National University Hospital

POLICIES

Laboratory Services Operating Hours

Clinical Chemistry CORE Laboratory	24 hours
Haematology CORE Laboratory	24 hours
Blood Transfusion Services	24 hours
Microbiology Laboratory	24 hours
Non-CORE Chemistry	Office hours
Flow Cytometry Laboratory	Office hours
Cytogenetics Laboratory	Office hours
Molecular Diagnosis Centre	Office hours
Laboratory Administration	Office hours
Laboratory Information Services	Office hours
Point-of-Care Administration	Office hours
NUH Referral Laboratory Services	Monday-Friday 830hrs – 1700hrs Saturday 830hrs – 1200hrs

Office hours: Monday to Friday 0830hrs to 1800hrs.

All laboratories will be fully staffed during office hours. Laboratories operating on a 24 hour shift will have a reduced staff strength on Saturdays, Sundays, public holidays and after-office hours.

Turnaround Times

- Routine Tests
  These tests are performed in a batch mode or in a continuous flow on receipt. Most tests will be resulted within 24 hours of receipt.
- Scheduled Tests
  These tests are performed on a fixed schedule basis with turnaround time ranging from a few days to a week. A few esoteric tests may take up to two weeks to result.
- Referred Tests
  These tests may take a few days to a few weeks. Both courier schedules and testing schedules of the referred laboratory must be taken into consideration when tracing for results.
- Urgent Tests
  An urgent test or sample will be processed for testing as soon as it is received in the laboratory. The expected time to availability of the results is dependent on the tests requested, however it should be available in less than 2 hours after receipt in the laboratory.

Tests available on an URGENT basis for Inpatient wards:

- Chemistries: Sodium, Potassium, Chloride, Carbon Dioxide, Urea, Creatinine, Glucose, Calcium, total & ionised, AST, CK, LDH, CKMB, Troponin, Myoglobin, Amylase, serum, Osmolality, Serum & urine, Magnesium, Ammonia, Lactate, Beta hydroxy butyrate, Bilirubin, neonatal, C-reactive protein
- Blood gases, carboxyhaemoglobin
- Therapeutic drugs: Acetaminophen, Salicylate, Digoxin, Theophylline, anti-epileptics, aminoglycosides
- Full blood count
- Coagulation studies: PT/INR
- ABO Rh Group and Type
- Crossmatch of Blood and Blood Products
- Type specific non-crossmatched blood
- Blood films for Malarial and Filarial parasites

Additional tests available on an URGENT basis for Outpatient Centres
These tests will be considered as urgent when the attending clinician requires the results for the same clinic session.

- Thyroid hormones: T3, free T3, T4, freeT4, TSH
- Reproductive hormones: LH, FSH, Estradiol, Testosterone, Progesterone, Prolactin
- Tumour markers: AFP, CEA, Total Beta HCG, PSA
- Lipids
- Troponin
- Iron panel: Iron, Ferritin, Transferrin
- Therapeutic drugs
- Urine formed elements
- Glycated Haemoglobin

All tests will be performed promptly on receipt in the laboratory. The actual time will vary depending on the required time on the analyser for each test.

Table 1: Expected turnaround time for URGENT tests

Test	URGENT TAT
General Chemistries	1.5 hours
Blood Gases	30 mins
Therapeutic Drugs	1.5 hours
Full Blood Count	40 mins (without film review)
PT/INR	45 mins

ABO Rh Group and Type	30 mins
Crossmatch	10-30 mins (30 mins with Type & Screen)
Blood Film for Malarial or Filarial Parasites	1.5 hours
Thyroid Hormones	2.0 hours
Tumour Markers	2.0 hours
Iron Panel	2.0 hours
Troponin	1.5 hours
Urine Formed Elements	1.0 hour
Glycated Haemoglobin	2.0 hours

Test Amendments

Tests for the cancellation must submit the Test Cancellation/Charge Waiver Form, DLM-FORM-GEN-081 to the appropriate laboratory.

Add-On Test may only be requested via EPIC if a suitable sample is available.

- Cancellation of Tests

  Notice of cancellation of tests due to the incorrect identification on the samples. All results will be invalidated and the billing cancelled from the patients account. Billing will be posted to the ordering location. Requesting doctor/location require to fill in Test Cancellation/Charge Waiver form and submit to the laboratory as soon as possible. The Head of Department of the requesting location is required to approve the charge waiver.

  Notice of cancellation of tests due to incorrect or double ordering. Test results will not be removed from the patient record as there is no error in the results. However, the billing will be cancelled from the patients account. Billing will be posted to the ordering location. Requesting doctor/location require to fill in Test Cancellation/Charge Waiver form and submit to the laboratory as soon as possible.

  Notice of cancellation of tests prior to analysis of the sample. No patient billing will be incurred.

- Add-On Tests

  We discourage additional tests being requested on samples drawn earlier due to sample degradation and evaporation after testing. Due to small sample volumes and high levels of evaporation in paediatric samples from microtainer collections we do not accept add-on tests from paediatric samples. For Outpatient requests please call the testing laboratory in advance to ensure a suitable and adequate sample before considering Add-On Test.

  In the event there is insufficient sample to Add-On Test, the order will appear in the patient's records to redraw.

Specimen Rejection

Specimens will be rejected by the laboratory for a wide variety of reasons:

- Incorrect transit temperature (eg not received in ice). Please refer to individual test requirements for preferred temperatures.
- Incorrect specimen type, for example plasma instead of whole blood.
- Inadequate specimen volume. Please refer to individual test requirements for minimum volume.
- Inadequate preservation of 24hour urine collection. Obtain collect bottle from the laboratory prior to collection. Not all tests can be collected during a single collection due to differences in preservation requirements.
- Expired transport medium.
- Incorrect specimen container, for example a sterile container or a trace-metal free blood tube.
- Unlabelled specimens cannot be labeled in the laboratory. The samples will be archived.
- A specimen is received with a request form and the identifiers are mismatched.
- For unlabelled “precious” samples, eg. csf or extracted fluids that cannot be recollected, the person responsible for collecting the sample would be required to personally verify the correct patient identification at the laboratory prior to analysis. An incident report will be raised and the notice of verification will be appended to the patient report.

Handling of Results

- All laboratory results are treated with the strictest confidentially. We comply with the Personal Data Plan Act 2012 (PDPA) in all result handling and correspondence. All results conveyed verbally to the ordering clinician or designee is documented for audit purposes. All patient results may be viewed in EPIC. For HIV, only the ordering clinician or a clinician of consultant level or above may access the results. It requires a double log in to access these results.
- A patient's laboratory results are released into EPIC with result verification in LIS. Results are released by test based completion and will not be limited to the completion of an order to transmit the results. Clinicians may then review and verify patient lab results from EPIC.
- Microbiology may release interim reports which will be superseded when final results are available.
- Complex results from referred laboratories will not be transcribed into LIS. The reports will be scanned and uploaded to EPIC for clinicians to review and verify.
- Scanned reports will be used for medico-legal toxicology reports, as well as some bone marrow, cytogenetics, flow cytometry and molecular diagnosis reports.
- For NUH patients no hardcopy reports are generated. However, a copy of a laboratory report may be generated from EPIC.
- For NUH Referral Lab clients hard copy reports will be generated from LIS on completion of the tests.

Amendment of Results

- Any amendments made to results after their release will be conveyed to the ordering doctor or designee by phone.
- Amended results released from LIS will overwrite previous erroneous results displayed in EPIC as a corrected result. Previous results, person corrected results have been reported to, and date and time of result amendment communication will also be included in the patient report.

Critical Results

- The following results are considered as “Critical Values” and are reported to the Ordering Clinician within one hour of availability.
- A number of the critical values are only reported within NUH (see Table 2).
- Table 3 is the list of drugs that we notify as “Alert Values” above which the drug concentrations can be considered toxic.

Table 2: Critical Values

Division	Test	Critical Values
Clinical Chemistry	Calcium, serum	< 1.75 mmol/L > 3.00 mmol/L
	Glucose, serum	< 2.5 mmol/L > 20.0 mmol/L
	Sodium, serum	< 120 mmol/L >160 mmol/L
	Potassium, serum	< 2.5 mmol/L > 6.0 mmol/L
	Troponin I (NUH only)	> 26.2 ng/L on first presentation per admission
	Ammonia (NUH only)	> 100 umol/L
	Creatine Kinase	> 10,000 U/L on first presentation per admission
	Lactate (NUH only)	>5.0 mmol/L
	Bilirubin, neonatal (NUH only)	> 300 umol/L
	RPR (NUH antenatal only)	>2 titre
Haematology	APTT	>100 seconds
	INR	≥5.0
	Haemoglobin	< 6 g/dL
	White Blood Count	≤1x10^9/L ≥ 50x10^9/L on first presentation per admission
	Malaria/Filaria Parasite	Malarial/Filarial Parasite present on first presentation per admission
	Blast Cells	Presence of Blast Cells
	Glucose-6-phosphate Dehydrogenase, neonatal	Deficient or Indeterminate
	Toxic vacuolation, neonatal	Toxic Vacuolation seen
Microbiology	AFB Smear	Positive
	Blood Culture	Positive
	CSF Culture	Positive
	CSF Gram Smear	Positive
	Molecular Detection of Mycobacterium Tuberculosis	Mycobacterium tuberculosis complex detected
	Cryptococcal Antigen, CSF	Positive (titre ≥ 1)
	Microscopy - Microsporidia	Microsporidia seen
	Meningitis/Encephalitis Pathogens Panel PCR, CSF	Positive
	Respiratory Pathogens Panel PCR	For patients ≤ 18 years: Bordetella pertussis, Bordetella parapertussis and SARS-CoV-2

Table 3: Alert Values

Division	Test	Call Back Concentrations
	Acetaminophen	>200 mg/L
	Amikacin	>35 mg/L
	Digoxin	>2.4 ug/L
	Gentamicin	>13 mg/L
	Lithium	>1.5 mmol/L
	Phenobarbital	>40 mg/L
	Phenytoin	>20 mg/L
	Salicylate	>300 mg/L
	Theophylline	>20 mg/L
	Valproate	>120 mg/L
	Vancomycin, trough or random	>30 mg/L
	Vancomycin, peak	>50 mg/L

NUH Patients

- Our Healthcare Messaging System (Rooster) is utilised for the reporting of critical values to the Ordering Clinician via SMS.
- Once a critical result has been validated in LIS it will flow to an interface engine. Here the result is matched with the most up to date location for the patient, the Ordering Clinician and the critical result.
- The consolidated information creates and sends a SMS to the Ordering Clinician with details of the patient's name, identity number, location, critical result, and reference range.
- The Clinician is required to reply within 10 minutes of receiving the message with one of three options (they respond by replying 1,2 or 3)
    1. Correct doctor and acting on it.
    2. Wrong doctor but acting on it.
    3. Wrong doctor and not acting on it.
- When options 1 or 2 are selected, no further action is required.
- When option 3 is selection, Rooster will escalate to the next Clinician on the specific Department roster and cycle the process to start the clock at 10 minutes again.
- If no response, or option 3, the call will be intervened manually by the Call Centre staff.
- Call Centre staff will source for the next most suitable Clinician and retrigger the sms. The second message sent still needs to be acknowledged to close the case.
- Any cases that are unable to receive an sms the Call Centre staff will connect a doctor to the laboratory staff for the reporting of the results. A result read back is required to ensure the results are documented correctly by the recipient. All critical result notification is documented to indicate the recipient, time (for both electronic and manual notification) and the lab staff reporting the result (for manual reporting).