Clinical Biochemistry Handbook

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Amendments on this document from previous version (List details in box)	
1. Add additional information for Vit A and E in appendix 3 2. Add PCT 3. Update PSA ranges 4. Update telephone number for NUH	

CONTENTS

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1. Policy

This handbook describes the services offered by the Biochemistry Department of the East and South East London Pathology Partnership (ESEL PP).

2. Scope and Purpose

Welcome to the Clinical Biochemistry Handbook.

The Pathology specialties provide a comprehensive screening and diagnostic service. This includes the availability of medical and scientific advice at all times. Members of each specialty participate in audit, research, teaching, training and quality assurance schemes.

We aim to provide an up to date, high quality, cost effective service to our hospital and primary care users and are committed to working with local partners to facilitate patient care pathways.

UKAS accreditation is currently held by the each of the four laboratories.

The Clinical Biochemistry test menu includes general chemistry and endocrine tests, therapeutic drug monitoring, HbA1c and a range of more complex and specialised investigations.

The laboratory is equipped with automated analysers for core biochemistry, routine endocrinology and measurement of troponin, haematinics and tumour markers, and three automated analysers for HbA1c measurement.

More complicated Clinical Biochemistry investigations performed include specialised endocrine tests, analysis of trace metals, measurement of drugs of abuse and immunosuppressants. Some tests are provided for other hospitals within the local area and more specialised tests are offered to hospitals throughout the UK.

For the majority of tests the result is available the same day, often within an hour or two of receipt of the specimen for more urgent tests. Some investigations are carried out less frequently, for example weekly. Outside normal working hours some investigations may not be readily available without discussion with the on call clinical biochemist. Some highly specialised, non-urgent tests may be analysed in laboratories elsewhere in the UK. Due to the complex nature of these investigations results may sometimes not be available for several weeks.

3. Definitions and Abbreviations

ESELPP – East and South East London Pathology Partnership
ESL – Essential Services Laboratory
POCT – Point of Care Testing
RLH – Royal London Hospital, Whitechapel
NUH – Newham University Hospital
SBH – St Bartholomew's Hospital
WXH – Whipp's Cross University Hospital
HH- Homerton Healthcare

4. Location, Address and Telephone Numbers

Maps for each location can be found at our websites
https://www.bartshealth.nhs.uk/contact-us/
https://www.homerton.nhs.uk/finding-us

4.1 Laboratory Hours

We are a large department with laboratories operating over four sites within Barts Health Trust. The Royal London Hospital (RLH) site is the Hub site and operates a routine and urgent service 24 hours a day. The sites at St Bartholomew's Hospital (SBH), Newham University Hospital (NUH), Whipps Cross University Hospital (WXH) and Homerton Healthcare (HH) are Essential Service Laboratory (ESL) sites which offer urgent and inpatient services 24 hours a day.

4.2 Laboratory Contact Details

Information about the Biochemistry Department and the tests offered can be found on the ESELPP website: https://www.eselpathology.nhs.uk/

Non-urgent advice is available by email:
mailto:bhnt.clinbiochemadvice-barts@nhs.net

Site	Address	Telephone Number
Royal London Hospital	Department of Clinical Biochemistry Royal London Hospital Pathology and Pharmacy Building 80 Newark Street Whitechapel London E12ES	020 3246 0611
St Bartholomew's Hospital	Department of Clinical Biochemistry St. Bartholomew's Hospital Clinical Biochemistry Pathology Laboratory 2nd Floor Museum Block North Wing EC1A 7BE	020 7377 7000 Ext 55362
Newham University Hospital	Department of Clinical Biochemistry Newham University Hospital Glen Road Plaistow London E13 8SL	0207 363 8428
Whipps Cross University Hospital	Department of Clinical Biochemistry Whipps Cross University Hospital Whipps Cross Road Leytonstone London E11 1NR	020 8539 5522 Ext 5179

Homerton Healthcare Hospital	Department of clinical Biochemistry Homerton row Hackney London E9 6SR	020 08510 7887

5. Results, Enquiries and Clinical Advice

Please note we are unable to provide results directly to patients, please contact your relevant health care provider.

GPs and other clinicians can obtain results via telephone using the contact numbers in the table above during routine working hours (Monday - Friday 0900:-17:30).

GPs wishing to make a non-urgent enquiry may use the Advice & Guidance function within the e-referrals (ERS) system.

Non-urgent Biochemistry clinical queries may be made via email:
BHNT.ClinBiochemAdvice-barts@nhs.net

Need information about blood tests?
Lab Tests online UK has been designed to help patients better understand the many clinical lab tests, but is also used widely by healthcare professionals as a source of information. https://labtestsonline.org.uk/

A Consultant Chemical Pathologist or Clinical Biochemist is available at all times for clinical advice and enquiries about interpretation of results and follow-up tests. They can be contacted on bleep 1611 (during the working day) or via the Royal London switchboard at all other times or if calling from HH, NUH, WXH or externally.

5.1 Reports and Results

Reports are available electronically and in paper form. All networked hospital computers have access to Biochemistry results as soon as they are available. Electronic access to results is also available to GP practices via their practice management system.

5.2 Completion of request forms

In hospital, clinical biochemistry tests should be requested electronically using CRS (Royal London, Barts, Whipps and Newham). In Primary Care, T-Quest should be used for electronic requesting. Paper request forms may be used where electronic requesting is unavailable.

It is essential that clinical details are provided on request forms to allow interpretation of results, the addition of any further tests required and to enable the laboratory to decide on the most appropriate action to be taken with the results. The responsibility for providing these details should rest with the clinician requesting the

investigation and not be delegated to the person performing the blood test. Please ensure that the actual date and time of collection is hand written on the form or sample by the healthcare worker obtaining the sample.

5.3 National Screening Programmes

The Biochemistry laboratory does not test samples for national screening programmes. Please contact the screening programme directly if you require more information.

5.4 Academic Research and Clinical Trials

Please contact Barts Health Research for any research or clinical trials related queries.

6. Quality Assurance and Clinical Governance

The department aims to give the highest quality of service. The laboratory participates in appropriate internal quality control and recognised external quality assurance schemes. It is UKAS accredited and the scope can be found on the UKAS website. The laboratory adheres to Caldicott principles and conforms to the Data Protection Act.

6.1 Complaints and Compliments Procedure

Bart's Health NHS Trust (The Trust) is committed to delivering the safest and best quality care possible. The Trust welcomes concerns and complaints, as it seeks to learn from them in order to drive improvements and further enhance our Patients' and carers' experience. The Trust will aim to resolve concerns at the point of contact wherever possible.

Individuals who have access to the Intranet should raise any issues via Datix, which can be accessed from the home page.

GP concerns should be raised via the local CCG to a team within the Trust which send the concern to the Pathology Department. Please contact:
Barts Health: BHNT.CentralComplaints@nhs.net
Homerton Healthcare: HUH-tr.qualityandrisk@nhs.net

Patient complaints should be raised via PALS
To contact PALS please email:
Barts Health Sites: RLHpals.bartshealth@nhs.net
Homerton Healthcare: Huh-tr.pals.service@nhs.net

The Trust will ensure that all complainants feel they are listened to, that we have responded to all their concerns and shown an appropriate level of empathy in our response to their complaint.

Anyone choosing to make a complaint, or a patient who complains, will not be treated differently as a result of a complaint having been made. To support this process, complaint documents will be held separately to the patient's clinical records and the importance of this is highlighted in relevant training programmes for our staff. GPs and patients may notify the trust of a complaint or compliment by contacting the Central Complaints Team via email BHNT.CentralComplaints@nhs.net

6.2 Confidentiality

A duty of confidence arises when one person discloses information to another (e.g. patient to clinician) in circumstances where it is reasonable to expect that the information will be held in confidence. It is a legal obligation that is derived from case law, it is a requirement established within professional codes of conduct and it must be included within NHS employment contracts as a specific requirement linked to disciplinary procedures.

NHS organisations are trusted to deal with information in an efficient, safe and reliable manner. If the information is not available, incorrect or given to an unauthorised person patient care may suffer.

As a public body that processes information, we have a legal obligation to comply with the Data Protection Act 2018 and the Freedom of Information Act 2000, by ensuring that all information is used lawfully, shared appropriately, recorded accurately and stored securely. All our staff team takes responsibility for this and are provided with annual training.

The role of our Caldicott guardian is to ensure the highest levels of confidentiality and security for patient identifiable information held in the NHS. The Caldicott guardian covers a number of areas of concern, including keeping patients aware of what the NHS does with their information, making sure that our staff are familiar with their responsibilities and good practice, and ensuring that we have good security measures in place on our computer systems so that patient information is not easily accessible by unauthorised users.

7. Samples/Specimen

7.1 Specimen bottles/sample types

The tubes types and order of collection are detailed in Appendix 2.
The sample requirements for each test are specified in Appendix 3.

7.2 Sample labelling

All requests for patients within the Trust should be made via CRS. If CRS is not available, please follow the guidelines below.

All GP patient requests can be made via T-Quest. Alternatively, please complete a pre-printed request form and send it to the relevant site laboratory along with the sample(s) in a sealed specimen bag. Please follow the guidelines below.

The printed barcoded label must be attached lengthwise down the tube so that the barcode scanners can read the barcode and samples can be processed. Please do not wrap the barcode label around the tube; the barcode scanners cannot read the label and this will delay sample processing and the availability of results. Multiple labels on a single specimen container are not acceptable.

Please ensure that if requesting through an electronic system e.g. CRS or T-Quest, the printed labels produced are applied in singlet to each specimen container.

Please note - All samples must fulfil all labelling criteria as detailed below. This must include adequate quality barcode labels – for any samples received with poor barcode quality (e.g. misaligned, faded, upside down) the laboratory will not be able to guarantee that results will be reported within published turnaround times.

7.3 Sample identification

Three points of identification are required to enable the sample to be processes. Full name, date of birth and identification number are suitable but please be aware that many of our patients have similar names and if an identification number is not available please give a further identifier such as address. Laboratory staff are instructed not to take responsibility for processing samples which lack this information and it is likely that the requestor will need to provide a further, appropriately labelled sample.

	Essential	**Desirable**
On Sample Container	Patient's full name - spelled correctly or an anonymised coded identifier Date of Birth Hospital or NHS number Sample type Date and Time	
On Request form	Patient's full name - spelled correctly or an anonymised coded identifier Date of Birth Patient's sex Hospital number or NHS number Patient's location (Destination for report) The requesting doctor (Consultant or GP) Sample type Date sample was collected Urgency of sample	Requester's bleep number Clinical information Time sample was collected Identity of person that collected sample

7.4 Sample acceptance and rejection criteria

It is the responsibility of the clinician requesting the test to ensure that the details on the request form are accurate and complete.

It is the responsibility of the person taking the sample to ensure that the sample is correctly labelled.

Occasionally, samples may need to be rejected. Reasons include, but are not limited to following:

- Sample container broken or leaking
- Incorrect sample received for requested test(s)
- Insufficient sample – small amounts in the tubes or insufficient tubes for all the tests
- Grossly haemolysed, icteric or lipaemic samples
- Old / aged samples
- Inadequate sample quality e.g. clotted EDTA sample
- Inadequately labelled or unlabelled samples
- Samples contaminated e.g. by being taken from a patient's drip arm

7.5 Sample Storage Policy and Add-on Requests

Serum, plasma and whole blood samples are generally stored for a minimum of 48 hours after the report has been issued. Routine samples are stored for up to 3 days with samples for special tests often being stored for longer. Additional requests for tests required for immediate management where the patient will not be rebled may be made by contacting the department, however some tests are not stable and may therefore not be available to add on even after just a few hours.

7.6 Specimen Transport

All samples must be placed in sealed plastic specimen bags with a request form, if not requesting electronically via CRS. Please keep the request form and sample in separate sections of the specimen bag to avoid cross contamination in the event of a sample leak.

The responsibility for safe collection and packing of samples rests entirely with the sender. All samples must be presented to the person undertaking transport in a safe and suitable manner that complies with necessary regulations.

In-patient samples (including urgent samples) can be delivered to the laboratory by the air chute within the Royal London, Newham, Whipps Cross Hospitals and Homerton Healthcare. However, these should not be used for transporting CSF samples for bilirubin ('xanthochromia').

Urgent samples may be personally delivered to the laboratory reception areas:

- 2nd Floor Pathology Laboratory, Museum Block, North Wing, Barts
- Zone 3. Pathology, along main hospital corridor, Newham
- 4th Floor, Pathology and Pharmacy Building, Royal London
- Junction 2, Second Floor, Pathology, Whipps Cross
- Block 3, Ground floor, Pathology Building, Homerton Healthcare

Please contact the porters to arrange delivery of urgent samples.

Samples are delivered from GP surgeries and phlebotomy centres by scheduled courier deliveries, as well as from the spoke laboratories to the hub.

When analysis is required for immediate clinical management of the patient it is advisable to communicate with the laboratory staff so that they become aware of the sample and can prioritise it accordingly.

Patients may take their specimens to any of the pathology laboratory reception areas but must ensure it is fully labelled with the minimum of 3 patient identifiers (full name, date of birth and hospital or NHS number) as well as the date and time of the sample.

8. Tests

8.1 Test Repertoire

The finding of a value outside the quoted reference range does not necessarily indicate the presence of a pathological cause, and the more tests performed which are independent variables, the greater the probability of finding a result outside the reference range. Similarly, the presence of abnormality is not excluded by a result within the reference range.
From time to time reference ranges are changed. These are communicated with users and updated on the electronic reports. There may sometimes be a delay in updating handbooks and protocols, according to service demands. If you notice any discrepancies in reference ranges please bring them to our attention but it is likely that those displayed with results transmitted electronically are the most up to date.

See Appendix 3 for more details.

8.2 Urgent Tests

The routine expected turn-around-time (TAT) for testing is described in Appendix 3. Samples from A&E are processed as urgent samples and many of the results will be available within 1 hour of receipt of the sample in the Biochemistry laboratory. If the clinical situation requires urgent testing, please contact the department to arrange for priority testing.

8.3 Point of Care Testing

Biochemistry testing is increasing required at the point of care in preference to sending samples to the laboratory e.g. using blood glucose meters, urine dipsticks, blood gas machines and pregnancy testing kits. Any POCT testing should be performed to the same standard of safety and quality as testing in a traditional laboratory setting. The POCT team is pleased to assist and support the introduction and monitoring of POCT equipment within Barts Health and, will ensure appropriate engagement with quality through the multidisciplinary POCT governance group. Please contact the Team on Ext 60376 (RLH) 5385 (WX) 8428 (NUH) 7891 (HH) to discuss any POCT issues.

8.4 Factors affecting tests

Many factors affect test performance. The most common of these are haemolysis, icterus and lipaemia. Each test has a different set of cut-off values for these interferences so it is not possible to list them in this handbook but if a sample is

affected by these, the affected tests will not be reported and a comment will be added to the report to explain why.

8.5 Minimum Requesting Intervals

There are minimum requesting intervals in place for some tests in biochemistry. A minimal retesting interval is defined as the minimum time before a test should be repeated, based on the properties of the test and the clinical situation in which it is used. Those adopted in the laboratory have been determined by panels of national experts and currently available evidence.

Test	Source	Time Interval
B12	Primary and Secondary Care	3 months
Folate	Primary and Secondary Care	3 months
Ferritin	Primary Care	3 months
Iron	Primary Care	3 months
Protein Electrophoresis	Primary and Secondary Care	1 month
Serum Free Light Chains	Primary and Secondary Care	1 month
TFT	Primary Care	1 month
Vitamin D	Primary and Secondary Care	6 months

9. Additional Information

9.1 FAQs

My patient has to collect a 24 hour urine sample. What instructions should I give them?

- write your full name and date of birth on the container
- begin by emptying your bladder as normal into the toilet.
- note the time and write it on the bottle; for the next 24 hours put all urine passed into the bottle(day and night)
- do not urinate directly into the bottle but use a clean container (e.g. a jug) and then transfer the urine into the bottle
- end the collection by emptying your bladder exactly 24 hours after the start time and adding this urine to the bottle
- take the completed collection to your GP or the hospital laboratory as soon as is practical, with the request form
- check the cap is firmly in place before transporting the bottle and after each addition of urine

What dietary restrictions should be observed prior to collection of urine for 5HIAA?

The following should be avoided for three days before, and during the period of, the urine collection -avocados, bananas, chocolate, eggplants, figs, grapes, kiwifruit, nuts, pineapple, plums, tomato (or juices made from these products). List all medications on the request form.

How and why do I perform a Synacthen Test?

A Synacthen Test is most often performed for the investigation of adrenal insufficiency.

Principle

Cortisol secretion is stimulated by ACTH from the anterior pituitary. This test evaluates the ability of

the adrenal glands to produce cortisol in response to stimulation by a synthetic ACTH preparation (Synacthen).

Side effects

Hypersensitivity to Synacthen has been reported.

Preparation

The test should ideally be performed in the morning.

Procedure

Take a basal blood sample for measurement of cortisol (gold-topped tube) and ACTH (lavender tube) Inject Synacthen 250 µ g iv or im (children 36 µg/kg body weight) Take blood for cortisol after 30 and 60 minutes.

Interpretation

There is much debate about the most appropriate protocol for the test and about what constitutes a normal response. A rise in cortisol to above about 420 nmol/L is generally taken to exclude adrenal insufficiency.

Note

The test should not be performed without prior discussion with the laboratory, if the patient has already been started on steroid replacement.

My patient needs to have drug levels measured. When should I measure them relative to the last dose?

Measurement of therapeutic drug concentrations can be useful in patient management to tailor drug therapy to individual needs in order to optimise the beneficial effects and minimise toxicity and to assess compliance. However, it is important to be aware of the time of blood sampling relative to the last dose in order to interpret the results and this information should accompany the request.
See Appendix 4

9.2 High Risk Patients

Samples from patients who may be suspected to have acquired viral haemorrhagic fever must not be sent to the laboratory without prior discussion; this includes samples for all routine testing. Under no circumstances must these samples be sent via the air chute. Please contact the on-call Virology registrar via switchboard for more information.

9.3 Referral laboratories

Tests that are not available in-house in the Biochemistry Department at ESELPP are referred out to other laboratories. The laboratory that performs these tests is stated on the final report produced by ESELPP. The service provided by these laboratories is regularly reviewed to ensure it is fit for purpose. Further details can are available from the Duty Biochemist if required.

Appendices

Appendix 1: Key Personnel

Position	Name	Email Address
Pathology		
Head of Pathology	Charlotte Mustoe	c.mustoe1@nhs.net
Pathology Clinical Director	Tom Butler	tombutler1@nhs.net
Pathology Quality and Governance Manager	Heather Dolphin	heather.dolphin@nhs.net
Pathology Business Manager	Sarah Glover	sarah.glover9@nhs.net
Blood Sciences		
Blood Sciences Divisional Manager	Karl Jewell	karl.jewell@nhs.net
Biochemistry Clinical		
Consultant Chemical Pathologist and Clinical Lead for Biochemistry	Ruth Ayling	ruthayling@nhs.net
Consultant Biochemist	Zehra Arkir	Zehra.arkir@nhs.net
Consultant Biochemist	Anne Dawnay	
Biochemistry Technical		
Biochemistry Scientific Lead	Greg Dearman	greg.dearman@nhs.net
Biochemistry Automation Operational Lead	Shatha Abu-Hijleh	shatha.abu-hijleh@nhs.net
Specialist testing Lead	Ashraf Ghahani	ashraf.ghahani@nhs.net
ESL Sites		
ESL Operational Lead, NUH	Gareth Heywood-Beldon	gareth.heywood-beldon@nhs.net
ESL Operational Lead, SBH	Richard Mclean	richard.mclean1@nhs.net
ESL Operational Lead, HH	Nathan North	nathan.north@nhs.net
Biochemistry Quality		
Biochemistry Quality Manager	Elizabeth Perry	elizabeth.perry1@nhs.net
Biochemistry Quality Manager	Editha Dawey	e.dawey@nhs.net

Appendix 2: Blood Collection Tube Types

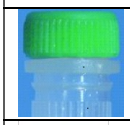
Adult

	Lid Colour	Tube Type	Order of Collection *To avoid sample contamination from anticoagulants contained in tube*	Sample Mixing *Number of tube inversions to insure adequate mixing*
		Blood culture Bottle – not for Biochemistry testing	**1**	**8 times**
	Light Blue	Sodium citrate – not for Biochemistry testing	**2**	**3-4 times**
	Red Top	Plain Tube (contains clot activator)	**3**	**5 times**
	Yellow Top	Serum Separator Tube (SST) contains clot activator and gel	**4**	**5 times**
	Green Top	Lithium heparin	**6**	**8 times**
	Purple Top	Potassium EDTA	**7**	**8 times**
	Grey Top	Fluoride/Oxalate	**8**	**8 times**
	Dark Blue Top	Clot activator (serum for trace metals)	**9**	**8 times**

Paediatric

<u> Please note Paediatric tubes lid colour may differ by manufacturer please check additive information on tubes if unsure**</u>**

These are not exhaustive and must to be used only as a guide. Definitive information as well as further special collection and transport instructions can be found in Cerner Millennium or by accessing discipline-specific user-handbooks at: https://bartshealth.nhs.uk/pathology

	Lid Colour	**Tube Type**	**Order of Collection** *To avoid sample contamination from anticoagulants contained in tube*	**Sample Mixing** *Number of tube inversions to insure adequate mixing*
	Green	Sodium citrate 1.3 ml	**1**	**10 times**
	Pink	Potassium EDTA 250 -500 µl	**2**	**10 times**
	Dark Green	Lithium heparin 250-500 µl	**3**	**5 times**
	Grey	Fluoride Oxalate 250 – 500 µl	**4**	**10 times**
	Yellow	Separator Tube (SST) contains clot activator and gel, Serum 200 - 600 µl	**5**	**10 times**
	Red	Plain Tube, serum 250-500 µl	**6**	**Not Required**

Separate bottles are required for Biochemistry, Serology, Immunology and Virology (including microbiology).
Multiple bottles may be required for larger volume or specialist tests, please contact the duty biochemist (bleep 1611) if unsure.

Appendix 3: Test Repertoire

*These tests are performed at laboratories outside Bart's Health, for further details please contact Duty Biochemist.

Blood

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Acetoacetate *(28)**	Interpretative comment provided with result	Special Tube		Not routinely offered, perchloric acid treatment required, contact duty biochemist bleep 1611.
Acid Maltase *(28)**	Interpretative comment provided with result		4	Glycogen / lysosomal storage diseases.
ACTH *(5)*	09:00h: < 50 ng/L 24:00h: < 10 ng/L applicable from 6 weeks of age		4	Sample must arrive in laboratory within 10 minutes, double-bagged in iced-water Interpretation of results requires measurement of cortisol sample taken simultaneously
Acyl and Free Carnitines *(28)**	Interpretative comment provided with result	Guthrie card *(or lithium heparin blood)*		Investigations of suspected mitochondrial fatty acid metabolism defects including Medium chain acyl-CoA dehydrogenase deficiency (MCADD), long chain acyl-CoA DH deficiency and primary carnitine deficiency
Alanine Aminotransferase (ALT) *(1)*	Female <33 U/L Male: <41 U/L		4	
Alanine Aminotransferase (ALT) with pyridoxal phosphate **NB: Homerton only** *(1)*	Male 10-50 U/L Female 10-35 U/L		4	Please note: Homerton has had a change in methodology and in reference ranges.
Albumin *(1)*	<1 yr 30-45 g/L 1-15 yr 30-50 g/L 16 yr & above 35-50 g/L		4	
Alcohol *(1)*	See ethanol		4	
Aldosterone *(7)*	Upright 250-950 pmol/L Supine 150-550 pmol/L		4	Require concurrent plasma renin activity for full interpretation of result

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Alkaline Phosphatase (ALP) *(1)*	16Yrs & Above 30-130 U/L 1 Month -15yr 60-425 U/L <1 Month 70-380 U/L		4	
Alpha-1-antitrypsin *(7)*	0.9-2 g/L		4	
Alpha-1-antitrypsin phenotyping *(14)*	Interpretative comment provided with result		4	
Alpha Fetoprotein (AFP) *(3)*	Non-pregnant : ≤5.8 KU/L Applicable from age 6 months		4	Monitoring germ cell tumours
Aluminium (20)*	< 0.5 µmol/L		4	
Amino acids (28)*	Interpretative comment provided with result		4	Sample should be received in the laboratory within 30 minutes
Amikacin (1)	Normal range (Once daily dosing) Pre dose <5 mg/L		2	If advice is required please contact the Microbiology Registrar for the relevant hospital site
Ammonia *(1)*	<4 weeks <100 µmol/L 4 weeks and above <50 µmol/L		4	Sample to be brought to the laboratory in iced water within 15 minutes
Amylase Isoenzymes *(7)*	Interpretative comment provided with result		4	Drug-induced pancreatitis in HIV/AIDS patients on HAART
Amyloid A *(56)**	<10 mg/L		4	
Androstenedione (A4) *(7)*	Adults: 2 - 5.4 nmol/L Prepubertal children (from 6m): <0.8 nmol/L		4	
Angiotensin Converting Enzyme (ACE) *(5)*	10 – 70 U/L		4	
Anti Mullerian Hormone (AMH) *(15)**	Interpretative comment provided with result		4	
Apolipoprotein B *(28)**	Male 0.52-1.09 g/L Female 0.49-1.03 g/L		4	

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Arsenic *(28)**	<95 nmol/L		4	Patients should be on a non-seafood diet for 5 days before sampling.
Aspartate Aminotransferase (AST) *(1)*	Female <32 U/L Male <40 U/L		4	
Aspartate Amininotransferase (AST) with pyridoxal phosphate **NB: Homerton only** *(1)*	Female 10-35 U/L Male 10-50 U/L		4	Please note: Homerton has had a change in methodology and in reference ranges
Beta-2-microglobulin *(7)*	≤ 60 ys < 2.4 mg/L > 60 ys < 3.0 mg/L		4	Assessing level of activity in myeloproliferative disease Not indicated for screening for, or diagnosis of, these disorders
Bicarbonate *(1)*	22 – 29 mmol/L		4	
Bile acid (total) quantitation *(1)*	<14 µmol/L 2nd and 3rd trimester of pregnancy		4	For cholestasis of pregnancy only
Bilirubin (Total) *(1)*	< 21 µmol/L		4	
Bilirubin (Direct) *(1)*	≤ 7 µmol/L		4	
Biotinidase *(28)**	4.0-15.0 nmol/ mL/min		4	Investigations of multiple carboxylase deficiency
C-Peptide *(14)*	370 – 1470 pmol/L (fasting adult)		4	Sample to in the laboratory within 2hrs If taken for the investigation of hypoglycaemia, this should be documented by measurement of laboratory plasma glucose and a sample for measurement of insulin should be taken concurrently
C-Reactive Protein (CRP) *(1)*	< 5 mg/L		4	
CA 125 *(3)*	< 35 KU/L		4	
CA 15-3 *(3)*	<35 KU/L		4	

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
CA 19-9 *(3)*	< 35 kU/L		4	
Cadmium (28)*	< 27 nmol/L (non-smokers) <54 nmol/L (smokers)		4	Send empty tube from the same batch with sample
Caeruloplasmin *(7)*	Female 0.16-0.45g/L Male 0.15-0.3g/L		4	Investigations for Wilsons disease
Calcitonin *(14)*	Females <6.4 ng/L Males <9.52 ng/L		4	Monitoring of medullary cell carcinoma of the thyroid Fasting morning sample preferred. Bring to laboratory immediately
Calcium (adjusted) *(1)*	2.20-2.60 mmol/L		4	Results not reported when albumin < 20 g/l
Carbamazepine *(1)*	Therapeutic level 4 – 12 mg/L		4	Pre-dose specimen required.
Carcinoembryonic Antigen (CEA) *(3)*	<4.7 µg/L		4	
Chloride *(1)*	95-108mmol/L		4	
Cholesterol (Total) *(1)*	Interpret according to cardiovascular risk see NICE CG181		4	
Cholesterol – HDL *(1)*	Female 1.2-1.7 mmol/L Male 0.9-1.5 mmol/L		4	
Cholesterol – LDL *(1)*	Interpret according to cardiovascular risk		4	
Cholinesterase *(21)**	Interpretative comment provided with result		4	Investigation of: suxamethonium apnoea (take samples >48h post operatively to avoid anomalous results) or organophosphate poisoning (neurotoxin)
Chromium (28)*	Interpretative comment provided with result		4	2 x bottles must be taken and labelled with order of draw, from a plastic cannula
Chromogranin A *(28)**	< 60 pmol/L			Send to lab on ice. Patient should be off PPI for at least 2 weeks. Please state if not. Patient must be fasted for sample collection.

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Chromogranin B (GAWK) *(28)**	< 150 pmol/L			Send to lab on ice. Patient must be fasted for sample collection.
Ciclosporin *(3)*	Therapeutic ranges differ according to clinical circumstances		4	Pre-dose sample required
Clobazam *(15)**	< 670 nmol/L		4	Pre-dose sample required
Clonazepam *(15)**	80 – 270 nmol/L		4	Pre-dose sample required
Clozapine (14)*	0.35-0.50 mg/L		4	Blood count monitoring is essential during treatment but routine measurement of clozapine itself is not required
Cobalt (28)*	Interpretative comment provided with result		4	
Copper *(7)*	Adult: 11-20 0-18 years: 12.6-26.8 Pregnancy (16-40 weeks): 27-40		4	
Cortisol *(1)*	Interpretative comment provided with report. Cortisol concentration >420nmol/L makes adrenal insufficiency unlikely		4	
Creatine Kinase (CK) *(1)*	Female 25-200U/L Male 40–320U/L		4	Levels may be up to twice as high in AfroCaribean and Asian populations.
Creatinine *(1)*	<1 month 27-77 µmol/L <1 year 14-34 µmol/L 3 yrs 15-31 µmol/L 5 yrs 23-37 µmol/L 7 yrs 25-42 µmol/L 9 yrs 30-47 µmol/L 11 yrs 29-56 µmol/L 13 yrs 39-60 µmol/L 15 yrs 40-68 µmol/L Adult Female 45-84 µmol/L Adult Male 59 –104 µmol/L		4	
Cryoglobulins *(14)*	None should be detected		4	Must be kept at 37°C during transport to lab Contact laboratory for specific instructions prior to taking sample

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Dehydroepi androsterone sulphate (DHEAS) *(7)*	Female1.6–7.8 µmol/L Male 2.3 –10.0 µmol/L Pre-adrenarche < 0.5 µmol/L		4	
11-Deoxycortisol *(7)*	09:00h 7 – 13 nmol/L (from age 6 weeks)		4	
Digoxin *(1)*	Therapeutic range 0.5-2.0 µg/L		4	Sample to be taken 6-8 hours post dose
Dihydro testosterone (DHT) *(21)*	Female <0.6 nmol/L Male 0.32 –1.64 nmol/L Pre-pubertal children (from age 3 months) <0.27 nmol/L		4	
Ethanol *(1)*	Legal limit is 80mg/dL in England and Wales 50mg/dL in Scotland		4	
Ethylene Glycol *(TAT dependent upon clinical circumstances)**	None should be detected		4	Suspected ingestion of ethylene glycol
Ferritin *(3)*	Male 30-400 µg/L Female 30-400 µg/L Female 50yrs <13-150 µg/L		4	For females aged 40-50 "A range of 30-400ug/L may be considered normal in postmenopausal women"
Folate (3)	>3.8 µg/L		4	
Free Fatty Acids *(28)**	Interpretative comment provided with result		4	Investigations of neonatal hypoglycaemic episodes and suspected fatty acid oxidation defects
Fructosamine *(5)*	< 285 µmol/L.		4	
Follicle Stimulating Hormone (FSH) *(3)*	Females U/L Follicular 1.5 -12.4 Ovulation 4.7-21.5 Luteal 1.7-7.7 Menopausal >25 Males 1.5-12.4		4	Measurement is generally recommended in days 1-3 of the menstrual cycle

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Galactose-1-phosphate uridyl transferase *(28)**	20.2 – 46.4 µmol/h/gHb			If the patient has been transfused in the 28 days prior to sample testing may be misleading and it may be more appropriate to test one or both parents
Gamma Glutamyl transferase (GGT) *(1)*	Females <40U/L Males <60U/L		4	
α-Galactosidase *(28)**	Interpretative comment provided with result	or blood spots on Guthrie card	4	Investigation of suspected Fabry's disease
Gastrin *(28)**	< 40 pmol/L		4	Send on ice immediately to lab. Patient must be fasting and off PPI 2weeks, H2-blockers 3 days and antacids 24h. Contact laboratory for specific instructions prior to taking sample.
Gentamicin (1)	Normal range (Once daily dosing) Pre dose <1mg/L		4	If advice is required please contact the Microbiology Registrar for the relevant hospital site.
Gut hormone screen (includes gastrin, glucagon, pancreatic polypeptide, somatostatin, VIP, chromogranins A and B) *(28)**	Interpretative comment provided with result		7	Send on ice immediately to lab. Patient must be fasting and off PPI 2weeks, H2-blockers 3 days, antacids 24h. Contact laboratory for specific instructions prior to taking sample
Glucagon *(28)**	Interpretative comment provided with result			Contact laboratory for specific instructions prior to taking sample Patient must be fasting, send on ice immediately to lab
Glucose *(1)*	Fasting 3.5 – 6.0 mmol/L Random 3.5 -11 mmol/L		4	
Growth Hormone *(7)*	Interpretative comment provided with result		4	
Haemoglobin A1c (HbA1c) – IFCC *(5)*	≥ 48mmol/mol consistent with a diagnosis of diabetes mellitus		4	Separate sample required

TEST *(Turnaround time in days)*	Reference Range	Sample type	Vol ml	Additional information
Haptoglobin *(1)*			4	
Human chorionic gonadotrophin (hCG) *(1)*	Females ≤1U/L ≤7U/L post menopause Males <2U/L		4	
β-Hydroxybutyrate *(28)**	Interpretative comment provided with result		4	.
17-alpha-hydroxy progesterone (17-OHP) *(10)*	Females: Follicular 1–8.7 nmol/L Luteal: < 18 nmol/L Neonatal: < 20 nmol/L Pre pubertal < 15 nmol/L Males 1 – 8.7 nmol/L		4	
IgA *(1)*	0.8 - 4.0 g/L		4	
IGF-1 *(7)*	Age related reference range, see report		4	Send to lab immediately
IgG *(1)*	5.5 - 16.5 g/L		4	
IgM *(1)*	0.4 – 2.0 g/L		4	
Inhibin *(20)**	Interpretative comment provided with result		4	
Insulin (fasting) *(7)*	2.6 – 24.9mU/L		4	Sample must arrive in the laboratory within 30 minutes Concurrent glucose sample required for adequate interpretation. Many exogenous insulins are not detected by this assay (Roche cobas)
Iron *(1)*	Female 9-30 µmol/L Male 12-32 µmol/L		4	
Lactate *(1)*	0.5 – 2.2 mmol/L		4	Send to lab immediately

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Lactate Dehydrogenase (LDH) *(1)*	Adults <250 U/L 0-20 days(<600 U/L)		4	values may be higher in paediatric patients
Lamotrigine *(20)**	Therapeutic range 3-15mg/L		4	Pre-dose sample required
Lead *(28)**	< 0.24 µmol/L		2	
Levetiracetam* (20)	12-46 mg/L		4	Pre-dose sample required
Lipase (1)	13-60 U/L		4	Test has superseded Amylase
Lithium *(1)*	Therapeutic range 0.4 – 1.0 mmol/L		4	Sample should be taken at least 12-hours post dose
Luteinising Hormone (LH) *(3)*	Females Follicular 2.4-12.6 U/L Ovulation 14-95.6 U/L Luteal 1-11.4 U/L Menopausal >7.7 U/L Males 1.7-8.6 U/L		4	
Magnesium *(1)*	0.70 – 1.0 mmol/L		4	
Manganese *(28)**	73 – 210 nmol/L Up to 1yr: 73 – 350 nmol/L	Special tube		Contact laboratory for special tube and collection instructions
Mercury *(28)**	< 25 nmol/L		2	Send empty tube from the same batch with sample Preferred for exposure to organic mercury
Methanol *(TAT dependent upon clinical circumstances)*	None should be detected		4	Suspected intoxication
Methylmalonic acid *(14)**	Interpretative comment provided with result		4	

TEST *(Turnaround time in days)*	Reference Range	Sample type	Vol ml	Additional information
Metanephrines *(14)*	Metanephrine <510 pmol/L Normetanephrine <1180 pmol/L 3-methoxytyramine <180 pmol/L		4	
Mycophenolate *(3)**	Therapeutic range (guide) 1.0 – 3.5 mg/L		4	Pre-dose sample
Oestradiol *(3)*	Females pmol/L Follicular 45 - 854 Ovulation 151 - 1461 Luteal 82-1251 Menopausal pmol/L <505 Males pmol/L 95 – 223		4	
Osmolality *(1)*	275 – 295 mmol/kg		4	
Paracetamol *(1)*	Please refer to national guidance on treatment of paracetamol overdose eg in BNF		4	
Parathyroid Hormone (PTH) *(3)*	1.6 – 6.9 pmol/L		4	
PTH-related Peptide *(28)**	Interpretative comment provided with result	Special tube required		Contact laboratory prior to taking sample
Phenobarbitone *(1)*	Therapeutic range (BNF) 15-40 mg/L		4	Pre-dose sample required
Phenytoin (adjusted for albumin) *(1)*	Therapeutic range 5 – 20 mg/L		4	Pre-dose sample required
Phosphate *(1)*	1 month 1.3 - 2.6 mmol/L 1 month-1 yr 1.3 – 2.4 mmol/L 1 Yr to 16 yrs 0.9 – 1.8 mmol/L >16 Yrs 0.8 – 1.5 mmol/L		4	

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Porphyria screen *(up to 28 dependent upon clinical circumstances)**	Interpretative comment provided with result	 and/or urine	4	Please discuss sample requirements with Duty Biochemist Protect sample from light in transit to laboratory and provide full clinical details, including type of porphyria suspected
Potassium *(1)*	3.5 – 5.3 mmol/L		4	:
Progesterone *(3)*	>30nmol/L suggests that ovulation has occurred		4	Sample should be taken 7 days before a period
Procalcitonin *(1)*	Interpretative comment provided with result		4	
Procollagen III (P3NP) *(28)**	0 - 3 yrs: 17-45 ug/L 4 - 9 yrs: 9-29 ug/L 9 - 16 yrs: 4.5-43.6 ug/L 16 - 20 yrs: 1.5-20.3 ug/L		4	Suspected liver damage due to methotrexate treatment
Prolactin *(3)*	Females 102-496 mU/L Males 86-324 mU/L		4	
Prostate specific antigen (PSA) *(3)*	<49y <2.51 µg/L 50-59y <3.51 µg/L 60-69y <4.51 µg/L 70-79y <6.51 µg/L 80+ <7.51 µg/L		4	
Protein electrophoresis *(7)*	Interpretative comment provided with result		4	
Protein (Total) *(1)*	60 – 80g/L		4	
Renin activity *(15)**	Upright 2.2-7.7 nmol/L/hr Supine 0.5-3.0 nmol/L/hr		4	Send to lab immediately. Do NOT put sample on ice
S100 *(28)**	0.05 – 0.15 µg/L		4	Diagnosis and monitoring of malignant melanoma
Salicylate *(1)*	Toxicity likely >300mg/L (but may occur at lower concentrations)		4	
Selenium *(14)*	0.56-1.38 µmol/L Children <2yr 0.2-0.9 µmol/L		4	

TEST *(Turnaround time in days)*	Reference Range	Sample type	Vol ml	Additional information
Serum free light Chains (SFLC) *(10)*	**Age (years)** / **Kappa (mg/L)** / **Lambda (mg/L)** / **FLC ratio** 20-40: 7.5-16.8 / 9.1-20.2 / 0.73-1.48 41-60: 9.6-21.6 / 9.8-22.6 / 0.87-1.45 61-80: 11.3-27.6 / 10.3-24.4 / 0.99-1.80 80+: 14.2-37.0 / 13.7-38.0 / 1.0-1.80		4	Screening for and monitoring of multiple myeloma patients
Sex hormone binding globulin (SHBG) *(3)*	Female 20-49y 32.4-128 ≥ 50y 27.1-128 Male 20-49y 18.3-54.1 ≥50y 20.6-76.7		4	
Sirolimus *(3)*	Therapeutic ranges differ according to clinical circumstances		4	Pre-dose sample required
Sodium *(1)*	133 – 146 mmol/L		4	
Tacrolimus *(3)*	Therapeutic ranges differ according to clinical circumstances		4	Pre-dose sample required
Testosterone *(3)*	Females 16-49y 0.29-1.67 nmol/L ≥50y 0.10-1.42 nmol/L Males 18-49y 8.64-29.0 nmol/L ≥50y 6.68-25.7 nmol/L		4	
Thallium (28)*	Thallium Whole blood = <4.89 nmol/L		2	
Theophylline *(1)*	Adults/children: 10 – 20 mg/L Neonates *5* – 13 mg/L		4	Pre-dose sample required
6-Thioguanine nucleotide (TGN) *(20)**	MEMP range <5700 pmol/RBC MEMP:TGN ratio <11		4	Therapeutic drug monitoring in patients prescribed azathioprine/6-mercaptopurine
Thiopurine methyl-transferase (TPMT) *(20)**	Normal 26-50 pmol/h/mgHb Low 10-25 pmol/h/mgHb Deficient <10 pmol/h/mgHb		4	. Measurement PRIOR to commencement with thiopurine drugs

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Thyroglobulin *(7)*	Detectable thyroglobulin suggests residual or recurrent tumour in patients treated for thyroid cancer ug/L		4	Measured in the management of patients with thyroid cancer who have been treated with total thyroidectomy/131iodine ablation
Thyroid Peroxidase Antibodiess (TPO) *(3)*			4	
Thyroid Stimulating Hormone (TSH) *(3)*	0.27 – 4.2 mU/L		4	
Thyroxine, free (fT4) *(3)*	10.5-24.5 pmol/L In pregnancy 1st Trimester 11.6-19.2 2nd Trimester 9.3-16.3 3rd Trimester 8.0-15.2		4	
Topiramate* (20)	5-20 mg/L		4	Pre-dose sample required
Transferrin *(1)*	2000 – 3380 mg/L		4	
Transferrin Glycoforms *(20)**	Interpretative comment provided with result		4	Investigation of inborn errors of protein glycosylation
Tri-iodo thyronine, free (fT3) *(3)*	3.1 – 6.8 pmol/L		4	
Triglycerides *(1)*	<1.7mmol/L		4	
Troponin *(1)*	Troponin T ≤14 ng/L (99th percentile 10% CV)		4	NICE guidance suggests one sample on initial assessment and a further sample after 3 hours
Urate *(1)*	Females 140–360 µmol/L Males 200 – 430 µmol/L		4	
Urea *(1)*	<10.8 - 5.5 mmol/L 1Y 1.0 - 5.5 mmol/L 1 Y- 15Y 2.5-6.5 mmol/L Adult 2.5- 7.8 mmol/L		4	
Valproate *(3)*	Therapeutic ranges differ according to clinical circumstances		4	

TEST *(Turnaround time in days)*	**Reference Range**	**Sample type**	**Vol ml**	**Additional information**
Vancomycin (1)	Target range pre dose trough 10-15mg/L		4	If advice is required please contact the Microbiology Registrar for the relevant hospital site.
Very Long Chain Fatty Acids (includes pristanate & phytanate) *(28)**	Interpretative comment provided with result		4	
Vigabatrin *(5)**	Therapeutic level 6 – 278 µmol/L		4	Pre-dose sample required
Vitamin A *(15)*	Adult 1.05- 2.45 µmol/L ≤ 6 y 0.70–1.50 µmol/L 7-12 y 0.90–1.70 µmol/L 13-18 y 0.90 – 2.50 µmol/L		4	Samples should preferably be collected before breakfast (i.e. fasting) and prior to any medication
Vitamin B1 (15)*	67-265 nmol/L		4	Protect from light during transit to laboratory. Send to lab immediately
Vitamin B6 (15)*	15-27 nmol/L		4	Protect from light during transit to laboratory. Send to lab immediately
Vitamin B12 *(3)*	197 - 771 ng/L		4	
Vitamin D (25-hydroxy) *(5)*	<25 nmol/L deficient 25-50 nmol/L insufficient in some people >50 nmol/L sufficient for most people		4	Routine monitoring of vitamin D is not required after replacement therapy Corrected calcium should be measured one month after completion of a loading dose
Vitamin E *(15)*	11.6 – 46.4µmol/L		4	Samples should preferably be collected before breakfast (i.e. fasting) and prior to any medication
White Cell Enzymes (Lysosomal Enzymes) *(28)**	Interpretative comment provided with result		5 to10ml	Samples must be received in the laboratory by 1pm (Monday to Friday only)
Zinc *(7)*	11 – 24 µmol/L		7	

Stones

TESTS	Reference range	Sample type	Additional Information
Stones (Urinary Calculi) *(14)**	Not normally present	Use plain urine container	

Sweat

TESTS	Reference range	Sample type	Additional Information
Chloride *(3)*	< 40 mmol/L Interpretative comment provided with result.		Sweat tests are organised by Paediatric Day Care, RLH on ext 14 - 40610

CSF

TESTS	Reference Range	Sample type	Vol ml	Additional information
Alpha-fetoprotein (AFP) *(28)**	<3.0 ng/mL	Plain	1 ML	Investigation of primary pineal tumours and cerebral metastases of germ cell tumours
Amino acids *(28)**	Interpretative comment provided with report	Plain	0.5 ML	Investigation of non-ketotic hyperglycaemia Simultaneous plasma amino acid sample essential
Angiotensin Converting Enzyme (ACE) *(20)**	< 1.2 U/L	Plain	0.5 ML	Investigation of neurosarcoid
Bilirubin ("xanthochromia") *(1)*	Interpretative comment provided with report	Plain		Ideally 3rd or 4th sample Simultaneous CSF sample for protein measurement and serum sample for protein and bilirubin (or recent results) must be available to enable appropriate interpretation. **Protect from light and hand deliver to lab immediately, avoiding use of the pneumatic air tube.** This test should be limited to those patients with ongoing clinical suspicion of SAH after a negative CT scan, and performed at least 12 hours after onset of symptoms
Glucose *(1)*	Approximately 60% of blood glucose concentration		0.5 ML	Simultaneous plasma glucose sample essential
Human chorionic gonadotrophin (HCG) *(28)**	< 2 IU/L	Plain	1 ML	Investigation of primary pineal tumours and cerebral metastases of germ cell tumours
IgG *(14)**	< 40 mg/L	Plain		
Lactate *(1)*	1.1 – 2.8 mmol/L		0.5 ML	
Neurotransmitters *(28)**	Interpretative comment provided with result	Special tubes required		Investigation of disorders of dopamine, serotonin and tetrahydropterin metabolism Contact laboratory for advise prior to planning procedure

TESTS	Reference Range	Sample type	Vol ml	Additional information
Oligoclonal Bands *(14)**	Not normally detected	Plain CSF & SST for blood		Investigation of multiple sclerosis (Test requires a paired serum sample  4 ML)
Protein (Total) *(1)*	Adults:150-450mg/L Newborn:400–1200 mg/L <1mo: 200–800mg/L	Plain	1 ML	
Tau protein (asialoglycoprotein; asiolotrasferrin; beta-transferrin; Tau protein)*	Interpretative comment provided with result	Plain	0.1 ML	Identification of CSF in an unknown fluid such as rhinorrhoea or otorrhoea

Faeces

TESTS	Reference Range	Sample type	Additional information
Alpha-1 antitrypsin *(21)**	<0.49 mg/g	Plain	Investigation of protein losing enteropathy
FIT (2)	Interpretative comment provided with result	Special container required	Containers are delivered to Practices four times a year
Porphyria screen (28 depending on complexity)*	Interpretative comment provided with result	Plain	Please discuss sample requirements with Duty Biochemist Protect sample from light in transit to laboratory and provide full clinical details, including type of porphyria suspected.
Reducing Substances *(7)*	None should be detected	Plain	Sample must be received in laboratory within 30 minutes Solid samples will not be analysed.

Urine

Tests	Reference Range	Sample type	Vol ml	Additional information
Albumin (3)	< 20mg/24hr	Plain 24hr		
Albumin/Creatinine ratio (ACR) *(3)*	<3 mg/mmol	Plain KIMA vacutest	1 KIMA Tube	
Alpha-aminoadipic semialdehyde (Alpha-AASA) *(90)**	Interpretative comment provided with result	Plain KIMA vacutest	1 KIMA Tube	Investigation of pyridoxine-dependent epilepsy

Tests	Reference Range	Sample type	Vol ml	Additional information
Amino acids *(28)**	Interpretative comment provided with result	Plain KIMA vacutest	1 KIMA Tube	Investigation of homocystinuria, renal transport defects, including cystinuria and proximal renal tubular dysfunction
Arsenic *(28)**	< 12.9 nmol /mmol Creatinine < 534 nmol/24hr	Plain KIMA vacutest 24 hr	1 KIMA Tube N/A	Avoid dietary seafood for 3 days prior to urine collection
Bence Jones Protein *(7)*	Not detected	Plain KIMA vacutest	1 KIMA Tube	
Cadmium (28)*	<10nmol/24h	Acid washed 24 hr	N/A	Please contact the lab prior to collection, preparation of a special collection bottle is required.
Calcium *(3)*	2.5 – 7.5 mmol/24h	Acid (24hr)	N/A	
Citrate *(20)**	Female 1.3 – 6.0 Male 0.6 – 4.8 mmol/24hr	Acid (24hr)	N/A	
Cortisol (free) *(21)**	< 124 nmol/24h	Plain (24hr)	N/A	
Copper *(28)**	< 0.7 µmol/24h 16.4-76.2 µmol/mmol Creatinine	Acid washed (24hr)	N/A	Investigation and monitoring of Wilson's disease. Please contact the lab prior to collection, preparation of a special collection bottle is required.
Creatinine (3)	0-18 Y No Ref >18Y M (9.0-21.0) >18Y F (7.0-14.0) mmol/24h	Plain	1 KIMA Tube or 24hr	
Creatinine Clearance *(3)*	0-18 Y No Ref >18Y M (95-140) >18Y F (85-125) mL/min	24 HR Plain	N/A	
Cystine/homocystine *(7)* *(28)*	Qualitative: No excess Quantitative:See report	Plain (random) KIMA vacutest	1 KIMA Tube	Investigation of cystinosis / cystinuria / homosytinuria
Drugs of abuse screening *(3)*	None should be present	Plain KIMA vacutest (random)	1 KIMA Tube	
GAGS (glycosaminogycans) *(28)**	Interpretative comment provided with result	Plain KIMA vacutest (random)	1 KIMA Tube	Investigation of mucopolysaccharide disorders

Tests	Reference Range	Sample type	Vol ml	Additional information
Homocystine *(7)**	0 - 5 µmol/mmol creatinine	Plain KIMA vacutest (random)	1 KIMA Tube	
Homovanillic acid (HVA) *(8)*	Adult: < 45 µmol/24h Paediatrics: 1 - 6mo: <6 µmol/24h 6 - 12mo: <8 1 - 5y: <14 5 - 10y: <33 10 - 15Y: <39 HVA:Creatinine Ratio: <4y <20 µmol/mmol creatinine 4 - 7y < 10 7 - 10y < 6 10 - 16y: < 5	Acid (24 hr) Children (random) Plain KIMA vacutest	N/A 1 KIMA tube	Diagnosis and monitoring of neuroblastoma
5-Hydroxyindoleacetic acid (5HIAA) *(8)*	Adult < 50µmol/24h	Plain or acid (24 hours)	N/A	Investigation and monitoring of carcinoid tumours
Laxative / diuretic screen *(28)**	See report	Plain KIMA vacutest (random)	1 KIMA Tube	Investigations for diarrhoea and fluid loss. Laxative abuse
Magnesium *(3)*	2.4 - 6.5 mmol/24h	Acid (24hr)	N/A	
Mercury (28)*	< 15 nmol/24hr	Acid washed (24hr)	N/A	Preferred for exposure to vapour or inorganic mercury salts. Please contact the lab prior to collection, preparation of a special collection bottle is required.
Metanephrines *(8)*	Adult nmol/24hr Normetanephrines: <4400 Metanephrines: <2000 3-methoxytryramine: <2500	Plain or Acid (24hr)	N/A	Investigation of phaeochromocytoma
Mucopolysaccharide screen *(28)**	Interpretative comment provided with result	Plain KIMA vacutest (random)	1 KIMA Tube	

Tests	Reference Range	Sample type	Vol ml	Additional information
Organic acids *(28)**	Interpretative comment provided with result	Plain KIMA vacutest (random)	1 KIMA Tube	Investigation of metabolic disorders
Osmolality *(1)*	50 - 1200 mOsm/kg	Plain KIMA vacutest (random)	1 KIMA Tube	
Oxalate *(20)**	Interpretative comment provided with result	Acid 24 hour)	N/A	Investigation of renal calculi
Phosphate *(3)*	15 – 50 mmol/24h	Acid (24 hour)	N/A	
Porphyria screen *(up to 28 dependent upon clinical circumstances)**	Interpretative comment provided with result	Plain KIMA vacutest (ideally early morning urine) and/or blood	1 KIMA Tube	Please discuss sample requirements with Duty Biochemist Protect sample from light in transit to laboratory and provide full clinical details, including type of porphyria suspected
Potassium *(1)*	25 - 125 mmol/24h	Plain (24 hr)	N/A	
Protein (Total) *(3)*	< 0.15 g/24hr	Plain (24hr)	N/A	
Protein/Creatinine ratio *(3)*	<15 mg/mmol	Plain KIMA vacutest (random)	1 KIMA Tube	
Sodium *(1)*	40 - 220 mmol/24h	Plain (24hr)	N/A	
Steroid Profile *(up to 28 depending on clinical circumstances)**	Interpretative comment provided with result	Plain (24hr)	N/A	Random samples and nappy collections may be suitable, please contact the Duty Biochemist to discuss
S-Sulphocysteine *(28)**	Interpretative comment provided with result	Plain KIMA vacutest (random)	1 KIMA Tube	Investigations of paediatric neurological damage, especially when associated with facial dysmorphia. Send to lab immediately

Tests	Reference Range	Sample type	Vol ml	Additional information
Sulphonylurea screen (28)*	Interpretative comment provided with result	Plain KIMA vacutest (random)	1 KIMA Tube	Investigation of hypoglycaemia Sample should be taken at the time, or soon after, an episode of hypoglycaemia, confirmed by laboratory plasma glucose measurement
Thallium (28)*	Thallium Urine = <4.89nmol/L	Plain Random	20 ml	
Urate *(3)*	1.5 - 4.5 mmol/24h	Plain (24hr)	N/A	
Urea *(3)*	430 - 710 mmol/24h	Plain (24hr)	N/A	
Urinary Calculi (stones) *(14)**	Interpretation provided on report	Use plain container		
Urine Reducing Substance (*7*)	Not normally detected	Plain KIMA vacutest (random)	1 KIMA Tube	Transport to laboratory immediately
Urine Bilirubin *(3)*	Not normally detected	-	-	Not offered by the laboratory, suggest testing at point of care using urine dipsticks
Urine Urobilinogen	Not normally detected	-	-	Not offered by the laboratory, suggest testing at point of care using urine dipsticks

NB: for a fasting blood test patients must not eat or drink anything except water for a minimum of 10 hours before the test

Appendix 4: Drug Sampling Times

Drug	Sampling time	Time to steady state (days)[#]	Sample Type	Sample Vol mL
Carbamazepine	pre-dose	4		4
Ciclosporin	pre-dose	n/a		4
Digoxin	6-10hrs post-dose	5-7		4
Lamotrigine*	pre-dose	7		4
Leviratecam*	pre-dose	2		4
Lithium	12-24hrs post-dose	7		4
Mycophenolate*	pre-dose	n/a		4
Phenobarbital	pre-dose	29		4
Phenytoin	predose peak useful if toxicity suspected 3-9 hours after oral dose, 2-4 hours after iv dose	21 (after oral dose)		4
Tacrolimus	pre-dose	n/a		4
Topiramate*	pre-dose	5		4
Theophylline	oral: predose or 4-6 hours post slow-release preparation iv: pre-treatment if already on oral treatment, then at 6 & 18 hrs	2-3 days		4
Valproate	pre-dose	2-4		4

[#] Minimum number of days after starting/change in dose before measurement of drug should be considered.