



HOSPITAL REHABILITASI CHERAS PATHOLOGY SERVICES HANDBOOK

2022



HRC

**HOSPITAL REHABILITASI CHERAS
PATHOLOGY SERVICES HANDBOOK
2022**

THE COMMITTEE MEMBERS

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FOREWORD



YBrs DR JASMEET SINGH S/O SUCHA SINGH

**Director
Hospital Rehabilitasi Cheras
(MMC NO: 38937)**

I would like to congratulate Pathology Department for successfully publishing this second edition of Pathology Services Handbook.

This handbook would be a good reference for all clinicians as well as laboratorians. The idea of having this booklet is that we need a standard guidance for everybody in the patient care. It should conveniently provide all the possible information which can be a valuable communication resource.

I hope that effort and hard work by the Pathology team will be well-utilized by all the clinicians.

FOREWORD



PUAN ROHAIYU BINTI ISMAIL

**Head of Pathology Department
Hospital Rehabilitasi Cheras**

This second edition handbook is intended to provide our service users with concise guide to the range of services by Pathology Department.

This handbook supersedes the earlier edition and it is an effort by us to give more improvement to our services for the sake of patients.

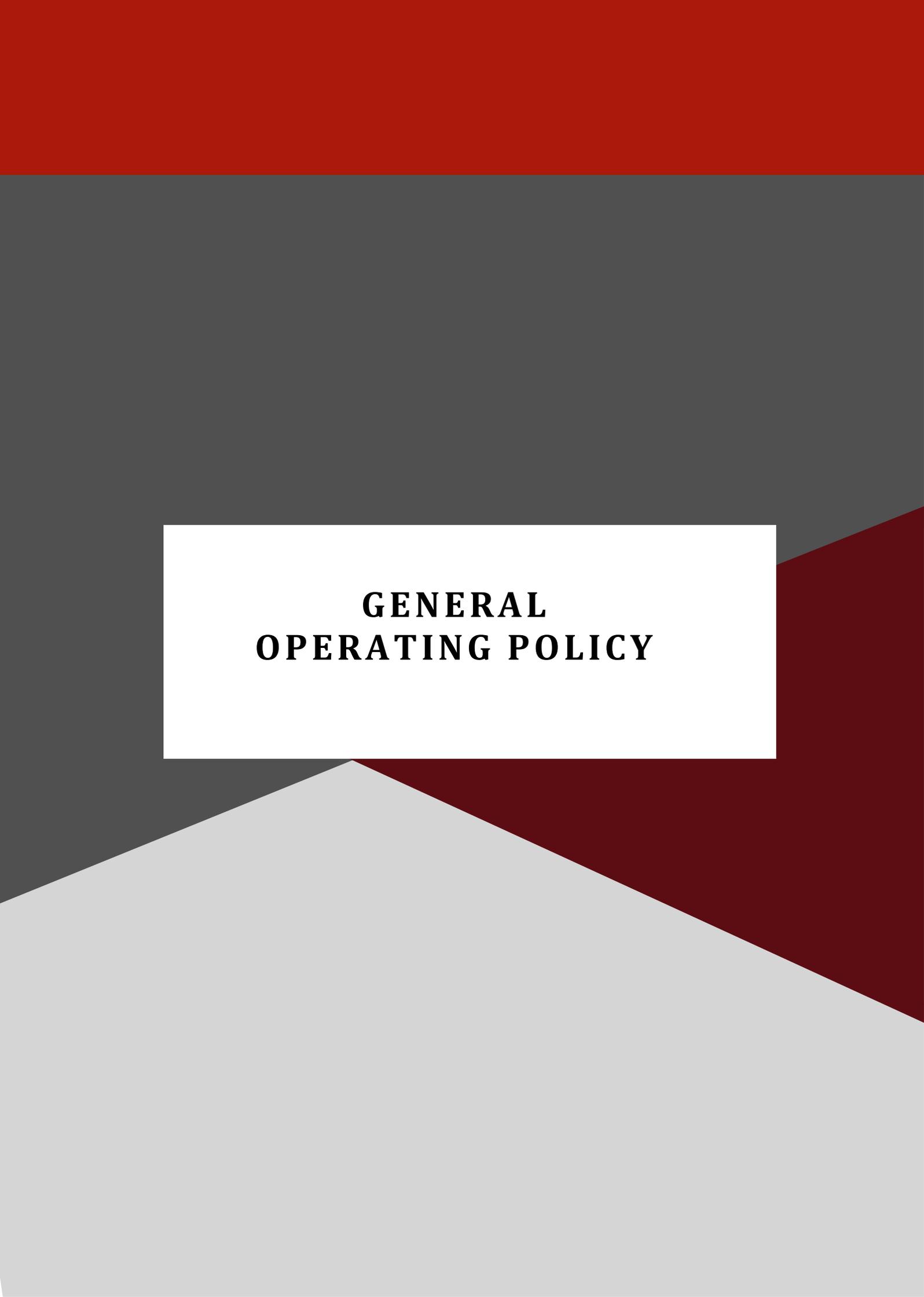
We do welcome any comments or suggestions you may have pertaining to pathology service in the hospital. Any feedbacks please reach me at 03-9145 3400 ext. no: 2901 or email to rohaiyu@moh.gov.my.

Thank you.

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**GENERAL
OPERATING POLICY**

INTRODUCTION

The Pathology Department is an organization at the Cheras Rehabilitation Hospital which serves to provide specialized clinical support services in the field of disease diagnostics. Located at Level G hospital building, this department commences service on 2 July 2012.

Laboratory in Pathology Department is equipped with diagnostic equipment integrated with computer system, Laboratory Information System (LIS). The results of the test are confirmed through internal quality control (IQC) and external quality control (EQA). The role of ensuring quality assurance is played by our team of Medical Laboratories and Medical Laboratory Technicians as well as support services from Patient Care Assistants.

OBJECTIVES

- I.** To achieve 90 percent of Laboratory turnaround time, LTAT for urgent Full Blood Count Test within 45 minutes.
- II.** To ensure immediate notification of critical values within 30 minutes after validation as an initiative for patient safety.
- III.** Targeting 70 percent of laboratory staff to undergo technical training.

VISSION

To commit to the provision of world class diagnostic services with high quality and timely turnaround.

MISSION

- I.** Our department will provide excellent service to fulfil the certification and accreditation of ISO 9001, ISO 15189, and Malaysian Society for Quality in Health (MSQH).
- II.** To use appropriate technology and the latest knowledge; to be pure minded; and sensitive to customers' needs in order to facilitate patient treatment.
- III.** To develop quality culture based on teamwork and professionalism
- IV.** To ensure that all testing are carried out in accordance with procedures and using the appropriate methodologies.
- V.** To ensure all laboratory personnel are competent and comply with the policies, procedure, guidelines, standard and rules.

FUNCTION

- I. Providing and facilitating medical laboratory test service to support the medical rehabilitation programs and services in HRC.
- II. Assisting in provision of appropriate consultative/advisory services in the various aspects of pathology

CLIENT'S CHARTER

We are committed to provide quality services to the clients by assuring that:

- I. Every client will be treated ethically and professionally.
- II. Each specimen will be handled according to the standard work process and procedure
- III. Routine tests which are performed in the HRC Pathology Laboratory will be carried out within four (4) hours.
- IV. Urgent tests which are performed in the HRC Pathology Laboratory will be given special attention based on the following Laboratory Turn Around Time (LTAT):

• STAT Biochemistry Test	45 minutes
• STAT Full Blood Count (FBC) Test	45 minutes
• STAT Blood Gas Test	45 minutes
• STAT Urine Biochemistry & Microscopy Test	45 minutes
• STAT Coagulation (PT/APTT) Test	60 minutes

PRIORITY OF TEST

- **STAT/Urgent** - For emergency cases only

- **Routine** - Non urgent tests

Note:

- I. Do not abuse the term STAT/urgent for non urgent/non-emergency cases.
- II. For test requests that do not stated with 'STAT' or 'Waiting' will be considered as routine sample.

SCOPE OF SERVICE

- I.** Medical laboratory services shall be provided to the requests by the clinicians for patient management in Hospital Rehabilitasi Cheras. Test requests by external clinicians for external patient management shall have consent by the hospital administrator.
- II.** The Pathology Department practices integrated laboratory services in the following areas:
 - A.** Specimen Reception (Pre-analytical Section)
 - B.** Biochemistry (Biochemistry Section)
 - C.** Haematology (Haematology Section)
 - D.** Urine Microscopy and rapid test (Wet Laboratory Section)
- III.** Facilitating the blood transfusion procedure in Hospital Rehabilitasi Cheras
- IV.** The Laboratory Store which is administered by Pathology Department supplies the test consumables and reagents for the whole usage in HRC.

ORGANISATION AND MANAGEMENT

Postal Address

Pathology Department,
Hospital Rehabilitasi Cheras
,Jalan Yaacob Latif,
Bandar Tun Razak, Cheras, 56000
Kuala Lumpur.

Tel. no: 03 – 9145 4300 ext 2900 (Office)

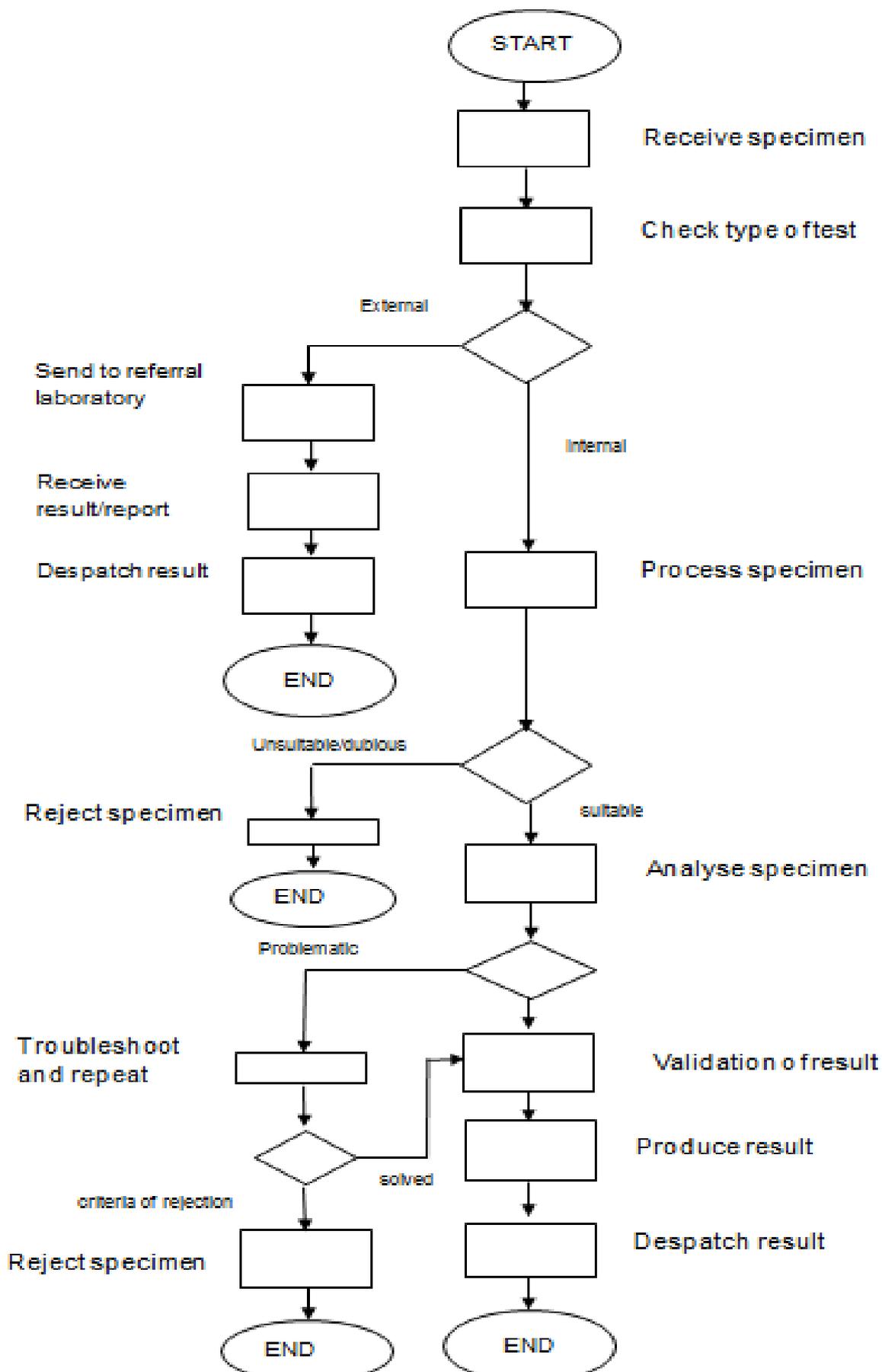
Fax. no: 03 – 9130 0514

Email: patologi.hrc@moh.gov.my

Service Hours

Working days	: 8.00 am to 5.00 pm After 5.00 pm - passive call
Weekends and public holidays	: 8.30 am to 2.00 pm After 2.00 pm - passive call

GENERAL WORKFLOW FOR HANDLING SPECIMEN



SERVICE AGREEMENT

- I. Any new examination request by clients shall be reviewed which also include for examination that needs to be referred to external laboratories.
- II. The Pathology Department shall maintain records of reviews of new test request and any pertinent discussions with a client relating to the client's requirement.
- III. If a contract needs to be amended after the examination has commenced, the process of contract review shall be repeated and the amendments shall be communicated to all affected client.
- IV. All requests for conducting tests in Pathology Department will be reviewed for the capability and resources available in the department for the provision of the testing services.
- V. The request can be made by filling up PERPAT 301 form or special form required according to the test ordered.
- VI. List of the tests and services provided, specific instructions for the proper collection of specimen, patient preparation, primary sample/specimen required and container to be used is available in the Pathology Services Handbook.
- VII. If the department is unable to do the testing, due to unforeseeable circumstances or unavailability of resources; or the testing is not offered by the department, the test will be outsourced to a suitable laboratory.

EXAMINATION BY REFERRAL LABORATORIES

- I. Tests services by the referral laboratory is kept up to date.
- II. A register of all referral laboratories is maintained in the HRC
- III. The Pathology Department shall be responsible for all referred clinical testings for the patients.
- IV. Arrangement with the referral laboratories shall be reviewed periodically to ensure that:
 - A. The requirements are adequately defined, documented and understood
 - B. The laboratory has the capability to meet the requirements
 - C. The examination methods used is appropriate for its intended use

SUPPORT SERVICE COMMUNICATION

The laboratory is committed to meet the requirements of clients and responsible to provide any clarification of their request. To establish good communication with the client, the following practices shall take place:

- Critical value observed in internal testing shall be communicated to the requesting party immediately.
- The support service is available 24/7 including passive call service after office hour. Laboratory on-call roster for after hour test service shall be circulated to wards in monthly basis as a convenience to get in touch with the lab personnel on-duty.
- Clients will be informed if there are any delays in the performance of results
- A basic range of tests is provided to meet the needs of clients in Hospital Rehabilitasi Cheras. Tests that are not listed in internal service shall be referred or outsourced to accredited/competent laboratories.
- The department shall coordinate and assist the review of Point of Care Testing services as subjected to relevant guidelines and policies.
- Clients will be informed if there are delays in the performance of test.

CONTACT NUMBERS

CONTACT NUMBERS

PERSON	LINE
GENERAL LINE: 03-9145 3400	
Head of Pathology Department	2901
Laboratory Supervisor	2906
Store Officer	2905
Specimen Reception Counter 1	2902
Specimen Reception Counter 2	2903
POCT Officer (Glucometer)	2902/2903
POCT Officer (Cardiac Marker / Urinalysis)	2902/2903
Office	2900
Fax	03-91300514
E-mail	patologi.hrc@moh.gov.my

LIST OF TESTS

Name of tests	TAT (Routine)	TAT (Urgent)	Specimen & Type/ Container	Volume
Renal profile (RP) • Na • K • Cl • Creatinine • Urea	4 hours	45 minutes		
Liver function Test (LFT) • Albumin • Alkaline Phosphatase (ALP) • Alanine Transaminase (ALT) • Total Bilirubin • Total Protein		-	Blood plasma - Lithium heparin	3.5 ml (adult) 0.5 ml (paediatric)
Fasting Serum Lipid (FSL) • Cholesterol • HDL • LDL • Triglyceride		-		
Calcium		-		
Phosphate		-		
Uric Acid		-		
Magnesium		-		
Glucose		-	Blood serum - Fluoride oxalate	2 ml (adult)
Blood Gases		45 minutes	Whole blood - Heparinised syringe in ice	2 ml
Coagulation PT/APIT INR		1 hour	Blood plasma - Sodium citrate	1.8 ml
Full Blood Count (FBC)		45 minutes	Whole blood - EDTA tube	2.5 ml (adult) 0.5 ml (paediatric)
ESR		-	Whole blood - Sodium citrate	1.28 ml
Fecal Occult Blood		-	Random faeces - Sample container	1.0 g
Urine Pregnancy Test		-	Sterile sample container	10 ml
UFEME	-			

LIST OF TESTS OFFERED AFTER OFFICE HOUR

TYPE OF TEST	OFFERED BY
Full blood count	HRC Laboratory
Coagulation (PT, APTT, INR)	
Blood gases	
Renal profile (BUSE, creatinine,urea)	
Liver function test (ALP, ALT, albumin, total protein)	
Serum glucose	
Serum calcium	
Serum phosphate	
Urine pregnancy test	
Urine biochemistry & microscopy (UFEME)	
Serum/urine osmolality	
Serum amylase	
Serum lactate	
Serum ammonia	
Blood culture & sensitivity	
Urine culture & sensitivity	
Pus culture & sensitivity	
Tracheal culture & sensitivity	
Infectious disease screening forneedle stick injury	
Toxicology (PCM/salicylate/urine paraquat)	

TYPES OF REQUEST FORM

**MINISTRY OF HEALTH MALAYSIA
PATHOLOGY SERVICES FORM (PERPAT-301)**



KEMENTERIAN KESIHATAN MALAYSIA
PERKHIDMATAN PATOLOGI
HOSPITAL.....

(PER-PAT-301)

UNTUK KELOMPOK MAKMAL
LAB No.

1. Nama:		2. No. Pendaftaran:	
3. No. K/P:		4. Jantina: <input type="checkbox"/> Lelaki <input type="checkbox"/> Perempuan	
5. Umur:	6. Keturunan:	7. Wad/Klinik:	
8. Tarikh Masuk Wad:	9. Pekerjaan:	10. Taraf Perkahwinan: 11. <input type="checkbox"/> Bayar <input type="checkbox"/> Percuma	
12. No. Laporan Dahulu:		13. Butiran Penting	
14. Ringkasan Klinikal, Penemuan Pembedahan dan Riwayat Keluarga:		Ya	Tidak
		<input type="checkbox"/>	<input type="checkbox"/>
		Jaundice	<input type="checkbox"/>
		Lymphadenopathy	<input type="checkbox"/>
		Hepatomegaly	<input type="checkbox"/>
		Splenomegaly	<input type="checkbox"/>
		Bleeding Tendency	<input type="checkbox"/>
		H/O Transfusion	<input type="checkbox"/>
		Haematinics	
		Drug/Chemical History	
		Data Makmal Terdahulu	
		Hb	
		Platelet	
		TWDC	
15. Diagnostics:			
16. Kategori Permohonan/Jenis Ujian:			
<input type="checkbox"/> Patologi Kimia	<input type="checkbox"/> Klinikal	<input type="checkbox"/> Hematologi	<input type="checkbox"/> Histo/Saitologi
B. Sugar <input type="checkbox"/>	Bld. Count <input type="checkbox"/>	FBP <input type="checkbox"/>	Spesimen
B. Urea <input type="checkbox"/>	ESR <input type="checkbox"/>	BM Asp. <input type="checkbox"/>	
S. Elec <input type="checkbox"/>	BFMP <input type="checkbox"/>	Hb Analysis <input type="checkbox"/>	Spesimen
B. Gases <input type="checkbox"/>	U. Sugar <input type="checkbox"/>	Coagulation <input type="checkbox"/>	
S. Bilirubin <input type="checkbox"/>	U. Alb. <input type="checkbox"/>		Ujian
LFT <input type="checkbox"/>	U. ME <input type="checkbox"/>		
Se. Creatinine <input type="checkbox"/>	Stool ME <input type="checkbox"/>		
Lain-lain:			
17. Pengambilan Spesimen: Tarikh: [][][][][][] Masa: [][][][][]			
18. Nama Doktor:			
19. Tarikh:			
Tandatangan dan Cop Doktor			

WJRH01.2 (NSR) 8.0

LAPORAN SELEH BELAKANG

HOSPITAL KUALA LUMPUR THERAPEUTIC DRUG MONITORING (TDM) REQUEST FORM (HKL/JP/CT/PK-01-06)

DEPARTMENT OF PATHOLOGY / PHARMACY, HOSPITAL KUALA LUMPUR THERAPEUTIC DRUG MONITORING (TDM) REQUEST FORM

HKL/JP/CT/PK-01-06

Lab No.:

* Please refer to the back page of the second copy page for sampling time guidelines.
 * Actual sampling time and actual dosing time must be stated on form to avoid confusion and misinterpretation of result.
 * Please complete the form.
 * Lab service hour : Weekdays: 8.00am - 5.00 pm / Saturday: 8.30am - 1.30 pm
 Sunday & Public Holiday Requested by appointment only, Please Call 6077

A. Patient Particulars									
Name:					R/N:				
NRIC:			Weight (kg):		Height (cm):		Sex: M / F		
Ward / Clinic:			Bed:		Age:		Date of Admission:		
B. Laboratory Results		C. Indications For TDM			D. Clinical Summary & Diagnosis			E. Concurrent Medications	
Creatinine (µmol/L)		Toxicity Suspected							
Blood Urea (mmol/L)		Poor Response							
Potassium (mmol/L)		Non Compliance							
Albumin (g/L)		Routine Monitoring							
F. Additional Information									
ALT (u/L)					Initiation Dose/ Loading Dose:				
WBC (x10/L)					Date:				
Heart Rate (bpm)									
Body Temperature (°C)									
G. Drug Analysis									
Drug <i>Tick (✓) where appropriate</i>	Tube	Present Dose Regimen	Date Started	Date			Results	Therapeutic Range	Unit
				Pre Sampling (time)	Last Dose Given (time)	Post Sampling (time)			
*PARACETAMOL	Plain								µmol/L
*SALICYLATE	Plain						1.09 - 2.17		mmol/L
BENZODIAZEPINE	Plain								ng/mL
ETHANOL	Plain						-		mmol/L
AMIKACIN	Plain						T: < 17 P: 34 - 51		µmol/L
GENTAMICIN	Plain						T: < 4.18 P: 10.45 - 20.9		µmol/L
VANCOMYCIN	Plain						T: 6.9 - 13.5 P: 13.6 - 27.6		µmol/L
CARBAMAZEPINE	Plain						17 - 51		µmol/L
PHENOBARBITAL	Plain						64.7 - 172.4		µmol/L
PHENYTOIN	Plain						40 - 79		µmol/L
VALPROIC ACID	Plain						346.5 - 693		µmol/L
THEOPHYLLINE	Plain						55.5 - 110		µmol/L
DIGOXIN	Plain						AF: 1-2.6 CCF: 0.64-<1.28		nmol/L
METHOTREXATE	Plain						24hr : 5 - 10 48hr : 0.5 - 1.0 72hr : 0.2		µmol/L
CYCLOSPORIN	EDTA						100 - 250 (>6/12) 250 - 375 (<6/12)		ng/mL
SIROLIMUS	EDTA						T1: 5 - 11 T2: 13 - 19		ng/mL
TACROLIMUS	EDTA						5.0 - 20.0		ng/mL
EVEROLIMUS	EDTA						3.0 - 8.0		ng/mL
MYCOPHENOLIC ACID	EDTA						T: 1.0 - 3.5		ng/mL
* Sample received after office hour will be analysed at Core Lab :									
Requested by Doctor: Signature & Stamp: Date :					Scientific Officer: Signature & Stamp: Date :				
H. Pharmacist Assessment and Recommendation									
Pharmacokinetic profile									
1) CrCl :									
2) Ke :									
3) T½ :									
4) Vd :									
Informed : _____ on _____ at _____ am/pm								Pharmacist's Signature & Stamp Date :	

PRE-ANALYTICAL REQUIREMENTS

PRE - ANALYTICAL REQUIREMENTS

Request form

A standard laboratory request form i.e. **PER-PAT 301 is used for all categories of tests except otherwise** stated (refer to individual sections).

All request forms must be filled in legibly. The completed forms shall be signed by a doctor and accompanied by the properly collected specimens.

The following information must be provided for every request:

- I. Patients' details:** Name, identity card (IC) number, sex and age.
- II. Source:** Ward, clinic and name of hospital (if relevant)
- III. Patient's clinical summary:** Relevant clinical summary including provisional diagnosis and treatment. Abbreviations are discouraged.
- IV. Test details:** Request must specify the test required.
- V. Specimen information:** Date and time of specimen collection, type of specimen and anatomic site (if relevant)
- VI. Requester details:** Doctor's name, signature and official stamp.

One set (3 pieces) of carbonised request forms should be used for a patient requiring all categories of tests. Mark () at the appropriate box for the tests required. Tests which are not listed in the request form should be stated under the column OTHERS.

All request forms must be signed either by a House Officer, Medical/ Dental Officer or Specialist depending on the category of test requested.

Urgent requests must be justified by clinical summary, diagnosis and reason for the urgency. The word "URGENT" or "STAT" must be written clearly or stamped preferably in red at the top on the right hand corner of the request form.

Do not abuse the term "URGENT" or "STAT" for non-emergency cases.

Specimens

The specimens should be collected by the ward or clinic staff properly, labelled and despatched to the laboratory in appropriate containers as specified.

The specimen containers must be labelled with at least two identifiers (1.e. name of patient and patient's I.C number) and test requested.

The specimen containers should be placed in biohazard plastic bags with the respective request forms stapled outside the bag.

Types of containers

The specimen should be sent to the laboratory in appropriate containers. Refer to for the recommendation and guidelines provided in this handbook.

Transportation of specimen

The specimens should be transported to the laboratory as specified according to the type of test in appropriate time frame and according to transport requirements for the test.

URGENT samples must be brought to the laboratory by the ward or clinic staff immediately. The time of specimens received at the counter should be clocked in and the specimens will subsequently be attended by the laboratory staff for the URGENT tests to be carried out.

REJECTION CRITERIA

Requests which do not fulfil the laboratory requirements will be rejected. Below are the common/primary rejection criteria:

- I.** Leaking specimen
- II.** Wrong container.
- III.** Test request is not stated.
- IV.** Insufficient sample.
- V.** Requests with incomplete patient's particulars : - Incomplete identity card (IC) number.
 - A.** Name of the patient is not provided.
 - B.** No ward/clinic written on the request form.
- VI.** Form received without specimen or specimen received without form.
- VII.** The specimen is not suitable for analysis e.g. haemolysed blood sample.
- VIII.** Patient's information on the request form does not tally with that on the specimen bottle.
- IX.** Unlabelled specimen.
- X.** Test is not offered in HRC or referral laboratories.
- XI.** Redundant request
- XII.** Wrong sampling or storage method
- XIII.** Tests that need preappointment

NOTIFICATION OF SPECIMEN REJECTION

- I.** The respective ward or clinic staff will be notified if the specimen is rejected.
The laboratory procedure for rejection is as follows:
- II.** If the porter is waiting, the rejection form and information about the rejection will be given to the porter.
- III.** If the porter is not waiting, the laboratory staff will call the ward/ clinic staff and inform about the reasons for rejection . The rejection form will be dispatched to the designated pigeon hole.
- IV.** If the specimen is blood or urine, a new specimen will be requested. If it is a precious specimen e.g. CSF, tissue, paediatric sample ; the ward staff would be informed to come to the laboratory to rectify the problem.

OUTSOURCING OF TESTS

The Pathology Department will be outsourcing certain tests which are not offered by this laboratory.

For outsourcing of tests, the following procedures must be followed :

- I.** The request must be made by a medical officers or specialist.
- II.** The requesting specialist is required to fill up a request form.
- III.** Use a set of PER-PAT 301 request form (in triplicate).
- IV.** The following information must be provided on the request form :
 - A.** Patients' details including name, identity card (I.C) number, sex and age.
 - B.** Ward or clinic (where the result/report needs to be sent to).
 - C.** Adequate and relevant clinical summary

TYPES OF BLOOD VACUTAINER

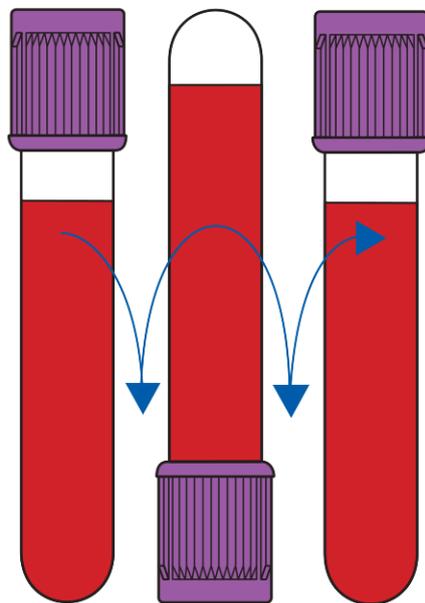
Vacutainer tube	Additives	Number of inversion after collecting blood	Laboratory use
	Clot activator and gel for serum separation	6-8 Reason: To ensure proper mixing of clot activator with blood	For serum determinations in chemistry. Blood clotting time: 30 minutes.
	Lithium heparin and gel for plasma separation	6-8 Reason: To prevent clotting	Plasma determinations in chemistry.
	Sodium fluoride Sodium fluoride/ Na EDTA	6-8 Reason: To ensure proper mixing	For glucose determinations. Oxalate and EDTA anticoagulants will give plasma samples. Sodium fluoride is the antiglycolytic agent. Tube inversions ensure proper mixing of additive with blood.
	Spray-coated K ₂ EDTA (plastic)	6-8 Reason: To prevent clotting	K ₂ EDTA for whole blood hematology determination and immunohaematology testing (ABO grouping, Rh typing, antibody screening).
	Buffered sodium citrate 0.105 M glass 0.109 M plastic	3-4 Note: Must be completely filled due to the amount of additive in the tube.	For coagulation determinations.

Inversion Technique

Tilt the tube repeatedly (do not shake and avoid foaming) immediately after filling in order to mix the sample thoroughly with the anticoagulant.

Leave the containers at room temperature for at least 30 minutes to separate serum from blood cells in blood that was taken from non-anticoagulated patients.

This period is shorter when coagulation has been activated



IMPORTANT NOTES

Haemolysis - Cause and Effect

Haemolysis should be avoided because it invalidates certain lab determinations. The presence of haemolysis of moderate or greater degree adversely affects the blood specimen in several ways.

It releases erythrocyte contents such as potassium, lactate dehydrogenase and acid phosphatase into the serum thereby elevating their levels.

It colours the blood plasma and serum which will interfere with colorimetric assays especially photometric measurements using shorter wavelengths of the visible spectrum.

As some red blood cells have been damaged, the packed cell volume (PCV) and red blood cell (RBC) count will be falsely depressed. Although the haemoglobin value will be accurate, the calculated red blood cell indices will be affected by the depressed PCV and RBC.

Among the more common causes of haemolysis are as the following :

A. Collection of Blood

During phlebotomy avoid probing, traumatic venipuncture, using a needle that is too small (less than 22 gauge) and drawing from a haematoma as these will cause haemolysis.

Make sure venepuncture site is dry. Residual alcohol may cause lysis of red blood cells.

A slow return of blood flow into tubes could also causes haemolysis. The pressure created by the vacuum tube or syringe collapses the lumen of the vein against the needle, thereby crushing numerous red cells.

Fluttering of the lumen against the needle which can cause haemolysis can be stopped by reducing the negative pressure exerted by repositioning the needle with a slight rotation or deeper insertion .

Avoid drawing the plunger back too forcefully if using a needle and syringe. Applying excessive negative pressure can create haemolysis. Our natural tendency is to use more force to enhance blood flow, however patience and alternating gentle pressure with a short release will yield best results.

B. Transfer of blood

Expelling blood from a syringe through the needle into a tube with force can cause haemolysis. Using a large bore needle will help prevent haemolysis of the blood and maintain the integrity of the sample.

Do not apply pressure to the plunger: allow the tubes to fill by the negative pressure of the vacuum tube.

Do not shake blood in container to mix with anticoagulants as frothing results in haemolysis. Gently mix by repetitive inversion 6 to 10 times. Agitation of whole blood not containing an anticoagulant is certain to produce haemolysis.

C. Extreme temperature

Extreme temperatures hot or cold can cause haemolysis. Avoid placing ice or frozen gel packs directly on tubes of blood as it can result in haemolysis.

REFERENCE RANGES

REFERENCE RANGE OF TEST OFFERED

TYPE OF TEST	AGE	REFERENCE RANGE	TEST METHOD
Arterial Blood Gas (ABG)			
1. Blood pH	10 d-3 mth 4-12 mth Adults	7.34-7.45 7.38-7.45 7.37-7.45	Severinghouse principal (Potential Metric Measurement)
2. CO₂ pressure	4 - 12 mth Adults male Adults Female	3.6-5.3 kPa 4.7-6.1 kPa 4.3-5.7 kPa	
3. O₂ pressure	10 d-3 mth Adults	9.3-11.4 kPa 9.5-13.9 kPa	Clark Measurement principle
Coagulation			
1. Prothrombin Time	1 d - 12 yr 13 yr - 99 yr	9.87 - 12.03 sec 12.6 - 14.0 sec	Electromechanical Method
2. Activated Partial Thrombin Time (APTT)	Adults	31.2 - 47.2 sec	
Fecal Occult Blood	All	Single line - Negative Double line - Positive	Aminophenazone Method
Urine Pregnancy Test	All	Single line - Negative Double line - Positive	Chromatographic Immunoassay
ESR	All	4-7 mm/hr	Standard Westergren and Wintrobe Methods

REFERENCE RANGE OF TEST OFFERED

TYPE OF TEST	AGE	REFERENCE RANGE	TEST METHOD
Urine Biochemistry (Qualitative) Colour Blood Bile Urobilinogen Ketone Protein Nitrite Glucose pH Specific gravity Leukocytes	All	Straw Negative Negative 1 mg/dl or less Negative Negative Negative Negative (5.0 - 8.0) 1.000 - 1.030 Negative	Colour - Visual Blood - Peroxidase-like activity of Hemoglobin Bile - Coupling of bilirubin with diazotized dichloraniline Urobilinogen - Ehrlich reaction Ketone - Acetoacetic acids reacts with nitroprusside Protein - colour change of tetrabromphenol blue in the presence of protein pH - double indicator principle Specific gravity - pKa changes Leukocytes - Esterase
Dengue Combo Test 1. NS1 2. IgG 3. IgM	All	NS1 Single line - Negative Double line - Postive IgG & IgM Single line - Negative Double line - Positive IgG/IgM Triple line - Positive IgG, Positive IgM	Immuno-chromatography Method

REFERENCE RANGE OF TEST OFFERED

TYPE OF TEST	AGE	REFERENCE RANGE	TEST METHOD
Albumin	5 d -14 yrs 15 - 18 yrs Adults	3.8–5.4 g/dL 3.2–4.5 g/dL 3.5–5.2 g/dL	Bromcresol Green (BCG) Roche cobas c 311
Alkaline phosphatase	2 - 5 days 6 d - 6 mth 7 mth - 1 yrs 2 - 3 yrs 4 - 6 yrs 7 - 12 yrs 13 - 17 yrs Male 13 - 17 yr Female Adult male Adult female	<553 U/L <1076 U/L <1107 U/L <673 U/L <673 U/L <720 U/L <448 U/L <448 U/L <270 U/L <240 U/L	PNPP, AMP Buffer Roche cobas c 311
Alanine amino-transferase	1 d 2-5d 6 d -6 mth 7 myh - 1 yr 2 -3 yr 4 -6 yr 7 - 12 yr 13 - 17 yrs Male 13 - 17 yrs Female Adult male Adult female	<31 U/L <49 U/L <56 U/L <54 U/L <33 U/L <29 U/L <39 U/L <27 U/L <24 U/L <41 U/L < 31 U/L	UV without P5P Roche cobas c 311
Bilirubin - Total	1 d 2 d 3 - 5 d Children and adults	< 8.2 mg/dL < 12 mg/dL < 24 mg/dL <1.1 mg/dL	Diazonium Ion Roche cobas c 311
Calcium plasma	1 - 12 mth 1 - 4 yr 5 - 20 yr Adults	2.25–2.75 mmol/L 2.20–2.70 mmol/L 2.10–2.55 mmol/L 2.15–2.50 mmol/L	o-cresolphthalein complexone Roche cobas c 311
Chloride	1 d - 4 wk 1 - 12 mth >1 yr Adults	97–108 mmol/L 97–108 mmol/L 97–106 mmol/L 97–107 mmol/L	ISE indirect

REFERENCE RANGE OF TEST OFFERED

TYPE OF TEST	AGE	REFERENCE RANGE	TEST METHOD
Cholesterol, Total	1–3 yr 4–6 yr 7–9 yr 10–12 yr 13–15 yr 16–18 yr	2.79–4.99 mmol/L 2.74–4.99 mmol/L 2.69–5.43 mmol/L 2.72–5.64 mmol/L 2.79–5.30 mmol/L 2.38–6.05 mmol/L	Cholesterol oxidase, esterase, peroxidase Roche cobas c 311
Creatinine	1–2 yr 3–4 yr 5–6 yr 7–8 yr Adults	<0.35 mg/dL <0.42 mg/dL <0.47 mg/dL <0.53 mg/dL <1.17 mg/dL	Alkaline picrate- kinetic rate blanked, IFCC-IDMS Standardized Roche cobas c 311
Glucose	Fetal Infants Adults	3.0–5.7 mmol/L 2.8–10.0 mmol/L 3.6–6.1 mmol/L	Hexokinase Roche cobas c 311
Magnesium	5 mth–6 yr 7–12 yr 13–20 yr Adults	0.70–0.95 mmol/L 0.70–0.86 mmol/L 0.70–0.91 mmol/L 0.66–1.07 mmol/L	Chlorophosphona-zo III Roche cobas c 311
Potassium plasma	1–6 mth >1 yr Adults	3.5–5.6 mmol/L 3.3–4.6 mmol/L 3.5–5.1 mmol/L	ISE indirect Roche cobas c 311
Protein, Total	7 mth–12 mth 2 - 12 mth 1–2 yr Adults	51–73 g/L 56–75 g/L 56–75 g/L 64–83 g/L	Biuret, serum blank, end point Roche cobas c 311
Sodium plasma	8 d–1 mth 2–6 mth 7 m–1 yr Adults	132–142 mmol/L 132–140 mmol/L 131–140 mmol/L 146–157 mmol/L	ISE indirect Roche cobas c 311

REFERENCE RANGE OF TEST OFFERED

TYPE OF TEST	AGE	REFERENCE RANGE	TEST METHOD
Uric acid	1-3 yr 4-10 yr 10-16 yr 16-18 yr Adults	2.1-5.6 mg/dL 1.8-5.4 mg/dL 3.1-7.0 mg/dL 2.1-7.6 mg/dL 3.6-8.2 mg/dL	Uricase, colorimetric Roche cobas c 311
Triglycerides	Premature Adults ≤65 Adults >65	<0.7 mmol/L <2.3 mmol/L <3.7 mmol/L	Enzymatic, end point Roche cobas c 311
Urea	< 6 mth < 7 mth Adults	< 7.0 mmol/L < 8.0 mmol/L 1.7 - 8.3 umol/L	Urease, UV Roche cobas c 311
Phosphorus	1-3 yr 4-10 yr 10-16 yr 16-18 yr Adults	3.1-6.0 mg/dL 3.0-5.4 mg/dL 2.9-5.1 mg/dL 2.7-4.9 mg/dL 2.6-4.5 mg/dL	Phosphomolybdate method Roche cobas c 311

REFERENCE RANGE OF TEST OFFERED

Age	0 Day	3-6 months	1 Year	2 - 6 Year	6 -12 year	Male	Female	Male/ Female	-
WBC	10.0 - 26.0	6.0 - 18.0	6.0 - 16.0	5.0 - 15.0	5.0 - 13.0	-	-	4.0 - 10.0	x10 ⁹ / L
HB	14.0 - 22.0	11.1 - 14.1	11.1 - 14.1	11.1 - 14.1	11.5 - 15.5	13.0 - 17.0	12.0 - 15.5	-	g/dL
PLT	150 - 450	200 - 550	200 - 550	200 - 450	180 - 400	-	-	150 - 400	x10 ⁹ / L
PCV	0.45 - 0.75	0.30 - 0.40	0.30 - 0.38	0.34 - 0.40	0.35 - 0.45	0.40 - 0.50	0.36 - 0.46	-	L/L
RBC	5.0 -7.0	4.1-5.3	3.9-5.1	4.0-5.2	4.0-5.2	4.5-5.5	3.8-4.8	-	x10 ¹² /L
MCV	100-120	68 - 84	72 - 84	75 - 87	77 - 95	-	-	83 - 101	fl
MCH	31-37	24-30	25-29	24-30	25-33	-	-	27 - 32	pg
MCHC	30.0 - 36.0	30.0 - 36.0	32.0 - 36.0	31.0 - 37.0	31.0 - 37.0	-	-	31.5 - 34.5	g/dl
RDW	-	-	-	-	-	-	-	11.46 - 14.0	%
NE#	4.0 - 14.0	1.0 - 6.0	1.0 - 7.0	1.5 - 8.0	2.0 - 8.0	-	-	2.0 - 7.0	x10 ⁹ / L
NE%	-	-	-	-	-	-	-	40 - 80	%
LY#	3.0 - 8.0	4.0 - 12.0	3.5 - 11.0	6.0 - 9.0	1.0 - 5.0	-	-	1.0 - 3.0	x10 ⁹ / L
LY%	-	-	-	-	-	-	-	20 - 40	%
MO#	0.5-2.0	0.2-1.2	0.2-1.2	0.2-1.2	0.2-1.2	-	-	0.2 - 1.0	x10 ⁹ / L
MO%	-	-	-	-	-	-	-	2 - 10	%
EO#	0.1-1.0	0.1-1.0	0.1-1.0	0.1-1.0	0.1-1.0	-	-	0.02 - 0.5	x10 ⁹ / L
EO%	-	-	-	-	-	-	-	1.0 - 6.0	%
BA#	-	-	-	-	-	-	-	0.02 - 0.1	x10 ⁹ / L
BA%	-	-	-	-	-	-	-	<1-2	%

CRITICAL VALUES

CRITICAL LIMITS FOR PAEDIATRIC PATIENT

TEST	ANALYTE	LOWER CRITICAL LIMIT	UPPER CRITICAL LIMIT
Biochemistry	Potassium (K ⁺)	2.8 mmol/L	6.0 mmol/L
	Sodium (Na ⁺)	125 mmol/L	155 mmol/L
	CSF Glucose	1.6 mmol/L	-
	Calcium	1.7 mmol/L	3.1 mmol/L
	Magnesium (Mg ²⁺)	0.5 mmol/L	1.8 mmol/L
	Phosphate (PO ₄ ²⁻)	0.4 mmol/L	2.8 mmol/L
	CSF Protein	-	1.87 mmol/L
	Creatinine	-	330 umol/L
	Bilirubin	-	Neonate 513 umol/L Children 428 umol/L
	Urea	-	19.0 mmol/L
	Uric Acid	-	500 umol/L
Blood Gasses	pH	-	7.60
	pO ₂	5.85 kPa	16.2 kPa
	pCO ₂	2.6 kPa	9.1 kPa
Full Blood Count	Hb	Neonates 6.0 g/dL Paeds 7.0 g/dL	Neonates 22.0 g/dL Paeds 20.0 g/dL
	Hct	Neonates - 0.25 Paeds - 7.0	Neonates - 0.7 Paeds - 0.4
	Platelet	50 x 10 ³ / uL	1000 x 10 ³ / uL
	WBC	2.0 x 10 ³ / uL	50 x 10 ³ / uL
Coagulation	Fibrinogen	70 mg/dL	-
	INR (ratio)	-	> 5
Osmolality	Serum osmolality	250 mmol/kg	310 mmol/kg
Biochemistry HKL	Lactate	-	3.0 mmol/L
	Creatine Kinase (CK)	-	100 U/L

CRITICAL LIMITS FOR ADULT PATIENT

TEST	ANALYTE	LOWER CRITICAL LIMIT	UPPER CRITICAL LIMIT
Biochemistry	Potassium (K ⁺)	2.8 mmol/L	6.0 mmol/L
	Sodium (Na ⁺)	125 mmol/L	155 mmol/L
	Glucose	2.8 mmol/L	20 mmol/L
	Magnesium (Mg ²⁺)	1.5 mmol/L	3.0 mmol/L
	Phosphate (PO ₄ ²⁻)	0.41 mmol/L	2.0 mmol/L
Blood Gasses	pH	7.2	7.55
	pO ₂	7.8 kPa	-
	pCO ₂	-	9.3 kPa
Full Blood Count	Hb	6.0 g/dL	19.0 g/dL
	Hct	0.2	0.6
	Platelet	20 x 10 ³ / uL	1000 x 10 ³ / uL
Coagulation	Fibrinogen	100 mg/dL	-
	INR (ratio)	-	> 5
	PT (sec)	-	> 2.5
	APTT (sec)	-	80 sec or > 2x upper reference range
Osmolality	Serum osmolality	< 250 mmol/kg	350 mmol/kg
Biochemistry HKL	Lactate	-	5.0 mmol/L
	Creatine Kinase (CK)	-	5000 U/L
	Lithium (Li ²⁺)	-	1.5 mmol/L

**LIST OF REFERRAL
LABORATORIES**

LIST OF REFERRAL LABORATORIES
AND AVAILABLE LINKS TO THEIR ONLINE SERVICES HANDBOOK

1. Department of Pathology, Hospital Kuala Lumpur (HKL)

* <http://hkl.moh.gov.my/index.php/services/clinical-department>

2. Institut Perubatan Respiratori (IPR)

3. Department of Pathology, Hospital Tunku Azizah

4. Pusat Darah Negara (PDN)

* <https://pdn.gov.my/v2/>

5. Dept. of Diagnostic Laboratory Services,
Hospital Canselor Tuanku Mukhriz,
Pusat Perubatan Universiti Kebangsaan Malaysia

*<https://hctm.ukm.my/makmal/>

6. Institute for Medical Research (IMR) / National Institute of Health (NIH)

*https://www.imr.gov.my/images/handbook/imr_handbook_2017.pdf

* <https://www.imr.gov.my/en/diagnostic-services>