*	*3.5 - 11.0*	*6.0 - 9.0*	*1.0 - 5.0*
MONO	*x109/L*	*0.2 - 1.0*	*0.2 - 1.0*	*0.2 - 1.0*	*0.2 - 1.0*	*0.2 - 1.0*
EOS	*x109/L*	*0.02 - 0.5*	*0.02 - 0.5*	*0.1 - 1.0*	*0.1 - 1.0*	*0.1 - 1.0*
BAS	*x109/L*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*
Reticulocytes	*%*	*0.5 - 2.5*	*0.5 - 2.5*			
Reticulocytes	*x109/L*	*50 - 100*	*50 - 100*	*30 - 100*	*30 - 100*	*30 - 100*

Adapted from Haematological Values, Dacie's Book, Practical Haematology, 11th Edition, 2012

Parameter	Unit	0D - 2D	3D - 6D	7D - 13D	14D - 30D	31D - 60D	61D - 90D	91D - 180D
WBC	*$x10^9/L$*	*10 - 26*	*7 - 23*	*6 - 22*	*6 - 22*	*5 - 19*	*5 - 15*	*6 - 18*
RBC	*$x10^{12}/L$*	*5.0 - 7.0*	*4.0 - 6.6*	*3.9 - 6.3*	*3.6 - 6.2*	*3.0 - 5.4*	*3.1 - 4.3*	*4.1 - 5.3*
HGB	*g/dL*	*14.0 - 22.0*	*15.0 - 21.0*	*17.1 - 17.9*	*16.1 - 16.9*	*11.5 - 16.5*	*9.4 - 13.0*	*11.1 - 14.1*
HCT	*%*	*45 - 75*	*45 - 67*	*42 - 66*	*31 - 71*	*33 - 53*	*28 - 42*	*30 - 40*
MCV	*fL*	*100 - 110*	*92 - 118*	*88 - 126*	*86 - 124*	*92 - 116*	*87 - 103*	*68 - 84*
MCH	*pg*	*31 - 37*	*31 - 37*	*31 - 37*	*31 - 37*	*30 - 36*	*27 - 33*	*24 - 30*
MCHC	*g/dL*	*30 - 36*	*29 - 37*	*28 - 38*	*28 - 38*	*29 - 37*	*29 - 36*	*30 - 36*
PLT	*$x10^9/L$*	*100 - 450*	*210 - 500*	*160 - 500*	*170 - 500*	*200 - 500*	*210 - 650*	*200 - 550*
NEUT	*$x10^9/L$*	*4 - 14*	*3 - 5*	*3 - 6*	*3 - 7*	*3 - 9*	*1 - 5*	*1 - 6*
LYMP	*$x10^9/L$*	*3 - 8*	*2 - 8*	*3 - 9*	*3 - 9*	*3 - 16*	*4 - 10*	*4 - 12*
MONO	*$x10^9/L$*	*0.5 - 2.0*	*0.5 - 1.0*	*0.1 - 1.7*	*0.1 - 1.7*	*0.3 - 1.0*	*0.4 - 1.2*	*0.2 - 1.2*
EOS	*$x10^9/L$*	*0.1 - 1.0*	*0.1 - 2.0*	*0.1 - 0.8*	*0.1 - 0.9*	*0.2 - 1.0*	*0.1 - 1.0*	*0.1 - 1.0*
BAS	*$x10^9/L$*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*	*0.02 - 0.1*
Reticulo-cytes	*$x10^9/L$*	*120 - 400*	*50 - 350*	*50 - 100*	*50 - 100*	*20 - 60*	*30 - 50*	*40 - 100*

Coagulation Test	Unit	Male	Female	Remarks
Prothrombin Time (PT)	*Seconds*	*12 - 15*		*Normal range depends on changes of reagent lot number*
Activated Partial Thromboplastin Time (APTT)	*Seconds*	*31 - 47*		
Fibrinogen	*g/L*	*2 - 4*		
Thrombin Time	*Seconds*	*14 - 21*		
INR		*Therapeutic range 2.0 - 3.0*		

Appendix 6: Maximum Surgical Blood Ordering Schedule (MSBOS)

Name of Procedure		GSH/GXM
Cardiology		
1	Cardiac catheterisation	GSH
2	Coronary angiogram	GSH
3	Pacemaker insertion	GSH
Cardiothoracic		
1	VATS	
	+bullectomy	GSH
	+lobectomy	3
2	CABG	4
3	CABG with preoperative autologous blood donation (PABD)	4 - n (n = no. of PABD bag)
4	Minimally invasive cardiac surgery (MICS)	2
5	Valve repair i.e., MVR, atrial etc.	4
Obstetrics & Gynaecology		
1	Vaginal hysterectomy	GSH
2	Total abdominal hysterectomy (TAH)	2
3	Total abdominal hysterectomy with bilateral salpingo-oophorectomy (TAHBSO)	2
4	Myomectomy	2
5	Ovarian Cystectomy	GSH
6	Termination of pregnancy - Dilatation & Curettage (D&C)	GSH
7	Vaginal repair	GSH
8	Manual removal of placenta (MRP)	GSH
9	Caesarean section	2
10	Evacuation under anaesthesia for Postpartum haemorrhage (PPH)	2
11	Total Laparoscopic Hysterectomy	GSH
12	Laparoscopic Sacrocolpopexy	GSH
13	Transcervical Resection of Myoma (TCRM)	GSH
14	Ectopic pregnancy (not ruptured); laparoscopy	GSH
15	Ectopic pregnancy (ruptured); laparoscopy/ laparotomy	2
16	Diagnostic hysteroscopy	GSH
General Surgery		
1	Abdominal- perineal resection	2
2	Cholecystectomy	GSH
3	Gastrectomy	2
4	Hemicolectomy, small bowel resection	GSH

Name of Procedure		GSH/GXM
5	Hiatus hernia repair: Abdominal	GSH
6	Anterior resection	2
7	Perforated viscus	GSH
8	Mastectomy	GSH
9	Oesophagectomy	4
10	Pancreatectomy	4
11	Portocaval shunt	4
12	Splenectomy	2
13	Thyroidectomy, parathyroidectomy	GSH
14	Varicose veins	GSH
15	Vagotomy	GSH
16	Whipple's procedure	4
17	Exploratory Laparotomy (for bleeding)	4
18	Resection of retroperitoneal tumour	4
19	Hepatectomy	4
Orthopaedic		
1	Femoral osteotomy	2
2	Fractured humerus for fixation	GSH
3	Fractured femur for internal fixation	2
4	Laminectomy, spinal fusion	2
5	Harrington rods	4
6	Putti- Platt shoulder repair	GSH
7	Total hip replacement	2
8	Total knee replacement	GSH
9	Total shoulder replacement	GSH

* Last updated in March 2021

Appendix 7

Hospital UiTM

REQUEST FORM FOR TRANSFUSION REACTION INVESTIGATION (BLOOD AND BLOOD COMPONENTS)

1. When a patient has an adverse reaction to any blood or blood component, **STOP** transfusion immediately. **URGENTLY** inform the doctor in charge of the patient and the Blood Bank.

2. Report all reactions and do the following:

   2.1 Preserve the blood bag and giving set with all attached labels. Seal it securely and send immediately to the Blood Bank.

   2.2 Send the following samples for transfusion reaction investigation to the Blood Bank or relevant laboratory.

   a. Post-transfusion sample I (immediately)
      I. 3 mls of blood in EDTA tube
      II. 3 mls of blood in plain tube
      III. urine for haemoglobinuria

   b. Post-transfusion sample II (after 24 hours)
      I. 3 mls of blood in EDTA tube
      II. 3 mls of blood in plain tube
      III. urine for haemoglobinuria

   3.3 Please send for other appropriate investigations if necessary.

   2.4 Please refer to Section 10: Adverse effect of transfusion in Handbook on Clinical Use of Blood for details.

Hospital: ..... Ward/Clinic: .....

Patient's name: ..... IC/Passport No: .....

Race: ..... Age: ..... Sex: .....

Diagnosis.....

i. Date and time transfusion started .....

ii. Date and time of onset of reaction .....

iii. Blood/ Blood Component Serial No. .....

iv. Volume Blood/ Blood Component transfused .....

v. Blood Pressure: Before transfusion ..... After transfusion .....

Effective Date of Use:

Adapted from Transfusion Practice Guidelines for Clinical and Laboratory Personnel, National Blood Centre, Malaysia.

vi. Temperature: Before transfusion …… After transfusion ……

vii. Nature of Reaction: Tick off (√) the positive symptoms/signs.

Fever	☐ Shock	☐ Haematuria	☐
Chills /Rigors	☐ Jaundice	☐ Haemoglobinuria	☐
Urticaria	☐ Dyspnoea	☐	
Pain	☐ (Location of pain if present.....……)		

viii. Solution used for starting IV drip: - N.Saline / 5% Dextrose / Others ……

ix. History of previous transfusion: Yes / No

Date of last transfusion: ……

x. History of previous transfusion reaction if any:

……

……

xi. Medication (If any, please specify):

……

xii. Applicable for female patients ONLY:

History of pregnancy: Yes / No No. of pregnancies: ……

History of abortion: Yes / No No. of abortions: ……

xiii. History of transplant: ……

Date of transplant: ……

*Please describe the event in chronological order if multiple bags of blood/blood products are transfused per admission (as attachment)

Date: …… Signature: ……

Name: ……

PLEASE SEND THIS FORM TO THE BLOOD BANK WITH ALL REQUIRED SAMPLES FOR INVESTIGATION

Effective Date of Use:

Adapted from Transfusion Practice Guidelines for Clinical and Laboratory Personnel, National. Blood Centre, Malaysia.

Appendix 8: Rejection Criteria, Haematology & Transfusion Medicine

A) In - house test

Test	Reason of rejection/ Rejection Criteria
Activated Partial Thromboplastin Time	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%
CBC + Differential	Clotted, Lipaemic, Insufficient
Coagulation Screen	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%
Complete Blood Count	Clotted, Lipaemic, Insufficient
DIVC Screen	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%
Erythrocyte Sedimentation Rate	Haemolysed, Insufficient, Clotted
Quantitative D- Dimer	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%
Fibrinogen	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%
G6PD	Post- transfusion sample
Mixing Test	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%, Not clinically indicated (Use of anticoagulant has not been ruled out)
Peripheral Blood Film	Clotted, Lipaemic, Insufficient, Clotted
Prothrombin Time	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%
Reticulocyte Count	Clotted, Lipaemic, Insufficient
Thrombin Time	Haemolysed, Insufficient, Overfilled, Clotted, HCT >55%

B) Outsourced test

Test	Outsourced institution	Reason of acceptance	Reasons of Rejection/ Rejection criteria
ALL screen (E2A - PBX1, ETV6 - RUNX1, MLL - AF4, BCR - ABL e1a2, SIL - TAL1)	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection.
AML screen (RUNX1 - RUNX1T1, CBFB - MYH11)	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection.
Anti - A & Anti - B titre	PDN	1 EDTA tube (4ml)	Insufficient sample, improper tube collection.
Antibody Identification	PDN	1 EDTA tube (2ml), 1 plain tube (4ml) - red stopper	Insufficient sample, improper tube collection.
Antibody Identification (Extended)	PDN	1 EDTA tube (2ml), 1 plain tube (4ml) - red stopper	Insufficient sample, improper tube collection.
Anti - D titre	PDN	1 EDTA tube (2ml), 1 plain tube	Insufficient sample, improper tube collection.

Test	Outsourced institution	Reason of acceptance	Reasons of Rejection/ Rejection criteria
		(4ml) - red stopper	
BCR - ABL1 detection (e1a2, e13a2, e14a2)	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection.
BCR - ABL1 quantitation (e13a2, e14a2)	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection.
BCR - ABL1 TKD Mutation Analysis	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection.
CD4/CD8	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection.
Chromosomal analysis (Karyotyping) for Oncology	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
Chromosomal analysis for post- natal case	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
DNA analysis for Alpha Thalassaemia	HKL	Minimum 4ml fresh EDTA blood	Repetitive request, only done once, no Hb analysis done before the request.
DNA analysis for Beta Thalassaemia	PPUKM	Minimum 4ml fresh EDTA blood	Repetitive request, only done once, no Hb analysis done before the request.
Erythropoietin	PPUM	4ml of a plain tube (red stopper)	Haemolysed blood, improper tube collection.
Factor IX Assay (Haemophilia B)	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, wrong indication for test, not following the PDN Guidelines.
Factor VIII Assay (Haemophilia A)	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, wrong

Test	Outsourced institution	Reason of acceptance	Reasons of Rejection/ Rejection criteria
		immediately	indication for test, not following the PDN Guidelines.
Factor VIII Inhibitor	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, wrong indication for test, not following the PDN Guidelines.
Factor XIII Assay	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, wrong indication for test, not following the PDN Guidelines.
Factor Assay: Others	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately.	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, wrong indication for test, not following the PDN Guidelines.
FISH: IGH Break Apart Probe (14q32.3)	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FISH- (CLL): P53/ATM, D13S319/ 13q34/ CEP12	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FISH- (MDS): D7S522/ CEP7	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FISH- (MDS): CSF1R/ D5S23, D5S721	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FISH- (MDS): E.G.R1/ D5S23, D5S721	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.

Test	Outsourced institution	Reason of acceptance	Reasons of Rejection/ Rejection criteria
FISH- (MM): D13S319/ 13q34	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FISH- (MM): IGH/ FGFR3	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FISH- (MM): IGH/ MAF	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FISH- (MM):TP53	PPUKM	Lithium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
Flow Cytometry (Immunophenotyping) - Bone Marrow	PPUKM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
Flow Cytometry (Immunophenotyping) – Whole Blood	PPUKM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
FLTT3- ITD/D835 mutation	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
G6PD Enzyme Level	PPUKM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
Hb Analysis	HKL	Minimum 4ml fresh EDTA blood	Repetitive request, only done once, post- transfusion sample.
HLA Typing Class I (Loci A, B, C) - High Resolution (SBT)	IMR	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Typing Class I (Loci A, B, C) - High Resolution	IMR	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper

Test	Outsourced institution	Reason of acceptance	Reasons of Rejection/ Rejection criteria
(SSO) - per locus			tube collection, sample sent without an appointment.
HLA Typing Class I (Loci A, B, C) - Low Medium Resolution (SSP)	IMR	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Typing Class I & II (Loci A, B, DR)	IMR	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Crossmatching (CDC)	IMR	1 plain tube (4ml) - red stopper, 1 sodium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Crossmatching (Flow Cytometry)	IMR	1 plain tube (4ml) - red stopper, 1 sodium heparin tube	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Typing Class II (Loci DR, DQ) - Low Medium Resolution (SSP)	IMR	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Typing Class II (Loci DR, DQ) - High Resolution (SBT)	IMR	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Typing Class II (Loci DR, DQ) - High Resolution (SSO) - per locus	IMR	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
HLA Antibody Test	IMR	1 plain tube (4ml) - yellow stopper	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
JAK V617F	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
JAK2 ex12/MPL ex10 mutation	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper

Test	Outsourced institution	Reason of acceptance	Reasons of Rejection/ Rejection criteria
			tube collection, sample sent without an appointment.
Lymphocyte Subset - Full (B & T Cell)	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
NPM1 mutation	PPUM	Minimum 4ml fresh EDTA blood	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
Osmotic Fragility	PPUM	Special heparinised bottle (from PPUM)	Aging sample (>24hours), insufficient sample, improper tube collection, sample sent without an appointment.
Platelet Antibody Screening	PDN	By appointment, 3 bottles of citrate tube	No appointment, wrong sample collection.
PML- RARA detection (bcr1, bcr2, bcr3)	PPUM	Minimum 4ml fresh EDTA blood	Aging sample, insufficient sample.
Protein C	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, a wrong indication of the test, acute thrombosis event, not following the PDN Guidelines.
Protein S	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, a wrong indication of the test, acute thrombosis event, not following the PDN Guidelines.
Thrombophilia Profile	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, a wrong indication of the test, acute thrombosis event, not following the PDN Guidelines.

Test	Outsourced institution	Reason of acceptance	Reasons of Rejection/ Rejection criteria
von Willebrand Studies	PDN	3 bottles of citrate tube double spin, stored frozen - 80C or else send immediately	Repetitive request (within 6 months of the last request), improper sample collection, inadequate history, a wrong indication of the test, acute thrombosis event, not following the PDN Guidelines.

Appendix 9: Turnaround time (TAT) for in-house & outsource tests in Medical Microbiology & Parasitology.

1. **TAT of in-house test**

NO	LIST OF TESTS	TAT
Bacteriology and serology		
1.	Culture and Sensitivity - All samples	2- 5 days
2.	FEME	48 hours
3.	Blood Culture C&S - Preliminary results	1 hour
4.	Positive/Detected Acid Fast Bacilli (AFB) on Modified Kinyoun Stain	1 working day
5.	RPR	Run twice a week 3 - 7 days
Virology and serology		
6.	Serology Test i) Anti - HIV ii) HBsAg iii) Anti HCV iv) Anti HBs v) Treponema pallidum Ab	Run twice a week 3 times/ week
7.	Needle Stick Injury i) Anti- HIV ii) HBsAg iii) Anti HCV iv) Anti HBs v) HIV particle agglutination (PA)	2 hours
8.	SARS CoV-2 RTK Ag	1 hour
Mycology		
9.	Culture & Sensitivity	14 days
Parasitology		
10.	BFMP	3 hours
11.	Microfilaria microscopy	1 WD
12.	*Trichomonas vaginalis* wet mount	1 WD
13.	Ova and cyst microscopy	1 WD
Immunology		
14.	i) ANA ii) RF IgM iii) ENA iv) Anti CCP	3- 7 days (Run once a week)
Molecular Microbiology		
15.	SARS-CoV-2 rRT-PCR	2 - 3 days

16.	Gene Xpert for SARS-CoV-2 Detection	3 hours
17.	Gene Xpert MTB/RIF Ultra for MTB Detection	1 WD

2. TAT (outsourced tests)

NO	LIST OF TESTS	OUTSOURCED LABORATORY	TAT
	IMMUNOLOGY		
1.	Antinuclear cytoplasmic antibody (ANCA) p- ANCA c- ANCA	LABLINK	7- 10 WD
2.	Tryptase		
3.	Liver Autoantibody Screening 1. Anti- mitochondrial antibody (AMA) 2. Anti- Smooth Muscle Ab (ASMA) 3. Anti- Liver Kidney Microsomal Ab (anti- LKM) 4. Anti- Gastric Parietal Cell Ab (GPC)		
4.	Ig A Ig M Ig G Ig E		
	BACTERIOLOGY AND SEROLOGY		
5.	*Brucella* IgG *Brucella* IgM		
6.	*Melioidosis IgM*	IMR	7- 10 working days
7.	*Total IgE* *IgE to Aspergillus*		
8.	*Bartonella Ab total*		
9.	*HLA- B27*		
10.	*Legionella Antigen*	LABLINK	7- 10 working days
11.	*Leptospira IgM*		
12.	*Rickettsial antibody*		
13	*Toxoplasma IgG* *Toxoplasma IgM*		
14.	*Mycoplasma Ab Total*		
15.	*Chlamydophila pneumoniae/* *C.trachomatis/C.psittaci antibody*		
16.	*Antistreptolysin O antibody titre (ASOT)*		
17.	*TB Culture*	Universiti Malaya Medical Centre/	2 months

NO	LIST OF TESTS	OUTSOURCED LABORATORY	TAT
		LABLINK	
18.	*TB PCR/ Line Probe Assay*		3 WD
19.	*Anti- cardiolipin antibody*		7- 10 WD
20.	*TPPA/TPHA*	HSB/LABLINK	7- 10 WD
VIROLOGY AND SEROLOGY			
21.	Adenovirus Antigen (IF)	HSB	7- 10 WD
22.	Cytomegalovirus IgM		
23.	Cytomegalovirus IgG		
24.	Dengue IgM & IgG		
25.	NS1 Antigen (Dengue)		
26.	Enterovirus Antigen (IF)		
27.	*Epstein Barr Virus* IgM		
28.	*Epstein Barr Virus* IgG		
29.	Hepatitis B e Antigen (HBeAg)		
30.	Hepatitis B e Antibody (HBeAb)		
31.	Hepatitis A Virus IgM		
32.	Hepatitis B core IgM (HBc IgM)		
33.	Hepatitis B core total antibody (HBc total Ab)		
34.	*Herpes simplex* Type 1 & 2 Antibody (IgM)		
35.	*Herpes simplex* Type 1 & 2 Antibody (Ig G)		
36.	HIV 1 &2 (Western Blot)		
37.	Influenza A Virus Antigen (IF)		
38.	Influenza B Virus Antigen (IF)		
39.	Influenza C Virus Antigen (IF)		
40.	Japanese encephalitis Antibody (IgM)		
41.	Japanese encephalitis Antibody (IgG)		
42.	Japanese encephalitis Antibody (IgM)		
43.	Measles Virus Antibody (IgM)		
44.	Measles Virus Antibody (IgM)		
45.	Mumps Virus Antibody (IgM)		
46.	Mumps Virus Antibody (IgG)		
47.	Nipah Virus Antibody (IgM)		
48.	Nipah Virus Antibody (IgG)		
49.	Rubella IgG		

NO	LIST OF TESTS	OUTSOURCED LABORATORY	TAT
50.	Rubella IgM		
51.	HBV DNA	GENEFLUX	3 days
52.	HCV RNA		
53.	HIV RNA		7 - 10 days
54.	JK and BK Virus		7 - 10 days
55.	CMV PCR		7 - 10 days
56.	*Coxiella burnetti* antibody	Innoquest	7 - 10 days
MYCOLOGY			
57.	*Histoplasma* antibody	HSB	7- 10 days
58.	*Pneumocystis jirovecii molecular* Qualitative	GENEFLUX	3 days
PARASITOLOGY			
59.	Coccidian Oocysts (*Cryptosporidium, Isospora, Cyclospora*) - special staining methods	HSB	7- 10 days

Appendix 10: Guidelines for Rejection Criteria, Medical Microbiology & Parasitology Specimens

GENERAL:

- No patient identification on test request form/order.
- No patient identification on specimen container or slides.
- A mismatch between the name of the patient on the specimen and the name on the test request form/order.
- No sample origin/source.
- No test indicated on test request form/order.

SPECIFIC:

Improper specimen collection/quality and transportation

- Unsterile /wrong collection container.
- Specimen leaked from the container.
- Dry swab.
- Specimens for culture were received in fixative (formalin).
- No/absence of specimen in a container.
- Insufficient quantity- insufficient specimen to perform testing.
- Improper transport medium.
- Urine specimen collected more than 6 hours before receiving in the laboratory.
- Duplicate specimens were collected within a 24- hour period (except for blood culture in cases whereby infective endocarditis is suspected).
- Lysed serum for serological tests.
- Specimens are more than 24 hours from the time of collection.
- Any specimen deemed unsuitable for the request (after consultation with Clinical Microbiologist).

NOTE:

The following specimens are deemed ***precious,*** and the laboratory should **accept** the specimens even though they may fall under the rejected specimen category.

Precious *specimens*: Specimens are regarded as precious when the specimens are difficult to obtain, involve an invasive procedure and if rejected will be subject to difficulties/problems in obtaining new specimens.

These specimens include but are not limited to the following:

1. **Specimens** obtained via invasive procedures
    - Biopsy specimen
    - Bone marrow aspirate
    - Broncho alveolar lavage
    - Pus aspirates performed under imaging guidance
    - Sterile fluids (except blood culture)
        - CSF
        - Pericardial fluid
        - Pleural fluid

- Peritoneal fluid
- Synovial fluid
- Amniotic fluid (via amniocentesis)
- Urine obtained via suprapubic aspiration

2. **Specimens** obtained during surgical procedures in operation theatre
3. **Medico**- le.g.al specimens
4. **Autopsy** specimen