AMENDMENT SUMMARY
TO
CLINICAL LABORATORY HANDBOOK (CLH) 1ST EDITION VERSION 1, YEAR 2021

Page in CDL Handbook	Item in CLH	Amendment	Page in this amendment summary
iii	ORGANIZATION CHART DEPARTMENT OF CLINICAL DIAGNOSTIC LABORATORIES	The CDL organisation chart is updated.	1
iv	ORGANIZATION CHART INTERNATIONAL STANDARD ORGANIZATION (ISO) 15189 MEDICAL LABORATORIES COMMITTEE	The ISO Organization chart is updated.	2
v	DEFINITION	The title of the page is amended to TERMINOLOGY. Addition of terminologies to the list. Refer to page.	3
1-9	GENERAL OPERATING POLICIES	This section is extensively revised following the extension of CP and H & TM units and the relocation of MMP and AP units to HASA affecting the overall general operating procedure with subheadings as below: a) Organisation Structure Addition of page v for "MSQH CARTA ORGANISASI" b) JABATAN MAKMAL DIAGNOSTIK KLINIKAL c) LOCATION d) OBJECTIVES e) OPERATION HOURS f) SPECIMEN RECEPTION COUNTER (SRC) g) SPECIMEN RETENTION / TEST ADDITIONS h) ENQUIRY, FEEDBACK, SUGGESTION, COMPLAINTS & CUSTOMER SATISFACTION SURVEY	4
10	PHONE DIRECTORY	The current head of the department: Dr Noraziah Binti Sahlan Head of Department Phone number: 03-3396 3000 ext 10801	-
10	PHONE DIRECTORY	Clerk: Phone number: 03-3396 3000 ext 10802	-

		The current head of Unit (Chemical Pathology) Assoc. Prof. Dr. Noor Alicezah Mohd Kassim Head of Unit (Chemical Pathology) & Pathologist Phone number: 03-6126 7399	-
		A Chemical Pathologist is added in the list; Assoc. Prof. Dr Aletza Mohd. Ismail Senior Consultant Pathologist 03-6126 7396	-
		The current head of the Unit Haematology and Transfusion Medicine Dr Zalizah binti Khalid Head of Unit (Haematology and Transfusion Medicine) & Pathologist 03-6126 7393	-
11		The current head of the Unit Anatomic Pathology Dr Awla Binti Azrai Head of Unit (Anatomic Pathology) & Pathologist 03-6126 7432	-
12	Medical Genetic unit	The name of the unit is changed to the Genetic Pathology unit.	-
12	Dr Nurul Azira Mohd Shah	Dr Nurul Azira Mohd Shah Document Control Manager & Senior Pathologist	-
CHEMICAL PATHOLOGY			
15	2. SERVICES	The word in the yellow font is corrected for spelling errors. The addendum is in the blue font. **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)	-

15	2. SERVICES	The item **2.2** is added. The addendum is in the blue font. Refer to the page.	14
15	3. REQUEST FORMS 4. SPECIAL COLLECTION PROCEDURES	The addendum is in the blue font. Refer to the page.	15
16	The item number 7 is added. 7. FACTORS AFFECTING LABORATORY RESULT	The addendum is in the blue font. Refer to the page.	16
17	TABLE 1. CRITICAL LIMITS FOR CHEMICAL PATHOLOGY	The addendum is in the blue font. Refer to the page.	20
18	LIST OF TESTS	The addendum is in the blue font. Refer to the page.	21
43	PROFILE TEST	The addendum is in the blue font. Refer to the page.	55
ANATOMIC PATHOLOGY			
46	2) CYTOPATHOLOGY	The words in the yellow font are corrected for spelling errors. Diagnostic and screening services based on the morphologic study of cells. It is divided into two categories: i) Gynaecological-based cytology ii) Non-gynaecological-based cytology – Fine needle aspiration cytology (FNAC), brushings and body fluid cytology. In addition to diagnostic interpretation, the Anatomic Pathology specialty also conducts FNAC clinics and provides in-patient FNAC and rapid on-site (ROSE) evaluation services.	-
50	1.1.2. Liquid-based cytology:	The statement 1.1.2.1 is removed/deleted. 1.1.2.1 Label a clean glass slide with the patient's name and at least one other unique identifier (e.g. NRIC No, MRN no.).	-

51	2.0 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)	The words in the yellow font are corrected for spelling errors. 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.	-
53	3.1 FNAC Clinic	The addendum is in the blue font. **3.1.2** The FNAC clinic is held twice a month in the Radiology Department.	-
54-55	SPECIMEN REPORTING AND TURNAROUND TIME (TAT)	The item numbered **2.6 Turn Around Time (TAT)** is amended. The item numbered **2.7** is added. Refer to the page. The addendum is in the blue font.	60
57	Table: FNAC Specimen type: FNAC of any site (for cell block)	The addendum is in the blue font. Refer to the amended table.	61
58-59	Table: Body Fluid	The addendum is in the blue font. Refer to the amended table.	62
HEMATOLOGY & TRANSFUSION MEDICINE			
60-61	HEMATOLOGY & TRANSFUSION MEDICINE	The addendum is in the blue font. 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: A. Haematology B. 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. The laboratory shares the Specimen Reception Counter with the Chemical Pathology Unit. When specimens are received at the counter, the laboratory staff will stamp the reception time on the respective request form and acknowledge the receipt of the specimen through UniMEDS.	
60-61	1. Services 3. Special Collection Procedures	The addendum is in the blue font.	65
62	6. Reporting of Results	The word in the yellow font is corrected for spelling errors. The addendum is in the blue font.	67
63	TABLE 1: ABNORMAL LIFE - THREATENING HAEMATOLOGY RESULTS	The number of the table is removed and the title of the table is changed to **CRITICAL VALUE IN HAEMATOLOGY RESULT.** The other addendum is in the blue font.	68
64	7. Enquiry for Laboratory Services	The addendum is in the blue font.	69
65	1. Services	The addendum is in the blue font.	70
66	2. Request forms	For item **2.4,** the addendum is in the blue font.	71
67	Table 2: Information for PER-SS-BT 105 form	The number of the table is deleted and the table only has the title "Information for PER-SS-BT 105 form". The addendum is in the blue font.	72
68	3. Specimen Collection	The addendum is in the blue font. **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 platelets, fresh frozen	-

		plasma and cryoprecipitate (where applicable).	
69-71	4. Special Collection Procedures 5. Receipt of Specimen 6. Rejection of Specimen 7. Reporting of Results 8. Issuing, Storage and Transport of Blood and Blood Products to the Ward 9. Administration of Blood and Blood Products	The addendum is in the blue fonts.	74
73	13. Maximum Surgical Blood Ordering Schedule (MSBOS)	13. 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. On the other hand, a **GXM** should be requested for procedures that would likely require a blood transfusion (please refer to the current MSBOS which is updated annually).	-
74	15. Enquiry for Laboratory Services	The addendum is in the blue font.	76
75-79	LIST OF TESTS Table 3: LIST OF IN-HOUSE TESTS FOR HAEMATOLOGY AND TRANSFUSION MEDICINE	The table is updated with amendments in blue fonts. The table number is changed from 3 to 1. Table 1: LIST OF IN-HOUSE TESTS FOR HAEMATOLOGY AND TRANSFUSION MEDICINE	77

80-90	Table 4: LIST OF OUTSOURCED TESTS FOR HAEMATOLOGY & TRANSFUSION MEDICINE	The table is updated with amendments in blue fonts. The table number is changed from 4 to 2. Table 2: LIST OF OUTSOURCED TESTS FOR HAEMATOLOGY & TRANSFUSION MEDICINE	83
MEDICAL MICROBIOLOGY & PARASITOLOGY			
93	6. REPORTING OF RESULTS	The addendum is in the blue font. 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 a sterile clinical specimen. ● A positive blood film for malarial parasites (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.	-
94	8. SUPPLIES	The addendum is in the blue font. The supply of containers relevant to medical microbiology & parasitology examination can be obtained from the central store of CTC Sg. Buloh and HASA.	-
94	10. ENQUIRY OF LABORATORY SERVICES	The addendum is in the blue font. Enquiries regarding the laboratory services can be made at 03-3396 3128/3129	-
95-98	LIST OF TESTS IN-HOUSE & OUTSOURCED TESTS IN MEDICAL MICROBIOLOGY & PARASITOLOGY	The addendum is in the blue font. Refer to the updated table.	93
98	MOLECULAR BACTERIOLOGY	The addendum is in the blue font. Refer to the updated table.	99

99-104	VIROLOGY AND SEROLOGY	The changes are marked in blue font. Refer to the updated table.	100
104	MOLECULAR VIROLOGY	The addendum is in the blue font. Refer to the updated table.	107
105	MYCOLOGY	The addendum is in the blue font. Refer to the updated table.	110
107-108	IMMUNOLOGY	The addendum is in the blue font. Refer to the updated table.	112
APPENDIX			
111	Appendix 1: Chemical Pathology Tests & Clinical Indications	The addendum is in the blue font. Refer to the updated table.	117
115-122	Appendix 2: Chemical Pathology Tests & Reference Ranges	The addendum is in the blue font. Refer to the updated table.	123
123	Appendix 3: Additional Rejection Criteria, Chemical Pathology	The addendum is in the blue font.	136
137-140	Appendix 9: Turn-around time (TAT) for in-house & outsource tests in Medical Microbiology & Parasitology	The addendum is in the blue font. Refer to the updated table.	137

Legend:

blue	addendum/amendment
yellow	corrected spelling/grammatical error
purple	deleted word/ sentence

CARTA ORGANISASI
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DR. NOR SALMAH BAKAR
DR. NORIZAL MOHD NOOR
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CHAIRUL SOPIAN

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SHALWANA SHAFEI
NOR HIDAYAH RAMLI
NURUL AZWANI ABU BAKAR
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NURUL FATIHAH HASANI
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DR. SITI NORBAHIYAH AWAD

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Disemak Oleh:
Nama: Dr. Noraziah Sahlan
Jawatan: Ketua Jabatan
Tarikh: 24 Mei 2023

Disahkan Oleh:
Nama: Prof. Dr. Sazzli Shahlan Kasim
Jawatan: Pengarah
Tarikh: 6 Jun 2023

Punca Kuasa: Mesyuarat Jawatankuasa Pengurusan Hospital Bil. 1/2023 pada 13 Januari 2023
Dikemaskini: 12 April 2023

ISO 15189 COMMITTEE

UNIVERSITI TEKNOLOGI MARA | Hospital Al-Sultan Abdullah

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LABORATORY INFORMATION SYSTEM
SHALWANA SHAFEI

PA: CDL Puncak Alam
SB: CDL Sg Buloh
REP: Representative

Disahkan oleh :

DR NORAZIAH SAHLAN

Kemaskini pada 9.3.2023

TERMINOLOGY

Definition of terminologies used in this handbook:

Critical limits	Boundaries of low and high lab test values beyond which may cause imminent danger to the patient and/or require immediate medical attention.
Critical value (CV)	Test results or value that falls outside the critical limits or the presence of any unexpected abnormal findings, cells or organisms which may cause imminent danger to the patient, and/or require immediate medical attention.
LTAT	Laboratory TurnAround Time. A laboratory turnaround time is defined as the total time taken for a sample to be processed within the laboratory, from its arrival at the reception until a validated result has been released.
Phlebotomy	The removal of blood from a vein using a needle, also known as venepuncture. Phlebotomy may be used to obtain blood for diagnostic tests or as a treatment itself for certain conditions.
Specimen and sample	These terms are often used interchangeably. However, a specimen refers to an item to be characterized biochemically or biologically. Sample refers to a finite portion of that specimen that is taken for analysis.
Specimen collection	Producing a specimen from a patient for laboratory analysis.
Specimen handling	The process of handling, manipulating and storing collected patient's specimens or packaging before transportation.
Specimen transport	The process of transporting the collected, labelled, and packaged patient's specimen for laboratory analysis.
STAT/ Urgent	Short TurnAround Time. A short turnaround time is defined as a minimum time period for known routine LTAT for a test. Requiring immediate action or attention. The abuse or overuse of this status overloads the process and devalues the term when there is a truly urgent situation. It should not be used lightly.
TAT	TurnAround Time. This is a generic term for clinical processes. A total turnaround time is defined as the cumulative time taken for a sample to be processed. It includes the start time at which the sample is taken from a patient, time spent in transportation, its arrival at reception, pre-analysis and post analytical phases until validation by laboratory staff, the result being issued and its subsequent receipt by the requesting physician.

GENERAL OPERATING POLICIES

Page 1-9

INTRODUCTION

The department started its operation in October 2010 as the Centre for Pathology Diagnostics and Research Laboratories (CPDRL) before Pathology and Medical Microbiology & Parasitology (MMP) became two separate departments. The laboratory was awarded the MS ISO 15189:2007 accreditation on the 31st of December 2014. It is continually upgrading test repertoire offered to reflect medical development. The laboratory comprises four (4) specialties including Chemical Pathology (CP), Haematology and Transfusion Medicine (HTM), Anatomic Pathology (AP) and Medical Microbiology and Parasitology (MMP). In 2020, these two departments merged again as the Department of Clinical Diagnostic Laboratories (CDL) to cater to the growing needs of the hospital.

LOCATION

The CDL is located at two (2) facilities of Hospital Universiti Teknologi MARA; Hospital Al-Sultan Abdullah (HASA), UiTM Puncak Alam and Pusat Pakar Perubatan UiTM (PPUiTM) Sungai Buloh. The main laboratory, which is located at Level 1, Block A, HASA, UiTM Puncak Alam provides services in all four (4) specialties while the branch laboratory which is located at Level 1, PPUiTM Sungai Buloh provides CP and HTM services only.

ORGANIZATIONAL STRUCTURE

Refer to pages iii and iv.

OBJECTIVES

- To achieve > 80% customer satisfaction based on Laboratory Customer Survey conducted yearly.
- To conduct an internal audit once a year to ensure compliance with relevant regulatory requirements including MS ISO 15189 and Malaysian Society for Quality in Health (MSQH).
- To attain > 80% of technical personnel attends at least 20 hours per year of training/ CME related to their job.
- To accomplish appropriate Turnaround Time (TAT) for the defined laboratory tests from the subspecialties of Chemical Pathology, Haematology and Transfusion Medicine, Anatomic Pathology and Medical Microbiology and Parasitology.

OPERATION HOURS

The laboratory's operational hours are outlined in the table below:

Location	Unit	Operation Time
CDL, HASA, UiTM Puncak Alam	Chemical Pathology	24 hours
	Haematology & Transfusion Medicine	
	Medical Microbiology & Parasitology	
	Anatomic Pathology (Histopathology & Cytology)	8:00 am-5:00 pm Monday to Friday (excluding public holidays).
CDL, PPUiTM Sg Buloh	Chemical Pathology	24 hours
	Haematology & Transfusion Medicine	

The pathologist and Clinical Microbiologist are available for consultation or assistance during and after office hours for both locations.

SCOPE OF SERVICE

The laboratory provides the following diagnostic and research services:

- ❖Chemical Pathology
- ❖Haematology & Transfusion Medicine
- ❖Anatomic Pathology (Histopathology & Cytology)
- ❖Medical Microbiology & Parasitology

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 the properly collected specimens. In the event of HIS interruption, manual test ordering will be done using the following forms:

- ➢ Chemical Pathology/Haematology: Pink
- ➢ Anatomic Pathology (Histopathological Examination /HPE, Fine Needle Aspiration Cytology/FNAC, & Non-Gynaecology): White
- ➢ Anatomic Pathology (Pap Smear): Blue
- ➢ Medical Microbiology/Parasitology: Green

Standard request form KKM - PER PAT-301 and PDN format form should be used for outsourced tests where relevant.

Relevant clinical information with provisional diagnosis and treatment should be provided to ensure the acceptance of requests.

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 "STAT" option on the UniMEDS.

PATIENT IDENTIFICATION

Proper patient identification is crucial to ensure that specimen is being drawn from the individual designated on the online request form in HIS. In areas where a physician/medical officer/nurse/staff draws laboratory specimens, proper patient identification and specimen labelling will be the responsibility of the physician/nurse.

Compare information from the patient with the online request form and/or the patient's identification tag/bracelet.

In the event, the patient is unconscious, young, special needs, or unable to speak the language of the phlebotomist, a nurse, next of kin, or friend should be asked to identify the patient.

SPECIMEN COLLECTION

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

- **Procedure for venepuncture**

  - ➢ Verify the patient's diet restrictions.
  - ➢ 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.
- 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.
- The acceptable order of draw for multiple samples is:
  - Blood culture bottle(s)
  - Coagulation tube (Blue-top, sodium citrate tube)
  - Serum tube with or without clot activator, with or without gel (i.e. Yellow/Red-top)
  - Heparin tube (Green-top)
  - EDTA tube (Lavender-top)
  - Glycolytic inhibitor (Grey-top, oxalate fluoride tube)
  - Other additive tubes
- 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

*World Health Organization. (2010). WHO guidelines on drawing blood: best practices in phlebotomy.

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

Urgent requests must be indicated and appropriately labelled.

Note: For blood bank specimens, refer to the Transfusion Medicine section.

SPECIMEN TRANSPORT

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 30^0C
- refrigerated 2 to 8^0C
- frozen -20 to 0^0C

All collected specimens/samples from the patients in the ward, operating theatre, and day care or clinic should be dispatched to the laboratory in the appropriate containers and thereafter put into a biohazard plastic bag. Separate biohazard bags should be used for samples that will be sent to different units and send to the appropriate specimen reception counters. Refer to the specified test list of the individual specialty.

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 the dry ice. Frozen specimens that have been allowed to thaw cannot be refrozen and are unacceptable for analysis.

Place each blood bottle, leakproof aliquot tube, or primary specimen container in a double-layered, biohazard-labelled transport bag. The specimen should be placed in the sealable compartment and the completed requisition slip placed in the outer pouch to prevent contamination. Please ensure the containers and bags are properly sealed to avoid spills.

SPECIMEN RECEPTION COUNTER (SRC)

CDL currently operates in two separate venues; HASA UiTM Puncak Alam and PPUiTM Sg Buloh (refer to Table 1).

1) Main SRC, HASA UiTM Puncak Alam

The main SRC at HASA UiTM Puncak Alam operates daily and receives specimens for 24 hours for Chemical Pathology, Haematology & Transfusion Medicine and Medical Microbiology & Parasitology units. For the Anatomic Pathology unit, the main SRC operates between 8:00 am – 5:00 pm (Monday to Friday; excluding public holidays).

2) Main SRC, PPUiTM Sg Buloh

The main SRC at PPUiTM Sg Buloh operates daily and receives specimens for 24 hours for Chemical Pathology and Haematology & Transfusion Medicine units. Specimens for Anatomic Pathology and Medical Microbiology & Parasitology units will be transported to HASA UiTM Puncak Alam for the tests to be performed.

Table 1: Specimen reception counters at HASA UiTM Puncak Alam and PPUiTM Sg Buloh.

Specimen Reception Counters	Operating hours	Units	Comment
HASA UiTM Puncak Alam	24 hours, Monday – Sunday (including public holidays)	Chemical Pathology, Haematology & Transfusion Medicine and Medical Microbiology & Parasitology	-
	8:00 am – 5:00 pm, Monday to Friday (excluding public holidays).	Anatomic Pathology	
Main SRC, PPUiTM Sg Buloh	24 hours, Monday – Sunday (including public holidays)	Chemical Pathology and Haematology & Transfusion Medicine	Anatomic Pathology and Medical Microbiology & Parasitology specimens will be transported to CDL HASA UiTM, Puncak Alam

The time of specimen received at the counters must be acknowledged by the laboratory personnel.

RESULTS

All the results of in-house tests from various specialties in the laboratory will be validated by the Pathologist & Clinical Microbiologist on duty/Medical Officer/Science Officer/Senior MLT. Clinical advice/consultation on the interpretation of test results is available where necessary or upon request. Preliminary reports / urgent results will be informed to the specialist / medical officer/ staff nurse in charge via phone call and documented. For Chemical Pathology tests, only Troponin T results and critical values will be notified via phone. Tracing and collecting other urgent results are the responsibility of the requester.

All the outsource test results will be acknowledged by the Pathologist/Clinical Microbiologist on duty/Medical Officer/Science Officer. The original results will be dispatched to the ward/clinic. A copy of the outsource test results will be kept in the laboratory for documentation.

SPECIMEN REJECTION

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

- Specimen received without a label or with improper identification
- Unlabelled/mislabelled
- 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

The client or customer will be notified as soon as possible should the test request be unacceptable for any of the above reasons.

SPECIMEN RETENTION / TEST ADDITIONS

Except for unstable specimens (e.g., those for cultures, CBCs, urinalysis), laboratories retain most specimens for several days. If a test is to be added to a specimen that is already in the laboratory or if a repeat assay is requested, these should be communicated to the laboratories via 03 – 6126 5215 for PPUiTM Sg Buloh and 03 – 3396 3000 (ext. 10807) for 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 are acceptable. The add-on test(s) should be ordered in the HIS and a new request form should be sent to the laboratory.

QUALITY MANAGEMENT

The laboratory is subjected to external accreditation by 'Skim Akreditasi Makmal Malaysia (SAMM), MS ISO 15189 (latest version)'. Each of the laboratories runs a comprehensive Quality Management System (QMS), participating in relevant proficiency testing and quality assessment schemes at the national, regional and / international level, and operates a scheduled internal quality audit, corrective action and quality improvement.

The following quality control and quality assurance programmes are carried out in the CDL:

- Reagent assessment
- Method validation to ensure the test method implemented meets the requirement for accuracy, recovery, precision and detection limits.
- Calibration Method
- Quality control Method
- Internal and external quality assurance programme
- Quality system review and audit
- Turnaround time (TAT)

The laboratories comply with safety procedures as specified in the 'Laboratory Safety Manual'.

FUTURE DIRECTION

To make available appropriate skills and subspecialty services to meet the expanding clinical requirements.

To ensure the laboratory abides by standard MS ISO 15189 (latest version).

ENQUIRY, FEEDBACK, SUGGESTION, COMPLAINTS & CUSTOMER SATISFACTION SURVEY

To ensure that we are meeting the needs of our users/clients/customers, the laboratories are always keen to receive any enquiry, comments, and feedback regarding the service provided. We welcome any suggestions to improve the service.

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

CDL, HASA, UiTM I Puncak Alam

Hematology & Transfusion Medicine unit: Cik Halimatun Radziah Othman/ Pn Nurul Hanini Mohd; 03 - 3396 3131

Transfusion Medicine unit: Cik Halimatun Radziah Othman/ En Muhammad Fakhri Sallehuddin; 03-3396 3135

Chemical Pathology unit: Dr Rafezah Razali/ Pn Nurul Iza Ismail/ En Mohammad Shafiq Zahari; 03-3396 3130

Medical Microbiology & Parasitology: Pn. Norzilawati Mohd Isa/ Cik Noor Aini Abu Bakar; 03-3396 3128

Anatomic Pathology: En. Muhamad Idham Mohamed/En. Khairil Idzwan Jamaludin; 03-3396 3127

CDL, PPUiTM, Sg Buloh Campus

Hematology unit: Encik Mohd Nasrul Isham Mohd Jamain; 03- 6126 5209/ 5215

Transfusion Medicine unit: Encik Hamdan Mohd Noor; 03-6126 5209/ 5215

Chemical Pathology unit: Cik Sarina Ali/ Puan Che Wan Juliana Che Wan Jaafar; 03-6126 5213/ 5215

Complaints can be submitted via Quality Improvement and Patient Safety Department (QIPS) or Incident Reporting System website (https://incident.uitm.edu.my/)

The online 'Laboratory Customer Survey' or '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 version) or scan the QR code below to fill in the survey:

Chemical Pathology

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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 PER PAT-301 form or other specified forms must be filled when ordering any outsourced tests.

Additional tests: Additional tests to primary samples can be requested but subjected to sample integrity and sufficiency. Please contact (HASA: 03-339630313130, Sg Buloh: 03-612652155215) prior to a request.

4. SPECIAL COLLECTION PROCEDURES

4.1 24-hour Urine Collection

Most quantitative assays are performed on urine specimens 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 with patient details and "**2HPP**"; indicating 2 Hours Postprandial.
- Send the second sample immediately to the laboratory.

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

- All specimens must be transported to the laboratory without delay.
- The pneumatic tube system has a higher risk of hemolysis if sample is not pre-centrifuged prior to transfer.
- Ideally, clinics and phlebotomy stations should be provided with centrifuges and equipment to process the specimens on site before transportation to the core laboratory.
- Temperature labile analytes or with short half-life e.g. ammonia, ABG, lactate, renin, ACTH, PTH transported chilled (in ice); within 30 minutes.
- 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 (4-8^{0}C) and up to 30 days if stored at -20^{0}C.
- Whole blood for HbA1c ion exchange method is stable for ~ 14-21days when kept at 4^{0}C, but 4–10 days at -20^{0}C.
- 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.

Chemical Pathology

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TABLE 1. 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	Calcium	3.0 mmol/L
0.41 mmol/L	Magnesium	2.0 mmol/L
0.32 mmol/L	Phosphate	2.87 mmol/L
7.2	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	Calcium	3.1 mmol/:
0.5 mmol/L	Magnesium	1.8 mmol/L
0.4 mmol/L	Phosphate	2.8 mmol/L
-	pH	7.6
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)	300 µmol/L
-	CSF-Protein	1.87 g/L
-	Urea	19.0 mmol/L
-	Uric Acid	500 µmol/L
-	TSH (Cord blood)	21.0 mIU/L

Chemical Pathology

Page 18 **LIST OF TESTS (Refer to Clinical Indications and Reference Ranges: App. 1 & 2)**
Updated 1 November 2023

NO.	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTION	DESTINATION
1.	17-hydroxy progesterone	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
2.	5-HIAA, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
3.	Acetaminophen (PCM)	Serum	3 ml	Plain tube	1) Complete PER PAT.301form. 2) Send the form with the sample to CDL immediately.	CDL HASA
4.	Adrenocorticotropic Hormone (ACTH)	Plasma	3 ml	EDTA tube	1) Pre-freeze the tube & syringe overnight before use. 2) Complete PER PAT.301form. 3) After collection, send the sample (IN ICE) and the request form immediately to the laboratory.	UMMC
5.	Alanine Transaminase (ALT)	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
6.	Albumin	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
7.	Albumin - Peritoneal	Peritoneal fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
8.	Albumin CSF	CSF	3 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh

9.	Alcohol Level	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately. *MANDATORY TO USE PLAIN TUBE WITHOUT GEL.	HKL
10.	Aldosterone	Plasma	4 ml	EDTA tube	1) BY APPOINMENT with the laboratory (at least 3 days before blood taking). 2) Complete PER PAT.301 form. 3) Sample volume must be at least 4 ml. 4) Samples must be sent immediately WITHOUT ice. 5) Please DO NOT prechill blood tube and syringe before blood taking. 6) Record patient's posture whether supine or upright in column 'clinical history' on request form. 7) Blood should be taken between 8 am -10 am.	UMMC
11.	Alkaline Phosphatase	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
12.	Alpha 1 antitrypsin	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
13.	Alpha-1-Fetoprotein	Serum	3 ml	Plain tube	1) Send the form with the sample to CDL immediately.. *Run in batch analysis. (call the laboratory for details).	CDL HASA

14.	Aluminium	Serum	6 ml	Plain tube (royal blue)	1) BY APPOINMENT with the laboratory (at least 1 week before blood taking). 2) Get royal blue (plain) tubes from Chem Path laboratory. 3) Complete PER PAT.301 form and send the form and the sample to CDL within 2-4 hours.	UMMC
15.	Amikacin	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
16.	Aminolevulinic acid (Delta -ALA)	Random urine	at least 15 ml	Urine container	1) Get IEM Request form at CDL Specimen Reception Counter. 2) After collection, send the form and the sample to CDL immediately.	IMR
17.	Aminophylline	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	UMMC
18.	Ammonia	Plasma	4.0 ml	Lithium heparin tube in ice	1) BY APPOINMENT with the laboratory (please call the laboratory before sending the sample). 2) Complete PER PAT.301 form. 3) Send the sample with the form immediately to CDL. 4) Keep samples in ice after collection.	UMMC

19.	Amylase	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
20.	Amylase (Other Fluid)	Other fluids	10 ml	Bijou bottle	Send to the laboratory immediately	CDL HASA & Sg Buloh
21.	Amylase (Urine)	Random urine	30 ml	Urine container	Send to the laboratory within 2-4 hours.	CDL HASA & Sg Buloh
22.	Androstenidione	Serum	10 ml	Plain tube	1) BY APPOINMENT (at least 2 week before blood taking). 2) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. *Transportation to Australia is on Saturday. It is advisable to send sample on Friday.	Innoquest Pathology
23.	Angiotensin Converting Enzyme (ACE)	Serum	8 ml or 2 plain tubes	Plain tube	1) BY APPOINMENT (at least 1 week before blood taking). 2) Requires 2 plain gel tubes. 3) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. *Transportation to the USA is on every Tuesday and Thursday. It is advisable to send samples on Monday or Wednesday.	Innoquest Pathology
24.	Anti Acethylcholine Receptor Antibody	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form along with the sample to CDL within 2-4 hours.	UMMC

25.	Anti- Mullerian Hormone	Serum	3 ml	Plain tube	1) Get Innoquest Pathology Request Form, at CDL Specimen Reception Counter and complete it. 2) Send the samples within 2-4 hours.	Innoquest Pathology
26.	Apolipoprotein (a)	Serum	3 ml	Plain tube	1) Make an appointment with the laboratory. 2) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. 3) Send the samples with form to CDL immediately.	Innoquest Pathology
27.	Apolipoprotein (b)	Serum	3 ml	Plain tube	1) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. 2) Send the samples within 2- 4 hours.	Innoquest Pathology
28.	Aspartate Transaminase	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
29.	Bence Jones Protein	Random urine	20 ml	Urine container	1) Complete PER PAT.301 form. 2) Send the sample and the form to CDL immediately.	UMMC
30.	Benzodiazepine	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	HKL
31.	Beta Human Chorionic Gonadotrophin (HCG)	Serum	3 ml	Plain tube	Send the sample to CDL within 2-4 hours.	CDL HASA

32.	Beta-2-Glycoprotein	Serum	4 ml	Plain tube	1) Make an appointment with the laboratory. 2) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. 3) Send the sample to the laboratory immediately.	Innoquest Pathology
33.	Beta-2-Microglobulin	Serum	3 ml	Plain tube (red top)	Send the sample to CDL within 2-4 hours.	UMMC
34.	Direct Bilirubin	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
35.	Bilirubin (total)	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
36.	Bilirubin (total), CSF	CSF	at least 15 ml	Bijou bottle	Send the sample to CDL immediately.	CDL HASA & Sg Buloh
37.	Blood Amino Acid	Plasma	6 ml	Lithium Heparin tube	1) Get IEM form at CDL Specimen Reception Counter and complete it. 2) Require 2ml of plasma, therefore 5ml blood is required to avoid insufficient plasma volume. 3) Send the form with the sample to CDL immediately.	IMR

37.	Blood Amino Acid	Plasma	6 ml	Lithium heparin tube	1) Get IEM form at CDL Specimen Reception Counter and complete it. 2) Require 2ml of plasma, therefore 5ml blood is required to avoid Insufficient plasma volume. 3) Send the form with the sample to CDL immediately.	IMR
38.	Blood Pyruvate	Whole blood	5 ml	Fluoride tube	1) Make an appointment with the laboratory. 2) Complete PER PAT.301. 3) Send the sample and the form to CDL immediately. 4) Keep the sample IN ICE.	UMMC
39.	C- Peptide	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
40.	Caeruloplasmin	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	HKL
41.	Calcitonin	Serum	3 ml	Plain tube	1) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. 2) Send the samples within 2-4 hours.	Innoquest Pathology
42.	Calcium, Urine 24 hours	Urine 24 hours	24 hours collection	Urine 24 hours bottle	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh

43.	Calprotectin (Stool)	Stool	NA	Stool container	1) BY APPOINMENT (at least 1 week before collection). 2) Samples must be freshly collected. *The test will be done every Tuesday. Therefore, it is advisable to collect the sample on Monday.	Innoquest Pathology
44.	Cancer 15-3 (CA 15-3)	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with a sample to CDL within 2-4 hours.	UMMC
45.	Cancer AG 125(CA 125)	Serum	3 ml	Plain tube	Send the sample to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA
46.	Cancer AG19-9 (CA 19-9)	Serum	3 ml	Plain tube	1) Send the sample to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA
47.	Carbamazepine	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
48.	Carcino embryonic AG (CEA)	Serum	3 ml	Plain tube	1) Send the sample to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA

47.	Carbamazepine	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
48.	Carcinoembryonic AG (CEA)	Serum	3 ml	Plain tube	1) Send the sample to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA
49.	Chloride	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
50.	Chloride, Urine 24 hours	Urine 24 hours	24 hours collection	Urine 24 hours bottle	Send the sample to CDL immediately.	CDL HASA & Sg Buloh
51.	Cholesterol (total)	Pleural fluid	3 ml	Bijou bottle	Send the sample to CDL immediately.	CDL HASA & Sg Buloh
52.	Chromogranin A	Serum	8 ml	Plain tube	1) Call the Chemical Pathologist on duty. 2) Please send 3 bottles on a plain tube (3ml each) to CDL. 3) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. 4) Send the form with the sample to CDL immediately.	Innoquest Pathology
53.	Complement 3	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the sample and the form to CDL within 2-4 hours.	UMMC
54.	Complement 4	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC

55.	Copper	Serum	3 ml	Plain tube (royal blue)	1) BY APPOINMENT (at least 1 week before taking). 2) Get royal blue (plain) tubes from the CDL. 3) Complete PER PAT.301 form. 4) Send the sample and the form to CDL within 2-4 hours.	UMMC
56.	Copper, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle (acid wash)	1) BY APPOINMENT (at least 1 week before collecting sample). 2) Please get a 24-hour bottle (acid wash bottle) from the laboratory 1 week after booking. 3) Complete PER PAT.301 form. 4) Send the form with the sample to the laboratory immediately.	UMMC
57	Corrected Calcium	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
58.	Cortisol 0hr	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once blood is taken, send to the laboratory immediately.	CDL HASA

59.	Cortisol 30min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA
60.	Cortisol 60min	Serum	3 ml	Plain tube	3) Please notify the laboratory at least 2 days before the dynamic function test. 4) Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA
61.	Cortisol Serum	Serum	3 ml	Plain tube	1) Send the sample to the laboratory within 2-4 hours. * Run in batch analysis (call the laboratory for details).	CDL HASA
62.	Cortisol, 120 min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA
63.	Cortisol, 90 min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA

64.	Cortisol, Midnight	Serum	3 ml	Plain tube	1) Send the sample to the laboratory within 2-4 hours. * Run in batch analysis (call the laboratory for details).	CDL HASA
65.	Cortisol, Morning	Serum	3 ml	Plain tube	1) Send the sample to the laboratory within 2-4 hours. * Run in batch analysis (call the laboratory for details).	CDL HASA
66.	Cortisol, salivary	Saliva	-	Special Collection Kit	1) BY APPOINTMENT (At least 2 days before sample collection) 2) Get sample collection kit and Innoquest Request Form at CDL Specimen Reception Counter and complete it. 3) Send the sample with the form to CDL Immediately.	Innoquest Pathology
67.	Cortisol, Urine 24 hours	Urine 24 hours	at least 500 ml	Urine 24 hours bottle	1) Send the sample to CDL immediately. * Run in batch analysis (call the laboratory for details).	CDL HASA

68.	Cotinine (Nicotine metabolite)	Random urine	at least 50 ml	Urine container	1) BY APPOINMENT. 2) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. 3) Send the sample with the form to CDL Immediately.	
69.	C-Reactive Protein	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
70.	Creatine Kinase	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
71.	Creatinine	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
72.	Creatinine PD 0 Hour	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
73.	Creatinine PD 2 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
74.	Creatinine PD 24 Hours	Peritoneal dialysis fluid	Timed collection	24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
75.	Creatinine PD 4 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
76.	Creatinine, PD Overnight	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
77.	Creatinine, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
78.	Cyclosporine	Whole blood	4 ml	EDTA tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC

79.	Dehydrotestosterone	Serum	10 ml	Plain tube	1) BY APPOINMENT (at least 2 weeks before blood taking) 2) Get Innoquest Pathology Request Form at CDL Specimen Reception Counter and complete it. *Transportation to Australia is on Saturday. It is advisable to send samples on Friday.	Innoquest Pathology
80.	DHEAS	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
81.	Digoxin level	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
82.	eGFR	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
83.	Everolimus	Whole blood	3 ml	EDTA tube	1) BY APPOINMENT. 2) Complete PER PAT.301 form. 3) Send the form with the sample to CDL immediately.	UMMC
84.	Faecal Occult Blood (FOB)	Stool	NA	Stool container	Send to CDL immediately.	CDL HASA & Sg Buloh
85.	Fasting Plasma Glucose	Plasma	3 ml	Fluoride tube	1) Fasting sample is required (at least 8 hours fasted). 2) Send the form with the sample to CDL immediately.	CDL HASA & Sg Buloh

86.	Fat globules	Stool	NA	Stool container	1) BY APPOINMENT 2) Complete PER PAT.301 form. 3) Send the form with the sample to CDL immediately. * Sample must be freshly collected.	UMMC
87.	Folate	Serum	3 ml	Plain tube	Send to the CDL within 2-4 hours. * Run in batch analysis (call the laboratory for details). * Tests will be analyzed by batch once a week.	CDL HASA
88.	Free Light Chain	Serum	4 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
89.	Gamma glutamyl transferase (GGT)	Serum	3 ml	Plain tube	Send to the CDL within 2-4 hours.	CDL
90.	Free T3	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
91.	Free T4	Serum	3 ml	Plain tube	1) Send to CDL within 2-4 hours. 2) The assay in CDL Sg Buloh is unaffected by biotin (<= 409 nmol/L OR <= 100 ng/mL).	CDL HASA & Sg Buloh

92.	Free Thyroxine (FT4) (Cord blood)	Serum	5 ml	Plain tube	Send to the CDL within 2-4 hours.	CDL HASA & Sg Buloh
93.	Fructosamine	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
94.	FSH	Serum	3 ml	Plain tube	Send the sample to CDL immediately. *Run in batch analysis (call the laboratory for details).	CDL HASA
96.	FSH 30min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once blood is taken, send to the laboratory immediately.	CDL HASA
97.	FSH 60min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once blood is taken, send to the laboratory immediately.	CDL HASA
98.	Gastrin	Serum	3 ml	Plain tube	1) Get Innoquest Pathology Request Form, at CDL Specimen Reception Counter and complete it. 2) Send the sample within 2-4 hours.	Innoquest Pathology

99.	Gentamicin	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
100.	Glucose (Pleural Fluid)	Pleural fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
101.	Glucose 1HPP	Plasma	3 ml	Fluoride tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
102.	Glucose 2HPP	Plasma	3 ml	Fluoride tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
103.	Glucose CSF	CSF	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
104.	Glucose, PD 0 Hour	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
105.	Glucose, PD 2 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
106.	Glucose, PD 4 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
107.	Glucose, PD Overnight	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh

108.	Glucose Random	Plasma	3 ml	Fluoride tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
109.	Growth Hormone	Serum	3 ml	Plain tube (red top)	1) BY APPOINMENT 2) Complete PER PAT.301 form. 3) Send the sample and the form to CDL within 2-4 hours.	UMMC
110.	Haptoglobin	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form a with the sample to CDL within 2-4 hours.	UMMC
111.	HbA1c	Whole blood	3 ml	EDTA tube	1) Send to CDL within 2-4 hours of blood taking. 2) TEST WILL BE REJECTED IF REQUESTED 3) WITHIN 8 WEEKS AFTER PREVIOUS REQUEST. 4) Any special request must be discussed with the Chemical Pathologist on duty.	CDL HASA & Sg Buloh
112.	Homocysteine	Plasma	4 ml	EDTA tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to the laboratory within 2-4 hours.	UMMC
113.	HS Troponin I	Serum	3 ml	Plain tube	Send to CDL immediately.	CDL HASA
114.	HS Troponin T	Serum	3 ml	Plain tube	1) Send the sample to CDL immediately. 2) The assay is unaffected by biotin (<82 nmol/L OR < 20 ng/mL).	CDL Sg Buloh

115.	IGF-1	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
116.	Inborn Error Metabolism (IEM) Screening	Dried blood spot	3 circles of Dried Blood Spot (DBS)	Filter paper	1) Newborn must be >7 days old of life. 2) Get '903 Whatman filter paper' at CDL. 3) Put 3 circles of Dried Blood Spot (DBS). 4) Ensure blood completely dried at room temperature before putting in plastic sheet. 5) Complete PER PAT.301 form. 6) Send the form with the sample to CDL immediately.	UMMC
117.	Intrinsic Factor Antibody	Serum	3 ml	Plain tube	1) Get Innoquest Pathology Request Form, at CDL Specimen Reception Counter and complete it. 2) Send the samples within 2- 4 hours.	Innoquest Pathology
118.	Insulin	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form a with the sample to CDL within 2-4 hours.	UMMC
119.	Lactate	Plasma	3 ml	Fluoride tube	1) Samples must be kept IN ICE after collection. 2) Complete PER PAT.301 form. 3) Send the form with the sample to CDL immediately.	UMMC

120.	Lactate (arterial)	Arterial heparinized blood	1 ml	Heparinized syringe	Send to CDL immediately on ice.	CDL HASA & Sg Buloh
121.	Lactate (venous)	Venous heparinized blood	1 ml	Heparinized syringe	Send to CDL immediately on ice.	CDL HASA & Sg Buloh
122.	LDH	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
123.	LDH (Pericardial)	Pericardial fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
124.	LDH (Pleural)	Pleural fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
125.	LH	Serum	3 ml	Plain tube	1) Send the sample to CDL within 2-14 hours. 2) The assay is unaffected by biotin (<= 205 nmol/L OR <= 50 ng/mL)	CDL HASA
126.	LH 0min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA
127.	LH 30min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA

128.	LH 60min	Serum	3 ml	Plain tube	1) Please notify the laboratory at least 2 days before the dynamic function test. 2) Once the blood is taken, send the sample to the laboratory immediately.	CDL HASA
129.	Lipase	Serum	5 ml	Plain tube	1) BY APPOINMENT. 2) Get Innoquest Pathology Request form from CDL Specimen Reception Counter and complete it. 3) Send the sample and the form to CDL immediately.	Innoquest Pathology
130.	Lipoprotein (a)	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form a with the sample to CDL within 2-4 hours.	IMR
131.	Lithium	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the sample with the sample to CDL immediately.	UMMC
132.	Magnesium	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
133.	Magnesium, Urine 24 hours	Urine 24 hours	24 hours collection	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh

134.	Mercury (Blood)	Whole blood	6 ml	EDTA tube (royal blue)	1) BY APPOINMENT with the Laboratory (at least 1 week prior to blood taking). 2) Get royal blue (EDTA) tube from the CDL Specimen Reception Counter. 3) Complete PER PAT.301 form. 4) Send the form with the sample to CDL within 2-4 hours.	UMMC
135.	Mercury Urine	Random urine	50 ml	Urine container	1) BY APPOINMENT with the laboratory (at least 1 week before sample collection) 2) Get Innoquest Pathology Request form from CDL Specimen Reception Counter and complete it. 3) Send the sample and the form to CDL immediately.	Innoquest Pathology
136.	Metanephrine Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC

137.	Myoglobin	Random urine	20 ml	Urine container	1) BY APPOINMENT with the laboratory (at least 1 week before sample collection) 2) Get IEM request form from CDL Specimen Reception Counter and complete it. 3) Send the sample and the form to CDL immediately. * Sample must be freshly collected.	IMR
138.	NT-proBNP	Serum	4 ml	Plain tube	1) Send the sample to the laboratory within 2-4 hours of blood taking. 2) The assay is unaffected by biotin (<= 14326 nmol/L OR <= 3500 ng/mL).	CDL HASA and Sg Buloh
139.	Oligoclonal band (CSF electrophoresis)	CSF and serum	1 ml (CSF) 3 ml (serum)	Bijou bottle (CSF) Plain tube (serum)	1) BY APPOINMENT. 2) Complete PER PAT.301 form. 3) Send the form with the samples to CDL immediately. *CSF sample must be SEND TOGETHER WITH serum sample.	UMMC
140.	Osmolality (serum)	Serum	3 ml	Plain tube	Send the sample to CDL within 2-4 hours.	CDL HASA
141.	Osmolality (urine)	Random urine	20 ml	URINE	Send to CDL immediately.	CDL HASA

142.	Parathyroid (intact)-iPTH	Plasma	3 ml	EDTA tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
143.	pH (Pericardial Fluid)	Pericardial fluid	at least 15 ml	Bijou bottle	Send the sample to CDL immediately	CDL HASA & Sg Buloh
144.	pH (Peritoneal Fluid)	Peritoneal fluid	at least 15 ml	Bijou bottle	Send the sample to CDL immediately	CDL HASA & Sg Buloh
145.	PH (Pleural Fluid)	Pleural fluid	at least 15 ml	Bijou bottle	Send the sample to CDL immediately.	CDL HASA & Sg Buloh
146.	Phenobarbitone	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
147.	Phenytoin (Dilantin)	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
148.	Phosphate	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
149.	Phosphate, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh

150.	Porphobilinogen	Random urine	20 ml	Urine container	1) BY APPOINMENT. 2) Complete PER PAT.301 form. 3) Requires at least 5 ml of fresh urine and protects it from light (wrap the bottle with aluminum foil). 4) Send the sample to the laboratory immediately.	UMMC
151.	Porphyrin	Random urine	20 ml	Urine container	1) BY APPOINMENT. 2) Complete PER PAT.301 form. 3) Requires at least 5 ml of fresh urine and protects it from light (wrap the bottle with aluminum foil. 4) Send the sample to the laboratory immediately.	UMMC
152.	Potassium	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
153.	Potassium, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
154.	Procalcitonin	Serum	3 ml	Plain tube	Send the sample to CDL immediately.	CDL HASA
155.	Prolactin	Serum	3 ml	Plain tube	Send the sample to the laboratory within 2-4 hours.	CDL HASA
156.	Prostate Specific Antigen (Total)	Serum	3 ml	Plain tube	Send the sample to CDL immediately	CDL HASA

157.	Prostate Specific Antigen (free)	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours. 3) Total PSA must be analyzed before the request is made. *Total PSA result must be between 2.5 - 10 ng/ml.	HKL
158.	Protein Electrophoresis (random urine)	Random urine	20 ml	Urine container	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	HKL
159.	Protein Electrophoresis (serum)	Serum	2 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	HKL
160.	Salicylate Acid	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately. .	UMMC
161.	Sex Hormone Binding Globulin	Serum	3 ml	Plain tube	1) Get Innoquest Pathology Request Form from CDL Specimen Reception Counter and complete it. 2) Send the sample within 2-4 hours of blood taking.	Innoquest Pathology
162.	Sirolimus	Whole blood	4 ml	EDTA tube	1) BY APPOINMENT. 2) Complete PER PAT.301 form. 3) Send the form with the sample to CDL immediately.	UMMC

163.	Sodium	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
164.	Sodium Valproate	Serum	3 ml	Plain tube	1) Complete PER PAT.301. 2) 2) Send the form with the sample to CDL immediately.	UMMC

165.	Sodium, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
166.	Stone Analysis	Stone		Sterile container	1) Please make sure only stone specimens are in the container. NO URINE. 2) Complete PER PAT.301 form. 3) Send the sample and the form to the laboratory within 2-4 hours. *Transportation to India is on Tuesday. It is advisable to send the sample on Monday.	Lablink
167.	Stool Reducing Sugar	Stool	3 ml	Stool container	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
168.	Tacrolimus	Whole blood	3 ml	EDTA tube	1) Complete PER PAT.301 form. 2) Send the form a with the sample to CDL immediately.	UMMC
169.	Testosterone (total)	Serum	3 ml	Plain tube	1) Send the sample to the laboratory within 2-4 hours. *Tests will be analyzed by batch once a week.	CDL HASA

170.	Theophylline	Serum	4 ml	Plain tube	1) BY APPOINMENT. 2) Complete PER PAT.301 form. 3) Send the form with the sample to CDL immediately.	UMMC

171.	Thyroglobulin	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours	UMMC
172.	Thyro-globulin Antibody	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
173.	Thyroid Stimulating Immunoglob ulin (TSI)	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	UMMC
174.	Thyroperoxid ase Antibody-TPO	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC
175.	Total Protein	Pericardial fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
176.	Total Protein (CSF)	CSF	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
177.	Total Protein (Peritoneal Fluid)	Peritoneal fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh

178.	Total Protein (Pleural Fluid)	Pleural fluid	at least 15 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
179.	Total Protein, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
180.	Triglyceride (Peritoneal Fluid)	Peritoneal fluid	at least 10 ml	Bijou bottle	Send to CDL immediately.	CDL HASA & Sg Buloh
181.	Triglycerides , Fasting	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
182.	TSH Cord Blood	Cord blood	3 ml	Plain tube	Send to CDL immediately.	CDL HASA & Sg Buloh
183.	TSH Receptor Antibody	Serum	3 ml	Plain tube	1) BY APPOINMENT 2) Get Innoquest Pathology Request form at CDL Specimen Reception Counter and complete it. 3) Send the sample and the form to CDL immediately.	Innoquest Pathology
184.	TSH	Serum	3 ml	Plain tube	1) Send to CDL within 2-4 hours. 2) The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh

185.	TSH, 0 min	Serum	3 ml	Plain tube	1) Send to CDL within 2-4 hours. 2) The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh
186.	TSH, 30 min	Serum	3 ml	Plain tube	1) Send to CDL within 2-4 hours. 2) The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh
187.	TSH, 60 min	Serum	3 ml	Plain tube	1) Send to CDL within 2-4 hours. 2) The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).	CDL HASA & Sg Buloh
188.	TSH, 90 min	Serum	3 ml	Plain tube	1) Send to CDL within 2-4 hours. 2) The assay in CDL Sg Buloh is unaffected by biotin (<= 4912 nmol/L OR <= 1200 ng/mL).1200 ng/mL).	CDL HASA & Sg Buloh
189.	Urine Albumin Creatinine Ratio (UACR)	Random urine	3 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
190.	Urine Protein Creatinine Ratio (UPCR)	Random urine	3 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
191.	Urea	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
192.	Urea, PD 0 Hour	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
193.	Urea, PD 2 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
194.	Urea, PD 24 Hours	Peritoneal dialysis fluid	Timed collection	24 hours bottle	Send to CDL immediately.	CDL HASA & Sg Buloh

195.	Urea, PD 4 Hours	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
196.	Urea, Post Haemodialysis	Serum	Timed collection	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
197.	Urea, Pre Haemodialysis	Serum	Timed collection	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
198.	Urea, PD Overnight	Peritoneal dialysis fluid	Timed collection	Sterile container	Send to CDL immediately.	CDL HASA & Sg Buloh
199.	Urea, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	1) REFRIGERATE during collection. 2) Send to the laboratory in an ice box that contains a cold ice pack.	CDL HASA & Sg Buloh
200.	Uric Acid	Serum	3 ml	Plain tube	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
201.	Uric acid, Urine 24 hours	Urine 24 hours	24 hours urine collection	Urine 24 hours bottle	1) DO NOT REFRIGERATE during collection. 2) Send the sample to CDL immediately.	CDL HASA & Sg Buloh
202.	Urine Amino Acid	Random urine	10 ml	Urine container	1) BY APPOINMENT. 2) Complete PER PAT 301. form. 3) Send the form with the sample to CDL immediately.	UMMC
203.	Urine Calcium (random)	Random urine	20 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
204.	Urine Chloride (random)	Random urine	3 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
205.	Urine Creatinine (random)	Random urine	3 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
206.	Urine Magnesium	Random urine	3 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh

207.	Urine Organic Acid	Random urine	5 ml	Urine container	1) Get IEM form at CDL Specimen Reception Counter and complete it. 2) Send the form with the sample to CDL immediately.	IMR
208.	Urine Orotic Acid	Random urine	5 ml	Urine container	1) Get IEM form at CDL Specimen Reception Counter and complete it. 2) Send the form with the sample to CDL immediately.	IMR
209.	Urine Phase Contrast	Random urine	30 ml	Urine container	1) BY APPOINMENT 2) Get Innoquest Pathology Request form at CDL Specimen Reception Counter and complete it. 3) Send the form with the sample to CDL immediately.	Innoquest Pathology
210.	Urine Phosphate (random)	Random urine	3 ml	Urine container	Send to CDL within 2-4 hours.	CDL HASA & Sg Buloh
211.	Urine Potassium (random)	Random urine	20 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
212.	Urine Pregnancy Test (UPT)	Random urine	20 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
213.	Urine Reducing Sugar	Random urine	10 ml	Urine container	1) Make an appointment with the laboratory. 2) Complete PER PAT 301. form. 3) Send the form with the sample to CDL immediately.	UMMC

214.	Urine Sodium (random)	Random urine	20 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
215.	Urine Total Protein (random)	Random urine	20 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
216.	Urine Urea (random)	Random urine	20 ml	Urine container	Send to CDL immediately.	CDL HASA & Sg Buloh
217.	Vancomycin	Serum	3 ml	Plain tube	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL immediately.	CDL HASA
218.	Vitamin B1 (Thiamine)	Whole blood	6 ml	Lithium heparin tube	1) BY APPOINMENT (at least 1 week before blood taking). 2) Get the Innoquest Pathology Request Form and lithium heparin tube (which has been wrapped with aluminium foil) from the laboratory. *Transportation to Australia is on Saturday. It is advisable to send samples on Friday.	Innoquest Pathology
219.	Vitamin B12	Serum	3 ml	Plain tube	1) Send the sample to the laboratory within 2-4 hours. *Run in batch analysis (call the laboratory for details).	CDL HASA
220.	Vitamin D	Serum	3 ml	Plain tube (red top)	1) Complete PER PAT.301 form. 2) Send the form with the sample to CDL within 2-4 hours.	UMMC

221.	Zinc, Urine 24 hours	Urine 24 hours	3 ml	Urine 24 hours bottle (acid wash)	1) BY APPOINTMENT (least 1 week before sample collection). 2) Please get a 24-hour bottle (acid wash bottle) from the laboratory 1 week after booking. 3) Complete PER PAT.301 form. Send the form with the sample to the laboratory immediately.	UMMC
222.	Zinc (Serum)	Serum	6 ml	Plain tube (royal blue)	1) BY APPOINTMENT (at least 1 week before blood taking). 2) Get royal blue (plain) tubes from the CDL. 3) Complete PER PAT.301 form. 4) Send the form with the sample to CDL within 2-4 hours.	UMMC

Chemical Pathology
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PROFILE TEST

PROFILE						
No.	Test	Specimen Type	Volume Required	Specimen container	Instruction	Destination
1.	Fasting serum lipids i. Total Cholesterol ii. Triglycerides iii. LDL-c iv. HDL-c	Serum	3 ml	Plain tube	A fasting sample is required (at least an 8- hour fast) Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh
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 Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh
3.	Renal Profile i. Urea ii. Creatinine iii. Sodium iv. Potassium v. Chloride	Serum	3 ml	Plain tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh
4.	OGTT i. Fasting Glucose ii. Glucose-2HPP (2 hours postprandial)	Plasma	3 ml	Fluoride tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh
5.	BUSE i. Urea ii. Sodium iii. Potassium iv. Chloride	Serum	3 ml	Plain tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh
6.	Bone Profile i. Albumin ii. ALP iii. Total Calcium iv. Corrected Calcium v. Phosphate	Serum	3 ml	Plain tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh

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 Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh
8.	Iron Profile i. Total Iron ii. TIBC iii. UIBC iv. Ferritin	Serum	3 ml	Plain tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA
9.	Female infertility studies i. FSH ii. LH iii. Estradiol iv. Progesterone	Serum	3 ml	Plain tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA
10.	Thyroid Function Test i. TSH ii. Free T4	Serum	3 ml	Plain tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA & Sg Buloh
11.	Amenorrhea studies i. FSH ii. LH iii. Estradiol	Serum	3 ml	Plain tube	Send to the Chemical Pathology lab within 2-4 hours.	CDL HASA
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	1. Complete PER PAT.301 form. 2. Send to the Chemical Pathology lab within 2-4 hours. *Refrigerate during 24-hour urine collection.	UMMC

13.	Blood Gases (Arterial or Venous) i. pH ii. PCO2 iii. PO2 iv. HCO3 v. Base Excess	Whole Blood	1ml	Heparin 1ml syringe	Send to the lab immediately in an ice- water bath	CDL HASA & Sg Buloh
14.	Blood Gases (Cord Blood) i. pH ii. PCO2 iii. PO2 iv. HCO3 v. Base Excess	Cord Blood	1ml	Heparin 1ml syringe	Send to the lab immediately in an ice- water bath.	CDL HASA & Sg Buloh
15.	Urine Drug of Abuse i. Amphetamine ii. Cannabinoids iii. Morphine	Urine (random)	At least ½ of a urine container.	Urine Container	1. Complete PER PAT.301 form (available at the Chemical Pathology lab). 2. Urine must be collected in at least ½ of the urine container. 3. Seal the urine container after collection. 4. Send to the Chemical Pathology lab within 2-4 hours.	UMMC
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. 1.Urine must be collected at least ½ of the urine container. 2. Seal the urine container after collection. 3. Send it to the Chemical Pathology lab immediately.	Lablink
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. 1.Complete PER PAT.301 form (available at the Chemical Pathology lab).	Lablink

					2. Send to the Chemical Pathology lab within 2-4 hours * Please send 2 separate plain tubes.	
18.	Aldosterone Renin Ratio (ARR)	Plasma	4 ml	K2- EDTA	BY APPOINTMENT with the lab. (at least 3 days before collection). 1. Complete the PER PAT.301 form. 2. Sample volume must be at least 4 ml. 3. Sample must be sent immediately WITHOUT ice. *Please DO NOT pre- chill tube and syringe before blood taking. *Record patient's posture whether supine or upright in column 'clinical history' on the request form. *Blood should be taken between 8 am -10 am	UMMC
19.	Acylcarnitine Profile	Dried blood spot	At least 4 circles of dried blood spot	Filter Paper	1. By appointment with the lab (at least 1 week before collection). 2. Get 903 Whatman filter paper at CDL. 3. Put at least 4 circles of Dried Blood Spot (DBS). Please put only 1 layer of blood at each circle to avoid interference of	UMMC

					the result. 4. Ensure blood is completely dried at room temperature before putting in a plastic sheet. 5. Complete PER PAT.301 form and send it along with a sample to CDL immediately.	

Anatomic Pathology

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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 1 shows the TAT for the different categories of specimens.

Table 1: 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

27.2 Wrong organ removed

2.7.3. Reports of the following infections

a) Bacteria in the heart valves or bone marrow.

b) Organisms in an immune-compromised patient such as AFB, fungi, virus, and protozoa in cerebrospinal fluid (CSF).

c) Unusual organisms or organisms in unusual sites e.g. amoeba in the eye

2.7.4 Reports on critically ill patients requiring immediate therapy.

a) Crescents in greater than 50% of glomeruli in a renal biopsy.

b) Transplant rejections.

2.7.5 Cases that have immediate clinical consequences

a) Fat in an endometrial curettage.

b) Mesothelial cells in a heart biopsy.

c) 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

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 either immersing in 95% alcohol or spray-fix. For air-dried slides, 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.

Body fluids			
Specimen type	**Container**	**Sample Volume / size**	**Remarks**
Bronchoalveolar lavage (BAL)	Sterile specimen container (in saline).	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 either immersing in 95% alcohol or spray-fix. For air-dried slides, 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 lab 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.

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.
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 either immersing in 95% alcohol or spray-fix. For air-dried slides, leave to air-dry.	At least 1 air-dried and 1 alcohol-fixed slide.	-
Serous fluid (eg Pericardial, Peritoneal, Pleural)	Sterile specimen container.	The minimum volume of 75mls (for large volume collection and washings)	As much fluid as possible should be sent for evaluation.
Sputum	Sterile specimen container.	As collected. The entire amount of expectorated samples 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 it refrigerated at 4°C and send it to the lab as soon as possible. Please ensure specimens for

			microbiology are 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 it 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.

Hematology & Transfusion Medicine

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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 list is routine requests during and after office hours:

a) Complete Blood Count (CBC) – TAT: 4 hours (inpatient), 5 working days (outpatient)
b) Complete Blood Count + Differential Count (CBC+DIFF) – TAT: 4 hours (inpatient), 5 working days (outpatient)
c) Reticulocytes – TAT: 4 hours (inpatient), 5 working days (outpatient)
d) Coagulation Screen – TAT: 4 hours (inpatient), 5 working days (outpatient)
e) Peripheral Blood Film – TAT: 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:

a) Complete Blood Count (CBC)and Complete Blood Count + Differential Count (CBC+DIFF) (Emergency Department) – TAT: 45 minutes
b) Complete Blood Count (CBC) and Complete Blood Count + Differential Count (CBC+DIFF) (inpatient) – TAT: 60 minutes

*For number (a) and (b), the TAT may be delayed if a blood film review is required.

c) Reticulocytes – TAT: 60 minutes
d) Coagulation Screen – TAT: 90 minutes
e) Peripheral Blood Film- Urgent request is subjected to communication between pathologist and requesting clinician.

1.3 Specialized tests

These tests are run in batches (e.g., DNA Analysis) and outsourced to the referral laboratories (refer to **Table 2**). For the outsourced tests, the TAT depends on the complexity of the test.

3. Special Collection Procedures

In-house and outsourced tests require special collection procedures. Please refer to **Table 1** and **Table 2** for instructions. Failure to adhere to a specific procedure may cause rejection.

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 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 will be documented.

~~Table 2:~~ CRITICAL VALUE IN HAEMATOLOGY RESULTS

ADULT					
No	**Analyte**	**Unit**	**Low Critical Limit**	**Upper Critical Limit**	**Remark/Action**
1.	Haemoglobin	g/dL	6.0	19.0	Clotted specimens will be rejected.
2.	Haematocrit	%	20	60	
3.	Platelet	10^9/L	20	1000	
4.	Fibrinogen	g/L	1.0	-	
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					
	Analyte	**Unit**	**Low Critical Limit**	**Upper Critical Limit**	**Remark/Action**
1.	Haemoglobin (Paeds)	g/dL	7.0	20.0	Clotted specimens will be rejected.
2.	Haemoglobin (Neonate)	g/dL	8.0	22.0	Clotted specimens will be rejected.
3.	Haematocrit (Paeds)	%	20	40	
4.	Haematocrit (Neonate)	%	25	70	
5.	Platelet	10^9/L	50	1000	
6.	Fibrinogen	g/L	0.7	-	
7.	Total WBC	10^9/L	2.0	50	

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

2. Enquiry for Laboratory Services

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

Enquiry	Extension No.
Specimen reception ~~and Result~~	10807
Result and analytical issue	3131
MLT and pathologist on-call	Refer to the monthly on-call roster for the contact numbers

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) ~~daily or on a case-to-case basis~~. 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 adverse 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 and Institute for Medical Research (IMR). The PDN will perform extended antibody panels to identify new red cell antibody/antibodies following a positive antibody screening test. On the other hand, tests that are relevant to renal transplants will be outsourced to IMR.

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

2.4 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.

~~Table 2:~~ **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 labeling 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:

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 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 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 the 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 products will be ready at the time they are required. However,

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 products 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. Ideally, the issued blood/blood product should 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.

9. Administration of Blood and Blood Products

9.2 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.

15. Enquiry for Laboratory Services

Any enquiries regarding the laboratory services please contact the following directories.

ENQUIRY	CONTACT NO./EXTENSION
Transfusion Medicine related tests (Specimen reception)	3135
Blood and blood product request	
MLT and pathologist on-call	Refer to the monthly on-call roster for the contact numbers.

Hematology & Transfusion Medicine

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LIST OF TESTS

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
LIST OF 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.
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.
3.	Reticulocytes	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.
4.	Erythrocyte Sedimentation Rate	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.
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.
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.
7.	Fibrinogen	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.

8.	Thrombin Time (TT)	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.
9.	Quantitative D-Dimer	Plasma	Citrate Tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.
10.	G6PD	Whole Blood/Cord Blood	EDTA Tube	1-2 mL	To reach the laboratory as soon as possible.
LIST OF 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.
12.	Direct Coombs Test	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 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.
14.	Rh(D) Phenotyping	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 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.
	INR				
	Activated Partial Thromboplastin Time (APTT)				

16.	Mixing Test for APTT				
	Activated Partial Thromboplastin Time (APTT) for patient	Plasma	Citrate tube	2 mL	Must be clinically indicated and another anticoagulant use has been ruled out.
	Activated Partial Thromboplastin Time (APTT) for Normal 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.
	Prothrombin Time (PT) for Normal pool				
	Prothrombin Time (PT) for Immediate Mixing				
	Prothrombin Time (PT) for 2-hour Incubation				

18.	DIVC Screen				
	Prothrombin Time (PT)	Plasma	Citrate tube	2 mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.
	INR				
	Activated Partial Thromboplastin Time (APTT)				
	Fibrinogen				
	D-Dimer				
19.	Peripheral Blood Film				
	Complete Blood Count + Differential Count	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity is within 4 hours.
	Peripheral Blood Film (PBF) Comment				

20.	Bone marrow Examination				
	Complete Blood Count + Differential Count	Whole Blood	EDTA Tube	2 - 3mL	By appointment only and discussion with pathologist-on-call.
	Peripheral Blood Film (PBF) Comment				
	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	Whole Blood	EDTA Tube	2 - 3mL	To reach the laboratory as soon as possible. Sample integrity at room temperature is within 4 hours.
	Peripheral Blood Film (PBF) Comment				
	Hb Analysis (HPLC)				
	Hb Analysis (CE)				

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.
	Indirect Coombs Test/ Antibody				
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.
	Indirect Coombs Test/ Antibody				
	Cross match (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 separate forms.
	Indirect Coombs Test/ Antibody (Post transfusion sample)				
	Cross match (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	TURN AROUND TIME (WORKING DAYS)
1.	ALL screen (E2A- PBX1, ETV6-RUNX1, MLL-AF4, BCR-ABL e1a2, SIL-TAL1)	Bone marrow / 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)	Bone marrow / 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)	Bone marrow / Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14

4.	BCR-ABL1 TKD Mutation Analysis	Bone marrow / Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14
5.	CD4/CD8	Whole Blood	EDTA Tube	3 mL	PER PAT. 301	By appointment only. Inform the lab before requesting transport arrangements.	UMMC	7 working days, verbal report – 24 hours
6.	Chromosomal analysis (Oncology)	Bone marrow	Lithium heparin	3 mL	Borang Permohonan Ujian Khusus (Unit sitogenetik, PPUKM)	Special transport medium - obtained from the lab, by appointment only	PPUKM	21
7.	Chromosomal analysis (post-natal)	Bone marrow	Lithium heparin	3 mL	Borang Permohonan Ujian Khusus (Unit sitogenetik, PPUKM)	Special transport medium - obtained from the lab, by appointment only	PPUKM	21
8.	DNA Analysis for alpha Thalassaemia	Whole Blood	EDTA tube	3 mL	DNA Analysis for Thalassemia Syndrome (IMR/CaRC/HAEM/22/2203/03(1) REQ Form	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	45

9.	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	45
10.	Erythropoietin	Whole Blood	Plain tube	3 mL	PERPAT.301	NA	UMMC	30
11.	Factor VIII Assay (Haemophilia A)	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PER PAT. 301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	30
12.	Factor VIII Inhibitor	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PER PAT. 301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	30
13.	Factor IX Assay (Haemophilia B)	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PER PAT. 301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	30

14.	Factor XIII Assay	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PER PAT. 301	Request shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	30
15.	Immuno-phenotyping	Bone marrow / Whole Blood	EDTA	3 mL	PER PAT. 301	By appointment only. Inform the lab before requesting transport arrangements. For reliable flow cytometric analysis, the specimen must be sent to the laboratory immediately. Specimen kept for more than 6 hours is not suitable for analysis.	PPUKM	30 working days, verbal report – 24 hours
16.	FLTT3-ITD/D835 mutation	Bone marrow / Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14
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/MPL ex10 mutation	Bone marrow / Whole Blood	EDTA Tube	3 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14

19.	NPM1 mutation	Bone marrow / Whole Blood	EDTA Tube	4 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14
20.	Platelet Antibody Screening	Whole Blood	Citrate tube	6 mL (in 3 citrate bottles)	PDN Quality Form – Haematology / Serology Request Form	Must be clinically relevant before requesting otherwise the request will be rejected by PDN. By appointment from Monday to Thursday only. Strictly PDN Guidelines.	PDN	30
21.	PML-RARA detection (bcr1, bcr2, bcr3)	Bone marrow / Whole Blood	EDTA Tube	4 mL	Molecular & Genetic Analysis Lab Form, UMMC form	By appointment. To request CBC+DIFF separately.	UMMC	14
22.	Lupus Anticoagulant	Plasma	Citrate tube	6 mL (in 3 citrate bottles)	PER PAT. 301	Requests shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	30
23.	von Willebrand Study	Plasma	Citrate tube	6 mL (in 3 citrate bottles)	PER PAT. 301	Requests shall be discussed with pathologist-on-call and agreed. Laboratory shall be notified prior to blood collection.	UMMC	30

	LIST OF TESTS FOR TRANSFUSION MEDICINE SECTION							
NO	TEST	SPECIMEN TYPE	SPECIMEN CONTAINER	VOLUME REQUIRED	FORM	INSTRUCTION	DESTINATION	TURN AROUND TIME (WORKING DAYS)
24.	Anti-A and Anti-B titre	Whole Blood	EDTA Tube	3 mL	PDN Quality Form – PDN/IH/QP-01/04)	Strictly by appointment only.	PDN	The official report is ready in 2 weeks.
25.	Antibody Identification	Whole Blood	2 EDTA Tube & 2 Plain Tube (Red)	4 mL each	PER-SS-BT 105 (GSH/GXM Form) & PDN Quality Form – PDN/IH/QP-01/04)	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 laboratory and it is important to identify the antibody for a future emergency.	PDN	The official report is ready in 2 weeks. Blood is ready once the investigation is completed.

26.	Antibody Identification (Extended)	Whole Blood	2 EDTA Tube & 2 Plain Tube (Red)	4 mL each	PER-SS-BT 105 (GSH/GXM Form) & PDN Quality Form – PDN/IH/QP-01/04)	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 laboratory and it is important to identify the antibody for a future emergency.	PDN	The official report is ready in 2 weeks. Blood is ready once the investigation is completed.
27.	HLA Typing Class I & II (Loci A, B, DR)	Whole Blood	EDTA Tube	8 mL	HLA Typing Request Form (IMR)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30

28.	HLA Typing Class I (Loci A, B, C) - Low Medium Resolution (SSP)	Whole Blood	EDTA Tube	8 mL	HLA Typing Request Form (IMR)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30
33.	HLA Typing Class I (Loci A, B, C) High Resolution (SSO) - per locus	Whole Blood	EDTA Tube	8 mL	HLA Typing Request Form (IMR)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30
34.	HLA Typing Class I (Loci A, B, C) - High Resolution (SBT)	Whole Blood	EDTA Tube	8 mL	HLA Typing Request Form (IMR)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30

35.	HLA Typing Class II (Loci DR, DQ) - Low/Medium Resolution (SSP)	Whole Blood	EDTA Tube	8 mL	HLA Typing Request Form (IMR)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30
36.	HLA Typing Class II (Loci DR, DQ) - High Resolution (SSO) - per locus	Whole Blood	EDTA Tube	8 mL	HLA Typing Request Form (IMR)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30
37.	HLA Typing Class II (Loci DR, DQ) - High Resolution (SBT)	Whole Blood	EDTA Tube	8 mL	HLA Typing Request Form (IMR)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30
38.		Whole Blood				Must be clinically relevant (transplant purpose) prior to request otherwise request will	IMR	30

	HLA Antibody Test		Plain Tube (Gel)	6 mL of recipient blood	HLA Antibody Test Request Form	be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.		
39.	HLA Crossmatching (CDC)	Whole Blood	Plain tube (gel) + sodium heparin tube	6 mL WB in a plain tube (gel) of recipient blood + 18 mL WB in sodium heparin of donor blood	HLA Crossmatch Test Request Form (Living Donor)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30
40.	HLA Crossmatching (Flow Cytometry)	Whole Blood	Plain tube (gel) + sodium heparin tube	6 mL WB in a plain tube (gel) of recipient blood + 18 mL WB in sodium heparin of donor blood	HLA Crossmatch Test Request Form (Living Donor)	Must be clinically relevant (transplant purpose) prior to request otherwise request will be rejected. By appointment from Monday to Thursday only. The blood shall need to reach the outsourced lab by 10.30 am.	IMR	30

*For updated tests list and procedures, refer to UniMEDS – Healthcare Information System (CDL > Report > List of Test).

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LIST OF TESTS

IN-HOUSE & OUTSOURCED TESTS IN MEDICAL MICROBIOLOGY & PARASITOLOGY

BACTERIOLOGY AND SEROLOGY						
NO	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCONS**	**DESTINATION**
1.	AFB stain	Sputum & Other clinical specimens	3ml	Sterile	Collect 3 consecutive early mornings (fresh) sputum (NOT SALIVA). Send within 2-4 hours.	CDL
2.	TB Culture & Sensitivity	All specimens	3ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
3.	Bacterial Antigen (Latex Antigen detection)	CSF	3ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
4.	*Burkholderia pseudomallei* antibody (Meliodosis)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK

5.	*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
6.	*Clostridium difficile* Combo Test (Gdh+ Toxin A+B)	Stool (fresh)	Not applicable	Stool container	Send to CDL immediately	CDL
7.	Culture and Sensitivity	Blood	5ml-10ml (adult) 2-3ml (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
8.	Culture and Sensitivity	Sputum	Not applicable	Sterile	Sample should not be saliva. Send within 2-4 hours.	CDL

NO	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION
9.	Culture and Sensitivity	Tracheal aspirates/ BAL/NPA	3ml	sterile	The sample should not be saliva. Send within 2-4 hours	CDL
10.	Culture and Sensitivity	Fluid -pleural -peritoneal -pericardial -synovial -ascites - Other sterile body fluid	5ml	Sterile	Send within 2-4 hours. Send immediately	CDL
11.	Culture and Sensitivity	Nasal / Per nasal/ Throat swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL
12.	Culture and Sensitivity	CSF	1- 3ml	Sterile	Send immediately.	CDL
13.	Culture and Sensitivity	Ear discharge/ Ear swab	Not applicable	Sterile	Send within 2-4 hours.	CDL
14.	Culture and Sensitivity	Vitreous and aqueous fluid	1-3ml	Sterile	Send immediately.	CDL
15.	Culture and Sensitivity	Eye discharge	Not applicable	Sterile	Send within 2-4 hours.	CDL
16.	Culture and Sensitivity	Contact lens	Not applicable	Sterile	Send within 2-4 hours.	CDL
17.	Culture and Sensitivity	Corneal Scraping	Not applicable	Sterile	Send within 2-4 hours.	CDL
18.	Culture and Sensitivity	HVS/ Endocervical swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL

19.	Culture and Sensitivity	LVS	Not applicable	Amies Transport Medium	Only for medicolegal case investigation. Send immediately.	CDL
20.	Culture and Sensitivity	Urethral swab/ Penile swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL
21.	Culture and Sensitivity	Urine	5ml	Sterile	Please collect morning midstream urine and send it within 2-4 hours.	CDL
22.	Culture and Sensitivity	Stool	Not applicable	Stool container	Send within 2-4 hours.	CDL
23.	Culture and Sensitivity	Rectal swab	Not applicable	Amies Transport Medium	Send within 2-4 hours.	CDL
24.	Culture and Sensitivity	Pus	Not applicable	Sterile	Please specify the site of collection. Send within 2-4 hours.	CDL
25.	Culture and Sensitivity	Wound swab/ ulcer swab	Not applicable	Amies Transport Medium	Please specify the site of collection. within 2-4 hours.	CDL
26.	Culture and Sensitivity	Tissue/ bone	Not applicable	Sterile	Please specify the site of collection. within 2-4 hours.	CDL
27.	MRSA Screening	Nasal/ axilla/groin swab	Not applicable	Amies Transport Medium	Please specify the site of collection. Send within 2-4 hours.	CDL

28.	Culture and Sensitivity	Bone marrow	5-10ml (adult) 2-3ml (paediatric)	Blood culture bottle	Inoculate bone marrow collected with aseptic technique. If the sample is not sent immediately, please do not refrigerate it. Please leave it at room temperature.	CDL
29.	*Legionella* Antigen	Urine	5ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
30.	*Leptospira* IgM	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
31.	*Leptospira:* Microscopic agglutinatio n test (MAT)	Blood	5ml	Plain tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	IMR
32.	*Rickettsia* antibody	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	HOSP. SG. BULOH
33.	*Treponema Pallidum* Antibody	Blood	5ml	Gel tube	Send the sample to CDL within 2-4 hours.	CDL
34.	FEME (Fluids)	Sterile body fluids	3ml	Sterile	Send within 2-4 hours.	CDL

35.	Line Probe Assay	Sputum/ Tracheal aspirate/ BAL	2 ml	Sterile container	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	MKAK

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MOLECULAR BACTERIOLOGY						
NO	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**
1.	Gene Xpert Ultra MTB RIF	Sputum/ BAL	Not applicable	Sterile	Send immediately	CDL
2.	Respiratory Bacterial PCR	Naso-pharyngeal swab/NPA/ Sputum	2 ml	VTM/ Sterile container	Send the sample to CDL within 2-4 hours.	CDL
3	Rickettsial 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
4	TB PCR	Sputum/ BAL/ Tissue/ Fluid/Pus/ Bone/ Biopsy	Not applicable	Sterile	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK

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VIROLOGY AND SEROLOGY						
NO	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**
1.	Adenovirus Antigen (IF)	Sputum/tracheal aspirates/ NPA/BAL	Not applicable	Sterile	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	HOSP. SG. BULOH
2.	Cytomegalovirus IgM	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
3.	Cytomegalovirus IgG	Blood	5ml	Sterile	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
4.	Dengue IgM	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
5	Dengue IgG	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
6.	Rapid Dengue Test (NS1, IgG, IgM)	Blood	5ml	Gel tube	Send immediately	CDL

7.	Enterovirus Antigen (IF)	CSF	1ml	Sterile	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	HOSP. SG. BULOH
8.	Epstein Barr Virus IgM	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK

NO	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION
9.	Epstein Barr Virus IgG	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
10.	Hepatitis A Virus IgM	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
11.	Hepatitis B surface antigen (HBsAg)	Blood	5ml	Gel tube	Send the sample within 2-4 hours.	CDL
12.	Hepatitis B surface antibody (HBsAb)	Blood	5ml	Gel tube	Send sample within 2- 4 hours.	CDL
13.	Hepatitis B core IgM (HBc IgM)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK

14.	Hepatitis B core total antibody (HBc total Ab)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
15.	Hepatitis B e Antigen (HBeAg)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
16.	Hepatitis B e Antibody (HBe Ab)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
17.	Hepatitis C Antibody (Anti HCV)	Blood	5ml	Gel tube	Send sample within 2- 4 hours.	CDL
18.	Herpes simplex Type 1 & 2 Antibody (IgM)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
19.	Herpes simplex Type 1 & 2 Antibody (IgG)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
20.	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

21.	HIV 1 &2 (Particle agglutination)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	CDL
22.	HIV 1 & 2 (Western Blot)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	UMMC
23.	Japanese encephalitis Antibody (IgM)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
24.	Japanese encephalitis Antibody (IgG)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
25.	Japanese encephalitis Antibody (IgM)	CSF	1-3ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK

NO	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION
26.	Measles Virus Antibody (IgM)	Blood	5ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
27.	Measles Virus Antibody (IgM)	Blood	5ml	Sterile	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK

28.	Mumps Virus Antibody (IgM)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
29.	Mumps Virus Antibody (IgG)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
30.	Nipah Virus Antibody (IgM)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	UMMC
31.	Nipah Virus Antibody (IgG)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	UMMC
32.	Rubella IgM	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours	LABLINK
33.	Rubella IgG	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours	LABLINK

NO	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION
34.	SARS COV 2 Rapid Test kit Antigen (RTK Ag)	Nasopharyngeal swab	Not applicable	Dry swab	Transportation with triple packaging /ice pack. Sample must reach within 4 hours upon collection.	CDL
35.	Mycoplasma Antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
36.	*Coxiella burnetti* Antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	Gribbles
37.	Brucella Antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	Innoquest
38.	Bartonella antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with sample within 2-4 hours.	IMR
39.	Salmonella Antibody	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with sample within 2-4 hours.	Innoquest

40.	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
41.	Rotavirus Ag	Stool	-	Sterile container	Send sample within 2- 4 hours.	CDL
42.	TB Quantiferon	Blood	1 ml	4 TB Quantiferon container	Collect container from CDL Microbiology lab	CDL

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MOLECULAR VIROLOGY						
NO	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**
1.	SARS CoV2 RNA	Nasopharyngeal / Oropharyngeal swab	Not applicable	VTM	Transportation with triple packaging /ice pack.	CDL
2.	CMV Qualitative and Quantitative	Blood	3-5ml	EDTA	Transported on ice	Geneflux
		Urine	3 ml	Sterile		
		Eye vitreous fluid	0.2 ml			
		Tissue biopsy	min 2 cm			
		BAL	1-3 ml			
		Amniotic fluid	1-3 ml			
		CSF	1-3 ml			
		Saliva	1-3 ml			
		Semen	1-3 ml			
		Swab	1-3 ml			
3.	BK & JC Virus Qualitative and Quantitative	Blood	3-5ml	EDTA	Transported on ice	Geneflux
		Serum	3-5 ml			
		CSF	0.5- 1 ml	Sterile		
		Urine	1-3 ml			

4.	HBV DNA	Blood	3-5ml	EDTA	Transported on ice	Geneflux
5.	HCV RNA	Blood	3-5ml	EDTA	Transported on ice	Geneflux
6.	HIV RNA (Qualitative)	Blood	3-5ml	EDTA	Transported on ice	Geneflux
7.	HIV viral load	Blood	3-5ml	EDTA	Transported on ice	Geneflux
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
9.	Respiratory Virus PCR	Nasopharyngeal swab/ Nasal swab/ NPA/Sputum	2 ml	VTM/ Sterile container	Send to lab immediately.	CDL
10.	MERSCOV PCR	Nasopharyngeal swab	2 ml	VTM	Transported on ice	Geneflux
11.	Meningitis Viral Pathogen Panel	CSF / Blood	2 ml	Sterile container / EDTA	Complete PER PAT.301 form and send it along with sample within 2-4 hours.	LABLINK
12.	Viral Culture	CSF	2 ml	Sterile container	Complete PPUM form and send along with sample within 2-4 hours.	UMMC

NO	TEST	SPECIMEN TYPE	VOLUME REQUIRED	SPECIMEN CONTAINER	INSTRUCTIONS	DESTINATION
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
14.	Herpes Simple 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

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MYCOLOGY						
NO	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**
1.	*Aspergillus* Species Antibody	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	HOSP. SG. BULOH
2.	*Cryptococcal* Antigen	CSF/Blood	5ml	Sterile/Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	CDL
3.	Fungal Culture and Sensitivity	Blood	5-10ml (adult) 2-3ml (paediatric)	Blood culture for fungal 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
4.	Fungal Culture and Sensitivity	CSF	1-3ml	Sterile	Send immediately.	CDL
5.	Fungal Culture and Sensitivity	Pleural fluid	5ml	Sterile	Send immediately.	CDL
6.	Fungal Culture and Sensitivity	Peritoneal fluid	5-10ml	Sterile	Send immediately.	CDL

7.	Fungal Culture and Sensitivity	Pus	Not applicable	Sterile	Send sample within 2-4 hours.	CDL
8.	Fungal Culture and Sensitivity	Vitreous/Aqueous Fluid	3ml	Sterile	Send immediately.	CDL
9.	Fungal Culture and Sensitivity	Hair / Nail	Not applicable	Wrap with filter paper	Send sample within 2-4 hours.	CDL
11.	Fungal Culture and Sensitivity	Tissue	Not applicable	Sterile	Please specify the site of collection. Send sample within 2-4 hours.	CDL
12.	*Pneumocystis jirovecii molecular*	BAL Induced sputum	1-3ml	Sterile	Transport in ice	Geneflux

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IMMUNOLOGY						
NO	**TEST**	**SPECIMEN TYPE**	**VOLUME REQUIRED**	**SPECIMEN CONTAINER**	**INSTRUCTIONS**	**DESTINATION**
1.	Anti-nuclear antibody (ANA)	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL
2.	Anti - double-stranded DNA antibody (anti-dsDNA)	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL
3.	Anti-mitochondrial antibody (AMA)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample to CDL within 2-4 hours.	LABLINK
4.	Anti-phospholipid antibody	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	IMR
5.	Anti-cardiolipin	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL
6.	Extractable Nuclear antibody (ENA)	Blood	5ml	Gel tube	Send sample within 2-4 hours.	CDL
7.	Anti Neutrophil Cytoplasmic antibody (ANCA)	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK

8.	Rheumatoid factor (RF)	Blood	5ml	Gel tube	Send sample within 2- 4 hours.	CDL
9..	Immuno-globulin A	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
10.	Immuno-globulin G	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
11.	Immuno-globulin M	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
12.	Immuno-globulin E	Blood	5ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2-4 hours.	LABLINK
13.	HLA B 27	Blood	10 ml	EDTA tube	By appointment ONLY.	IMR
14.	Anti-CCP	Blood	5ml	Gel tube	Send a sample within 2 – 4 hours.	CDL

15.	Anti GBM	Blood	5 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
16.	Anti Smooth Muscle Antibody (ASMA)	Blood	5 ml	Gel Tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
17.	Anti Centromere Antibody	Blood	5 ml	Gel Tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
18.	Anti Endomysial Antibody	Blood	5 ml	Gel Tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
19.	Allergic Test – 54 Allergens	Blood	3ml	Gel Tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
20.	Anti NMDAR	Blood	3 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK

21.	Tryptase	Blood	3ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	IMR
22.	Anti-Ganglioside Panel	Blood	3 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
23.	Adenosine Deaminase (ADA)	Blood	3 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
24.	Anti-Muscle Specific Kinase (Anti-MUSK)	Blood	4 ml	Gel Tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
25.	Myositis Profile	Blood	3 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
26.	Encephalitis Receptor Autoimmune Profile	Blood/ CSF	3 ml/ 2 ml	Gel tube/ Sterile container	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK

27.	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
28.	Neuromyelitis Optica Autoimmune Profile	Blood	3 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
29.	Aquaporin 4	Blood	3 ml	Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK
30.	Paraneoplastic Antigen Autoimmune Profile	CSF/ Blood	3 ml	Sterile container / Gel tube	Complete PER PAT.301 form and send it along with the sample within 2- 4 hours.	LABLINK

Chemical Pathology
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Appendix 1: Chemical Pathology Tests & Clinical Indications

TEST	INDICATIONS
Acetaminophen (PCM)	1. It is used to find out any abuse/overdose of acetaminophen.
Alpha-1-feto protein (AFP)	1. To help confirm or rule out a cancer diagnosis when used with other examinations and tests. 2. To predict how cancer may behave over time. 3. 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	1. To screen for or monitor treatment for a liver or bone disorder. 2. 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	1. To detect liver damage and/or to help diagnose liver disease. 2. Elevated serum levels are found in hepatobiliary diseases, such as cirrhosis, metastatic carcinoma, viral hepatitis, myocardial infarction. 3. Decreased AST levels are found in patients undergoing renal dialysis or those with vitamin B6 deficiency.
Blood Gases	1. To determine oxygen and carbon dioxide saturation in patient blood. It also determines the acidity (pH) of the blood. 2. 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.

Beta Human chorionic gonadotropin (HCG)	1. HCG appears in the blood of pregnant women as early as 10 days after conception. 2. Quantitative HCG measurement helps determine the exact age of the fetus. 3. It can also assist in the diagnosis of abnormal pregnancies, such as ectopic pregnancies, molar pregnancies, and possible miscarriages. 4. It is also used as part of a screening test for Down syndrome. 5. This test is also done to diagnose abnormal conditions not related to pregnancy that can raise HCG level.
Bilirubin	1. To screen for or monitor liver disorders or haemolytic anemia. 2. Elevated serum bilirubin is found in haemolytic anemia (unconjugated), liver disorders and biliary obstruction.
Calcium	1. To evaluate calcium levels in the body. 2. 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. 3. Hypocalcemia may be observed in a patient with hypoparathyroidism, nephrosis or pancreatitis.
Carcinoembryonic Antigen (CEA)	1. A human tumor-associated antigens. 2. To help in the prognosis and management of patients with malignant diseases, especially colorectal cancer 3. A persistent elevation of CEA following therapeutic or surgical intervention signals residual disease or recurrence, whereas decreasing levels to within the normal range is indicative of successful intervention.
Cancer Antigen 125	1. It is not recommended as a screening tool. 2. To help in monitoring the response to therapy for epithelial ovarian carcinoma. Persistently elevated CA 125 antigen levels indicate poor response to therapy, whereas decreasing CA 125 antigen levels may indicate a positive therapeutic response. 3. It can be elevated in diseases other than epithelial ovarian carcinoma, including endometriosis, lung cancer and pregnancy.
CA 19-9 antigen	1. It is not recommended as a screening tool. 2. To help in monitoring the response to therapy for colorectal cancer Persistently rising CA 19-9 antigen levels may be correlated with disease progression and may indicate poor response to therapy.
Chloride	1. To evaluate electrolyte imbalance. 2. Decreased chloride level may be due to reduced dietary intake, prolonged vomiting and reduced renal reabsorption. 3.Increased chloride values are found in dehydration, kidney failure, high dietary or parenteral chloride intake, and salicylate poisoning.
Creatine Kinase	1. Elevated CK serum levels are found in skeletal muscle disease, particularly muscular dystrophy. 2. 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.

TEST	INDICATIONS
C-reactive protein	1. To identify the presence of inflammation and to monitor response to treatment for an inflammatory disorder. 2. 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, pituitary, and hypothalamus. e.g.: a) Overproduction (e.g. Cushing's syndrome) b) Underproduction (e.g. Addison's disease)
Oestradiol	1. The determination of oestradiol is utilised clinically in the elucidation of fertility disorders in the hypothalamus-pituitary-gonad axis, gynecomastia, oestrogen- producing ovarian and testicular tumors and in hyperplasia of the adrenal cortex. 2. Other clinical indications include monitoring of fertility therapy and determining the time of ovulation within the framework of in vitro fertilization.
Ferritin	1. To determine total iron storage capacity 2. To help diagnose iron deficiency or iron overload.
FSH	1. Determination of the FSH concentration is used in the elucidation of dysfunctions within the hypothalamus-pituitary-gonads system. 2. 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	1. To evaluate thyroid gland function. 2. 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	1. To determine the risk of atherosclerotic disease. 2. 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	1. To monitor blood glucose control in individuals with diabetes mellitus (Indicate the mean blood glucose level in 8-12 weeks). 2. HbA1c predicts the development of complications in diabetic patients and can be used for the diagnosis of diabetes mellitus.
Iron (total)	Aids in the diagnosis of iron deficiency anemia and iron overload.
LDH	1. 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. 2. Mild increases in LDH activity have been reported in cases of haemolytic anemias, muscular dystrophy, pulmonary infarction, hepatitis, nephrotic syndrome and cirrhosis.

TEST	INDICATIONS
LDL-cholesterol	1. To determine the risk of atherosclerotic disease. 2. It is a strong predictor for coronary atherosclerosis.
Luteinizing Hormone	1. Determination of the LH concentration is used in the elucidation of dysfunctions within the hypothalamus-pituitary-gonads system. 2. 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. 3.
Magnesium	1. To evaluate electrolyte imbalance. 2. Increased serum magnesium concentrations occur in renal failure, acute diabetic acidosis, dehydration, or Addison's disease. 3. Hypomagnesemia may be observed in chronic alcoholism, malabsorption, severe diarrhea, 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.
Osmolality	1. To determine the balance between water and certain chemicals in the blood. 2. Provision of diagnostic guide for dehydration and overhydration. 3. To help diagnose diabetes insipidus
Phosphorus	To evaluate the level of phosphorus and as a marker to evaluate an abnormal calcium level.
Potassium	1. To evaluate an electrolyte imbalance. 2. Hypokalaemia can be found in reduced intake of dietary potassium or excessive loss of potassium from the body by prolonged vomiting, diarrhea or increased kidney excretion. 3. Hyperkalemia may be caused by dehydration or shock, severe burns, diabetic ketoacidosis, and retention of potassium by the kidney.
Procalcitonin	1. To diagnose or rule out a bacterial infection. 2. To determine the severity of sepsis. 3. To guide treatment decisions. 4. To monitor treatment response 5. 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.
Prostate Cancer Antigen (PSA) Total	1. to screen for prostate carcinoma. 2. to guide diagnosis of prostate conditions that are non-cancerous/malignant. 3. to monitor treatment response.

TEST	INDICATIONS
Sodium	1. To evaluate electrolyte imbalance. 2. 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 anemia and iron overload.
Testosterone	1. 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. 2. Testosterone is determined in men when reduced testosterone production is suspected, e.g. hypogonadism, oestrogen therapy, chromosome aberrations (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	1. TSH is a very sensitive and specific parameter for assessing thyroid function. 2. It is particularly suitable for early detection or exclusion of disorders in the central regulating circuit between the hypothalamus, pituitary and thyroid. 3. To screen for congenital hypothyroidism in newborns. 4.
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	1. 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 (minimum effective concentration), for the duration of therapy. 2. Excessive concentrations of vancomycin must be avoided because high levels can result in ototoxicity (hearing damage) and nephrotoxicity (kidney damage).
Vitamin B12	Aids in the detection of vitamin B12 deficiency in individuals with macrocytic or unexplained anemia, or unexplained neurologic disease.

Chemical Pathology
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Appendix 2: Chemical Pathology Tests & Reference Ranges

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
1.	Acetaminophen (PCM)	Homogeneous enzyme immunoassay	Serum	Adult: 10 – 30 µg/ml
2.	Alanine Aminotransferase (ALT)	IFCC Modified (with pyridox. phosphate)	Serum	Men : ≤50.0 U/L Women : ≤35.0 U/L
3.	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
4.	Alpha-1-fetoprotein	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 9.0
5.	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
6.	Amylase	IFCC Based - EPS	Serum	Adults : 28-100 U/L
			Urine random	Men : 16 - 491 U/L Women :21 - 447 U/L

7.	Aspartate Aminotransferase (AST)	IFCC Modified (with pyridoxal phosphate)	Serum	Men : ≤50.0 U/L Women : ≤35.0 U/L
8.	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
9.	Bilirubin (direct)	Diazonium salt	Serum	Adult : ≤ 5.0 µmol/L
10.	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
11.	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
12.	Cancer AG 19-9 (CA 19-9)	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 35.0
13.	Cancer AG 125 (CA 125)	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 35.0
14.	Carcinoembryonic AG (CEA)	CLIA (Sandwich)	Serum	Men/Women (≥ 18y): ≤ 3.0

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
15.	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
16.	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 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
17.	Cholesterol	Cholesterol Oxidase/Peroxidase	Serum	Adults: <5.2 mmol/L
18.	Creatine Kinase	Catalytic CK activity (340nm)	Serum	Men: <190.0 U/L Women: <170.0 U/L
19.	Cortisol	CLIA (Competitive)	Serum	Morning hours (6-10 am) : 185-624 nmol/L Afternoon hours (4-8 pm) : < 276 nmol/L
20.	C-Reactive Protein (Latex)	Particle enhanced turbidimetric assay	Serum	Adults: < 5.0 mg/L
21.	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

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
22.	Ferritin	CLIA (Sandwich)	Serum	Male and Female 0 - 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: Male 18.7 - 102.0 ug/L Female 3.20 - 75.1 ug/L 18y - 200y: Male 23.9-336.2 ug/L Female 11.0-306.8 ug/L
23.	Folate	CLIA (Competitive)	Serum	Men/Women (≥18y): 7.0 - 45.1 nmol/L
24.	Follicle Stimulating Hormone (FSH)	CLIA (Sandwich)	Serum	Men >=18y : 1.27 - 19.26 IU/L 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
25.	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

26.	Free Thyroxine (FT4) *reported by CDL Sg Buloh	Electro-chemiluminescence (Competitive)	Serum	Adults: 12.0-22.0 pmol/L Newborn: 11.0-32.0 pmol/L 6 days – 3 months: 11.5-28.3 pmol/L 4-12 months: 11.9-25.6 pmol/L 1-6 years: 12.3-22.8 pmol/L 7-11 year: 12.5-21.5 pmol/L 12-20 years: 12.6-21.0 pmol/L
27.	Gamma-Glutamyl transferase (GGT)	Enzymatic colorimetric assay Other g-Glut-3-carboxy-nitro	Serum	Men: <60 U/L Women: <40 U/L
28.	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 hours	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
29.	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)
30.	HDL-Cholesterol	Non-separation method (Cholesterol esterase/ oxidase)	Serum	**According to *NCEP ATP III Guidelines** Men : ≥ 1.0 mmol/L Women: ≥1.3 mmol/L

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
31.	Iron (total)	Colorimetric assay	Serum	Adults: 5.83 - 34.5 µmol/L
32.	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
33.	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
34.	LDL-Cholesterol	According to Friedewald formula	Serum	**Target LDL-c based on cardiovascular risk** Low risk: < 3.0 mmol/L Moderate risk: < 3.0 mmol/L High risk: < 2.6 mmol/L or reduction of > 50% from baseline Very high risk: < 1.8 mmol/L or reduction of > 50% from baseline or reduction of >50% from baseline
35.	Luteinizing Hormone (LH)	CLIA (Sandwich)	Serum	Men (≥18y): 1.24 - 8.62 IU/L Women: Mid-Follicular Phase : 2.12-10.89 IU/LMid-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
36.	Magnesium	Xylidyl Blue	Serum	Newborn: 0.62-0.91 mmol/L 5 m–6Y : 0.70-0.95 mmol/L 6Y–12 Y : 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

** Adult Treatment Panel (ATP), National Cholesterol Education Program (NCEP)*

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
37.	NT-proBNP	Electro-chemiluminescence (Sandwich)	Serum	Any age/gender: <125
38.	Osmolality	Freezing point depression	Serum	Adult: 275 – 295 mOsm/kg
			Urine	Adult: 300 – 900 mOsm/kg
39.	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
			Urine (1st morning) Urine 24 Hrs	Urine 1st-morning urine: 13-44 mmol/L 24-hour urine: 13-42 mmol/24H
40.	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
41.	Progesterone	CLIA (Competitive)	Serum	Men (≥18y) : 0.44 - 6.55 nmol/L Women: Mid-Follicular Phase (Non-pregnant) 0.99 - 4.83 nmol/L Mid-Luteal Phase (Non-pregnant) : 16.41 - 59.02 nmol/L Post-Menopausal (Non-pregnant) :

				< 0.32 - 2.48 nmol/L Pregnancy 1st Trimester : 15.04 - 161.35 nmol/L Pregnancy 2nd Trimester : 61.72 - 144.05 nmol/L
42.	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
43.	Prostate Specific Antigen (Total)	CLIA (Sandwich)	Serum	Men/Women (≥18y): ≤ 4.0
44.	Total Protein	Biuret/endpoint (with blank)	Serum	**According to *Tietz Textbook** Newborn:46-70 g/L 1W:44-76 g/L 7M-1Y :51 -73 g/L 1Y-2Y :56-75 g/L >3Y :60-80 g/L Adults :64-83 g/L
45.	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

***** *Lopez, J. (2015). Carl A. Burtis and David E. Bruns: Tietz fundamentals of clinical chemistry and molecular diagnostics.*

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
46.	Testosterone	CLIA (Competitive)	Serum	Men 18y - 66y: 6.07 - 27.10 nmol/L Women 21y - 73y: <0.35 - 2.60 nmol/L
47.	Thyroid Stimulating Hormone (TSH) *reported by CDL HASA	CLIA (Sandwich)	Serum	Any gender (Serum) 0 - 11y: 0.79 - 5.85 mIU/L 12 y - 17y: 0.68 - 3.35 mIU/L 18y - 88y: 0.38 - 5.33 mIU/L Any gender (Cord Blood) <= 20 mIU/L
48.	Thyroid Stimulating Hormone (TSH) *reported by CDL Sg Buloh	Electro- chemi luminescence (Sandwich)	Serum	Adults: 0.270-4.20 mIU/L Newborn: 0.70-15.2 mIU/L 6 days – 3 months: 0.72-11.0 mIU/L 4-12 months: 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
49.	Triglycerides	Lipase/Glycerol kinase/GPO-PAP	Serum	**According to *NCEP ATP III Guidelines** Adults: <1.7 mmol/L
50.	hs Troponin T	Electro-chemiluminescence (Sandwich)	Serum	Adults: ≤14 ng/L
51.	hs Troponin I	CLIA (Sandwich)	Serum	Men: ≤19.8 ng/L Women: ≤ 11.6 ng/L
52.	Unsaturated Iron Binding Capacity (UIBC)	Direct determination with Ferrozine	Serum	Men: 22.3 61.7 µmol/L Women: 24.2-70.1 µmol/L
53.	Urea	Urease-Kinetic (340nm)	Serum	Adults: 2.78-8.07 mmol/L
			Urine (24 h)	Adults: 428-714 mmol/24 h
54.	Uric acid	Uricase/peroxidase	Serum	Men : 202.3-416.5 µmol/L Women: 142.8-339.2 µmol/L
			Urine 24hrs	1200-5900 µmol/24H
55.	Vancomycin	Kinetic interaction of microparticles in a solution (KIMS)	Serum	Trough: 10.0 – 20.0 mg/L Peak : 20.0 – 40.0 mg/L
56.	Vitamin B12	CLIA (Competitive)	Serum	Men/Women (≥18y): 133.0 - 675.0 pmol/L

** Adult Treatment Panel (ATP), National Cholesterol Education Program (NCEP).*

Blood Gases (reported in CDL HASA)

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
1.	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
2.	pCO^2	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
3.	pO^2	Optical		ABG: 0d-40y: 83-108 mmHg 41y-200 y: 72-103 mmHg VBG: 18 - 59 mmHg
4.	HCO^3	Calculated test		ABG: 21.0 – 29.0 mmol/L VBG: 20.0 – 28.0 mmol/L
5.	SpO2	Calculated test		ABG : 94.0 – 98.0 % VBG: 70 – 80 %
6.	BE	Calculated test		ABG: -7.0 to 2.0 VBG: -6.0 to 2.0
7.	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*

Blood Gases (reported in CDL Sg Buloh)

NO.	TESTS	METHOD	SPECIMEN TYPE	REFERENCE RANGE/UNIT
1.	pH	Potentiometric electrodes	Whole Blood	ABG: 7.35 – 7.45 VBG: 7.31 – 7.41
2.	pCO^2	Severinghaus principle		ABG : 32.0 –48.0 mmHg VBG: 41.0 – 51.0 mmHg
3.	pO_2	Clark measurement		ABG : 83.0 – 108.0 mmHg VBG: 30 – 40 mmHg
4.	HCO^3	Calculated test		21.0 – 26.0 mmol/L
5.	SpO2	Calculated test		ABG : 94.0 – 98.0 % VBG: 70 – 80 %
6.	BE	Calculated test		-2.0 – 3.0

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

Urine Full Examination Microscopy Examination (FEME)

A) Macroscopic Examination (reported in CDL HASA)

NO.	TESTS	METHOD	REFERENCE RANGE/UNIT
1.	Bilirubin	Diazonium salt	<8.5 µmol/L
2.	Erythrocytes	Peroxidase-like activity of Hb	0.3 mg/L
3.	Glucose	Glucose oxidase/peroxidase reaction	<2.8 mmol/L
4.	Ketone	Legal's test	<0.5 mmol/L
5.	Leucocytes	Indoxyl ester with diazonium salt	<25 Leu/µL
6.	Nitrite	Griess test	Negative
7.	pH	pH indicator	5.0 – 9.0
8.	Protein	Protein error of a pH indicator	<0.1 g/L
9.	Specific gravity	Refractometry	1.003 – 1.035
10.	Urobilinogen	Diazonium Salt	< 34 µmol/L
11.	Color	RGB Photodetectors	NA
12.	Clarity	Amplitude of Scattered Light	NA

B) Macroscopic Examination (reported in CDL Sg Buloh)

NO.	TESTS	METHOD	REFERENCE RANGE/UNIT
1.	Bilirubin	Diazonium salt	Negative
2.	Erythrocytes	Peroxidase-like activity of Hb	<18 Ery/µL
3.	Glucose	Glucose oxidase/peroxidase reaction	<1.4 mmol/L
4.	Ketone	Legal's test	<0.34 mmol/L
5.	Leucocytes	Indoxyl ester with diazonium salt	<10 Leu/µL
6.	Nitrite	Griess test	Negative
7.	pH	Hydrogen ions concentration	5.0 – 9.0
8.	Protein	Protein error of a pH indicator	<0.3 g/L
9.	Specific gravity	Detection of ion concentration (Presence of cation, protons are released and produce color change)	1.003 – 1.035
10.	Urobilinogen	Ehrlich's Test	< 17 µmol/L

C) Microscopic Examination

NO.	TYPE OF SEDIMENTS	NORMAL FINDINGS
1.	Erythrocytes	< 5 cells/µL
2.	Leucocytes	<10 cells/µL
3.	Epithelial cells	Renal tubular - negative Other epithelial cells < 10
4.	Hyaline cast	Occasional (1 – 5 casts)
5.	Epithelial cast	Negative
6.	Erythrocyte cast	Negative
7.	Granulated cast	Negative
8.	Leucocyte cast	Negative

9.	Crystals	Negative
10.	Bacteria	Negative
11.	Yeast cells	Negative

Chemical Pathology

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Appendix 3: Additional Rejection Criteria, Chemical Pathology

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

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

A) TAT of in-house test

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

Immunology		
13.	ii) ANA iii) RF IgM iv) ENA v) Anti CCP	3-7 days (Run once a week)
Molecular Microbiology		
14.	SARS-CoV-2 rRT-PCR	2-3 days
15.	Gene Xpert for SARS-CoV-2 Detection	3 hours
16.	Gene Xpert MTB/RIF Ultra for MTB Detection	1 working day

B) TAT (outsourced tests)

NO	LIST OF TESTS	OUTSOURCE LABORATORY	TAT
IMMUNOLOGY			
1.	Antinuclear cytoplasmic antibody (ANCA) i) p-ANCA ii) c-ANCA	LABLINK	7-10 working days
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 IgG IgE		
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	UMMC/LABLINK	2 months
18.	TB PCR/ Line Probe Assay		3 working days
19.	Anti-cardiolipin antibody		7-10 working days
20.	TPPA/TPHA	HSB/LABLINK	7-10 working days
VIROLOGY AND SEROLOGY			
21.	Adenovirus Antigen (IF)	Hospital Sungai Buloh	7-10 working days
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)	Hospital Sungai Buloh	7-10 working days
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		
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	GRIBBLES	7- 10 days
MYCOLOGY			
57.	*Histoplasma* antibody	Hospital Sungai Buloh	7-10 days
58.	*Pneumocystis jirovecii molecular* Qualitative	GENEFLUX	3 days
PARASITOLOGY			
59.	Coccidian Oocysts (*Cryptosporidium, Isospora, Cyclospora*) – special staining methods	Hospital Sungai Buloh	7-10 days

END