Department of Clinical Biochemistry

Belfast Trust Laboratories

The Department of Clinical Biochemistry provides services for primary, secondary and tertiary healthcare providers in the hospitals and community practices of most of greater Belfast. It also provides specialised services in Endocrinology, Metabolic Investigations, Newborn Blood Spot Screening, Toxicology, Trace Metals and Regulatory Peptides for Northern Ireland.

Belfast Trust Laboratories (BTL) Biochemistry is active in clinical research and maintains close working relationships with Departments in The Queens University Belfast and University of Ulster to facilitate innovative research and development. BTL has the primary role in vocational training of all the professions within laboratory medicine for Northern Ireland – Chemical Pathologists, Clinical Scientists and Biomedical Scientists – including teaching of medical and science undergraduates.

This publication is intended to provide a convenient source of information to enable users to access our services, order appropriate tests, ensure that samples are presented to the laboratory correctly, and aid interpretation and follow up of results. Every effort is made to ensure the information provided is up to date and accurate; however, interpretation of any test result should always take into consideration the clinical context. Any clinical or interpretative queries should be directed to the Duty Biochemist on week days 07821805019 or the on call Doctor (via the hospital switchboard) out of hours. Contact information is also given for key staff and their primary responsibilities and they may be contacted directly as appropriate.

It is important for users to note that this document will be regularly updated, which means any hard copies made of this information may not be valid beyond the time of printing. Similarly, locally-saved versions of this publication may only be valid at the time it was saved. The publication shown on the BHSCT websites (Intranet and Internet), Belfast Trust GP website and primary care intranet will be the current version.

Provision of Services on Multi-Sites

The Clinical Biochemistry Department is centred on the Royal Group Hospitals site of the Belfast Trust in the Kelvin Laboratories building. Limited repertoire facilities are also situated at the Mater Hospital (Laboratory building) and the Belfast City Hospital (Tower Block laboratories on ‘C’ floor). All staff are managed by a central management team and are trained and competent to work on any site as required. The Belfast Trust Laboratories are part of the central Quality Management System which includes control of documents, incidents, improvement audits, training/competency assessments, traceability, change management and verifications/validations. A redacted version of the Management Review is available to users on request. Identical analytical platforms are employed on all BHSCT sites and each site employs the same internal quality assurance materials and each is enrolled in the same external quality assessment schemes. The established reference ranges apply to all sites.

Transferred tests are analysed and reported according to the same BHSCT standard operating procedures (SOPs). Authorised personnel periodically evaluate the examination methods provided by the laboratory to ensure that are clinically appropriate for the requests received.

Inter site comparison analyses for all transferred tests are regularly performed to ensure consistency of results.

Users should be advised that all telephone communications will be automatically diverted to the alternate sites as appropriate.

Telephone

General queries should be directed to Duty Biochemist Line at the RVH (Tel: 07821805019 however this number is **only answered Monday to Friday from 09.00 – 17:00.** Any queries outside of these hours the Biochemistry Automation number below should be contacted). A menu selection will direct you to the appropriate area for the help required. You can also access laboratory sites or key individuals as appropriate using the details below

Site	Building	Area	Telephone Number
RVH	Kelvin	Biochemistry Automation Lab	02896 158910
		Central Specimen Reception	02895 151657
BCH	C-Floor	Biochemistry Automation Lab	02895 040916
MIH	Lab Building	Biochemistry Automation Lab	02895 041333
		Specimen Reception	02895 041329

Professional Contacts

Job Role	Title	Email Address	Contact Number
Service Manager Blood Sciences	**Dr Lisa McCoy**	Lisa.McCoy@belfasttrust.hscni.net	028961 54542 07385429854
Lead Scientist Blood Sciences	**Mrs Margaret McDonnell** Consultant Clinical Scientist	margaret.mcdonnell@belfasttrust.hscni.net	028961 51486
Discipline Manager	**Leanne McAdam**	leanne.mcadam@belfasttrust.hscni.net	028950 47272 07909518800
Medical Consultants	**VACANT POST**		
	Dr Grainne Connolly Consultant Chemical Pathologist	grainne.connolly@belfasttrust.hscni.net	028961 51545
	Dr Paul Hamilton Consultant Chemical Pathologist	Paul.Hamilton@belfasttrust.hscni.net	028961 51466
	Prof. Ian Young Consultant Chemical Pathologist	i.young@qub.ac.uk	028906 32743
	Dr Brona Roberts Consultant Chemical Pathologist	brona.roberts@belfasttrust.hscni.net	028961 51546
Technical Leads	**VACANT POST** (Automation)		
	Lynsey Reilly (Endocrine, HPLC and Regulatory Peptides)	Lynsey.Reilly@belfasttrust.hscni.net	02895047559
	Linda McKinstry (Toxicology and Special Investigations)	Linda.McKinstry@belfasttrust.hscni.net	02896156367
	David Hastings (Trace Metals)	David.Hastings@belfasttrust.hscni.net	
	Jarlath Rodgers (Immunoproteins)	Jarlath.Rodgers@belfasttrust.hscni.net	02896151497
	Glen McDowell (Metabolic & Neonatal)	Glen.McDowell@belfasttrust.hscni.net	
POCT Manager	**Emma Reilly**	emmak.reilly@belfasttrust.hscni.net	
Clinical Scientists	**Mrs Margaret McDonnell** Consultant Clinical Scientist – Speciality sections – endocrinology, HPLC, regulatory peptides, toxicology, trace metals, special investigations, inherited metabolic disorders, newborn screening, immunoproteins, oncology	margaret.mcdonnell@belfasttrust.hscni.net	028961 51486
	Dr Gareth McKeeman Consultant Clinical Scientist - General Biochemistry (Automation) and POCT	gareth.mckeeman@belfasttrust.hscni.net	02896 151478
	Dr Jennifer Cundick Consultant Clinical Scientist – Regional Newborn Blood Spot Screening Laboratory	jennifer.cundick@belfasttrust.hscni.net	02896 151463
	Mrs Gillian Hamilton Principal Clinical Scientist - Metabolic Laboratory	gillian.hamilton@belfasttrust.hscni.net	02896 151462
	Dr Kirsty Spence Principal Clinical Scientist - Endocrinology & Regulatory Peptides	kirsty.spence@belfasttrust.hscni.net	02896 151487
	Dr Michelle Hookham Principal Clinical Scientist - Toxicology, Special Investigations and Trace Metals	michelle.hookham@belfasttrust.hscni.net	02896 151465

Job Role	Title	Email Address	Contact Number
	Dr Amy Wotherspoon Principal Clinical Scientist – General Biochemistry (Automation)	Amy.wotherspoon@belfasttrust.hscni.net	02896 154636
	Mr Neil Gilmore Principal Clinical Scientist	neil.gilmore@belfasttrust.hscni.net	02896 154632
	Mr John Rafferty Clinical Scientist	JohnC.Rafferty@belfasttrust.hscni.net	02895 040321

Normal working hours

Normal working hours are 09:00 – 17:00 hours Monday to Friday.

The Automation Department in RVH remains open 24 hours a day for sample analyses, though with limited staff numbers outside of core hours; Specialist Sections are closed outside of normal hours, though a few tests are available on a limited basis during this time.

Clinical Biochemistry out of hours services for the Mater Hospital are provided from the Clinical Biochemistry Department, Kelvin Laboratories, Royal Group of Hospitals on the following basis:

Weeknights	**16:00 to 08:30**
Saturdays/Sundays	**24 hours**
Bank Holidays	**24 hours**

Clinical Biochemistry out-of-hours services for the City Hospital are provided from the Clinical Biochemistry Department, Kelvin Laboratories, Royal Group of Hospitals on the following basis:

Weeknights	**16:00 to 08:30**
Saturdays/Sundays	**24 hours**
Bank Holidays	**24 hours**

Urgent Samples

The laboratory must be telephoned using ***only*** the telephone numbers provided to arrange ***all*** urgent samples ***before*** the specimen is sent to the laboratory and instructions will be given.

You will receive a 'name of the day' code to help CSR staff identify samples as ***arranged*** urgent specimens.

It is ***NOT*** sufficient to mark the request form "urgent". The requesting clinician is responsible for arranging transport of urgent samples to the laboratory.

Transport of Specimens

There is a legal responsibility and a duty of care on anyone who dispatches clinical material (diagnostic specimens) to the Belfast Trust Laboratories (by whatever means, including hospital van, courier, taxi, post, internal portering, or pneumatic chute) to ensure that the specimens are packaged and labelled in compliance with the relevant and current transport regulations (ADR/CDG). Safe and efficient transport of specimens is essential to preserve the integrity of the specimen and to ensure it arrives at the laboratory in a timely manner and in a condition suitable for accurate and reliable testing. Please refer to C-18 for further information, and also to the relevant hospital protocol for detailed transport arrangements at your site.

Within the hospital environment it is preferable to use the pneumatic air-tube system, although this must **NEVER** be used for transport of CSFs, or blood gas samples, or samples on ice as the pneumatic may compromise sample integrity for these tests. It is also recommended that unique samples (e.g., fluids or time-critical samples from patients difficult to bleed) be hand-delivered to the department, as the pneumatic tube system is fallible. Please note the laboratory is not responsible for the maintenance or operation of the pneumatic tube systems and does not carry any supply of PODS. Received PODS are returned directly to the correct station using the built-in chip. It is the user's responsibility to report faults directly to the BHSCT dispatch team on telephone number 028 96059848 . Please refer to C-17 for further information.

MIH & BCH Transport Arrangements for Out of Hours (OOH) Services

Send all samples to the MIH & BCH laboratories, ***as normal***, at all times. Laboratory staff will arrange transport of the samples to the Clinical Biochemistry Department, RVH, Royal Group of Hospitals. Samples will be transported on a 20 minute cycle throughout the stipulated out-of-hours period. Motorcycle couriers are on duty to transport urgent samples from MIH & BCH Laboratories to the Clinical Biochemistry Department, RVH, Kelvin Laboratories, Royal Group of Hospitals on weekdays during rush hour (16:00-19:00). If the sample is a clinical emergency and must be transported immediately, use the ‘urgent specimen’ protocol above.

Completion of Biochemistry Urine Form and Blood Science Form

The importance of supplying the correct legible information cannot be over-stressed since specimens cannot be accepted for analysis where the identifying information on either the specimen or request form is inconsistent or inadequate.

The responsibility for requesting and following up on a laboratory test lies with a trained and authorised practitioner. Furthermore, it is the responsibility of the requester to ensure that samples are correctly labelled and request forms are completed to agreed standards.

The following Minimum Acceptance Criteria (MAC) for safe patient and sample identification ensure that the correct result will be available to guide management. The table below lists the updated Minimum Acceptance Criteria (MAC 2.0) for sample and request forms. **All points MUST be present and legible on the sample container and request form in order to progress to laboratory testing.**

SAMPLE	REQUEST FORM
• H&C number [1] • Patient Official First Name • Surname • Date of Birth (dd/mm/yyyy)	• H&C number [1] • Patient Official First Name • Surname • Sex • Date of Birth (dd/mm/yyyy) • Date & Time of Sample Collection • Full name of the requesting Consultant / Authorised Health Care Professional and their HCP code or GP cypher code[2] • Source name / encompass location code or GP practice code[3] • Source Name / encompass Location code[4] • Test Requested

Footnote

1. The H&C Number must be used unless the patient is not registered with a GP in NI / is registered but does not yet have their H&C number (in which case, it must clearly state “No H&C number available” on the request form) or In an emergency situation when the identity of the patient is UNKNOWN (in which case, use the local hospital emergency numbering system)
2. HCP code must be registered by Information Standards Group. To request a HCP code please visit https://regional.sharepoint.hscni.net/sites/CCIS/SitePages/NIHCPCodeRequest.aspx
3. A detailed descriptor of the source/location is required; for example, stating simply “outpatients” as a location name is no longer acceptable and will be rejected under MAC. The encompass location code should be provided on the request form to ensure the correct return of results. However, it is noted that not all areas are in a position to provide an encompass location code at present, and therefore, the provision of an encompass code will not be enforced under MAC at this time.

Note to encompass users: If the sample collection process is not properly followed on encompass, the laboratory will not receive an electronic request. Consequently, the MAC will not be met, and the sample will not be processed

NOTE: It is recommended that all categories listed as desirable are completed to ensure a more comprehensive service.

For example:

1. Medication e.g. thyroxine, digoxin (with time of last dose in relation to sampling) can be very relevant to interpretation of result.
2. If gender is not specified, the laboratory cannot provide gender-specific reference ranges.
3. Telephoning of critical results is further facilitated by identification of the requesting practitioner.

All specimens from known or potential carriers of Category III pathogens, e.g. Hepatitis B, Hepatitis C or HIV ***MUST*** be clearly marked with hazard labels on the request form and the specimen tube.

Encompass & OrderComms

The essential criteria will all be fulfilled if the sample and request form information are sent in an electronically-created paper format (Encompass & OrderComms) and we strongly encourage the use of Encompass & OrderComms.

It is critical that pre-printed Encompass & OrderComms request forms are amended to note the accurate sample time and date before sending to the laboratory for processing.

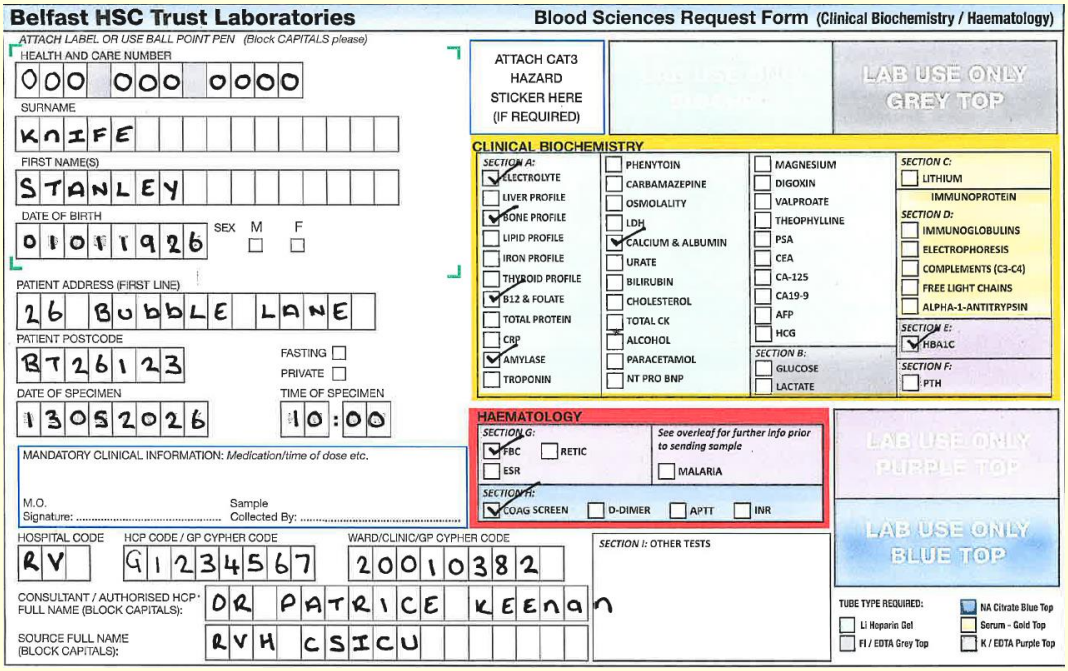
In the event of **Network outage or EPIC downtime**, the agreed BHSCT contingency for requesting laboratory investigations is the use of paper-based laboratory request forms.

The following must be adhered to during this period:

1. **Only urgent samples should be requested.**
2. As electronic ordering is unavailable, all requests must be submitted using **approved paper laboratory request forms**. All ward areas must maintain stocks of these forms for use when Business Continuity Plans are invoked.

PRODUCT CODE	REQUEST FORM	QUANTITY
WPH001556	Blood Science Specimen Request Form	PK/1000
WPH001418	Biochemistry Urine Specimen Request Form	PK/100
WPH000009	Microbiology Specimen Request Form	PK/100
WPH000012	Immunology Specimen Request Form	PK/100

3. All request forms and specimen labels must be completed in full by hand in accordance with Minimum Acceptance Criteria (MAC 2.0) as per the example below.



Minimum Re-testing Intervals

Minimum re-testing intervals (MRI) are 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.

The Royal College of Pathologists have published advice on the minimum retesting intervals in pathology: g147_national-minimum_retesting_intervals_in_pathology.pdf (rcpath.org)

MRIs facilitate a more efficient use of pathology services and hence improve patient care. Please consider the amount of unnecessary venepuncture that a patient may be subjected to by repeat testing.

Ward OrderComms are used to remind requesters when a previous test was requested within a defined time period.

Laboratory Results

Hospital patient results can be accessed electronically as soon as they become available in the laboratory. Printed reports are also delivered to wards throughout the day. GP reports are transmitted by electronic download (EDI) into individual practice systems.

The laboratory will endeavour to contact clinical staff about unexpected and / or abnormal results which are identified as potentially relevant to the immediate wellbeing of the patient concerned. A list of critical values for telephone reporting is provided in Appendix 12 Critical Result Management.

Rejection of requests for analysis or restrictions on reporting of results

The laboratory may be obliged to reject a request for analysis or restrict reporting of results when:

- There is insufficient information supplied to enable unequivocal identification of the patient, the specimen, the tests required or the source of the request.
- The specimen has been collected inappropriately e.g. unsuitable anticoagulant or preservative.
- The integrity of the specimen is in question e.g. leaked in transit, undue delay in transport, a pattern of results that suggests significant error (eg. sample from a drip arm or contaminated with EDTA).
- There is interference present which invalidates one or more test results (excessive haemolysis, icterus or turbidity). For hints and tips on how to avoid haemolysis, please refer to Appendix 20.

An appropriate comment will be added to the report, assuming a valid report can be entered into the patient record based on information supplied. Please contact the Duty Biochemist for a full explanation of the reason for rejection or restriction of reporting and advice on how to avoid this eventuality.

Test Repertoire

The Clinical Biochemistry laboratory is a UKAS accredited testing laboratory No. 8757.

The test schedule listing accredited tests can be found on the UKAS website: Clinical Biochemistry (BCH/MIH/RVH) Accredited Tests (No. 8757).

Any tests not currently on the schedule are highlighted in the comments section of the repertoire table below.

As per UKAS ISO 15189:2022 standard the laboratory shall obtain the informed consent of the patient for all procedures carried out on the patient.

NOTE : For most routine laboratory procedures, consent can be inferred when the patient willingly submits to the sample collecting procedure, for example, venipuncture.

Each test request accepted by the lab is treated as an agreement. The lab agrees to carry out the work following its procedures and standards, and the requester agrees to the lab's terms—such as how samples are submitted, what's being tested, reporting, turnaround times, and any limits on responsibility.

Measurement Uncertainty

Measurement Uncertainty recognises that all results are subject to measurement error and in order to compare a test result with a previous result or with a specific decision value it can be useful to have a feel for the reliability of the result. Measurement Uncertainty (MU) uses the principles of metrology to provide a measure of the dispersion of values within which the true result is likely to lie. Please contact the laboratory for more details.

Turnaround Times

Results for emergency requests should be available within 90 minutes of the sample arriving in the laboratory. The turnaround time may be lengthened for some samples because of additional checks and dilutions. Whenever possible, routine requests are reported within one working day of receipt. However, the turnaround times of some specialised investigations are, of necessity, longer due to the nature of some assays. A guide to expected turnaround times for individual test requests is included in the following table of test guidance information.
If clinically indicated, the laboratory will endeavour to respond to a specific request more rapidly; please contact the Duty Biochemist.

Referral Tests

Specialised tests which are not available in the Belfast Trust may be sent to selected referral laboratories for analysis by arrangement. The specific referral laboratory is identified on the laboratory report. Further information regarding samples sent to referral laboratories is listed in a table below.

'Adding–on' requests to existing samples

Additional tests are sometimes required after the original sample has been sent to the laboratory. All requests, whether the original, or an amended request made retrospectively, must be accompanied by a manual request form or OrderComms form, if possible. For lab users that are based on other sites outside core lab locations (i.e. GP, MPH, LVH, DH, offsite OP and private clinics) add-on requests can be accepted by telephone call.

Further information regarding 'adding-on' requests to received samples is detailed in Appendix 11 of this document.

PLEASE NOTE:

- Add-on tests will not be accepted unless a new request form is received (for on-site patients).
- Add-on tests will not be analysed until the current sample has been processed and initial tests completed.
- The test will be processed automatically upon receipt of the form and conditional upon the acceptance criteria being met – as detailed in Appendix 11.
- DO NOT use the Add-On facility for an URGENT request. You must send a fresh sample.
- Add-on tests for precious samples such as CSF or any other test for which a repeat sample is very difficult to obtain, should be discussed with the Duty Biochemist or out of hours Chemical Pathologist.

Point of Care Testing

Whilst the use of POCT devices can aid successful outcomes for patients, there is also a significant potential for causing patient harm. The POCT Committee oversees POCT within the Trust and the POCT Team will assist with ensuring that the analytical performance of devices and user training is adequate and appropriately quality controlled. All applications for new or replacement devices must be sent to the Trust POCT Committee for approval.

The POCT office can be contacted via by email DL-POCT@belfasttrust.local or by telephone 02896 151521.

Consumables

'Sample tubes, cards and any other sample collection materials prior to sample collection should be stored (unless otherwise stated) in cool and dry conditions, out of direct sunlight and away from any possible source of cross-contaminating material e.g. cleaning sprays/products. Only consumables within 'expiry date' are permitted for use.'

The following stock items will be stored, and issued on request, by the Biochemistry Laboratory. Some assays require special sample containers and preparation. Please see the specific test you wish to request for sample container type and request the container from the listed section where necessary.

Stock Supplied	Supplied By	Phone Number
24 hr urine bottle with preservative	CSR	02895 151657
Plain 24 hr urine bottle	CSR	02895 151657
Navy and black lidded Sodium Heparin blood tube for Trace Metals	CSR	02895 151657
Hypopack (See Appendix 13 for Hypopack request form)	Metabolic	02896 151480
Glass tube with preservative for Pyruvate	Metabolic	02896 151480
Specific request form and tubes for CSF Neurotransmitters	Metabolic	02896 151480
Blood Spot Card (Acylcarnitines) (please allow to dry before sending to laboratory – see reverse of card for sample information)	Metabolic	02896 151480
Glass tube containing preservative for Plasma Catecholamines	HPLC	02890 638 292

The following pages provide specific information on Clinical Biochemistry tests available including sample requirements and interpretative information.

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ACYLCARNITINES (TMS)	BLOOD SPOT CARD 2-3 blood spots	For the initial investigation and monitoring of fatty acid oxidation defects and classical organic acidurias. Fill designated card areas with blood Allow to dry before sending to laboratory. See reverse of card for sample information.	Qualitative report. Critical results are acted on immediately	14 days	Metabolic & Neonatal Screening
ACYLCARNITINE PROFILE (TMS) **PLASMA** *(See Samples Sent to Referral Laboratories)*					
ACYLCARNITINE PROFILE (POST MORTEM) *(See Samples Sent to Referral Laboratories)*					
ADRENOCORTICOTROPHIC HORMONE (ACTH)	Plasma - Purple Top EDTA tube – 4mL ON ICE 	***Transport to laboratory immediately on ice – must be received within 30 minutes of venepuncture.*** Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	14 days	Automation/ Endocrine
ALANINE AMINOTRANSFERASE (ALT)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	**Plasma concentrations of Sulfasalazine & Sulfapyridine may lead to false results. Contact the laboratory for further information.**	Males: <41 U/L Females: <33 U/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ALBUMIN **See Bone Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Part of a Bone and a LIVER profile. This test is not currently accredited by UKAS.	Adults: 35 - 50 g/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
ALBUMIN CREATININE RATIO (ACR, see MICROALBUMIN)	URINE (RANDOM) Yellow top Monovette 3.2 mL 13 mm x 75 mm  **See Appendix 3**	Early morning sample preferred This test is not currently accredited by UKAS.	<3.0 mg/mmoL	24 hrs Mon-Fri If received after 2pm on Friday, will be analysed on Monday.	Automation
ALCOHOL (ETHANOL)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Do not use alcohol or other volatile disinfectants at the site of venepuncture.	Not normally detected. Reported in mg/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
ALCOHOL (ETHANOL)	URINE (RANDOM) Plain Universal Minimum Volume 2mls **See Appendix 3**	This test is not currently accredited by UKAS.	<100 mg/L	1 day	Toxicology

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ALDOSTERONE	Plasma – Purple Top EDTA Tube – 4mL 	***Send sample to laboratory immediately*** - samples must be in the laboratory within 3 hours. Please DO NOT send samples on ice.	***See Appendix 8 for information on reference ranges***	14 Days	Endocrine
ALKALINE PHOSPHATASE (ALP) **See Bone Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Part of Bone and Liver profiles.	Adult: 30 - 130 U/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes Bone-Specific ALP: 1 month	Automation
ALKALINE PHOSPHATASE ISOENZYMES	Serum –Gold Top SST – 3.5mL 	This test is not currently accredited by UKAS.	Qualitative report	1 week	Immunoproteins
ALPHA-AMINOADIPIC SEMIALDEHYDE (A-AASA) *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ALPHA-1-ANTITRYPSIN (AAT)	Serum –Gold Top SST – 3.5mL 	AAT Phenotyping will be performed if the AAT level is <1.40 g/L, if the patient is less the 12 months old or if specifically requested. Phenotype analysis is not currently accredited by UKAS.	**Age related:** Birth (cord blood) 0.9 – 2.2 g/L 0 - 6 months 0.8 – 1.8 g/L 6 months - 1 year 1.1 – 2.0 g/L 1 year - 5 years – 2.2 g/L 5 years - 10 years 1.4 – 2.3 g/L 10 years - 15 years 1.2 – 2.0 g/L >15 years (Adult) 1.1 - 2.1 g/L	72 hours (level only – Phenotyping 14 days)	Automation
ALPHA-1-ANTITRYPSIN (GI protein loss) *(See Samples Sent to Referral Laboratories)*		If the patient has a low serum AAT concentration, the faecal AAT may be low even in the presence of protein loss through the gut. Please also send a yellow top serum sample for AAT analysis.			

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ALPHA-1-ANTITRYPSIN PHENOTYPES	Serum –Gold Top SST – 3.5mL 	This test is not currently accredited by UKAS.	Qualitative report	14 days	Immunoproteins
ALPHA-FETOPROTEIN (AFP)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	***See Appendix 5*** for ranges Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4*** Further information on tumour markers available via the following link: Guidelines For The Use Of Tumour Markers Roche Method.	Contact laboratory for interpretation	24 hrs Mon-Fri If received after 2pm on Friday, will be analysed on Monday	Automation
ALPHA-GALACTOSIDASE (FABRY) *(See Samples Sent to Referral Laboratories)*					
ALPHA-GLUCOSIDASE (POMPE) *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ALPHA-IDURONIDASE (MPS1) *(See Samples Sent to Referral Laboratories)*					
ALPHA SUB UNIT *(See Samples Sent to Referral Laboratories)*					
ALUMINIUM (PLASMA) *(See Samples Sent to Referral Laboratories)*		Sample sent to referral laboratory.			
AMIKACIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Contact Microbiology for clinical advice. See Belfast Trust Guidelines for empirical antibiotic prescribing in hospitalised adults. Usual sampling time varies dependent upon desired measurement of peak or trough values	For multiple daily dose regimen, peak plasma concentration should not exceed 30 mg/L; trough concentration should be less than 10 mg/L. For once daily dose regimen, trough concentration should be less than 5 mg/L	4 hours	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
AMINO ACIDS - PLASMA	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	For the investigation and monitoring of amino acid disorders, including urea cycle defects and some organic acidurias. (?epileptic encephaolopathy) ***Send to laboratory immediately***. It is important to give full clinical details including diet and any drug treatment.	Age related	14 days	Metabolic & Neonatal Screening
AMINO ACIDS - URINE	URINE Plain Universal Random urine (2ml) **See Appendix 3**	For the investigation of amino acid disorders, particularly if a transport defect is suspected (e.g. cystinuria or Hartnup disease) and for the investigation of Sulphite oxidase deficiency, molybdenum cofactor deficiency and Hypophosphatasia. ***Send to laboratory immediately.*** It is important to give full clinical details including diet and any drug treatment.	Qualitative report	14 days	Metabolic & Neonatal Screening
AMINO ACIDS - CSF	CSF White Top Universal (plain tube)  **See Appendix 3**	For the investigation of intractable seizures. CSF amino acid analysis is required for the diagnosis of glycine encephalopathy (GE) (also known as non-ketotic hyperglycinaemia or NKH) and 3-phosphoglycerate dehydrogenase deficiency. It may also be useful in the investigation of sulphite oxidase deficiency. ***Send to laboratory immediately. A paired plasma sample must also accompany the CSF.***	Dependent on plasma results	14 days	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
AMMONIA	Plasma – Purple Top EDTA – 	***Send to laboratory immediately.*** Collect blood from stasis. Patient should be resting and fasting if possible. Smoking should be avoided prior to sampling. Tubes should be filled completely and kept tightly stoppered at all times. ***Plasma concentrations of Sulfasalazine & Sulfapyridine may lead to erroneous results.*** ***Temozolomide at therapeutic concentrations may lead to erroneous results.*** ***UNDIAGNOSED HYPERAMMONAEMIA Diagnosis and Immediate Management*** ***Contact the laboratory for further information.***	Prem neonate: <150 µmol/L Term neonates: 0 to 28 days: <100 µmol/L 29 days and over: <40 µmol/L Note: causes of artefactual increase in ammonia include: • poor specimen quality/haemolysis • difficult venepuncture • skin contamination • contaminated tube • delayed analysis/protein breakdown	<4 hours	Automation
AMPHETAMINE (see Drugs of Abuse Screening)					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
AMYLASE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		28 - 100 U/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
AMYLASE	URINE Random Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  24 hour urine Plain 24 hr urine bottle **See Appendix 3**		Males: 16 - 491 U/L Females: 21 - 447 U/L	24 hrs Mon-Fri If received after 2pm on Friday, will be analysed on Monday.	Automation
ANDROSTENEDIONE (AD2) *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ANGIOTENSIN CONVERTING ENZYME (ACE)	Serum – yellow top – 3mL		8 - 65 U/L	3 days	Automation
ANGIOTENSIN CONVERTING ENZYME (ACE) *(See Samples Sent to Referral Laboratories)*	CSF Plain Universal				
ANTI THYROID PEROXIDISE ANTIBODY	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	1 day	Automation
APOLIPOPROTEINS (APOA, APOB, LPa) *(See Samples Sent to Referral Laboratories)*					
ARGININE VASOPRESSIN	N/A	**Test replaced by Copeptin-please see Copeptin details.**			

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ARSENIC	BLOOD Blue/black topped trace metal bottle 6mL 	Diets rich in seafood give misleading results due to presence of non-toxic organo-arsenic compounds. Exclude from diet for five days prior to sampling. Other foodstuffs such as chicken, rice and rice products also contain arsenicals and may influence results. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	14 - 95 nmol/L	<3 weeks	Trace Metals
ARSENIC	URINE Random urine. White Top Universal (plain tube)  **See Appendix 3**	Diets rich in seafood give misleading results due to presence of non-toxic organo-arsenic compounds. Exclude from diet for five days prior to sampling. Other foodstuffs such as chicken, red wine, rice and rice products also contain arsenicals and may influence results. Metal bedpan must NOT be used to collect urine. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	< 17 nmol/mmol creatinine **Reference:** Barlow NL, Bradberry SM. Investigation and monitoring of heavy metal poisoning. Journal of Clinical Pathology 2023;76:82-97.	<3 Weeks	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
BETA TRACE PROTEIN (CSF LEAK) (Asialotransferrin, Tau transferrin, Beta 2-transferrin) *(See Samples Sent to Referral Laboratories)*					
ASPARTATE AMINOTRANSFERASE (AST)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Markedly sensitive to haemolysis. See liver profile. ***Plasma concentrations of Sulfasalazine & Sulfapyridine may lead to false results. Contact the laboratory for further information***.	Males: <40 U/L Females: <32 U/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
B-CAROTENE *(See Samples Sent to Referral Laboratories)*					
BATTENS DISEASE ENZYMES (NCL SCREEN) *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
BENCE-JONES PROTEIN	URINE Qualitative analysis: Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  Quantitative analysis: 24hr urine bottle, no preservative. **See Appendix 3**	This test is not currently accredited by UKAS.	Not normally detected	1 Week	Immunoproteins
BETA-2-MICROGLOBULIN	Serum –Gold Top SST – 3.5mL 	If sending a sample from outside BHSCT please transfer promptly to allow analysis within 24 hours.	<60 years = 0.8 – 2.4 mg/L ≥ 60 years = ≤3.0 mg/L	7 days	Automation/ Proteins
BETA-2-MICROGLOBULIN (URINE) *(See Samples Sent to Referral Laboratories)*	Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm	Urine **BETA-2-MICROGLOBULIN** is unstable at acid pH – please forward to the laboratory as soon as possible for pH adjustment.	Male: ≤ 0.3 mg/L Female: ≤ 0.2 mg/L	48hrs	Immunoproteins

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
BICARBONATE (CO2, TCO2) **See Electrolyte Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Bicarbonate values can be falsely low in under-filled Vacutainer tubes.	22 - 29 mmol/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
BILE ACIDS (*See Samples Sent to Referral Laboratories)*					
BILE SALTS PROFILE (FOR THE DIAGNOSIS OF BILE ACID BIOSYNTHESIS DISORDERS) *(See Samples Sent to Referral Laboratories)*					
BILIRUBIN, TOTAL	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Bilirubin results unreliable for up to 24hrs post Indocyanine Green	Adult Male/Female: <21 umol/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
BILIRUBIN, Direct	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Bilirubin results unreliable for up to 24hrs post Indocyanine Green If patient is receiving phototherapy please ensure this is stated on the clinical details section request form. This is important to know when providing interpretation of the result and prevent unwarranted treatment.	Adult Male/Female: <3.4 umol/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
BIOPTERIN *(See Samples Sent to Referral Laboratories)*					
BIOTINIDASE *(See Samples Sent to Referral Laboratories)*					
BLOOD GASES	BLOOD Heparinised syringe	Failure to fill to the correct volume (1ml or 3ml) will result in erroneous patient results. Ensure there are no air bubbles in the sample. Remove needle and cap syringe. ***Send to laboratory immediately***. Sample must be analysed within 30 minutes of venesection. ***Do not send via pneumatic chute.*** ***Do not send in ice.*** For Interference Factors refer to 'POCT Devices' on The Hub.	pH: 7.35 - 7.45 $pC0_2$: 4. 5- 6.0 kPa $p0_2$: 11.0 -14.0 kPa Tot. $C0_2$: 22 - 29 mmol/L Std. Bicarb: 22 - 26 mmol/L BE: +/- 2.5 mmol/L	30 mins	Point of Care Testing

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
BONE PROFILE (comprising Calcium, ALP, Phosphate, Albumin)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		See individual analytes	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
BONE MARKERS (RESORPTION: β-CROSSLAPS)	Serum –Gold Top SST – 3.5mL 	**Timing of sample: Morning** (08:00 to 11:00) & **FASTING.** ***Samples should be taken at the same time and conditions for all measurements*** as the serum β-crosslaps concentration is to some extent subject to a circadian rhythm. **Sample must reach laboratory within 3 hours of collection.**	**Females:** **Pre-menopausal:** <0.573 ng/mL **Post-menopausal:** <1.0008 ng/mL **Males:** 30-50 yrs: 0.584 ng/mL **50-70 yrs:** <0.704 ng/mL **>70 years:** <0.854 ng/mL		Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
BONE MARKERS (P1NP) Total procollagen type 1 amino-terminal propeptide	Serum –Gold Top SST – 3.5mL 		**Females:** **Pre-menopausal:** 15.1 - 58.6 ng/mL **Post-menopausal** (no HRT): 20.3 - 76.3 ng/mL **Post-menopausal** (ON HRT): 14.3 – 58.9 ng/mL		Automation
BONE MARKERS FORMATION: Ostase	Serum –Gold Top SST – 3.5mL 		Adults: 5.5 - 24.6 µg/L		Automation
BRAIN NATRIURETIC PEPTIDE (NTProBNP)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	<125 ng/L excludes HF as a cause of signs/symptoms Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	See **Appendix 18** for reference intervals	2 days	Automation
C3	Serum –Gold Top SST – 3.5mL 		0.75 - 1.65 g/L	2 days (Mon-Fri) If received after 2pm on Fri, will be analysed on Mon	Automation/ Proteins

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
C4	Serum –Gold Top SST – 3.5mL 		0.14 - 0.54 g/L	2 days (Mon-Fri) If received after 2pm on Friday, will be analysed on Monday	Automation/ Proteins
CA 125	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4*** Further information on tumour markers available via the following link: Guidelines For The Use Of Tumour Markers *Roche Method.*	0 - 35 U/mL	24 hrs Mon-Fri If received after 2pm on Friday, results will be available on the next normal working day.	Automation
CA 19-9	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4*** Heavy consumption of black tea (1.5-2L/day) can be associated with elevated CA19-9 levels). Further information on tumour markers available via the following link: Guidelines For The Use Of Tumour Markers *Roche Method.*	0 - 37 U/ml	24 hrs Mon-Fri If received after 2pm on Friday, results will be available on the next normal working day.	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CADMIUM	BLOOD Blue/black topped Trace Elements bottle 6mL 	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	Non-smokers <7 nmol/L Smokers <30 nmol/L	<3 weeks	Trace Metals
CADMIUM	URINE Random urine. White Top Universal (plain tube)  **See Appendix 3**	Metal bedpan must NOT be used to collect urine. Contact laboratory for bottles. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	<0.9 nmol / mmol Creatinine	<3 Weeks	Trace Metals
CAERULOPLASMIN (Ceruloplasmin)	4 mL Serum Yellow Top 	If sending a sample from outside BHSCT please transfer promptly to allow analysis within 24 hours. **If copper is required a separate blood sample and request form is needed.**	Males: 0.15 - 0.30 g/L Females: 0.16 - 0.45 g/L	72 hours	Automation/ Proteins
CALCITONIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL ON ICE 	***Transport to laboratory immediately on ice – must be received within 2 hours of venepuncture.*** Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	2-4 weeks	Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CALCIUM (Adjusted for Albumin) **See Bone Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Avoid stasis when taking sample.	Adults: 2.20 – 2.60 mmol/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
CALCIUM	URINE 24hr or Random urine collection in acidified 24 hour bottle or acidified universal **See Appendix 3**	Contact laboratory for special bottle.	2.5 - 7.5 mmol/24hr	1 day	Automation
CALCIUM CREATININE RATIO	URINE Random only Urine collection in acidified universal bottle **See Appendix 3**	Contact laboratory for special bottle. This test is not currently accredited by UKAS.	<12 months: <2.0 mmol/mmol 1-3 years: <1.5 mmol/mmol 3-5 years: <1.1 mmol/mmol 5-7 years: <0.8 mmol/mmol >7 years: <0.6 mmol/mmol	1 day	Automation
CALCULI	Plain Universal	Send to laboratory in sterile container		21 Days	Special Investigations

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CALPROTECTIN *(See Samples Sent to Referral Laboratories)*					
CANNABANOIDS ***See Drugs of Abuse Screening***					
CARBAMAZEPINE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Trough sample	Single drug regime: 4-12 mg/L Multiple drug regime: 4-8mg/L	24 hrs Mon-Fri If received after 2pm on Friday, results will be available on the next normal working day.	Automation
CARBOXYHAEMOGLOBIN	Blood gas syringe preferred. Use Blood Gas Analyser	Tube must be filled to exclude air. Patients treated with oxygen prior to sampling may show normal levels even after severe poisoning. **NOTE: Must use blood gas analysers on ward – Do not send to lab.**	Adults (Non-smoker): <2.0% Smokers (Adult): 2.1% - 4.2% Heavy smokers (>2 packs/day): 8% - 9% Hemolytic anaemia: <4% Newborns: 10- 12% Critical Values: > 20%	4 hours	Point of Care Testing

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CARCINOEMBRYONIC ANTIGEN (CEA)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4*** Further information on tumour markers available via the following link: Guidelines For The Use Of Tumour Markers *Roche Method.*	Non-smoker: 0 - 3.8 ng/mL Smokers : 0 - 5.5 ng/mL	24 hrs Mon-Fri If received after 2pm on Friday, results will be available on the next normal working day.	Automation
CATECHOLAMINES (Adrenaline, Noradrenaline & Dopamine)	URINE 24hr urine bottle with acid preservative **See Appendix 3**	Contact laboratory for details ***Please see Appendix 6 for investigations of Phaeochromocytoma and Paraganglioma.*** This test is not currently accredited by UKAS	Adrenaline 5 - 120 nmol/24hr Noradrenaline 50 - 560 nmol/24hr Dopamine 300-3900 nmol/24hr	7 days	Endocrine
CATECHOLAMINES PAEDIATRIC	5-15mls urine in acidified bottle required MSSU bottle containing acid obtained from laboratory **See Appendix 3**	Contact laboratory for details	Age related reference range printed with results.	7 days	Endocrine
CERAMIDE (Globotriaosylceramide, GL3/GB3/CTH) *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CHLORIDE **See Electrolyte Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		95 - 108 mmol/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	
CHLORIDE OUTPUT	URINE 24h collection **See Appendix 3**	Do not collect in Boric acid container as this makes analysis impossible.	110 - 250 mmol/24hr	3 days	Automation
CHOLECALCIFEROL **(See Vit. D)**					
CHOLESTEROL **See Lipid Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Ranges refer only to fasting samples. Desirable/target levels depend on CVD risk. See NICE CG 181	Total Cholesterol: 2.8- 5.0 mmol/L HDL: 1.0 – 2.5 mmol/L LDL: <3 mmol/L TC:HDL ratio: 2-5 See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CHOLINESTERASE **(Plasma, Phenotyping)** *(See Samples Sent to Referral Laboratories)*				4 weeks	
CHROMIUM	URINE Random urine. White Top Universal (plain tube)  **See Appendix 3**	***Metal bed pan must not be used to collect urine.*** Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. This method is not to be used for detecting or monitoring nutritional deficiencies as a sufficiently low level of quantitation cannot be achieved.	<2.85 nmol/mmol creatinine	<3 Weeks	Trace Metals
CHROMOGRANIN A (PLASMA)	Plasma – Purple Top EDTA tube 4mL 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	<3nmol/L	4 weeks	Regulatory Peptides

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CICLOSPORIN / CYCLOSPORINE	WHOLE BLOOD – Purple Top EDTA tube 4mL 	Trough sample	No firm therapeutic range exists for ciclosporin in whole blood.	Same day if received by 1pm Mon-Fri Sat-Sun & Bank Holiday requests must be arranged and received by 11 am	Toxicology

CHROMIUM & COBALT in whole blood	Blood. Blue/black topped trace metal bottle. 6mL. 	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs. This method is not to be used for detecting or monitoring nutritional deficiencies as a sufficiently low level of quantitation cannot be achieved.	Whole blood metal levels ≥7ppb (119 nmol/L cobalt or 134.5 nmol/L chromium) in one or both metals, indicates the need for closer follow-up and cross-sectional imaging. For stemmed total hip replacements, blood metal levels lower than 7ppb (119 nmol/L cobalt or 134.5 nmol/L chromium) may be associated with wear or corrosion at non-articulating surfaces. Please refer to MHRA alert MDA/2017/018 for full details. For Profemur Cobalt Chrome Modular Neck Hip Replacements: please see MHRA (DSI/2025/005)	<3 weeks	Trace Metals
COBALT in Plasma	Blood. Blue/black topped trace metal bottle. 6mL.	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not	<10 nmol/L	< 1 week	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
		be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs. This method is not to be used for detecting or monitoring nutritional deficiencies as a sufficiently low level of quantitation cannot be achieved.			
COBALT	URINE Random urine. White Top Universal (plain tube)  **See Appendix 3**	***Metal bed pan must not be used to collect urine.*** Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. This method is not to be used for detecting or monitoring nutritional deficiencies as a sufficiently low level of quantitation cannot be achieved.	Males: <2.0 nmol/mmol creatinine (95th percentile) female <2.6 nmol/mmol creatinine (95th percentile)	<3 Weeks	Trace Metals
COCAINE (see drugs of abuse screening)					
COPEPTIN *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
COPPER (Plasma)	BLOOD Blue/black topped Trace Elements bottle 6 mL 	*In healthy term neonates there is a gradual increase in values between one week and six months of age. This is a dynamic period and defining a normal serum copper at any one instant is difficult. **If ceruloplasmin is required a separate blood sample and request form is needed.** Note: Normal serum copper does not exclude Wilson's disease. If Wilson's disease suspected please send samples for serum ceruloplasmin and 24 hour urine copper. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	Men >13 years: 10-22 µmol/L Women >13 years: 11-25 µmol/L 0 to 3 months: 1.5-7.0 µmol/L 3 to 6 months* 4.0-17.0 µmol/L 6 to 12 months: 8.0-20.5 µmol/L 1 to <6 years: 12.5-23.5 µmol/L 6 to <10 years: 13.0-21.5 µmol/L 10 to 13 years: 12.5-19.0 µmol/L Females (pregnancy) >15 to <50 years: 18-38 µmol/L	< 1 week	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
COPPER	URINE 24hr urine bottle, no preservative. **See Appendix 3**	***Metal bed pan must not be used to collect urine.*** Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	<0.7 µmol/24 hrs	<3 Weeks	Trace Metals
LIVER **COPPER** *(See Samples Sent to Referral Laboratories)*	Liver biopsy				
CORTISOL	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Diurnal variation. Note time of sample on request form. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	1day	Automation
CORTISOL	URINE 24hr urine bottle **See Appendix 3**	24 hour urine collection. MUST be in a plain bottle i.e. no preservative	***See Appendix 8 for information on reference ranges***	14 days	Endocrine
C-PEPTIDE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Must be received in laboratory within 4 hrs (Plasma must be separated from cells **AND FROZEN** within 4 hours) Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	7 days	Automation/ Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
C-REACTIVE PROTEIN (CRP)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Therapeutic drugs: Significantly decreased CRP values may be obtained from samples taken from patients who have been treated with carboxypenicillins such as Ticarcillin.	<5 mg/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
CREATINE KINASE (CK)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Reference ranges listed are for white Caucasian only; other ethnic groups may have higher values	Males: –39 - 308 U/L Females: –26-192 U/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
CREATINE KINASE ISOENZYME ELECTROPHORESIS *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CREATININE **See Electrolyte Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	***For Information on AKI ALERT System and GAIN Acute Kidney Injury Protocol see Appendix 1.*** ***Therapeutic concentrations of the following drugs can cause artificially low creatinine results: Adrenaline, Noradrenaline, Dopamine, Rifampicin, Levodopa and Calcium dobesilate.***	Males: 59 – 104 µmol/L Females: 45 – 84 µmol/L See **Appendix 18** for paediatric reference intervals For info on AKI alert and GAIN AKI protocol see **Appendix 1**.	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
CREATININE	URINE 24hr or random Use plain monovette/plain universal or plain 24 hr urine bottle (NOTE – for Calcium-Creatinine ratio require an acidified bottle) **See Appendix 3**		**Random**: Females: <20 mmol/L Males: <24.6 mmol/L **24 hour**: Females: 9-19 mmol/24 hrs Males: 6-13 mmol/24 hrs	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CREATININE CLEARANCE	PLASMA & 24 HR URINE Plain 24 hr urine bottle (if sending aliquot of 24 hr urine please record total volume on request form) Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	A combined plasma and 24 hour urine should be received together. Need to take account of body surface area when dealing with paediatric samples. See NICE CG182 on the identification of chronic kidney disease	71 - 151 mL/min	1 day	Automation
CRYOGLOBULINS	3 x 6 ml blood samples into three pre-heated (37 ^{o}C) plain clotting sample tubes; 1 x 4ml blood sample into a pre-*heated (37oC) EDTA sample tube.* *A further "room temperature" plain clotted sample should also be taken.* *These tubes are supplied by the laboratory.*	Requesting cryoglobulin analysis: For outpatient appointment please contact Angela Hurley or Angela McCusker (028 9615 0088) at the Immunology Day Centre. Patients will be booked into level 6B Outpatients for blood collection. Appointment will also be confirmed with laboratory staff who supply the necessary pre-heated blood collection equipment to level 6B. All Royal Hospitals requests will be collected from wards / clinics with prior arrangement. Please contact laboratory 028 961 51497. Please note- assay only available Monday to Thursday. This test is not currently accredited by UKAS.	Detected or not detected. If detected the cryoglobulin is quantitated and classified.	14 days	Immunoproteins

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
CSF Analysis (Oligoclonal bands)	Paired CSF (~2mL Plain sterile container) and one Gold top gel sample tube **must** be submitted together	This test is not currently accredited by UKAS.	Oligoclonal bands: Not detected	14 days	Immunoproteins
CSF NEUROTRANSMITTERS *(See Samples Sent to Referral Laboratories)*					
CSF SPECTROPHOTOMETRY (XANTHOCHROMIA)	Mark outside of envelope with **"Protect from Light"** CSF No. 3 or 4 sample in White Top Universal (plain tube) **See Appendix 3** 	**Timing of sample is important.** To reduce the risk of a false negative result, samples should be taken >12hours to up to 14 days after the onset of symptoms. **Samples must be sent to the laboratory protected from light** to reduce the risk of a false negative result.	Please contact the laboratory for assistance with interpretation of results.	1 day	Automation
CYSTINE	URINE Random sample No preservative **See Appendix 3**	Analysis of Cystine is a screening test	Qualitative	1 week	

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
DEHYDROEPI-ANDROSTERONE SULPHATE (DHAS)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	1 day	Automation
7-DEHYDROCHOLESTEROL *(See Samples Sent to Referral Laboratories)*					
DIGOXIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Sample should be taken 6-8 hrs after dose. Hypokalaemia potentiates toxicity.	0.5 - 2.0 µg/L Target range in heart failure: 0.5 - 1.0 µg/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
DIHYDROXY-TESTOSTERONE *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
DRUGS OF ABUSE SCREENING Amphetamines, Benzodiazepines, Cannabinoids, Cocaine, Methadone and Opiates.	URINE Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  **See Appendix 3**			Screening results: 24 hr. If confirmation required 7 days.	Automation/ Toxicology
ELASTASE, PANCREATIC	FAECES Plain universal Random	Excessively liquid samples may be unsuitable	Normal 200 - >500 ug/g stool Mod. Pancreatic insufficiency: 100 - 200 ug/g stool. Severe pancreatic insufficiency: <100 ug/g stool.	4 weeks	Metabolic & Neonatal Screening
ELECTROLYTE PROFILE (Comprising of Sodium, Potassium, Chloride, CO2, Urea, Creatinine)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		See individual analytes	1 day or 90 min in emergency	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ELECTROLYTE PROFILE (Chloride, Potassium, Sodium)	URINE 24hr urine collection in plain 24 hr bottle/monovette Random Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  See Appendix 3	**Do not use Boric Acid Container**	See individual analytes	1 day or 90 min in emergency	Automation
ESTIMATED GLOMERULAR FILTRATION RATE	Calculated in electrolyte profile		>60mL/min		Automation
ETHYLENE GLYCOL	PLASMA – Grey Top Sodium Fluoride EDTA Tube 5ml 	Available 24/7 by prior arrangement only. Contact laboratory. **Patient preparation** - Do not cleanse the sample draw site with alcohol or other volatile disinfectants. Use only aqueous disinfectants. Samples should be taken at least 2 hours after ingestion. **See Toxbase for further information.** https://www.toxbase.org/	Not normally detected	1 day – **do not wait for results before commencing treatment**	Toxicology

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
EVEROLIMUS	WHOLE BLOOD - Purple Top EDTA Tube 4ml 	Trough Sample	3.0 - 15.0 ug/L	Same day if received by 1pm Mon-Fri Sat-Sun & Bank Holiday requests must be arranged and received by 11 am	Toxicology
FERRITIN (see Iron Profile)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	Men (≥19yrs): 30 – 400 µg/L Women (19<60 yrs): 15 – 150 µg/L Women (≥60 yrs): 15 – 330 ug/L See **Appendix 18** for paediatric reference intervals	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
FGF23 *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
FOLATE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Protect from light ***Samples with extremely high total protein concentrations (hyperproteinaemia), which may be found in conditions such as lymphoma, multiple myeloma, MGUS, plastocytoma and amyloidosis, are not suitable for use in this assay*** Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	3.0 - 26.8 ug/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
FOLLICLE STIMULATING HORMONE (FSH)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	2 days	Automation
FREE ANDROGEN INDEX (FAI)	CALCULATION	Testosterone/SHBG X100	***See Appendix 8 for information on reference ranges***	3 days	Endocrine
FREE FATTY ACIDS (NON-ESTERIFIED FATTY ACIDS) (NEFA) *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
FREE LIGHT CHAINS	Serum –Gold Top SST – 3.5mL 		Kappa 3.3 - 19.4 mg/L Lambda 5.7 - 26.3mg/L K:λ ratio 0.26 - 1.65	72 hours	Immunoproteins
FREE T4	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	1 day	Automation
FREE T3	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	1 days	Automation
GALACTITOL *(See Samples Sent to Referral Laboratories)*					
GALACTOKINASE *(See Samples Sent to Referral Laboratories)*					
GALACTOSE-1-PHOSPHATE *(See Samples Sent to Referral Laboratories)*	Non-gel tube preferred, gel tube also accepted				

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
GALACTOSE-1-PHOSPHATE URIDYL TRANSFERASE (RED BLOOD CELL) (GPUT)	PLASMA Green Top Lithium Heparin NON-GEL 2 ml. [NOTE – green top non-gel preferred, gel also accepted (with black insert). **[This is a different blood tube from routine biochemistry tests – contact lab for details]** 	Qualitative screen for Classical Galactosaemia. Quantitative sample can be sent to referral laboratory by prior arrangement if required. Blood transfusion invalidates result. Advise contact Metabolic laboratory to request correct bottle (tel 02896 151480). ***Sample must be received within 12 hours of collection.*** To be received before 2pm (Monday to Friday only). Please contact the metabolic laboratory before sending. (tel 028 961 51480)	Qualitative report	24 hrs Mon-Fri If received after 2pm on Friday, results will be available on the next normal working day.	Metabolic & Neonatal Screening
GAMMA GLUTAMYL TRANSPEPTIDASE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		Male: 10 - 71 U/L Female: 6 - 42 U/L See **Appendix 18** for paediatric reference intervals	1 day	Automation
GASTRIN **As per B-1991 - Gastrin assay for research use only. Not for use in diagnostic procedures**	PLASMA – Purple Top K3- EDTA ON ICE 4ml 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen.	<85 ng/L	4 weeks	Regulatory Peptides

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
GENTAMICIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Contact Microbiology for clinical advice. See Belfast Trust Guidelines for empirical antibiotic prescribing in hospitalised adults.	For multiple daily dose regimen, peak plasma concentration should be 5–10 mg/litre (3–5 mg/litre for endocarditis); trough concentration should be less than 2 mg/litre (less than 1 mg/litre for endocarditis). For once-daily dose regimen, consult local guidelines on monitoring plasma-gentamicin concentration	1 day	Automation
GLUCAGON	PLASMA – Purple Top K3- EDTA ON ICE- 4ml 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen.	<210 ng/L	4 weeks	Regulatory Peptides

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
GLUCOSE	PLASMA – Grey Top Sodium Fluoride EDTA Tube 4ml 	***See Appendix 9 For guidance on the interpretation of Glucose results***.	Fasting: 4.1 - 6.1 mmol/L	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
GLUCOSE	CSF White Top Universal (plain tube)  **See Appendix 3**	Plasma glucose should be measured at the same time. ***See Appendix 9*** ***For guidance on the interpretation of Glucose results***.	Children up to 17 yr: 3.3 – 4.4 mmol/L Adults (≥ 18 yr): 2.2 – 3.9	1 day	Automation
MUCOPOLYSACCHARIDOSIS SCREEN	URINE Random urine in plain sterile container 10ml **See Appendix 3**	Urine screen for the investigation of glycosaminoglycan lysosomal storage disorders. Test includes total glycosaminoglycans quantitation and electrophoresis. Oligosaccharides/sialic acid are included in this screen. If screening result is abnormal, a follow-up blood enzyme analysis is sent to a Referral Laboratory for diagnosis.	Qualitative report	3 - 4 weeks	Metabolic & Neonatal Screening
GROWTH HORMONE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	**Random levels are not useful.** Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***		14 days	Automation/ Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
GUANIDINOACETATE AND CREATINE *(See Samples Sent to Referral Laboratories)*					
GUT AND ISLET CELL HORMONES	PLASMA – Purple Top K3- EDTA ON ICE 4ml 4x4 ml Purple top tubes 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen.		2-4 weeks	Endocrine
HAPTOGLOBIN	Serum –Gold Top SST – 3.5mL 		0.3 - 2.0 g/L	72 hours	Automation/ Proteins
HbA1c	WHOLE BLOOD – Purple Top EDTA 4mL 	This test is not currently accredited by UKAS	20-41 mmol/mol. **Prediabetes (increased risk for diabetes):** IFCC 39-47 mmol/mol Diabetic: IFCC > 48 mmol/mol HbA1c IFCC values of <53 mmol/mol for well controlled diabetics	5 days	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
HEAVY METAL SCREEN comprising arsenic (see arsenic comment), cadmium, lead, mercury	BLOOD Blue/black topped trace metal bottle. 6mL. 	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	See individual analytes for reference ranges	<3 weeks	Trace Metals
HEAVY METAL SCREEN comprising arsenic (see arsenic comment), cadmium, chromium, cobalt, lead, mercury, nickel and thallium.	URINE Random urine. Plain, plastic universal 25 mL. **See Appendix 3**	***Metal bed pan must not be used to collect urine.*** Losses of mercury from urine start to occur soon after the sample is taken. If it has to be stored, store refrigerated but preferably try to ensure that it gets to our laboratory with minimal delay. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. **Please contact laboratory on 028 96151479 before taking sample. Send sample to Trace Metals Laboratory immediately.**	See individual analytes for reference ranges	<3 weeks	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
HIGH DENSITY LIPOPROTEIN CHOLESTEROL (HDL) **See Lipid Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		>1.0 mmol/L Ranges refer only to fasting samples. Desirable/target levels depend on CVD risk. See NICE CG 181 See **Appendix 18** for paediatric reference intervals	1 day	Automation
HDL/CHOLESTEROL RATIO	Calculated value		<5.0		Automation
HOMOCYSTEINE	PLASMA – Purple Top EDTA Tube - ON ICE 4ml 	***Sample must arrive in the laboratory ON ICE within 30 min.*** Patients who are taking methotrexate, carbamazepine, phenytoin, nitrous oxide, anticonvulsants, or 6-azuridine triacetate, may have higher levels of Homocysteine due to metabolic interference with Homocysteine metabolism.	**Folate supplemented:** <15 years: <8 µmol/L 15 – 65 years: < 12 µmol/L >65 years: <16 µmol/L Pregnancy:<8 µmol/L **Non-supplemented:** <15 years: <10 µmol/L 15 – 65 years: <15 µmol/L >65 years: <20 µmol/L Pregnancy: <10 µmol/L	7 days	Automation/ Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
HOMOGENTISIC ACID	URINE Plain universal 10ml **See Appendix 3**	Random sample of urine, ***send to laboratory immediately***	Not normally detected	5-14 days	
HUMAN CHORIONIC GONADOTROPHIN (HCG) Pregnancy test	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4*** Further information on tumour markers available via the following link: Guidelines For The Use Of Tumour Markers	<5 IU/L - pregnancy unlikely for all women. Ref interval ≤15 IU/L for healthy post-menopausal women.	1 day	Automation
HUMAN CHORIONIC GONADOTROPHIN (HCG) Tumour Marker	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4*** Further information on tumour markers available via the following link: Guidelines For The Use Of Tumour Markers *Roche Method.*	<5.0 U/L	1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
3-HYDROXYBUTYRATE	PLASMA – Grey Top Sodium Fluoride EDTA Tube 	May be useful in the investigation of unexplained hypoglycaemia (please request a simultaneous laboratory glucose). Contact laboratory for details. Please give clinical details on request, including glucose level if available.	Fasting: 0.03 - 0.3 mmol/L. Interpretation dependent on concurrent glucose and clinical setting – please contact laboratory for interpretation	4 hours	Automation
5-HYDROXY-INDOLEACETIC ACID (5HIAA)	URINE 24hr urine collection in plain bottle **See Appendix 3**	Patient should avoid pineapple, banana, plums, tomatoes, kiwi fruit and walnuts for 3 days before and during the collection period B-375 This test is not currently accredited by UKAS	10 - 47 umol/24hr	14 days	Endocrine
17-HYDROXY PROGESTERONE	SERUM – Red Top Plain Tube 4mL (NO GEL) 	Gel tube unsuitable. Neonates must be >48hrs old before taking sample. Please contact laboratory immediately on the suspicion of Congenital Adrenal Hyperplasia (CAH) to arrange for urgent analysis. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	Adults: 21 days Prearranged urgent baby samples for ?CAH: 48 hours.	Regulatory Peptides

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
IBUPROFEN	URINE (RANDOM) Yellow top Monovette or Sterile Universal **See Appendix 3**	Please note: Ibuprofen analysis is only available to GI Consultants. This test is not currently accredited by UKAS.	Qualitative report	8 weeks	Toxicology
INSULIN ANTIBODIES *(See Samples Sent to Referral Laboratories)*					
INSULIN-LIKE GROWTH FACTOR 1 (IGF-1)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	14 days	Automation/ Endocrine
IgG 4	Serum –Gold Top SST – 3.5mL 		Age related normal ranges are given on report ***See Appendix 7 For more information***.	4 weeks	Immunoproteins
IgG subclasses (IgG 1,2,3)	Serum –Gold Top SST – 3.5mL 		Age related normal ranges are given on report ***See Appendix 7 For more information***.	4 weeks	Immunoproteins

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
IMMUNOGLOBULINS	Serum –Gold Top SST – 3.5mL 	***See Appendix 14 for clinical follow-up guidelines for SPE and Immunoglobulin analysis***	Age related ranges used. ***See Appendix 7 For more information***.	7 days	Automation/ Proteins
INHIBIN B (INB) *(See Samples Sent to Referral Laboratories)*					
INSULIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Must be received in laboratory within 4 hrs -Plasma must be separated from cells **AND FROZEN** within 4 hours Blood glucose estimation must be carried out at the same time. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	7 days	Automation/ Endocrine
INTESTINAL DISACCHARIDASES *(See Samples Sent to Referral Laboratories)*					
IRON PROFILE (comprising Iron, Ferritin and Transferrin)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Contact laboratory for details	See individual analytes	1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
IRON (see Iron Profile)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		Adults: 10-30 µmol/L See **Appendix 18** for paediatric reference intervals	1 day or 90 min in emergency	Automation
IRON	URINE 24 hr urine bottle or Desferrioxamine chelation test 6 hour collection **See Appendix 3**	***Metal bed pan must not be used to collect urine.*** Contact trace metal laboratory (028 96151479) for details of the desferrioxamine chelation test procedure Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	Men: 0.09 – 0.63 µmol/24hrs Women: 0.09 – 0.47 µmol/24hrs	<3 Weeks	Trace Metals
JEJUNUM BIOPSY		**SEE INTESTINAL DISACCHARIDASES**			
KEPPRA (Levetiracetam)	SERUM – Red Top Plain Tube 4mL 	Gel tube unsuitable. Can be analysed on same sample as lamotrigine if patient is on both drugs. Trough level required.	2 - 46 mg/L	10 days	Toxicology

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
LACTATE (PLASMA)	PLASMA – Grey Top Sodium Fluoride EDTA tube 	***Send to laboratory immediately*** - samples must be received in the laboratory within 30 minutes.	0.5 – 2.2 mmol/L	1 day or 90 min in emergency	Automation
LACTATE (CSF)	White Top Universal (plain tube)  [See Appendix 3]	***Send to laboratory immediately***	Adult: 1.1 - 2.4 mmol/L Neonates have higher levels: Neonate: 1.1-6.7 3-10 days: 1.1-4.4 >10 days: 1.1-2.8		Automation
LACTATE DEHYDROGENASE (LDH) **(IFCC Assay)**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Level increases markedly with haemolysis or delayed separation. ***Contact the laboratory for further information.***	Males: 135 - 225 Females 135 - 214 See **Appendix 18** for paediatric reference intervals	Urgent samples: <1 hour Routine Inpatient: <4 hours Outpatient and GP: <1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
LAMOTRIGINE	SERUM – Red Top Plain 4ml tube 	Gel tube unsuitable. Contact laboratory for sampling times. Can be analysed on same sample as Levetiracetam (Keppra) if patient is on both drugs. Trough level required.	1 - 15 mg/L	10 days	Toxicology
LEAD	BLOOD Purple top EDTA or blue/black trace elements bottle 	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	<0.23 µmol/L ***See Appendix 16 for Occupational Exposure Lead Monitoring***	<3 weeks	Trace Metals
LEAD	URINE 24 hr urine bottle or Random urine White Top Universal (plain tube)  **See Appendix 3**	***Metal bed pan must not be used to collect urine.*** Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	1.3 - 39.4 nmol/24hrs or 0.11-3.3 nmol/mmol creatinine	<3 Weeks	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
LIPASE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		13 - 60 U/L	1 day	Automation
LIPID PROFILE (Comprising of Cholesterol, Triglyceride, HDL, LDL)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Patient should be fasting for 14hrs before sample is taken (can be done on same sample as biochemistry profile). For information on optimal targets in high risk individuals please refer to JBS 2 guidelines.	See individual analytes	1 day	Automation
LIPOPROTEIN A (LPa) *(See Samples Sent to Referral Laboratories)*					
LITHIUM	Serum –Gold Top SST – 4mL  ***Do not use Lithium Heparin Green Top tube****	Sample should be taken 12hrs after dose. Note: If serum Li >4.0mmol/L, haemodialysis is required. Haemodialysis should be considered at Li >3mmol/L if patient is toxic as serum levels do not reflect severity of overdose.	≤65 years: <1.0 mmol/L >65 years: <0.8 mmol/L	1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
LIVER PROFILE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		See individual analytes For pregnancy related reference intervals (See *Appendix 21*).	1 day or 90 min in emergency	Automation
LOW DENISTY LIPOPROTEIN (LDL) **See Lipid Profile**	**CALCALCULATED in Lipid profile**		<3.0 mmol/L	1 day	Automation
LUTEINISING HORMONE (LH)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	2 days	Automation
LYSOSOMAL ENZYME SCREEN **(previously known as 'white cell enzymes')** *(See Samples Sent to Referral Laboratories)*					
MAGNESIUM (plasma)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		0.7 - 1.0 mmol/L See **Appendix 18** for paediatric reference intervals	1 day or 90 min in emergency	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
MAGNESIUM (Urine)	URINE 24hr or Random urine collection in acidified PLASTIC 24 hour bottle or acidified universal **See Appendix 3**	24hr collection in a PLASTIC bottle. ***Metal bed pan must not be used to collect urine.***	24-hr urine Mg 2.4 - 6.5 mmol/24h	1 day	Automation
MANGANESE	BLOOD Blue/black topped Trace Elements bottle 6mL 	For blood manganese, a plastic cannula is generally preferred to avoid contamination from stainless steel needles, which can falsely elevate results. If a stainless-steel needle must be used, the first 5-10 mL of blood should be discarded. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	80 - 260 nmol/L	<3 weeks	Trace Metals
MERCURY	BLOOD Blue/black topped trace metal bottle. 6mL. 	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	<25 nmol/L	<3 weeks	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
MERCURY	URINE 24 hr urine bottle or Random urine. White Top Universal (plain tube)  **See Appendix 3**	**Please contact laboratory on 028 906151479 before taking sample.** Urine should be refrigerated with 4 hours of completion of 24 hour urine collection. **Send random urine samples to the Trace Metals Laboratory immediately**. ***Metal bed pan must not be used to collect urine.*** Losses of mercury from urine start to occur soon after the sample is taken. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	<15 nmol/24 hrs or <3 nmol / mmol Creatinine	<3 Weeks	Trace Metals
METANEPHRINES	URINE 24hr urine bottle with acid preservative **See Appendix 3**	**Please see Appendix 6 for investigations of Phaeochromocytoma and Paraganglioma.** **Contact laboratory for details** This test is not currently accredited by UKAS	Metanephrine <1289 nmol/24h Normetanephrine <2960nmol/24h	14 days or Urgent requests: 4 working days (if arranged).	Endocrine
METHADONE (See Drugs of Abuse Screening)					
METHAEMOGLOBIN	WHOLE BLOOD – Use Heparinised syringe	Tube must be filled to exclude air. **NOTE: Must use blood gas analysers on ward – Do not send to lab.**	<1.5%	4 hours	Point of Care Testing

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
METHANOL	PLASMA – Grey Top Sodium Fluoride EDTA Tube 5ml 	Available 24/7 by prior arrangement only. Contact laboratory. **Patient preparation** - Do not cleanse the sample draw site with alcohol or other volatile disinfectants. Use only aqueous disinfectants. Samples should be taken at least 2 hours after ingestion. **See Toxbase for further information.** **https://www.toxbase.org/**	Not normally detected	1 day – **do not wait for results before commencing treatment**	Toxicology
METHOTREXATE	SERUM – Red Top Plain 4ml tube 	Note: It is ESSENTIAL to contact the laboratory before therapy is started. Samples should be taken at 24hr intervals after high dose of therapy until serum level is <0.1umol/L.		1 day	Automation
METHYL MALONIC ACID (MMA) *(See Samples Sent to Referral Laboratories)*					
MICROALBUMIN/CREATININE RATIO (ACR, see Albumin Creatinine Ratio)	URINE Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  **See Appendix 3**		<3 mg/mmol creatinine	1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
MICRONUTRIENT SCREEN **Trace Metals (Selenium, Copper, Zinc)** →	BLOOD Blue/black topped Trace Elements bottle GEL 	Please send separate form with each sample tube.	See individual analytes for reference ranges.	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation
Vitamin B12, Folate, Iron, →	Plasma – Green Top Lithium Heparin – Yellow Insert- 3mL , protect from light 				
Vitamins A & E →	Serum – Gold Top SST Tube 3.5mL Mark outside of envelope with **"Protect from Light"** 				
Vitamin C →	Plasma – Green Top Lithium Heparin – Yellow Insert- 3mL on ice. Mark outside of envelope with **"Protect from Light"** 				

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
MOLAR HCG *(See Samples Sent to Referral Laboratories)*					
MONOPROLACTIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Monoprolactin is reported only if total prolactin >700 mU/L	***See Appendix 8 for information on reference ranges***	3 days	Automation
MPS ENZYME ASSAYS *(See Samples Sent to Referral Laboratories)*					
MUCOPOLYSACCHARIDES		See **MUCOPOLYSACCHARIDOSIS SCREEN**			Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
NEUROENDOCRINE TUMOUR SCREEN	PLASMA – Purple Top K3-EDTA ON ICE 4 x 4ml required 	Fasting sample required. ***Transported to laboratory on ice within 2 hours*** or nearest laboratory for separation for transport frozen.	See individual tests and lab report.	4 weeks	Endocrine
NEUROKININ A	PLASMA – Purple Top K3-EDTA ON ICE 4ml 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen.	<20ng/L	4 weeks	Regulatory Peptides
NEURON-SPECIFIC ENOLASE (NSE) *(See Samples Sent to Referral Laboratories)*					
NEUROTRANSMITTERS (CSF) *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
NICKEL	URINE Random urine. White Top Universal (plain tube)  See Appendix 3 METAL BED PAN MUST **NOT** BE USED TO COLLECT URINE.	***Metal bed pan must not be used to collect urine.*** Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	<19 nmol / mmol Creatinine	<3 Weeks	Trace Metals
OESTRADIOL	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	2 days	Automation
OLIGOSACCHARIDE SCREEN *(See Samples Sent to Referral Laboratories)*					
OPIATES (See Drugs of Abuse Screening)					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ORGANIC ACIDS (ORG)	URINE Plain universal 5ml random urine sample **See Appendix 3**	Analysis of organic acids in urine can assist in the diagnosis of a number of disorders including organic acidemias, disorders of fat metabolism, unexplained high anion gap metabolic acidosis, investigation of neurological or neuromuscular disorders, suspected amino acid disorder (list not exhaustive) Give full clinical details including diet and drug treatment. Do not collect in Boric acid container as this makes analysis impossible.	Qualitative report	5-14 days	Metabolic & Neonatal Screening
OROTIC ACID	URINE Plain universal 5ml random urine sample **See Appendix 3** NB. Boric Acid container NOT suitable	For the differential diagnosis of urea cycle defects and the investigation of disorders of pyrimidine metabolism.	Age related	5-14 days	Metabolic & Neonatal Screening
OSMOLALITY	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		275 - 295 mmol/kg	1 day or 90 min in emergency	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
OSMOLALITY	URINE (RANDOM) Random Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  **See Appendix 3**	Interpretation dependant on clinical context. Do not collect in Boric acid container as this makes analysis impossible.	Interpretation of urine osmolality is dependent on the clinical context. Contact laboratory for advice if required.	1 day or 90 min in emergency	Automation
OXALATE **(See Renal Stone Profile)**				2 weeks	
PANCREATIC POLYPEPTIDE	PLASMA – Purple Top K3-EDTA ON ICE 4ml 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen.	<330 ng/L	4 weeks	Regulatory Peptides
PANCREATIC HORMONE SCREEN	PLASMA – Purple Top K3-EDTA ON ICE 4 x 4ml required 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen.		2-4 weeks	Regulatory Peptides

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PARACETAMOL	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	NB. New treatment line joining >100mg/L at 4h to >50mg/L at 12h; valid for a single OD at a known time. Staggered ingestions or uncertain timing information indicates treatment regardless of level. Please consult Paracetamol overdose treatment graph in 'Poisoning' section of BNF. NOTE: Amitriptyline and Imipramine cause a significant negative interference (≥ 10 %) in the paracetamol assay.	Therapeutic levels at 4hrs: <10 mg/L	1 day or 90 min in emergency	Automation
PARAQUAT	URINE White Top Universal (plain tube)  **See Appendix 3**	Sample taken >4 hours after overdose. Available by arrangement only. Please contact laboratory.	Not normally detected	1 day	Toxicology
PARATHYROID HORMONE (PTH)	PLASMA – Purple Top EDTA tube 4ml 	NO ICE REQUIRED. MUST BE RECEIVED IN LAB WITHIN 12HRS OF VENEPUNTURE Request plasma calcium at same time on a separate sample. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	4 days	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PHENOBARBITONE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Trough sample.	10 - 40 mg/L	28 hr	Automation
PHENYTOIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Trough sample.	10 - 20 mg/L	28 hr	Automation
PHOSPHATE (Plasma) **See Bone Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		Adults: 0.8 - 1.5 mmol/L See **Appendix 18** for paediatric reference intervals	1 day or 90 min in emergency	Automation
PHOSPHATE (URINE)	URINE (24 HOUR) 24hr urine bottle in special acidified container. Contact laboratory for bottle. **See Appendix 3**	Contact laboratory for special bottles.	24-hr urine phosphate 13 – 42 mmol/24hrs	1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PHOSPHATE (URINE)	URINE (Random) **TmP/GFR** If the sample is to be used for calculation of renal tubular reabsorption of phosphate (TmP/GFR), it should be taken into an acidified universal bottle (available from the lab), fasting, together with a plasma sample, to allow contemporaneous measurement of plasma and urine phosphate and plasma and urine creatinine. **See Appendix 3**		Contact laboratory if interpretation required	1 day	
PIPECOLIC ACID *(See Samples Sent to Referral Laboratories)*					
PLACENTAL ALP (PLAP) *(See Samples Sent to Referral Laboratories)*					
PLASMALOGENS *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PLASMA METANEPHRINES (PMET)	BLOOD EDTA 4ml (x2) 	Transport on ice within 30 min of collection. Centrifuge, separate and freeze at -20°C. Transport frozen by 1st class post (must arrive frozen).		2-4 weeks	Endocrine
PORPHYRINS *(See Samples Sent to Referral Laboratories)*		Includes total urinary porphyrin, Aminolaevulinic acid (ALA) and Porphobilinogen (PBG) as required.			

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PORPHYRINS **TUP & PBG** *(See Samples Sent to Referral Laboratories)*	10mls Urine in plain universal	Sample must be protected from light. An early morning urine is the preferred sample as a dilute urine sample may lead to an unreliable result. If acute porphyria is suspected, collect samples when patient is symptomatic. If cutaneous porphyria is suspected, please also send an EDTA blood sample for analysis by referral laboratory. Clinical information MUST be provided. Clinical information should at minimum indicate if the sample is for cutaneous or acute/neurological testing. If acute porphyria is suspected and urgent analysis is required please contact the toxicology lab on extension 51491 or the duty biochemist on 33798 or the on-call chemical pathologist We perform the screening & monitoring of urinary porphyrins. All 1st time positives & paediatric patients on the basis of clinical information are referred to the referral lab (Cardiff porphyria Lab) for further testing. This test in not currently accredited by UKAS.	**TUP-Porphyrin:creatinine** ratio, regional reference range of <35nmol/mmol creatinine. **PBG- urine porphobilinogen** <10.7 umol/L urine PBG:creatinine ratio <1.5umol/L/mmol	urgent samples approx 24 hours (mon-fri) routine samples approx 10 days (mon-fri) referral lab- approx 20 days	Special Investigations

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
POTASSIUM (plasma) **See Electrolyte Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Level increases markedly with haemolysis or delayed separation.	Adults: 3.5 – 4.6 mmol/L See **Appendix 18** for paediatric reference intervals	1 day or 90 min in emergency	Automation
POTASSIUM OUTPUT (URINE)	URINE 24 hr urine collection **See Appendix 3**		25 - 125 mmol/24 hr	1 day	Automation
PREDNISOLONE *(See Samples Sent to Referral Laboratories)*					
PREGNANCY TEST	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	See HCG			Automation
PRIMIDONE		Phenobarbitone measured			Automation
PRO-BRAIN NATRIURETIC PEPTIDE (PBNP)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		See **Appendix 18** for paediatric reference intervals		Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PROGESTERONE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Only analysed in female undergoing fertility investigations. Take sample 7 days before next period due. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***		2 days	Automation
PROINSULIN (PINS) *(See Samples Sent to Referral Laboratories)*					Endocrine
PROLACTIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Levels up to 800 mU/L can be induced by stress. Reference ranges not applicable if pregnant. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	2 days	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PROSTATIC SPECIFIC ANTIGEN (PSA)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4*** Further information on tumour markers available via the following link: Guidelines For The Use Of Tumour Markers *Roche Method.*	Males: Below 40yrs: Use clinical judgement < 49 yr: <2.5µg/L 49 - 59 : <3.5 µg/L 60-69: <4.5 µg/L 70 – 79: <6.5µg/L ≥ 80 yr: <7.5 µg/L	24 hrs Mon-Fri If received after 2pm on Friday, results will be available on the next normal working day."	Automation
PROTEIN CREATININE RATIO (PCR)	URINE (RANDOM) Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  **See Appendix 3**		<15.0 mg/mmoL creatinine	1day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
PROTEIN ELECTROPHORESIS Total Protein Electrophoresis	BLOOD SERUM –Gold Top SST – 3.5mL 	Use for myeloma query and myeloma patient monitoring. If SPE is not required please request Immunoglobulins only ***See Appendix 14 for clinical follow-up guidelines for SPE and Immunoglobulin analysis*** This test is not currently accredited by UKAS.	Visual interpretation	10-14 days	Immunoproteins
Plasma CHOLINESTERASE	See **cholinesterase**				
PLASMA PALMITOYL PHOSPHOCHOLINESESERINE *(See Samples Sent to Referral Laboratories)*					
PURINE AND PYRIMIDINE SCREEN *(See Samples Sent to Referral Laboratories)*					
PYRUVATE *(See Samples Sent to Referral Laboratories)*					
Quantitative Immunochemical Testing (QFIT) *(See Appendix 10)*		The QFIT Regional Programme is a replacement for Faecal Occult Blood (FOB).			

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
RENAL STONE PROFILE (Calcium, Phosphate, Urate, Oxalate, Sodium, Protein, Potassium, Citrate) **Cystine**	URINE 24 Hr urine collection in a container having **Thymol Preservative** **Plain Universal** **See Appendix 3**	Contact Laboratory for special bottle *See **Appendix 15** for further information*		Automated Tests (Calcium, Phosphate, Urate, Sodium, Protein, Urea, Creatinine) = 10days. Citrate – 4 weeks Oxalate – 2 weeks	Special Investigations
RENIN (Direct)	PLASMA – Purple Top EDTA tube 4ml 	***Send sample to laboratory immediately***-samples must be in the laboratory within 3 hours. Please DO NOT send samples on ice.	***See Appendix 8 for information on reference ranges***	14 days	Endocrine
RHEUMATOID FACTOR	BLOOD SERUM –Gold Top SST – 3.5mL 	Please note that Rheumatoid Factor for primary care is no longer available. Samples should instead be tested for anti-CCP antibody which is a more specific test for rheumatoid arthritis. Primary care users should instead send a sample (4ml Gold top tube) to Immunology for anti-CCP antibody. If sending a sample from outside BHSCT please transfer promptly to allow analysis within 24 hours.	0 - 14 IU/ml	72 hours	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
SALICYLATE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Take sample >4hr after overdose	Therapeutic Intervals may vary. Poisoning usually classified with the following levels: <300 mg/L - mild poisoning 300 - 700 mg/L - moderate poisoning >700 mg/L - severe poisoning >900 mg/L - very severe poisoning	1 day or 90 min in emergency	Automation
SELENIUM (Plasma)	BLOOD Blue/black topped Trace Elements bottle 6mL 	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	<18 months: 0.33 - 0.97 µmol/L 18mths to <4yrs: 0.51 - 1.12 µmol/L 4 to <19 yrs: 0.60 - 1.29 µmol/L 19 to <65 yrs: 0.75 - 1.46 µmol/L 65+ yrs: 0.66 - 1.57 µmol/L	< 1 week	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
SEX HORMONE BINDING GLOBULIN (SHBG)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Measured in all female patients when testosterone is requested and used to calculate Free Androgen Index Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	2 days	Automation
SIROLIMUS (RAPAMUNE)	WHOLE BLOOD – Purple Top EDTA tube 4ml 	Trough Sample	3.0 - 20.0 ug/L	Same day if received by 1pm Mon-Fri Sat-Sun & Bank Holiday requests must be arranged and received by 11 am	Toxicology
SODIUM **See Electrolyte Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		135-146 mmol/L	1 day or 90 min in emergency	Automation
SODIUM OUTPUT	URINE 24h collection **See Appendix 3**	Do not collect in Boric acid container as this makes analysis impossible.	40 - 220 mmol/24h	1 days	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
SOMATOSTATIN	PLASMA – Purple Top - K3-EDTA ON ICE 4ml 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen. **This assay is not for diagnostic purposes - for research use only.**	<50 ng/L	4 weeks	Regulatory Peptides
STEROID SULPHATASE (ARYL SULPHATASE C) *(See Samples Sent to Referral Laboratories)*					
SULPHONYLUREA *(See Samples Sent to Referral Laboratories)*					
SWEAT TEST	SWEAT	Investigation of suspected cystic fibrosis. Contact laboratory to arrange an appointment for a sweat test (02896 151480)	Age related	1-5 days	Metabolic & Neonatal Screening
TACROLIMUS	WHOLE BLOOD – Purple Top EDTA tube 4ml 	Trough sample	3.0 - 15.0 µg/L	Same day if received by 1pm Mon-Fri Sat-Sun & Bank Holiday requests must be arranged and received by 11 am	Toxicology

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
TEICOPLANIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Contact Microbiology for clinical advice. See Belfast Trust Guidelines for empirical antibiotic prescribing in hospitalised adults. This test is not currently accredited by UKAS.	Trough Level 20 - 50mg/L	1 day	Automation
TESTOSTERONE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Please see ***Appendix 8*** for Tanner stage reference ranges Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	2 days	Automation
BLOOD THALLIUM *(See Samples Sent to Referral Laboratories)*					
THALLIUM	URINE, Random urine. White Top Universal (plain tube)  **See Appendix 3**	***Metal bed pan must not be used to collect urine.*** Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI.	<5 nmol/L	<3 Weeks	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
THEOPHYLLINE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Overdose: Acute >100 mg/L Chronic >60mg/L may need haemodialysis. Monitor theophylline and potassium levels every 2-3 hours.	10-20 mg/L	1 day	Automation
THIOPENTONE	SERUM – Red Top Plain (No Gel) 	**By special arrangement only.** **Contact laboratory** Thiopentone is unstable in stored samples. Samples MUST be arranged with the Toxicology Lab prior to sending the sample. Fresh sample must arrive in the Toxicology Lab by 9am for analysis. An indication of whether the patient is still on infusion or when the infusion stopped should also be given.		1 day	Toxicology
THIOPURINE METABOLITES *(See Samples Sent to Referral Laboratories)*					
THIOPURINE METHYL TRANSFERASE (TPMT) *(See Samples Sent to Referral Laboratories)*					
THYROGLOBULIN	BLOOD SERUM –Gold Top SST – 3.5mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	14 days	Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
THYROGLOBULIN ANTIBODY	BLOOD SERUM –Gold Top SST – 3.5mL Analysed with thyroglobulin 	Thyroglobulin antibody >21 IU/L invalidates thyroglobulin result. Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***		Endocrine
THYROID FUNCTION - INTERFERING ANTIBODIES *(See Samples Sent to Referral Laboratories)*					
THYROID FUNCTION TEST Comprising of Free Thyroxine (fT4) Thyroid Stimulating Hormone (TSH)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 				
THYROID STIMULATING HORMONE (TSH)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 8 for information on reference ranges***	1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
TOBRAMYCIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Contact Microbiology for clinical advice. See Belfast Trust Guidelines for empirical antibiotic prescribing in hospitalised adults	Trough: <1 mg/L.	1 day	Automation
TOTAL PROTEIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL  SERUM – Gold Top SST 3.5 mL (if performed as part of protein electrophoresis request) 		60 - 80 g/L See **Appendix 18** for paedi atric reference intervals	1 day	Automation
TOTAL PROTEIN	URINE 24hr urine collection in plain bottle **See Appendix 3**		<140 mg/24hr	1 day	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
TOTAL PROTEIN	CSF White Top Universal (plain tube)  **See Appendix 3**		0.15 - 0.45 g/L	1 day	Automation
TRANSFERRIN (see Iron Profile)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		2.0 - 3.6 g/L See **Appendix 18** for paediatric reference intervals	1 day	Automation
TRANSFERRIN SATURATION (%)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Calculated test – part of Iron profile	Female: 16-40 % Male: 16-50 % See **Appendix 18** for paediatric reference intervals	1 day	Automation
TRIGLYCERIDE **See Lipid Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Patient must fast for 14 hrs before sample is taken	0.40 - 1.7 mmol/L See **Appendix 18** for paediatric reference intervals	28 hr	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
FREE T3 (TRIIODOTHYRONINE)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		***See Appendix 8 for information on reference ranges***	3 days	Automation
TRIMETHYLAMINE *(See Samples Sent to Referral Laboratories)*					
TROPONIN T (HIGH SENSITIVITY)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Sample taken at presentation (time 0) Second sample at +1hr Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	***See Appendix 2 For more information***. Adult female: ≤9 ng/L Adult male: ≤17 ng/L	90 min in emergency	Automation
TSH RECEPTOR ANTIBODY	BLOOD GEL 4ml Gold top tube 	For investigation of Grave's disease.	<1.75 IU/L	2-3 Weeks	Automation/ Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
URATE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		Males: 202 -417 µmol/L Females: 143 – 339 µmol/L	1 day	Automation
URATE	URINE 24hr collection using 10% thymol preservative. **See Appendix 3**	Contact laboratory for special bottle. ***Send to laboratory immediately***. Do not refrigerate.	1.5 – 4.5 mmol/24hr	7 day	Automation
UREA **See Electrolyte Profile**	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 		2.5 - 7.8 mmol/L See **Appendix 18** for paediatric reference intervals	1 day	Automation
UREA	URINE 24hr urine collection in plain bottle **See Appendix 3**		428-714 mmol/24 hr	1 day	Automation
VACULATED LYMPHOCYTES *(See Samples Sent to Referral Laboratories)*					

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
VALPROATE	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Trough sample Specimens for valproate analysis should be drawn just prior to dose, preferably in the fasting state.	50-100 mg/L Poor correlation between blood levels and therapeutic effect.	1 day	Automation
VANCOMYCIN	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	Contact Microbiology for clinical advice. See Belfast Trust Guidelines for empirical antibiotic prescribing in hospitalised adults. Vancomycin trough level should be sent not more than one hour before the next dose is due eg. if dose is due at 15:00, a trough level can be sent from 14:00 onwards.	Trough 10–20 mg/L (15–20 mg/L for patients with severe or deep-seated infections, such as severe sepsis, bacteraemia, endocarditis, pneumonia, bone/joint, CNS and device related infections. In other infections a trough level of 10-20 mg/L is acceptable)	1 day	Automation
VASOACTIVE INTESTINAL POLYPEPTIDE (VIP)	PLASMA – Purple Top K3-EDTA ON ICE 4ml 	Fasting sample required. ***Transport to laboratory on ice*** within 2 hours or nearest lab for separation for transport frozen.	<100 ng/L	4 weeks	Regulatory Peptides

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
VEGF *(See Samples Sent to Referral Laboratories)*					
VERY LONG CHAIN FATTY ACIDS (VLCFA) *(See Samples Sent to Referral Laboratories)*					
VITAMIN A	SERUM –Gold Top SST GEL – 3.5mL 	**Protect sample from light.** Analysed with Vitamin E. Samples should be collected after an overnight fast.	1.1 - 3.5 umol/L	14 days	Endocrine
VITAMIN B12	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	**Protect sample from light.** Fasting sample preferred ***Samples with extremely high total protein concentrations (hyperproteinaemia), which may be found in conditions such as lymphoma, multiple myeloma, MGUS, plastocytoma and amyloidosis, are not suitable for use in this assay*** Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***	>350 ng/L From NICE NG239: <180 =Confirmed B12 deficiency 180-350 = Indeterminate test result – possible B12 deficiency >350 = Suggests vitamin B12 deficiency unlikely	OPC/Primary Care: 1 day Routine Inpatient: 4 hours Emergency: 90 minutes	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
VITAMIN C (ASCORBATE)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	***Send to laboratory on ice within 30 mins of taking sample***. Protect from light.	>32 umol/L: Normal 10 - 32 umol/L: Risk of Vit C deficiency <10 umol/L: Severe risk of Vit C deficiency	14 days	Endocrine
1, 25 VIT D *(See Samples Sent to Referral Laboratories)*					
VITAMIN D	SERUM – Gold Top SST – 3.5mL 	Must be received by laboratory within 24hr of venepuncture-fasting sample recommended. Clinical justification for request **MUST** be provided.	***See Appendix 8 for information on reference ranges***	3 days	Endocrine
VITAMIN E	SERUM – Gold Top SST – 3.5mL 	Protect from light. Analysed with Vitamin A SAMPLES SHOULD ALSO BE TAKEN AFTER AN OVERNIGHT FAST	16.0 - 35.0 umol/L	14 days	Endocrine
WHITE CELL CYSTINE *(See Samples Sent to Referral Laboratories)*					
WHITE CELL ENZYMES		**SEE LYSOSOMAL ENZYME SCREEN**			

TEST	SAMPLE REQUIREMENTS	COMMENT	ADULT REFERENCE RANGE (Unless stated otherwise)	Expected TAT	SECTION/AREA
ZINC (Plasma)	BLOOD Blue/black topped trace metal bottle. 6mL. 	Green topped heparinised bottles are contaminated with zinc and must NOT be used. Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	Men 19 to <65 years: 10.1 - 20.2 µmol/L Men >65 years: 8.0 - 20.0 µmol/L Women 19 to <65 years: 9.6 - 20.5 µmol/L Women >65 years: 9.2 - 19.2 µmol/L Neonates <0.5 years: 5.0 - 21.5 µmol/L 0.5 to <19 years: 9.8 -19.0 µmol/L	< 1 week	Trace Metals

TESTS PERFORMED ON FLUID SAMPLES

Only certain tests have been validated and accepted for measurement in fluid samples, which are based on the fluid type collected. It is essential that the fluid type is detailed on the request. Note – tests performed on CSF are noted in the test list table above.

FLUID / TEST REQUEST	SAMPLE REQUIREMENTS	TESTS PERFORMED	REFERENCE RANGE	Expected TAT	SECTION/AREA
PERICARDIAL	Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  Or **White Top Universal (plain tube)**  **See Appendix 3**	Protein, LDH	See **Appendix 19** for interpretation information.	4 hr	Automation
PERITINEAL / ASCITIC	Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  Or **White Top Universal (plain tube)**  **See Appendix 3**	Protein, Albumin, LDH, Amylase, Triglyceride	See **Appendix 19** for interpretation information.	4 hr	Automation

FLUID / TEST REQUEST	SAMPLE REQUIREMENTS	TESTS PERFORMED	REFERENCE RANGE	Expected TAT	SECTION/AREA
PLEURAL	Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  Or **White Top Universal (plain tube)**  **See Appendix 3**	Protein, LDH, Glucose, pH	See **Appendix 19** for interpretation information.	4 hr	Automation
DRAIN	Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  Or **White Top Universal (plain tube)**  **See Appendix 3**	Creatinine	See **Appendix 19** for interpretation information.	4 hr	Automation

FLUID / TEST REQUEST	SAMPLE REQUIREMENTS	TESTS PERFORMED	REFERENCE RANGE	Expected TAT	SECTION/AREA
SERUM: ASCITES ALBUMIN GRADIENT (SAAG)	**Monovette or White Top Universal (plain tube**)  And paired serum yellow top SST sample 	Albumin (in both serum and ascitic fluid)	See **Appendix 19** for interpretation information.	4 hr	Automation

NOTE: *Fluid for pH must be collected in a heparinised blood gas syringe and analysed on the ward using a POCT blood gas analyser. There is no longer a blood gas analyser in the lab for performing such testing so these samples should not be sent to the laboratory.*

SAMPLES SENT TO REFERRAL LABORATORIES

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
ANGIOTENSIN CONVERTING ENZYME (ACE)	CSF 0.5ml Plain Universal	Sample sent to referral laboratory.	Up to 1.2 µmol/min/L	10 Weeks	Automation
ACYLCARNITINE PROFILE (PLASMA)	BLOOD Lithium Heparin 1ml Green top 	For the investigation and monitoring of fatty acid oxidation defects and classical organic acidurias. Can be more sensitive than blood spot analysis for long chain acylcarnitines If investigating for metabolic causes of myopathy, plasma is the preferred sample type. Sample sent to referral laboratory.	Qualitative report	5-14 Days	Metabolic & Neonatal Screening
ACYLCARNITINE PROFILE (POST MORTEM)	BLOOD SPOT CARD (2-3 spots) Contact Metabolic Laboratory (Tel: 02896 151482)	May be informative in the investigation of sudden infant death. **Pathology specimens only.** **Please state 'Post-Mortem' in clinical details.** Sample sent to referral laboratory.	Qualitative Report	6 Weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
ALPHA-AMINOADIPIC SEMIALDEHYDE (A-AASA)	URINE >1ml Plain universal **See Appendix 3**	For the diagnosis of Pyridoxine dependent epilepsy. Very dilute samples may not be suitable for analysis. ***Specimen must be received within 16 hours of sampling***. Sample sent to referral laboratory. This test is not currently accredited by UKAS.	Detailed in report		Metabolic & Neonatal Screening
ALPHA-GALACTOSIDASE (FABRY)	BLOOD 5ml EDTA (purple top)  BLOOD SPOT CARD (2 spots minimum)	Dried blood spot utilised as a screening test for Fabry Disease. Whole blood preferred for confirmation of Fabry's or if high index of suspicion. Whole Blood. Requires Urgent Delivery ***Send Mon-Thurs AM only (to arrive in laboratory before 1pm)*** Sample sent to referral laboratory	Qualitative report	1-2 Weeks	Metabolic & Neonatal Screening
ALPHA-GLUCOSIDASE (POMPE)	BLOOD 4ml EDTA (purple top)  BLOOD SPOT CARD (2 spots minimum)	Dried blood spot utilised as a screening test for Pompe Disease. Whole blood preferred for confirmation or if high index of suspicion. *Urgent transit required.* *Send Mon-Thurs AM only (to arrive in laboratory before 1pm).* *For further information. contact laboratory (tel 02896 151480)*	Provided with report	1-2 Weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
ALPHA-IDURONIDASE (MPS1)	BLOOD 4ml **5ml** EDTA (purple top) 	Enzymology for MPS-1 following a positive screening test. Consultant request only *Urgent transit required.* *Send Mon-Thurs AM only (to arrive in laboratory before 1pm).* *Contact laboratory (tel 02896 151480)*	Provided with report	1-2 Weeks	Metabolic & Neonatal Screening
ALPHA SUB UNIT	BLOOD 4ml gel (yellow) 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details.	Detailed in report.	6 weeks	Endocrine
ALPHA-1-ANTITRYPSIN (GI protein loss)	FAECES Plain Universal 0.5 g minimum	***Send to laboratory immediately*** for freezing to prevent protein degradation Sample then forwarded to Referral Laboratory. If the patient has a low serum AAT concentration, the faecal AAT may be low even in the presence of protein loss through the gut. Please also send a yellow top serum sample for AAT analysis.	0.0 - 0.48 mg/g faeces (wet weight)	6 weeks	Immunoproteins
ALUMINIUM (plasma)	BLOOD Blue/Black top trace metal bottle 6 mL 	Gadolinium-based contrast agents can interfere with clinical elemental analysis. Samples should not be collected less than 96 h after a Gadolinium-based contrast agent MRI. Wound site should be cleaned with alcohol only. Do not use iodine containing swabs.	< 0.4 µmol/L	4 weeks	Trace Metals

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
ANDROSTENEDIONE (AD2)	BLOOD 4ml clotted bottle (red top) Gel tube unsuitable 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details. This test is not currently accredited by UKAS.		4 weeks	Endocrine
APOLIPOPROTEIN A (APOA)	BLOOD 4ml GEL Gold top SST 	Sample sent to referral laboratory		1 Month	Automation
APOLIPOPROTEIN B (APOB)	BLOOD 4ml GEL Gold top SST 	Sample sent to referral laboratory		1 Month	Automation
B-CAROTENE	Mark outside of envelope with **"Protect from Light"** BLOOD 2ml **3.5 ml** clotted bottle (red top) 	**Protect sample from light.**		21 days	Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
BATTENS DISEASE ENZYMES (NCL SCREEN)	BLOOD 5-10ml EDTA (purple top) 	To aid diagnosis of Batten's Disease Consultant request only *Urgent transit required.* *Send Mon-Thurs AM only (to arrive in laboratory before 1pm).* *Contact laboratory (tel 02896 151480)*	Provided with report	1-2 Weeks	Metabolic & Neonatal Screening
BETA TRACE PROTEIN (?CSF LEAK) (Asialotransferrin, Tau transferrin, Beta 2-transferrin)	Nasal fluid Minimum 0.1 mls Small plain glass or plastic container and GEL 5ml Gold top tube 	For suspected CSF leak **Send paired serum specimen.** Sample sent to referral laboratory.		1-2 weeks	Metabolic & Neonatal Screening
BILE ACIDS (Total)	Plasma – Green Top Lithium-Heparin – Yellow insert – 3mL 	For assessment of obstetric cholestasis. For assessment of obstetric cholestasis. Sample sent to referral laboratory.	0 – 14 U/L	1 week	

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
BILE SALTS PROFILE (FOR THE DIAGNOSIS OF BILE ACID BIOSYNTHESIS DISORDERS) (PBSP)	BLOOD Lithium Heparin 1ml Green top  OR 2 mls urine in a plain tube See Appendix 3	FOR THE DIAGNOSIS OF BILE ACID BIOSYNTHESIS DISORDERS **RECOMMEND SEND URINE AND BLOOD** N.B. This test is not for assessment of obstetric cholestasis - see 'BILE ACIDS' Sample sent to referral laboratory.	Interpretation given with report	4-6 weeks	Metabolic & Neonatal Screening
BIOPTERIN	BLOOD SPOT CARD 5 x 10mm spots (large spots) **6 x 10mm**	For the investigation of defects in biopterin metabolism.	Interpretation given with report.	2-3 Weeks	Metabolic & Neonatal Screening
BIOTINIDASE	BLOOD Lithium Heparin 1ml Green top 	For the investigation of Biotinidase deficiency.	Provided with report	5-14 Days	Metabolic & Neonatal Screening
CALPROTECTIN	Faeces (1-5g) in plastic universal container	Sample sent to referral laboratory.	Reference range available with report	8 Days	Automation
CARBOHYDRATE DEFICIENT TRANSFERRIN TO MONITOR ALCOHOL CONSUMPTION	2mL Serum (Gel 5mL Yellow tube).	Sample sent to referral laboratory.		10 Days	Toxicology
CERAMIDE TRIHEXOSIDE (GB3)	URINE 5ml Plain Universal See Appendix 3	For monitoring of Fabry Disease Sample sent to referral laboratory	Interpretation given with report	4-6 weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
CHOLINESTERASE (Plasma, Phenotyping)	BLOOD EDTA 4ml Purple Top Tube  Sample should not be taken during a suspected episode of suxamethonium prolonged apnoea, take once awake and breathing unaided.	Contact laboratory. Sample sent to referral laboratory.		4 weeks	Toxicology
COPEPTIN	BLOOD Plasma (No Gel) Lithium Heparin Plasma 	Must be received at laboratory within 2 hours of collection. Plasma Osmolality sample must be provided at the same time for interpretation purposes. Sample sent to referral laboratory. Contact laboratory ext 51483 for further details.		6 weeks	Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
LIVER COPPER	Liver biopsy	Liver biopsy: >10.5 mg wet weight >0.5 mg dry weight (minimum), ideally >3 mg dry weight. A needle biopsy should be about 1 cm in length and should be transferred directly to the wall of a plain universal container. Please do not put onto lint/gauze/tissue/filter paper. Please do not use preservative e.g. formalin or saline. Sample may be transported to lab at room temperature if it will arrive within 5 hours. Sample will be frozen upon receipt in the lab. Please use taxi courier if sample is sent from outside RVH, this is more secure. Please contact the lab on 028 9615 1479 with the patients details, telephone phone contact number and details of when to expect delivery of the biopsy.	8 to 40 µg/g dry weight	4 weeks	Trace Metals
CREATINE KINASE ISOENZYME ELECTROPHORESIS	BLOOD GEL 4ml Gold top SST 	Sample sent to referral laboratory.	Creatine Kinase: Male 39 - 308 U/L Female 26 - 192 U/L CK Isoenzymes: CK-MM 97-100% CK-MB <3% if total CK is <501 otherwise <4% CK-BB 0%	6 weeks	Immunoproteins

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
NEUROTRANSMITTERS (CSF)	CSF Contact laboratory for specific request form and collection tubes. Transport in liquid nitrogen. 3 bottles from Queen Square lab Minimum volume of 0.5ml	**Neurology requests only** For assessment and monitoring of disorders of neurotransmission. Clinical indications include oculogyric crises, temperature instability, ptosis, parkinsonian features and dystonia. Sample sent to referral laboratory	Provided with report	4-6 weeks	Metabolic & Neonatal Screening
7-DEHYDROCHOLESTEROL	BLOOD Lithium Heparin 1ml Green top 	For diagnosis of Smith Lemli Opitz Syndrome. Cholesterol, 8-Dehydrocholesterol and full sterol profile included in the assay. Sample sent to referral laboratory.	Reference range provided on report.	4-6 weeks	Metabolic & Neonatal Screening
DIHYDROXY-TESTOSTERONE	BLOOD 4ml clotted bottle (yellow) 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details.		4-6 weeks	Endocrine
FGF23	BLOOD 4ml EDTA Purple 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details.		6-8 weeks	Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
FREE FATTY ACIDS (NON-ESTERIFIED FATTY ACIDS) (NEFA)	2ml blood in Fluoride Heparin bottle Grey Top. (Li-Hep, serum, EDTA are unsuitable) 	Can help differentiate between Endocrine and Metabolic causes of hypoketotic and hypoglycaemia. Please also request glucose and 3-hydroxybutyrate to aid interpretation. Sample sent to referral laboratory.	Interpretation dependent on concurrent plasma glucose/clinical setting. Contact laboratory for interpretation (tel 028961 51480)	1 week	Metabolic & Neonatal Screening
FRUCTOSAMINE	Plasma Or Serum	Sample sent to referral laboratory.		5 Days	
GALACTITOL	URINE Plain universal 5ml **See Appendix 3**	Levels are raised in Classical Galactosaemia and Galactokinase deficiency. Also used for monitoring treatment. Can be used to investigate for classical galactosaemia in those patients who have received a blood transfusion and therefore not suitable for galactosaemia testing via GPUT assay. Discussion with lab advisable in this situation. Samples sent to referral laboratory.	Qualitative Report	4 weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
GALACTOKINASE	BLOOD 2 ml lithium heparin with no gel (green top black insert) preferred.  Lithium heparin gel tubes also accepted. 	Used in the investigation of Galactokinase deficiency. N.B. Urine galactitol is used as first line screen for this condition (please see above). ***Urgent transit required. Contact laboratory (tel 02896 151480)*** ***Send Mon-Thurs AM only (to arrive in laboratory before 1pm).*** Sample sent to referral laboratory		4 weeks	Metabolic & Neonatal Screening
GALACTOSE-1-PHOSPHATE	BLOOD 2 ml lithium heparin with no gel (green top black insert) 	For Classical Galactosaemia Monitoring. Gel separator tubes are NOT suitable. Sample sent to referral laboratory. Urgent transit required. Send Mon-Thurs AM only (to arrive in laboratory before 1pm). Contact laboratory (tel 02896 151480)	Provided with report	4 weeks	Metabolic & Neonatal Screening
GUANIDINOACETATE AND CREATINE	URINE 1 ml plain universal **See Appendix 3** BLOOD 1 ml lithium heparin (green top) 	For the investigation of disorders of creatine biosynthesis. **Send blood and urine together.** **Urine must be received by lab within 1-2 hours of collection**. Sample sent to referral laboratory	Provided with report	3 weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
INHIBIN B (INB)	BLOOD 4ml Gel (yellow) 	Sample sent to referral laboratory.		4 Weeks	Automation
INSULIN ANTIBODIES	BLOOD 4ml clotted bottle (red) 	Must be received in lab within 1 hr		2 Weeks	Endocrine
INTESTINAL DISACCHARIDASES (BIOPSY)	DUODENAL BIOPSY Minimum weight 1.5mg	**Please call the metabolic lab on extension 51480 *prior to sampling* to arrange collection by laboratory staff.** **Sample must be taken and ready for collection prior to 4pm Mon-Thur. Please do not take samples outside these hours.** **Preferred sample type is Duodenal. Jeiunal also accepted. Please note different reference intervals apply.** Biopsy samples must be received in the lab ASAP. Metabolic Laboratory Staff will collect samples if given advance notice.		Up To 8 Weeks	Metabolic & Neonatal Screening
IOHEXOL	Serum (Gel 5mL Yellow tube)	Only performed for potential living donor patients to assess renal function. Sample sent to referral laboratory.		7 Days	Toxicology

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
LIVER IRON	Liver biopsy	Liver biopsy: >10.5 mg wet weight >0.5 mg dry weight (minimum), ideally >3 mg dry weight. A needle biopsy should be about 1 cm in length and should be transferred directly to the wall of a plain universal container. Please do not put onto lint/gauze/tissue/filter paper. Please do not use preservative e.g. formalin or saline. Sample may be transported to lab at room temperature if it will arrive within 5 hours. Sample will be frozen upon receipt in the lab. Please use taxi courier if sample is sent from outside RVH, this is more secure. Please contact the lab on 028 9615 1479 with the patients details, telephone phone contact number and details of when to expect delivery of the biopsy.	0.17-1.40 mg/g dry weight	4 weeks	Trace Metals
LIPOPROTEIN a (LPa)	BLOOD 4ml **5ml** GEL Gold top SST 	Sample sent to referral laboratory.		**5 Days**	

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
LYSOSOMAL ENZYME SCREEN (also known as 'white cell enzymes')	BLOOD 5-10 ml EDTA (purple top) 	For the investigation of a defined panel of lysosomal storage disorders (contact laboratory for details of enzymes included). NB Does not include MPS disorders. ***Requires urgent delivery. Send Mon-Thurs AM only (to arrive in laboratory before 1pm).*** Sample sent to referral laboratory.		4-6 weeks	Metabolic & Neonatal Screening
METHYL MALONIC ACID (MMA)	1 ml Lithium heparin. 	**Only available to Neurology patients.** Sample sent to referral laboratory.	0.10 – 0.42 umol/L	20 days	Toxicology
MOLAR HCG	Blood – Yellow Top SST – 6ml 	Sample sent to referral laboratory.		3-4 days	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
MPS ENZYME ASSAYS	EDTA 5ml  Except for Arylsulphatase B (MPS VI, Maroteaux-Lamy syndrome) where EDTA 10ml is Required.	For enzymatic confirmation of Mucopolysaccharidoses following a positive screening test. Mucopolysaccharidoses are initially screened for using electrophoresis of glycosaminoglycans extracted from urine. See Mucopolysaccharidosis screen.	Provided with report	1-2 Weeks	Metabolic & Neonatal Screening
NEURON-SPECIFIC ENOLASE (NSE)	Blood – Yellow Top SST – 4ml  CSF Contact Laboratory for specific request form/tubes required and transit requirements (tel 02896 151480)	Sample sent to referral laboratory. **To be sent within 30 minutes as needs to be separated within 60 minutes.**		1 month	Automation
OLIGOSACCHARIDE AND SIALIC (SCREEN)	Urine 3ml in plain container **See Appendix 3**	Analysis of urinary oligosaccharides by TLC stained with orcinol and resorcinol for oligosaccharides and sialic acid containing conjugates. Sample sent to referral laboratory.	Qualitative Report	3-4 weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
PIPECOLIC ACID	1mL Li heparin blood (green top tube)  0.5 mL CSF in plain tube 5 mL urine in plain container **See Appendix 3**	For the diagnosis of Pyridoxine dependent epilepsy. CSF is the preferred sample for diagnosis of Pyridoxine responsive seizures (then plasma, then urine). Both plasma and urine can give false negatives if the patient has already been given pyridoxine, but CSF doesn't. If pipecolic acid is being requested as part of the investigation of peroxisomal disorder then plasma or urine is suitable. Sample sent to referral laboratory	For interpretation see report	4-6 weeks	Metabolic & Neonatal Screening
PLACENTAL ALP (PLAP)	1ml CSF (plain universal)	Please contact Endocrine Laboratory.		1 Week	Automation
PLASMALOGENS	BLOOD 2ml EDTA (purple top) 	For the diagnosis of peroxisomal biogenesis disorder and rhizomolic chodrodysplasia punctata. ***Urgent transit required.*** ***Send Mon-Thurs AM only (to arrive in laboratory before 1pm). Contact laboratory (tel 02896 151480)***	Provided with report	4-6 weeks	Metabolic & Neonatal Screening
PLASMA ALUMINIUM	Navy blue cap Trace Elements bottle	Samples are highly prone to contamination from dust etc. Powder inside plastic gloves can be a significant source of aluminium contamination when handling samples.		6 Days	Trace Metals
PLASMA LYSO (GB3)	0.5 mls Lithium heparin plasma	**Special arrangement only for monitoring Fabrys patients** Sample sent to referral laboratory		6-8 Weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
PLASMA PALMITOYL PHOSPHOCHOLINESESERINE **(Non-funded test – funding source must be available before sending)**	1ml EDTA whole blood 	***Consultant request only and funding approval required.*** PPCS has replaced plasma oxysterol (cholestane-3β,5α,6β-triol) as a first-line screen for Niemann-Pick disease type C (NPC).	See referral report for reference intervals.	4 weeks	Metabolic Lab
PORPHYRINS	Mark outside of envelope with **"Protect from Light"** BLOOD EDTA 5-10ml Purple Top Protect from light. **Send to lab immediately**  URINE 2ml White Top Universal (plain tube)  **See Appendix 3** FAECES Plain universal (5.0g-10g).	**Protect from light** **Please include clinical details.** **Send to laboratory immediately** Sample sent to referral laboratory. To exclude forms of acute porphyria, the sample should be collected during an acute episode Faeces samples are only sent if requested by the referral laboratory.	Reference ranges and interpretation available on reports	2-3 weeks	Special Investigations

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
PREDNISOLONE	Serum 	AVAILABLE TO REGIONAL RESPIRATORY CONSULTANTS ONLY FOR COMPLIANCE PURPOSES. Sample sent to referral laboratory.	Interpretation dependent on Cortisol level	3 weeks	Toxicology
PROINSULIN (PINS)	BLOOD 4ml clotted bottle (red top) 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details. Must be received in lab within 1 hr		2 weeks	Endocrine
PURINE AND PYRIMIDINE SCREEN	URINE 2-5mls urine Plain universal BLOOD 4ml EDTA (purple top) 	Metabolite screen for inherited defects of purine or pyrimidine metabolism. Blood and plasma accepted, urine preferred. **Urine is the most useful screening sample, except for Thymidine phosphorylase (investigation for MNGIE) where plasma is preferred. Please note: dihydrouracil, dihydrothymine and ureidopropionate are not detected by this method** Sample sent to referral laboratory.		3-4 weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
PYRUVATE	Exactly 1ml of blood in special bottle with preservative Exactly 0.5ml of CSF in special bottle with preservative Send sample on ice via porter	Contact Metabolic laboratory (tel 02896 151480) for specific Pyruvate tube. May be considered in the investigation of an inherited disorder of lactic acidemia. Interpretation requires simultaneous measurement of blood lactate. The measurement of pyruvate is only useful when there is a raised lactate.		< 1 Week From Receipt	Metabolic & Neonatal Screening
STEROID SULPHATASE (ARYL SULPHATASE C)	BLOOD 5ml EDTA 	For the investigation of X-linked ichthyosis, Multiple sulphatase deficiency. ***Urgent transit required.*** ***Send Mon-Thurs AM only (to arrive in laboratory before 1pm).*** Sample sent to referral laboratory.		2 weeks	Metabolic & Neonatal Screening
SULPHONYLUREA	BLOOD Serum 4ml clotted bottle (Red top) 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details. Must be received in lab within 1 hr		4-6 weeks	Endocrine

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
THALLIUM (blood)	BLOOD Blue/black topped Trace Elements bottle 6mL 	Sample sent to referral laboratory. Contact RVH Trace Metals Laboratory 028 9615 1479 for further details. Please contact Clinical Scientist (ext.51465) to discuss sending sample to referral lab. Exposure is usually monitored by measurement of thallium in urine but in severe poisoning episodes, blood may also be taken for analysis.		5 Days	Trace metals
THIOPURINE METHYL TRANSFERASE (TPMT)	BLOOD EDTA 4ml Purple top tube 	Sample sent to referral laboratory.		5 Days	Toxicology
THIOPURINE METABOLITES	BLOOD EDTA 4Ml Purple top tube 	Sample sent to referral laboratory.		2 days	Toxicology
TOTAL HOMOCYSTEINE	Bloodspot Card 1-3 x 3mm dried blood spots	Special arrang ment only for monitoring patients with Classical Homocystinuria Sample sent to referral laboratory.		7 Days	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
TRANSFERRIN GLYCOFORMS (CDG Screen)	BLOOD 2 ml serum Yellow Top 	Screen for Congenital Disorders of Glycosylation. Not valid in infants <3 weeks old. Please allow at least 4-6 weeks after a transfusion. This is not a suitable test for alcohol abuse. Sample sent to referral laboratory	Qualitative	4-6 weeks	Metabolic & Neonatal Screening
TRIMETHYLAMINE	URINE 20 ml plain universal **See Appendix 3**	For the diagnosis of primary and secondary trimethylaminuria (Fish Odour Syndrome). Sample sent to referral laboratory. TMAU is associated with ingestion of certain foods so it is important to collect this sample at the time of the odour. For this we recommend a dietary 'Choline Load' before sample collection using foods known to produce the odour e.g. beans, eggs, liver. Suggested Procedure: at 13:00 and 19:00 a high choline meal containing (eg 2 eggs + 400g baked beans or other beans – can reduce quantity for children). Then; 1. Start collecting with the first urine passed on the day after the choline load and collect urine until the end of the day i.e. empty bladder before going to bed (does not need to be a strict 24 collection). or 2. collect a single 20ml sample first thing in the morning after the choline load if 24hr collection is impractical (e.g. in young children).		8 Weeks	Metabolic & Neonatal Screening
TROPONIN I	Li-Hep Plasma	Sample sent to referral laboratory.		TBC	Automation

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
URINE CARNITINES (FRACTIONAL REABSORPTION OF FREE CARNITINE)	1ml urine 0.5 ml Lithium Heparin plasma	Investigation for primary carnitine deficiency. Send paired PLASMA and URINE Fractional tubular reabsorption of free carnitine is calculated. Please take samples BEFORE giving the patient carnitine if at all possible.		5-14 Days	Metabolic & Neonatal Screening
VACUOLATED LYMPHOCYTES	BLOOD 2 ml EDTA (purple top) 	***Urgent transit required.*** ***Send Mon-Thurs AM only (to arrive in laboratory before 1pm).*** ***Contact laboratory (tel 02896 151480***) Consultant request only.		5 Days	Metabolic & Neonatal Screening
VEGF	Serum-No Gel 500ul Red Top 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details.	See report	4 weeks	Endocrine
VERY LONG CHAIN FATTY ACIDS (VLCFA)	BLOOD Lithium Heparin 1ml Green top or EDTA (purple top)  	For the investigation of Peroxisomal biogenesis disorders (e.g. Zellweger syndrome, infantile Refsum) and defects in specific peroxisomal enzymes such as X-linked adrenoleukodystrophy. Sample sent to referral laboratory.	See report	4-6 weeks	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	Expected TAT	SECTION/AREA
WHITE CELL CYSTINE (Leucocyte Cystine)	BLOOD 4 ml Lithium Heparin with no gel (green top black insert)  Lithium heparin gel tubes also accepted. 	Useful in the diagnosis of Cystinosis and monitoring Cystinosis treatment. ***Urgent transit required.*** ***Send Mon-Thurs AM only (to arrive in laboratory before 1pm).*** ***Advise to contact Metabolic laboratory before sending (tel 02896 151480***) Sample sent to referral laboratory.	Provided with report.		Metabolic & Neonatal Screening
THYROID FUNCTION - INTERFERING ANTIBODIES	BLOOD 4ml Gel (yellow) 	For results that do not fit with the clinical picture FT4 and TSH should be sent to referral laboratory for analysis by alternative method. Contact laboratory ext 51483 for further details.		2-3 weeks	Endocrine
1, 25 VIT D	4ml Gel(yellow) 	Sample sent to referral laboratory. Contact laboratory ext 51483 for further details.		4-6 weeks	Endocrine

SAMPLES SENT TO REFERRAL LABORATORIES (Non-Funded)

Funding May Be Required

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	EXPECTED TAT	SECTION/AREA
ESSENTIAL FATTY ACIDS (NON – FUNDED) PRICE – 140 EURO	GENOVA DBS testing kit If possible please do not collect blood postprandially but collect at least 2 hours after a meal or after an overnight fast	**Metabolic Consultant Request Only** ESFA are used for monitoring nutrition in selected patients with metabolic disorders such as VLCADD Sample sent to referral laboratory.		TBC	Metabolic & Neonatal Screening
GLYCOGEN STORAGE DISEASE (GSD SCREEN) (NON – FUNDED) PRICE – £295.87 (+£111 IF GSD IV REQUIRED)	5-8 ml green top lithium heparin (NO GEL) required. LiHep Gel tubes also accepted.	Does not include GSD IV but this can be requested as an additional test Sample sent to referral laboratory.		4-6 weeks, 7 weeks for GSD IV	Metabolic & Neonatal Screening
GLUCOSE TETRA-SACCHARIDE (HEX 4) (NON – FUNDED) PRICE – £111.09 (+COST FOR DRY ICE DELIVERY)	1 ml fresh urine	**Metabolic Consultant Request Only** Biomarker for Pompe disease and other glycogen storage diseases (GSDs) Sample sent to referral laboratory.		4-6 weeks	Metabolic & Neonatal Screening
SUCCINYLACETONE (BLOOD SPOT) (NON – FUNDED) PRICE – £35.36	2 blood spots or 1ml Lithium Heparin 2x10mm BS Dried blood spots must be collected onto Ahlstrom 226 or Whatman 903 grade or equivalent filter paper blood spot cards.	Investigation for suspected Tyrosinemia. Sample sent to referral laboratory.		15 days	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	EXPECTED TAT	SECTION/AREA
PLASMA PALMITOYL PHOSPHOCHOLINESERINE (PPCS) (NON-FUNDED) ESTIMATED COST £60	1ml EDTA whole blood	**Funding approval required before sending** Plasma PPCS has replaced oxysterol (cholestane-3β,5α,6β-triol) as a first-line screen for Niemann-Pick disease type C (NPC). Sample sent to referral laboratory. Not UKAS Accredited		4 Weeks	Metabolic & Neonatal Screening
RETINOL BINDING PROTEIN (NON – FUNDED)	1ml fresh urine	Sample sent to referral laboratory.		1-3 Weeks	Metabolic & Neonatal Screening
N-acetyl-glucosminidase (Non – Funded)	1ml fresh urine	Sample sent to referral laboratory.		TBC	Metabolic & Neonatal Screening
Vitamin B6 (Plasma PLP/PA Ratio) (Non – Funded)	Plasma: 600 µL*** For nutritional VB6 send whole blood. (to be received within 72 hours) and be protected from light	For investigation of suspected Hypophosphatasia Sample sent to referral laboratory.		10 working days from receipt	Metabolic & Neonatal Screening

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	EXPECTED TAT	SECTION/AREA
Thiamine (B1) **(Non-funded test – funding approval required before sending)**	Whole blood (fasting sample preferred*) EDTA. In parenterally fed patients we recommend a fasting sample or sample collected 8 hours after last feed. 350ul. Absolute minimum volume; this volume is insufficient to carry out repeat analysis if analysis fails.	**Funding approval required before sending** Rarely required. Investigation of vitamin B1 deficiency. Sample sent to referral laboratory.		10 Days	Endocrine

APPENDICES

The following provide additional information or useful guidance referred from the individual test information or the laboratory reports.

Appendix 1: **Electronic alert systems (e-alerts) for Acute Kidney Injury**

Appendix 2: **Guidelines on Use of High Sensitivity Troponin T (hsTnT) – August 2017**

Appendix 3: **Order of Draw & Urine Tube Selection**

Appendix 4: **Biotin/Vitamin B7 Interference in Immunoassays**

Appendix 5: **BHSCT Clinical Biochemistry Guidelines Alpha – Feto Protein (AFP) Reference Ranges**

Appendix 6: **Laboratory Investigation of Phaeochromocytoma and Paragangliomas (PPGLs)**

Appendix 7: **Immunoglobulin Reference Ranges**

Appendix 8: **Regional Endocrinology Laboratory Reference Ranges**

Appendix 9: **Guidelines on the interpretation of glucose results**

Appendix 10: **Quantitative Faecal Immunochemical Testing (QFIT)**

Appendix 11: **Information regarding 'Adding-on' Requests to Received Samples**

Appendix 12: **Critical Result Management**

Appendix 13: **Hypopack Request Form**

Appendix 14: **Clinical follow-up guidelines for Serum Protein Electrophoresis and Immunoglobulin analysis**

Appendix 15: **Investigation of Recurrent Renal Calculi**

Appendix 16: **Occupational Exposure Lead Monitoring**

Appendix 17: **Newborn Blood Spot Screening Programme**

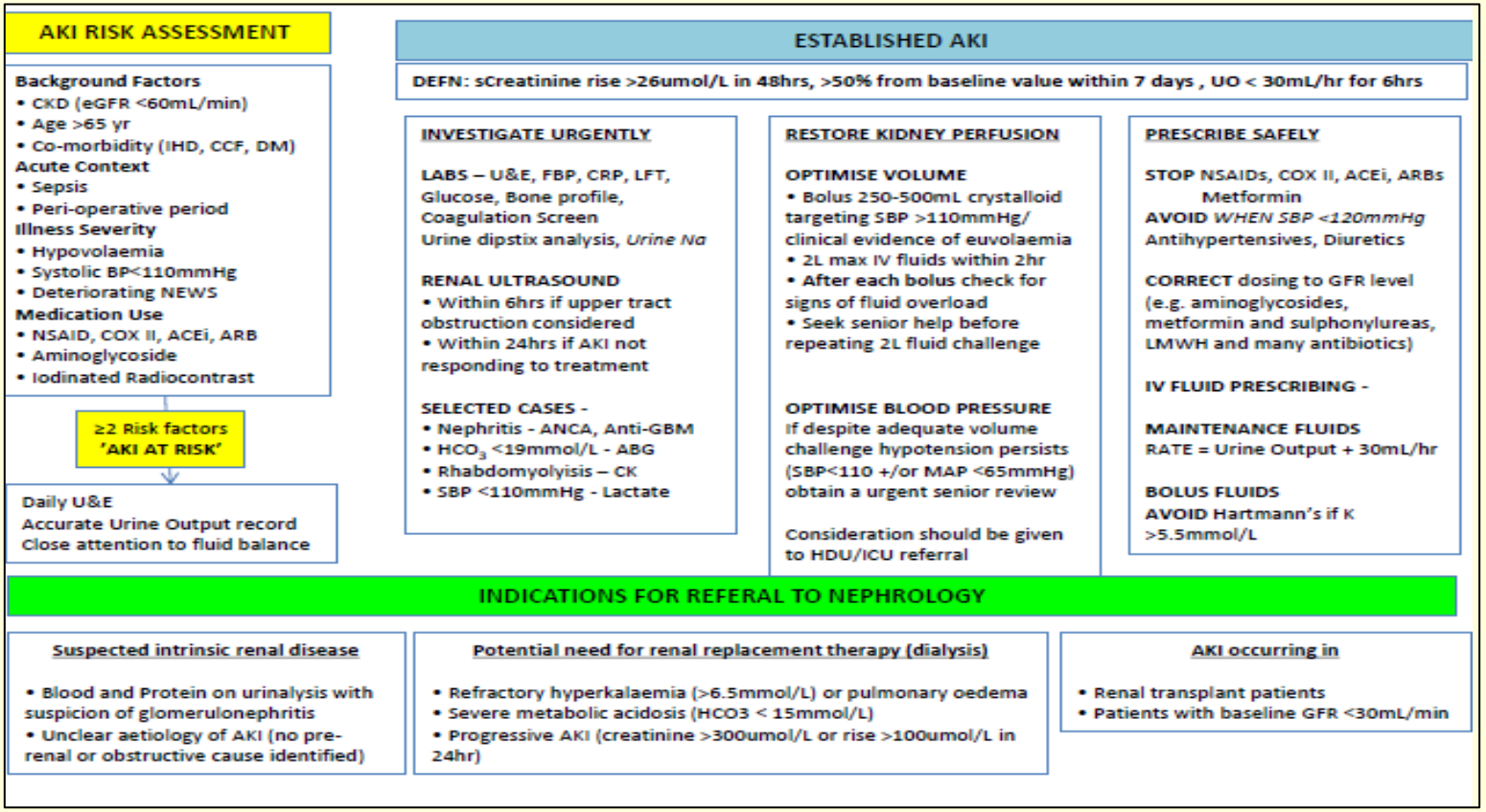
Appendix 18: **Regional Clinical Biochemistry Paediatric Reference Intervals [PLASMA]**

Appendix 19: **Analysis of Fluids in the Biochemistry Departments in NI**

Appendix 20: **Hints and Tips for Avoiding Haemolysis**

Appendix 1:

Electronic alert systems (e-alerts) for Acute Kidney Injury GAIN Guidelines 2014



Please note formula used for calculation of eGFR is Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI).

(See https://www.kidney.org/professionals)

Appendix 1: Cont.

Electronic alert systems (e-alerts) for Acute Kidney Alert

Electronic alert systems (e-alerts) for Acute Kidney Injury

Acute kidney injury (AKI) is common, often preventable and associated with high morbidity and mortality[1,3]. It is diagnosed by a reduction in urine output or a rise in plasma creatinine from a baseline value[1,2].

Delay in diagnosing AKI or failure to recognize AKI significantly contributes to the poor outcomes of patients with AKI[3]. There is therefore an urgent need to improve early recognition of AKI[3,4].

The development of electronic alert systems (e-alerts) for AKI would seem to be an effective way of doing this[4]. The electronic alert system uses laboratory data to 'flag' or 'alert' when a patient has a change in plasma creatinine level, which may identify that patient as having AKI. This 'alert' will appear on the screen when the creatinine result is looked up. The responsibility for looking up the result and taking the appropriate clinical action remains with the clinician(s) responsible for the patient.

The electronic alert systems are not designed to replace timely clinical investigation, examination and management of patients but are an additional 'warning system'.

It is hoped that electronic alert systems for AKI combined with better identification of the 'at risk' patient and improved clinical assessment will trigger earlier recognition and management of persons with AKI. This should improve patient outcomes.

References:

1. *NI Guidelines for Acute Kidney Injury (2010) https://rqia.org.uk/RQIA/files/3f/3fb3c25c-5b3a-4566-a7d6-94f77b2b262e.pdf*

2. *KDIGO Clinical Practice Guideline for Acute Kidney Injury. Kidney Disease: Improving Global Outcomes (KDIGO) Acute Kidney Injury Work Group. KDIGO Clinical Practice Guideline for Acute Kidney Injury. Kidney inter., Suppl. 2012; 2: 1–138.*
3. *NCEPOD Acute Kidney Injury: Adding Insult to Injury (2009)*
4. *RCPE UK Consensus Conference on "Management of acute kidney injury: the role of fluids, e-alerts and biomarkers" 16 & 17 November 2012*

Appendix 2:

Guidelines on Use of High Sensitivity Troponin T (hsTnT) – April 2022

Key Messages

1. Clinical context is critical to the interpretation of any hsTnT result.

2. All patients under investigation for possible acute coronary syndrome (ACS) should have hsTnT measured at presentation (Time 0).

3. It can take at least 3 hours for hsTnT to be detectable in the circulation after myocardial infarction.

4. There are different 99th percentile upper reference limits quoted for males and females. [**Males = ≤ 17 ng/L; Females = ≤ 9 ng/L**]. The lower reporting limit for the hsTnT assay is **5 ng/L.**

5. An initial hsTnT result **< 5 ng/L** at presentation has a high negative predictive value for ACS, if several hours post ictus. ***However, this may not hold for early presenters and collecting a second sample is important in this group***.

6. An initial hsTnT **≥ 52 ng/L** should be identified as high risk and the higher the hsTnT, with evidence of myocardial ischaemia, the more likely the diagnosis of AMI.

7. When further investigation is indicated a second sample should be collected at least **+ 1 hour** (from first sample, Time 0). The hsTnT change between 0 & 1 hour sample can help identify acute myocardial necrosis. [*See BHSCT Chest Pain Pathway for further guidance*].

8. A troponin change of **5 ng/L or more** in the first hour may indicate presence of ACS.

9. When the starting hsTnT concentration is low (i.e. < 52 ng/L) a **3 to 5 ng/L change** may be significant. Such patients should be observed and further samples collected at + 3 hours (from first sample, Time 0).

10. A hsTnT change of **>20 %** at **3 h** with **one value above the 99th percentile** is consistent with a diagnosis of ACS (4th universal definition of MI, 2018). The higher the % delta change, the more likely the diagnosis of MI.

11. Results produced using the laboratory Roche hsTnT assay, which is in use in labs across NI, are **not comparable** to any other troponin assay results.

See further information below on interpretation of hsTnT results.

Appendix 2: Cont.

Guidelines on Use of High Sensitivity Troponin T (hsTnT)

Interpretation of hsTnT results:

Presentation – 1st Sample (Time 0)

On presentation a **hsTnT < 5ng/L** has a high negative predictive value for an ACS. ***However, an early or rapid presentation may require further sampling at + 1h and/or + 3h.***

If the presentation ***hsTnT is between 5 and 51 ng/L*** *a* second sample should be collected at + 1 h to assist with ruling AMI/ACS in or out, in the appropriate clinical context. Further sampling at + 3 hour (and + 6 hour) may be necessary in cases where results are equivocal.

A result **≥ 52 ng/L** along with a high risk history (*See BHSCT Chest Pain Pathway for further guidance)* suggests ACS.

2nd Sample (@ + 1 hr from first sample)

The absolute change in hsTnT between the two samples can be used to support the diagnosis of ACS or alternatively assist the rule-out of acute myocardial necrosis.

- If the **second** hsTnT has **not increased by more than 3 ng/L** then this represents a low risk of ACS.
- A hsTnT **change ≥ 5ng/L** is considered significant and, alongside evidence of cardiac ischaemia, supports diagnosis of ACS.
- Observation and further sampling is recommended for patients with a changing troponin (**3 to 4 ng/L**) when ECG and clinical signs are equivocal and clinical suspicion remains. A further sample **at + 3 hr** (from first sample, Time 0) should be collected.

Further Sampling (@ + 3/6 hour from first sample)

- In some cases a 3rd sample at 3 and/or 6 hours post presentation may help to clarify the clinical picture.
- A **T1 to T3 change > 20%** is considered significant and, alongside evidence of cardiac ischaemia, supports a diagnosis of AMI. The greater the rise over 3 h the more likely a diagnosis of ACS.

Note: hsTnT concentrations should always be judged alongside the clinical picture and the guidelines above do not cover every eventuality. These guidelines should be viewed in line with the BHSCT Chest Pain Pathway (See link below).

References:

1. BHSCT Chest Pain Pathway

2. 2020 ESC guidelines for the management of acute coronary syndromes in patients presenting without persistent ST elevation. *European Heart Journal* (2021); 42: 1289-1367.

3. Fourth universal definition of myocardial infarction. *European Heart Journal* (2019); 40: 237-69.

Appendix 3:

Order of Draw

PATHNET NI — Clinical Biochemistry Speciality Forum

Regional Clinical Biochemistry Sample Tube Standardisation & Order of Draw — Active Date: 24/04/2026

Version 4 — Page 1 of 3

NOTE: Only tests analysed within each routine Clinical Biochemistry lab within NI region are noted and some tests are only analysed at one main site for the regional (these are noted). For more specialist regional tests and tests referred to other labs outside NI see local lab handbook for sample requirements.

Tube Type / Colour / Order codes for adult tubes shown (A = adult; P = paediatric)			Clinical Biochemistry Tests
1. **Blood Cultures**			Microbiology tests (See separate poster / relevant user manual for details)
2. **Sodium Citrate Plasma [3mL]**  Blue			Haematology Tests (See separate poster / relevant user manual for details)
3. **Plain Serum [4mL]**	A  Red KBC000139 454204	P[1]  450549	*Specialist Drugs [BHSCT]:* Methotrexate; Thiopentone, Lamotrigine, Levetiracetam *Specialist Endocrine [BHSCT]:* Androstenedione; 17-Hydroxyprogesterone
4. **Serum Separator Gel (SST) [3.5 mL]**	A  Yellow KBC000141 454228	P[1]  450548	*Serum Proteins:* Serum Protein Electrophoresis (SPE) [inc. Alb & TP], Immunoglobulins (IgG, IgA, IgM), Beta-2-Microglobulin (B2M), C3, C4, Ceruloplasmin, Haptoglobin, Rheumatoid factor (RF), Serum free light chains (FLC) BHSCT: Alpha-1-Antitrypsin (AAT), including phenotyping BHSCT: IgG subclasses (inc IgG4) BHSCT: Oligoclonal bands (with paired CSF) BHSCT: ALP Isoenzymes, CK Isoenzymes ACE *TDM:* Lithium *Bone Markers [BHSCT]:* Crosslaps (CTX), Ostase, Total P1NP *Vitamins [BHSCT]:* Vit D (Total); Vit A, Vit E **(Protect from light)** *Specialist Endocrine:* [BHSCT] Anti-Mullerian Hormone (AMH) **[For BHSCT RFC Only]**; Thyroglobulin & Thyroglobulin Antibody; TSH Receptor Antibodies

PPC GBO

NOTE: Only tests analysed within each routine Clinical Biochemistry lab within NI region are noted and some tests are only analysed at one main site for the regional (these are noted). For more specialist regional tests and tests referred to other labs outside NI see local lab handbook for sample requirements.

5.	**Lithium Heparin Plasma Gel [3mL]**		***General Chemistry:*** Profiles: ***ELEC***: Na, K, Cl, Bicarbonate (CO2), Urea, Creatinine (CKD-EPI) ***LFT***: TBil, ALP, Alb, AST, ALT, GGT (Adjusted Ca) ***BONE***: Ca, PO4, Alb, ALP (Adjusted Ca) ***LIPID***: Total Cholesterol, HDL, Triglycerides (LDL, TChol/HDL ratio, non-HDL Chol) ***IRON:*** Iron, Ferritin, Transferrin (Transferrin sat %) ***THYROID:*** TSH, FT4, (+ FT3 when required) ***B12 & FOLATE:*** Folate, Vit B12 ***Other:*** Amylase, CK, Beta-hCG, DBIL, CRP, Ethanol, LDH, Magnesium, Paracetamol, Pro-BNP, Salicylate, Troponin-T, Total Protein, Urate, Osmolality, Cortisol. CarboxyHb and MetHb (heparinised blood gas syringe ideally) **[Note: Serum SST Gold Top required for TP and Alb as part of SPE profile, and for ALP and CK Isoenzymes].** All above tests can be requested in same sample bottle. The tests noted below may require separate samples as noted as some are analysed at certain locations only. Lipase Amino Acids Vit C **[On ice & protect from light]** Bile Acids (SEHSCT) ***TDM & Antibiotics:*** Carbamazepine, Digoxin, Phenytoin, Theophylline, Valproate, Gentamicin, Vancomycin, Phenobarbitone, Amikacin, Tobramycin, Teicoplanin **[NOTE: Use gold top for Lithium]** ***Tumour Markers:*** AFP, CA19-9, CEA, CA-125, PSA Endocrine (BHSCT): Anti-TPO, DHEAS, FSH, LH, Oestradiol, Progesterone, Prolactin, SHBG, Testosterone Growth Hormone (GH), IGF-1 Insulin (inc. hypopak), C-Peptide **[Must be received in local lab within 4 hr]** Calcitonin **[On ice and received in local lab within 4 hr]**
	A Green	**P** (light green)	
PPC GBO	KBC000219 454247	KBC000206 450550	

PATHNET NI

Clinical Biochemistry Speciality Forum

Regional Clinical Biochemistry Sample Tube Standardisation & Order of Draw

Active Date: 24/04/2026

Version 4

Page 3 of 3

NOTE: Only tests analysed within each routine Clinical Biochemistry lab within NI region are noted and some tests are only analysed at one main site for the regional (these are noted). For more specialist regional tests and tests referred to other labs outside NI see local lab handbook for sample requirements.

<table>
<tr>
<td>6.

PPC
GBO</td>
<td>
K3-EDTA Plasma [4mL]
<table>
<tr><td>A</td><td>P</td></tr>
<tr><td>
Lavender</td><td></td></tr>
<tr><td>KBC000149
454021</td><td>KBC000181
450530</td></tr>
</table>
</td>
<td>
Ammonia
HbA1c
Homocysteine [On ice]
PTH [Must be received in lab within 12 hr]

Immunosuppressants (BHSCT): Cyclosporine, Everolimus, Sirolimus, Tacrolimus

Specialist Endocrine (BHSCT):
ACTH [On ice & must be received in lab within 30 min]
Aldosterone, Renin [Must be received in lab within 3 hr]

Gut Hormones (BHSCT):
(inc. CgA, Gastrin, Glucagon, Pancreatic Polypeptide, Somatostatin).
[4 adult bottles needed for full profile. On ice & received in local lab within 2hr]

Specialist Investigations (BHSCT):
Porphyrins [Protect from light]
</td>
</tr>
<tr>
<td>7. Pink Cross-Match [6mL]

Pink</td>
<td>Haematology BloodBank (See separate poster / relevant user manual for details)</td>
</tr>
<tr>
<td>8. Na Fluoride EDTA [2mL]

Grey

PPC: KBC000147
GBO: 454221</td>
<td>Glucose, Lactate, 3-Hydroxybutyrate

Specialist Toxicology (BHSCT): Methanol, Ethylene Glycol</td>
</tr>
<tr>
<td>9. Trace Elements

Dark Blue

PPC: KBC000154
GBO: 456080</td>
<td>NOTE: A Separate sample is required for Plasma metals and Blood metals
Analysed at Trace Elements Lab BHSCT:

Plasma Metals: Aluminium, Copper, Selenium, Zinc.

Blood Metals: Lead, Manganese, Chromium, Cobalt, Mercury, Cadmium, Arsenic.</td>
</tr>
</table>

PPC = E-Proc code; GBO = Greiner Bio-one code

[1] **NOTE** – Use longer pre-assembled tube if possible. Some tubes may not be listed on eProc.

Urine Tube Selection

PATHNET NI

Regional Clinical Biochemistry Urine/CSF Sample Tube Standardisation

Version 6

Clinical Biochemistry Speciality Forum

Active Date: 15/08/2025

Page 1 of 2

Urine Bottle	Clinical Biochemistry Tests
Yellow top Sarstedt Monovette Plain Yellow cap 3.2 mL 13 mm x 75 mm  PPC: KBC000241 **Manufacturer code: 10.250.002**	Drugs of abuse screening (Amphetamines, Benzos, Cocaine metabolites, methadone metabolites, Opiates, Cannabinoids). ACR/PCR - Albumin, Total Protein, Creatinine Random urine electrolytes – Sodium, Potassium, Chloride, Urea & Osmolality Urine Amylase Bence Jones Protein Fluid profiles – Pericardial, Peritoneal / Ascitic, Pleural, Drain (Monovette preferred but can also be accepted in plain white top universal container shown below)
White Top Universal (plain tube)  PPC: KBC000009 **Manufacturer code: I30593**	Urine Cystine screen & urinary pH Renal Stones - Calculi (Send clean and dry in a sterile container) Urine Oxalate: Creatinine ratio Urine Paraquat Urine Porphyrins **(Protect from light)** Urine Amino Acids / Organic Acids Urine Trace metals: Urine Arsenic, Cadmium, Chromium, Cobalt, Lead, Mercury, Nickel, Thallium (along with creatinine for metal/creatinine ratio). **[NOTE: For Mercury – send urine sample to the Trace Metals Laboratory, RVH immediately].** **CSF** CSF Total Protein, Glucose, Lactate CSF Albumin & CSF IgG (for Oligoclonal bands– need paired serum gold top also) CSF Amino Acids CSF Xanthochromia **(NOTE: Must be 3rd/4th sample and protected from light)**

PATHNET NI

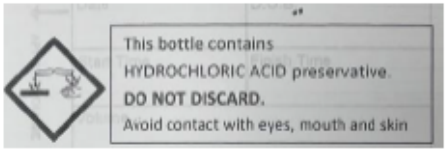
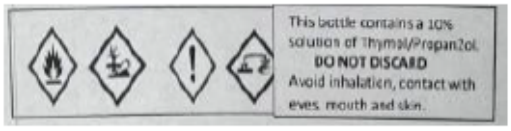
Regional Clinical Biochemistry Urine/CSF Sample Tube Standardisation

Version 6

Clinical Biochemistry Speciality Forum

Active Date: 15/08/2025

Page 2 of 2

24 hr Bottle – Plain no additives  PPC: KBC000004 **Manufacturer code: B2523**	24 hr Urine Output - Sodium, Potassium, Chloride, Total Protein, Amylase, Urea, Creatinine **(NOTE: For creatinine clearance require paired Li-Hep sample for plasma creatinine)** Urinary Free Cortisol Urine 5HIAA **[NOTE: Special diet must be adhered to]** 24 hr Urine Output for Trace metals: Copper, Lead, Mercury, Iron. **[NOTE: For Mercury – Urine should be refrigerated within 4 hours of completion of 24 hr urine collection].**
Acidified bottle – 24 hr or random plain universal with acid added* 	  Calcium, Magnesium, Phosphate [Random and 24 hr] Calcium Creatinine Ratio (Calcium and Creatinine analysed) – Random or from 24 hr collection. Phosphate Creatinine Ratio (Phosphate & Creatinine analysed) Calcium creatinine clearance ratio (requires paired blood sample for plasma calcium)  24 hr – Urine Metanephrines (Adults) and Catecholamines (Random spot urine Catecholamine accepted for Paediatric patients).
Thymol bottle (24 hr) – For metabolic stone work-up and/or Urine Urate* 	  24 hr renal stone profile (metabolic stone profile – inc. urine urate) RSP1, RPS2 & RSP3 must be requested on Encompass Please stick all 3 labels on the one 24 hr thymol container  Urine urate (if only urate needed)

NOTE – Sample consolidation information depicted above. Some specialist requests will require a separate sample bottle for ease of processing and to avoid long delays or tests being missed.

* **NOTE** – Specially prepared bottles obtained from local lab

Appendix 4:

Biotin/Vitamin B7 Interference in Immunoassays

The use of over-the-counter high dose biotin (vitamin B7) has increased recently. Supplements marketed as beauty products to improve the health of hair, skin and nails (generally 5-10 mg tablets) may be taken by patients. High-dose biotin (100 mg) may be prescribed to treat certain inherited metabolic diseases and there are ongoing trials of mega-dose (up to 300mg/day) biotin in multiple sclerosis.

Taking large doses of biotin can interfere with laboratory immunoassay test results and further information is available from the Duty Biochemist if required. Interference may be positive (falsely elevated results) or negative (falsely lowered results) depending on the assay design.

Clinicians should ask their patients if they are taking any biotin supplements, including products marketed for hair, skin, and nail growth. Clinicians must recognise that product labelling is sometimes obscure and patients may not be aware that they are taking biotin.

If the clinician has a test result that does not fit with the clinical picture, biotin ingestion should be considered as a potential cause of test interference. Close communication between the laboratory, clinician and patient is vital in this context as it is difficult to positively identify samples that contain biotin.

Clinicians should contact the Duty Biochemist when such results are considered. If appropriate arrangements can be made to send samples to a referral laboratory that uses an alternative assay.

Appendix 5:

BHSCT Clinical Biochemistry Guidelines
Alpha – Feto Protein (AFP) Reference Ranges

In utero, the AFP plasma concentration increases until it reaches a peak at 14 weeks gestation and then decreases steadily. AFP synthesis almost ceases at parturition resulting in an exponential fall of AFP plasma concentrations in the first year of life. The age-related reference range is shown below:

Age	AFP Reference Range (kU/L)
Birth	50,000 – 150,000
2 weeks	7,000 – 20,000
4 weeks	1,500 – 2,500
6 weeks	200 - 400
8 weeks	50 - 100
10 weeks	6 - 12
3 months to 50 years	3 - 8
50 – 70 years	< 15
70 – 90 years	< 20

NOTE: Higher values are seen in the premature infant and the degree of immaturity will influence the age (from birth) at which basal levels are attained

[Reference Ranges from PRU handbook of Clinical Immunochemistry – 9th Edition]

Appendix 5: Cont.

BHSCT Clinical Biochemistry Guidelines
Alpha – Feto Protein (AFP) Reference Ranges

Pregnancy-related Ranges

AFP is detectable in maternal plasma and in amniotic fluid during pregnancy. AFP concentrations peak around 30 weeks gestation and fall to normal non-pregnant concentrations at delivery. Reference ranges for maternal plasma at different gestational ages (in weeks), are shown below:

	Weeks gestation	AFP Reference Range (kU/L)	
		Lower	Upper
Maternal Plasma	**14**	< 10	50
	15	< 10	60
	16	10	69
	17	11	81
	18	13	98
	19	15	115
	20	18	123
	21	21	142

AFP as a Tumour Marker

AFP concentrations are elevated in 70-95% of patients with primary hepatocellular carcinoma and in patients with non-seminomatous germ cell tumours (NSGCT).

AFP Reference Range (tumour marker): **0 - 10 kU/L**

References

Protein Reference Units - Handbook of Clinical Immunochemistry 9th Edition (2007)
AFP Kit Insert – Roche Cobas Modular Analytics (2012)

[Reference Ranges from PRU handbook of Clinical Immunochemistry – 9th Edition]

Appendix 6:

Laboratory Investigation of Phaeochromocytoma and Paragangliomas (PPGL)

PPGLs are potentially lethal yet surgically curable causes of endocrine Hypertension. They are rare and clinical presentation is varied with an often insidious onset. However, once clinical suspicion is aroused it is imperative that reliable laboratory investigations are employed to identify the tumours.

Urine fractionated metanephrines are now recognised as the best first line investigation. Metanephrine, Normetanephrine and 3 Methoxytyramine are natural metabolites of the catecholamines Adrenaline, Noradrenaline and Dopamine respectively and measurement of excretion of the fractionated metanephrines in urine over 24 hours now replaces testing of the free catecholamines.

Fractionated Metanephrine excretion within the reference interval reliably excludes a PPGL where the clinical suspicion arises due to hypertension and associated symptoms (NPV >97%). This requires only a single 24 h urine collection as opposed to the X 3 collections recommended for traditional free catecholamine testing. A small number of false positive results is to be expected and any patients with an abnormal results should be referred for follow up investigations including imaging when this is warranted.

Sample requirements

Patients should be asked to avoid stimulants (eg coffee) and paracetamol for the day before starting a 24h urine collection. It is not necessary to stop any other medication which could cause a false positive result however, this may be necessary if an abnormal result is obtained. Please provide details of current medication on the request form.

Collection requires a special 24h urine bottle containing preservative (same as for catecholamine testing). It is most convenient for the patient to void the bladder on first rising in the morning (discard), note date and time on label/form; collect all urine voided for the next 24h including final void at the same time the following morning (note date and time again). Transport to lab without delay.

Reference values: 24h Urine Collection

Normetanephrine Output	< 2960 nmol/24 hours
Metanephrine Output	< 1289 nmol/24 hours

Reference

Phaeochromocytoma and Paraganglioma: An Endocrine Society Clinical Practice Guideline. Lenders *et al*, *J Clin Endocrinol Metab* **99 (6),** 1915-1942: 2014.

Appendix 7:

Immunoglobulin Reference Ranges

Age	IgA (g/L)	IgG (g/L)	IgM (g/L)
Cord	<0.02	5.2 - 18.0	0.02 – 0.20
0 - 2 weeks	0.01 - 0.08	5.0 - 17.0	0.05 - 0.20
2 - 6 weeks	0.02 - 0.15	3.9 - 13.0	0.08 - 0.40
6 - 12 weeks	0.05 - 0.40	2.1 - 7.7	0.15 - 0.70
3 - 6 months	0.10 - 0.50	2.4 - 8.8	0.20 - 1.00
6 - 9 months	0.15 - 0.70	3.0 - 9.0	0.40 - 1.60
9 - 12 months	0.20 - 0.70	3.0 - 10.9	0.60 - 2.10
1 - 2 years	0.30 - 1.20	3.1 - 13.8	0.50 - 2.20
2 - 3 years	0.30 - 1.30	3.7 - 15.8	0.50 - 2.20
3 - 6 years	0.40 - 2.00	4.9 - 16.1	0.50 - 2.00
6 - 9 years	0.50 - 2.40	5.4 - 16.1	0.50 - 1.80
9 - 12 years	0.70 - 2.50	5.4 - 16.1	0.50 - 1.80
12 - 15 years	0.80 - 2.80	5.4 - 16.1	0.50 - 1.90
15 - 45 years	0.80 - 2.80	6.0 - 16.0	0.50 - 1.90
Over 45 years	0.80 - 4.00	6.0 - 16.0	0.50 - 2.00

Source: PRU Handbook of clinical Immunochemistry 9th edition.

IgG Subclasses Reference Ranges

Age	IgG1 (g/L)	IgG2 (g/L)	IgG3 (g/L)	IgG4 (g/L)
0 - 6mths	1.0 – 3.0	0.3 – 0.5	0.1 – 0.6	<0.5
6mths – 2	2.3 – 5.8	0.3 – 3.9	0.1 – 0.8	<0.5
2 – 5	2.3 – 6.4	0.7 – 4.5	0.1 – 1.1	<0.8
5 – 10	3.6 – 7.3	1.4 – 4.5	0.3 – 1.1	<1.0
10 – 15	3.8 – 7.7	1.3 – 4.6	0.2 – 1.2	<1.1
adult	3.2 – 10.2	1.2 – 6.6	0.2 – 1.9	<1.3

Reference ranges established in house (Sheffield teaching hospital) and PRU collaboration.

In adults, IgG3 concentrations are higher in females than in males, and IgG4 higher in males than females.

No sex difference is seen before the age of 15 years.

Appendix 8:

Regional Endocrinology Laboratory Reference Ranges

Assay	Male	Female	Age / Notes
THYROID			
TSH	0.7 - 15.2 mIU/L	0.7 - 15.2 mIU/L	0 - 6 days
	0.72 - 11.0 mIU/L	0.72 - 11.0 mIU/L	>6d ≤3 mth
	0.73 - 8.35 mIU/L	0.73 - 8.35 mIU/L	≥3 ≤12 mth
	0.7 - 5.97 mIU/L	0.7 - 5.97 mIU/L	>1 ≤6 y
	0.6 - 4.84 mIU/L	0.6-4.84 mIU/L	≥6 ≤11 y
	0.51 - 4.3 mIU/L	0.51 - 4.3 mIU/L	>11 ≤20 y
	0.27 - 4.2 mIU/L	0.27 - 4.2 mIU/L	Adults
		0.33 - 4.59 mIU/L	pregnant: 1st trimester
		0.35 - 4.1 mIU/L	2nd trimester
		0.21 - 3.15 mIU/L	3rd trimester
FT4	11.0 - 32.0 pmol/L	11.0 - 32.0 pmol/L	0 - 6 days
	11.5 - 28.3 pmol/L	11.5 - 28.3 pmol/L	>6d ≤3 mth
	11.9 - 25.6 pmol/L	11.9 - 25.6 pmol/L	≥3 ≤12 mth
	12.3 - 22.8 pmol/L	12.3 - 22.8 pmol/L	>1 ≤6 y
	12.5 - 21.5 pmol/L	12.5 - 21.5 pmol/L	≥6 ≤11 y
	12.6 - 21.0 pmol/L	12.6 - 21.0 pmol/L	>11 ≤20 y
	12 - 22 pmoL/L	12 - 22 pmoL/L	Adults
		12.1 - 19.6 pmol/L	pregnant: 1st trimester
		9.63 - 17.0 pmol/L	2nd trimester
		8.39 - 15.6 pmol/L	3rd trimester
FT3	2.65 - 9.68 pmol/L	2.65 - 9.68 pmol/L	0 - 6 days
	3.0 - 9.28 pmol/L	3.0 - 9.28 pmol/L	>6d ≤3 mth
	3.3 - 8.95 pmol/L	3.3 - 8.95 pmol/L	≥3 ≤12 mth
	3.69 - 8.46 pmol/L	3.69 - 8.46 pmol/L	>1 ≤6 y
	3.88 - 8.02 pmol/L	3.88 - 8.02 pmol/L	≥6 ≤11 y
	3.93 - 7.7 pmol/L	3.93 - 7.7 pmol/L	>11 ≤20 y
	3.1 - 6.8 pmoL/L	3.1 - 6.8 pmoL/L	Adults
		3.78 - 5.97 pmol/L	pregnant: 1st trimester
		3.21 - 5.45 pmol/L	2nd trimester
		3.09 - 5.03 pmol/L	3rd trimester

Appendix 8: Cont.

Assay	Male	Female	Age / Notes
THYROID			
Thyroglobulin			Should only be requested post thyroidectomy. Thyroglobulin Ab >21 IU/mL may falsely elevate or lower Tg results.
Anti-Tg Autoantibodies			Should only be requested post thyroidectomy. Thyroglobulin Ab >21 IU/mL may falsely elevate or lower Tg results.
Anti TPO Antibody	<117 IU/mL	<117 IU/mL	0 - 6 days
	<47 IU/mL	<47 IU/mL	>6d ≤3 mth
	<32 IU/mL	<32 IU/mL	≥3 ≤12 mth
	<13 IU/mL	<13 IU/mL	>1 ≤6 y
	<18 IU/mL	<18 IU/mL	≥6 ≤11 y
	<26 IU/mL	<26 IU/mL	>11 ≤20 y
	<34 IU/mL	<34 IU/mL	adult
		<64 IU/mL	pregnant:1st trimester
		<51 IU/mL	2nd trimester
		<123 IU/mL	3rd trimester
TSH Receptor Antibody	<1.75 IU/mL	<1.75 IU/mL	
Calcitonin	< 9.5 ng/L	< 6.40 ng/L	

Appendix 8: Cont.

Assay	Male	Female	Age / Notes
HORMONE PROFILE			
FSH	1.5 - 12.4 IU/L	3.5 - 12.5 IU/L	Follicular Phase
		4.7 - 21.5 IU/L	Ovulation Phase
		1.7 - 7.7 IU/L	Luteal Phase
		25.8 - 134.8 IU/L	Post Menopause
LH	1.7 - 8.6 IU/L	2.4 - 12.6 IU/L	Follicular Phase
		14 - 95.6 IU/L	Ovulation Phase
		1.0 - 11.4 IU/L	Luteal Phase
		7.7 - 58.5 IU/L	Post Menopause
Oestradiol	< 159 pmoL/L	114 - 332 pmoL/L	Follicular Phase
		222 - 1959 pmoL/L	Ovulation Phase
		222 - 854 pmoL/L	Luteal Phase
		<505 pmol/L	Post Menopause
		563 - 11,902 pmol/L	pregnancy - 1st trimester
		5729 - 78098 pmol/L	pregnancy – 2nd trimester
		31,287->110,100 pmol/L	pregnancy – 3rd trimester
Prolactin	86 - 324 mIU/L	102 - 496 mIU/L (Non-pregnant range)	
Monoprolactin	63 - 245 mIU/L	75 - 381 mIU/L	
Progesterone	Not applicable	See report	

Assay	Male	Female	Age / Notes
INSULIN / C-PEPTIDE			
Insulin	2.6 - 24.9 mU/L	2.6 - 24.9 mU/L	Fasting healthy individuals
C-Peptide	1.1 - 4.4ug/L	1.1 - 4.4 ug/L	Fasting healthy individuals

Appendix 8: Cont.

Assay	Male	Female	Age / Notes
PITUITARY-ADRENAL AXIS			
ACTH	7.2 - 63.3 ng/L	7.2 - 63.3 ng/L	Ref range applicable for 7-10am
Cortisol	166 - 507 nmol/L	166 - 507 nmol/L	6-10am
	74 - 291 nmol/L	74 - 291 nmol/L	4-8pm
Urinary Free Cortisol	<180 nmol/24h	<180 nmol/24h	

Assay	Male	Female	Age / Notes
RENIN-ALDOSTERONE AXIS			
Renin	2.8 - 39.9 µIU / mL	2.8 - 39.9 µIU / mL	**7-10 am Supine** (after lying supine for 30 min)
	4.4 - 46.1 µIU / mL	4.4 - 46.1 µIU / mL	**7 – 10 am Upright** (after standing for 30 mins)
Aldosterone	32.4 - 654 pmol/L	32.4 - 654 pmol/L	**7-10 am Supine** (after lying supine for 30 min)
	61.2 - 978 pmol/L	61.2 - 978 pmol/L	**7 – 10 am Upright** (after standing for 30 mins)

Assay	Male	Female	Age / Notes
ANDROGENS			
Testosterone	8.6 - 29.0 nmoL/L	0.3 - 1.7 nmol/L	20 - 49 yrs
	6.7-25.7 nmol/L	0.1-1.4 nmol/L	≥ 50 yrs
	<0.09 nmol/L	<0.2 nmol/L	Tanner stage 1
	<15 nmol/L	<0.4 nmol/L	Tanner stage 2
	2.2-27.0 nmol/L	<0.8 nmol/L	Tanner stage 3
	6.2-26.5 nmol/L	<0.9 nmol/L	Tanner stage 4
	6.5-30.6 nmol/L	0.1-1.3 nmol/L	Tanner stage 5
SHBG	16.5 - 55.9 nmol/L	24.6 - 122 nmol/L	20 - 49 yrs
	19.3 - 76.4 nmol/L	17.3 - 125 nmol/L	≥ 50 yrs
FAI	35 - 92.6%	0.3 - 5.62%	20 - 49 yrs
	24.3 - 72.1%	0.19 - 3.63%	≥ 50 yrs

Appendix 8: Cont.

Assay	Male	Female	Age / Notes
ADRENAL ANDROGENS			
DHAS	2.93 - 16.5 umol/L	2.93 - 16.5 umol/L	<1 wk
	0.86 - 11.7 umol/L	0.86 - 11.7 umol/L	1-4 wks
	0.09 - 3.35 umol/L	0.09 - 3.35 umol/L	1-12 mths
	0.01 - 0.53 umol/L	0.01 - 0.53 umol/L	1-4 yrs
	0.08 - 2.31 umol/L	0.08 - 2.31 umol/L	5-9 yrs
	0.66 - 6.7 umol/L	0.92 - 7.6 umol/L	10-14 yrs
	1.91 - 13.4 umol/L	1.77 - 9.99 umol/L	15 - 19 yrs
	5.73 - 13.4 umol/L	4.02 - 11.0 umol/L	20 - 24 yrs
	4.34 - 12.2 umol/L	2.68 - 9.23 umol/L	25 - 34 yrs
	2.41 - 11.6 umol/L	1.65 - 9.15 umol/L	35 - 44 yrs
	1.2 - 8.98 umol/L	0.96 - 6.95 umol/L	45 - 54 yrs
	1.4 - 8.01 umol/L	0.51 - 5.56 umol/L	55 - 64 yrs
	0.91 - 6.76 umol/L	0.26 - 6.68 umol/L	65 - 74 yrs
	0.44 - 3.34 umol/L	0.33 - 4.18 umol/L	≥ 75 yrs
Androstenedione	**See report for reference range**		
17α OHprogesterone	2.0-10.1 nmoL/L	1.2-6.9 nmoL/L	Follicular Phase
		0.7-11.7 nmol/L	Luteal Phase
		7.9-24.1 nmol/L	1st trimester
		5.5-29.5 nmol/L	2nd trimester
		10.7-57.5 nmol/L	3rd trimester
		<5.9 nmol/L	NEWBORN EXTRACTED

Assay	Male	Female	Age / Notes
MISCELLANEOUS			
Alpha Sub-unit	On report	On report	
Copeptin	On report.	On report.	
DHT	On report	On report	
Parathyroid hormone	15 - 65 pg/mL	15 - 65 pg/mL	

Assay	Male	Female	Age / Notes
VITAMIN D			
25 OH-Vitamin D	> 50 nmoL/L	> 50 nmoL/L	Sufficient
	30-50 nmoL/L	30-50 nmoL/L	Vit D insufficiency
	< 30 nmoL/L	< 30 nmoL/L	Vit D deficiency
1,25 OH-Vitamin D	On report	On report	

Appendix 8: Cont.

IGF 1 REFERENCE RANGES

Age	Males			Females		
	2.5th centile (nmol/L)	97.5th centile (nmol/L)	n	2.5th centile (nmol/L)	97.5th centile (nmol/L)	n
3 – 6 months	1.6	12.3	41	1.8	11.3	28
6 – 12 months	1.5	12.4	44	2.0	12.1	35
1	1.5	12.6	59	2.4	13.6	37
2	1.8	13.6	38	3.4	16.8	34
3	2.5	15.2	28	4.5	20.3	48
4	3.5	17.6	29	5.7	24.2	42
5	4.8	20.4	34	6.9	28.3	50
6	6.2	24.1	51	8.3	32.8	49
7	7.5	28.3	34	9.8	37.5	37
8	8.8	33.3	58	11.4	42.4	47
9	10.1	38.8	61	13.1	47.6	39
10	11.2	44.9	51	14.7	52.1	42
11	12.3	51.4	49	16.1	55.9	50
12	13.2	56.9	47	17.3	59.1	54
13	14.1	61.2	42	18.3	61.3	38
14	15.1	64.1	35	19.1	62.9	38
15	15.7	65.6	15	19.8	63.5	21
16	16.4	65.9	13	20.2	63.5	11
17	16.9	64.8	4	20.4	62.7	14
18	17.3	62.4	1	20.4	61.0	5
19	17.6	59.0	2	20.3	58.8	3
20	17.8	55.2	4	19.9	56.2	13
21	17.9	51.6	10	19.4	53.7	7
22	17.9	48.5	10	18.7	51.4	7
23	17.8	45.6	16	18.1	49.1	15
24	17.7	43.0	19	17.6	47.0	16
25	17.3	40.6	25	17.0	44.9	15
26	17.0	38.6	15	16.5	43.1	18
27	16.8	36.9	19	16.0	41.3	13
28	16.4	35.5	16	15.5	39.7	13
29	16.1	34.5	18	15.1	38.3	14
30	15.7	33.7	18	14.7	36.8	10
31	15.5	33.1	17	14.3	35.5	12
32	15.2	32.8	16	14.0	34.5	10
33	14.9	32.4	15	13.6	33.4	7
34	14.5	32.0	21	13.4	32.5	10
35	14.3	31.7	14	13.1	31.7	11

36	14.0	31.3	16	12.9	31.2	9
37	13.8	30.9	16	12.6	30.7	14
38	13.5	30.7	19	12.4	30.3	15
39	13.2	30.3	18	12.2	29.9	6
40	12.9	30.0	39	12.0	29.7	51
41	12.6	29.6	92	11.8	29.5	74
42	12.4	29.2	93	11.5	29.3	88
43	12.1	29.0	101	11.3	29.1	79
44	11.9	28.6	99	11.1	29.0	71
45	11.6	28.3	75	10.9	28.8	72
46	11.3	28.0	100	10.7	28.7	53
47	11.1	27.6	98	10.5	28.6	70
48	10.8	27.4	79	10.3	28.6	69
49	10.6	27.1	88	10.1	28.4	94
50	10.3	26.9	97	9.9	28.2	59
51	10.0	26.6	61	9.7	28.0	47
52	9.8	26.3	78	9.5	27.8	52
53	9.5	26.2	76	9.4	27.5	48
54	9.3	25.9	54	9.2	27.1	44
55	9.0	25.7	62	9.0	26.7	68
56	8.8	25.5	44	8.8	26.3	46
57	8.6	25.4	63	8.6	25.9	55
58	8.3	25.3	70	8.5	25.4	51
59	8.2	25.2	70	8.3	24.9	36
60	8.0	25.0	61	8.1	24.4	59
61	7.9	24.9	58	8.0	23.8	60
62	7.8	24.8	85	7.8	23.4	55
63	7.7	24.6	62	7.6	23.1	57
64	7.6	24.6	64	7.5	22.7	47
65	7.5	24.5	46	7.4	22.3	40
66	7.4	24.4	57	7.3	22.0	50
67	7.4	24.4	53	7.2	21.7	41
68	7.3	24.2	58	7.1	21.5	71
69	7.2	24.2	68	7.0	21.4	45
70	7.2	24.2	68	7.0	21.2	48
71	7.1	24.1	68	7.0	21.1	59
72	7.0	24.1	64	7.0	21.0	47
73	6.9	24.1	72	7.0	21.0	44
74	6.9	24.1	40	7.0	21.0	33
75	6.8	24.1	39	7.0	21.0	24
76	6.7	24.1	32	7.0	21.1	24
77	6.6	24.1	27	7.1	21.2	20
78	6.6	24.1	19	7.1	21.4	25
79	6.5	24.1	14	7.2	21.5	10
80	N/A	N/A	0	7.2	21.7	3

Appendix 8: Cont.

Serum P3NP Reference Ranges
Adult range 2.3 – 6.4 µg/L
Age related ranges see table below

Age	female ug/L		male ug/L	
1-3 MTH	42.4	64.1	46.5	77.6
3-6MTH	24.7	37.8	24.6	43.3
6-9 MTH	16.2	23.2	14.9	21.4
9-12MTH	13.7	26.0	10.6	19.9
1-2YR	11.2	15.7	7.4	16.0
2-3YR	7.2	12.5	5.9	11.0
3-10YR	5.6	9.9	5.6	9.9
10-11YR	5.5	10.6	6.2	9.4
11-12YR	8.2	14.2	5.1	9.4
12-13YR	7.1	14.6	6.0	11.9
13-14YR	3.0	8.7	7.7	18.8
14-15YR	6.5	9.7	8.8	17.0
15-16YR	7.2	7.5	11.1	19.7
16-17YR	3.0	5.0	3.8	5.9
17-18YR	3.0	5.2	3.8	5.9

AMH *(Regional Fertility Centre only)*

Age	pmol/L	
	5th centile	95th centile
20-24	10.9	71
25-29	8.57	64.6
30-34	5.08	54.2
35-39	2.89	49.7
40-44	0.42	31.7
45-50	0.07	12.8
PCOS	17.2	122

Samples should be taken no sooner than 8 hours after a Biotin administration. For further information on effects of Biotin please refer to ***Appendix 4***

Appendix 9:

Guidelines on the interpretation of glucose results

Hyperglycaemia

For Diabetes Mellitus diagnosis see WHO guidelines 2006 (***The definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia***). Criteria summarised in Table 1 below:

Table 1: Oral Glucose Tolerance Test	Fasting plasma glucose	2-h plasma glucose*
Diabetes	**≥ 7 mmol/L**	**≥ 11.1 mmol/L**
Impaired Glucose Tolerance (IGT)		**≥ 7.8 & < 11.1 mmol/L**
Impaired Fasting Glucose (IFG)	**6.1 – 6.9 mmol/L**	
*** Venous plasma glucose 2-h after ingestion of 75 g oral glucose load (OGTT)**		

Hyperglycaemia in pregnancy

For the diagnosis of gestational diabetes mellitus in pregnancy see WHO guidelines 2013 (***Diagnostic Criteria and Classification of Hyperglycaemia First Detected in Pregnancy*).**

Gestational diabetes in pregnancy should be diagnosed at any time in pregnancy if one or more of the following criteria are met as summarised in Table 2 below:

Table 2: Gestational Glucose Tolerance Test	Fasting plasma glucose	1-h plasma glucose	2-h plasma glucose
Diabetes	**5.1 - 6.9 mmol/L**	**≥ 10 mmol/L***	**8.5 – 11 mmol/L**
*** There are no established criteria for the diagnosis of diabetes based on the 1-h post-load value**			

Hypoglycaemia

Hypoglycaemia in the non-diabetic child

Hypoglycaemia may occur in normal children following a period of starvation (e.g. gastroenteritis). However it may also be the first presentation of a more serious underlying metabolic abnormality such as hyperinsulinism. The blood concentrations of glucose vary with age as does the level at which patients become symptomatic.

Hypoglycaemia is defined as:

- ***<2.6 mmol/L in the newborn (see neonatal guidelines on management of hypoglycaemia)***
- ***<3.5 mmol/L in childhood***
- ***<4.0 mmol/L in a child taking glucose lowering medication***

NOTE: POCT (point of care testing) devices are at their least accurate in the low part of their range and it is important to confirm any suspected hypoglycaemia by an accurate laboratory based measurement of glucose. Treatment should not be delayed by waiting for the laboratory glucose.

Consideration of when to send samples for further investigation of hypoglycaemia aetiology, including those comprising 'hypopack', should not be limited to patients with glucose level below a set 'cut-off' value but also based on clinical setting (e.g. history of recurrent hypoglycaemia etc). If possible, appropriate samples should be collected before giving glucose to allow identification of the underlying cause. However**, DO NOT DELAY CORRECTING HYPOGLYCAEMIA IF THE BLOOD IS DIFFICULT TO OBTAIN**.

Appendix 10:

Quantitative Immunochemical Testing (QFIT)



The QFIT Regional Programme is a replacement for Faecal Occult Blood. The QFIT is a more sensitive and specific marker for detecting intact haemoglobin and early degradation products in faecal samples. In July 2017 NICE released guidance DG30 recommending the use of Quantitative FIT for patients with suspected colorectal cancer (symptomatic).

QFIT analysis is performed by Northern Trust at the Regional Bowel Screening Laboratory located at the Causeway Hospital.

QFIT kits for Secondary care can be ordered at bowel.screening@northerntrust.hscni.net

Primary Care have their own pathway for kits and are not supplied by the laboratory.

Appendix 11:

Information regarding 'Adding–on' Requests to Received Samples

It may be possible to retrospectively request additional testing on a sample already in the possession of the laboratory. This 'Add-on' facility is limited to clinicians to minimise repeated phlebotomy when this would facilitate clinical management. It is important to consider if the add on test(s) accurately reflect the patient's current status. It is not recommended where a patient's condition or treatment is rapidly changing.

DO NOT use the Add-On facility for an URGENT request where another sample can be obtained (see point 1 below for exceptions process). You must send a fresh sample.

Requests to add-on additional tests to samples already receipted in the Laboratory will be considered if the remaining sample is suitable for the Add-On test requested and original sample has been received and separated in a timely manner. Unsuitable samples include:

- **Wrong sample bottle (see Lab user manual for guidance)**
- **Insufficient sample remaining**
- **Haemolysed samples**
- **Samples referred to another laboratory**
- **Sample exceeds stability window for add-on requested (See Table 1).**

Due to the limited stability of some analytes and how samples are handled in the laboratory post-analysis, a number of tests cannot be accepted as an 'add-on' due to inadequate stability of the analyte *in vitro* and the risk of reporting erroneous results. Samples are often stored or processed for extended periods of time without lids, so evaporation may invalidate any results of additional tests, particularly for small volume (paediatric) samples. For such reasons Bicarbonate should not be added onto samples that have already been processed. Studies have shown a bicarbonate decrease of 4mmol/L per hour in uncapped samples.

Table 1 below provides information on what tests are suitable for add-on testing and any time constraints. Note - The maximum retention of the majority of routine biochemistry samples are only held for ~3 days post-analysis before discarded.

Categorising add-on test requests

1. ***Urgent add-on test request.***
   If the clinician feels that there is a **life threatening or critical situation** and a repeat sample cannot be obtained, then they must contact the duty biochemist to justify processing the sample. Note – this process may still take longer than collecting a new sample and requesting it for urgent throughput, so should only be used when sampling is difficult.
2. ***Time-point critical add-on test request.***
   There are a number of tests that can be accepted as add-on tests due to the time-points involved and where a repeat sample could provide a different interpretation. These can be accepted providing the storage and stability conditions are met.

These tests include:

- Troponin-HS
- Pre-dose TDM (e.g. LI, PYT, DIG, CARB, THEO, VAL, PHENO, VANC, TEICO) [**NOTE: GENT add-ons are prohibited due to carry-over risks**]
- Paediatric add-on requests can be considered (Note – TBIL & DBIL can only be accepted if within 4 hr of sample collection)
- Requests linked to overdose

3. *Add-on from GPs (Primary Care) & outlying clinics (OP)*
   GP add-on requests can be accepted by telephone call and will be processed providing all the sample stability requirements are met.

Requesting an add-on test

A request form must be received in the laboratory for all add-on tests requested from the local hospital site. Add-on requests can be requested on the Clinical Biochemistry request form or using the OrderComms system (Amended request and new form produced) with the following details clearly provided:

- **Patient details (Name, H&C / Hospital number, DOB)**
- **Patient location**
- **Sample number of the specimen to which tests should be added. Add-on test requested**
- **Name & signature of consultant or doctor who has agreed to the additional test**

Add-on requests meeting the criteria outlined in the categories above will be processed, if a request form has been received. Though, if the sample has not been receipted by the lab and there is no accession number available on the system, please wait until it is available before sending the request form as this ensures that requests are not lost and the process is fully auditable. Add-on testing remains at the discretion of the laboratory because of the additional risks and work it involves and we would appeal to you not to abuse this aspect of the service particularly. If at all possible requesting clinicians are asked to consider whether each additional request test could be ordered when the patient is next bled. Add-on tests can only be accepted if the current laboratory regime allows for the test to be completed within 24 hours. Please note that add-on requests for multiple tests will be processed using the criteria noted above.

For those requesting an add-on but unable to send a request form in a timely manner (i.e. GP, MPH, LVH & DH, off-site & private clinics) please contact the Clinical Biochemistry lab with all the required information – patient name, HCN, date/time of sample, sample ID number. Note that samples will be discarded ~3 days after analysis so do not contact for samples older than this. These will not be available.

Add on requests for precious samples (e.g. CSF, fluids) must be forwarded to a Clinical Scientist or Chemical Pathologist for discussion to determine if the add on request is appropriate and feasible.

Table 1: Tests that can be considered for add-on requests and the acceptable time window based on stability data and clinical significance. Note – samples must have been appropriately separated and stored at 4°C.

Unstable Analytes. Add-On testing NOT appropriate	**Up to 24hr from venepuncture the following tests can be added:**	**Up to 48hr from venepuncture the following tests can be added:**	**Up to 72hr from venepuncture the following tests can be added:**
Bicarbonate	Osmolality (plasma)	Vancomycin*	CRP, CK, Amylase
Gentamicin		Hydroxybutyrate	Albumin, TP
Lactate			ALT, AST, ALP, GGT
Bilirubin (Total or Direct)[1]			Phosphate, Magnesium
Glucose			
Folate (& B12)			Cholesterol, Trig, HDL
Alcohol (Ethanol)			Cortisol
HbA1c			Troponin-T, NT-proBNP
hCG (carry-over risk)			TMs – AFP, CEA, CA125, C19-9, PSA
LDH, Iron			TDM* – Carbamazepine, Phenytoin, Digoxin, Valproate, Theophylline, Phenobarbitone, Lithium[2]
PTH			Paracetamol/Salicylate*
CSF TP, GLU, LACT			Urate
			Transferrin, Ferritin
*** Please be aware of time of sample vs. time of dose for assessment if add-on is appropriate.** **[1] NOTE – TBIL and DBIL acceptable for add-on for neonates up to 4hr from sample collection** **[2] NOTE – Ensure that sample is a NOT a green-top Li-Hep for Lithium add-on** **[3] NOTE - Potassium can only be added on where there has been no more than 6hr between sample collection and separation & must be gel sample**			<u>Protein tests:</u> AAT, B2M, C3/C4, RF, Caeruloplasmin, Haptoglobin, Immunoglobulins, SPE Oligoclonal Bands
			<u>Profiles:</u> LIPID, ELEC[3] BONE TFT

The table is neither exclusive nor inclusive, as other factors may affect the acceptance of an add-on request. All requests may be referred or discussed with the appropriate Clinical staff within Biochemistry.

Appendix 12:

Critical Results Management

Please be aware that communication of critical results is only possible when accurate information is provided on the request for ward/clinic/patient location AND Consultant/GP name

Test	Alert Threshold		Additional Notes / potential clinical significance	RCPath Advisory
	Lower	Upper		
Alcohol (Ethanol) Adult **≤ 16 yrs**		≥4000 Any detectable		> 4000 Any detectable level in children
Ammonia		≥100	Cerebral oedema / coma	
Amylase		≥500	Acute pancreatitis	5xULN
AST		≥500	Acute liver failure	15xULN
ALT		≥500	Acute liver failure	15xULN
Bicarbonate	≤10		Patient likely to be seriously ill.	
Bilirubin Total **Conjugated**		≥300 ≥25	Acute Liver failure / brain damage in infants. Conjugated bilirubin only to be phoned in neonates	
Calcium (adjusted)	≤1.8	≥3.5	Low: cardiac arrhythmia, airway spasm; High: Cardiac arrest / coma	<1.8 / >3.5
Carbamazepine		≥25	Confusion / cardiac arrhythmia, hyponatraemia.	>25
Carboxyhaemoglobin (Co-oximetry)		>20%	Carbon monoxide poisoning	
CK		≥5000	Rhabdomyolysis, kidney failure	>5000
Cortisol Random **SST (30 min)**	≤65 ≤250		Adrenal insufficiency (Unless part of overnight DST)	<50
Creatinine: Adult **< 16 yrs** **New AKI-1 alert** **AKI-2 & AKI-3 alert**		≥350 ≥200	Acute kidney failure. <u>AKI-1</u> **Only if K > 6.0 mmol/L and for Primary Care & Out-patients**: If out of hours (OOH) then communication next morning to GP/Secretary (**TELAM queue** referral for BMS follow-up next day). <u>AKI-2 & AKI-3</u> **All new occurrences to Primary Care and Out-patients** (if OOH then contact OC Chemical Pathologist).	
CRP (GP & OP only)		≥300	Severe systemic inflammation, septic shock.	>300 (Primary Care)
Digoxin		≥2.5	Cardiac arrhythmia; K<3.3 exacerbates	>2.5
Cyclosporin		≥250 µg/L		
Everolimus		≥20µg/L		
Glucose: Adult **≤ 16 yr**	≤2.5 ≤2.5	≥25 ≥15	Low: coma neurological damage High: dehydration / ketoacidosis **NOTE**: No need to communicate if part of ITT	<2.5 / >25 > 15 in children

Test	Alert Threshold		Additional Notes / potential clinical significance	RCPath Advisory
	Lower	Upper		
Homocysteine		≥100	Except for known patients with Homocysteinuria	
Iron (<16 yrs only)		≥55	Only phone if 16 or under	
Lactate		>4.0	Lactic acidosis, hypoxia, metabolic disease	
Lipase		≥300	Acute pancreatitis	>300
Lithium **Phone source for Secondary Care**		≥1.5	Seizures / kidney failure. **NOTE:** Phone source for Secondary Care (Wards) For samples from Psychiatry Source: ➢ 9am -5pm phone to source / clinical team ➢ Out of hours and weekends – phone Psychiatry Registrar on call via switchboard	>1.5
Magnesium	≤0.4	≥3.0	Cardiac arrhythmia / sudden death.	<0.4
Methotrexate		>than previous	Phone if result greater than previous day. For GP – phone if METX is detected in the sample.	
Paracetamol	Any detectable (≤ 16 yrs only) ≥10 (Over 16 yrs)		Refer to nomogram. Toxicity, liver failure.	All detectable levels
Phenytoin		≥25	Drowsiness, dizziness, confusion.	>25
Phenobarbitone		≥70	Coma, respiratory depression.	> 70
Phosphate	≤0.3		Cardiorespiratory depression, rhabdomyolysis.	<0.3
Potassium	≤2.5	≥6.5	Low: paralysis, rhabdomyolysis High: cardiac arrest	<2.5 / >6.5
Salicylate		≥300	Serious toxicity >350	
Sirolimus		≥20µg/L		
Sodium: **Adult (>16 yrs)** **Children (≤16 yrs)**	 ≤125 ≤130	 ≥160 ≥160	Low: cerebral oedema High: coma, cerebral haemorrhage. Consider phoning changes ≥ 10 mmol/L within 24 hr	<120 >150
Tacrolimus		>20	Also phone if significant change in the result.	
Toxicology	Positive Screens		Informs patient management / investigation	
Theophylline		≥25	Arrhythmias, seizures	>25mg/L
Thyroid Function Test scenario 1 **fT4**		≥50	• Phone when ***first time*** fT4 ≥50 ***and*** TSH ≤1, also when ***first time*** fT4 ≤7 ***and*** TSH ≥40 • If from a ward, please phone regardless of time • GP or outpatient TFT results Mon-Fri 8am-6pm should be communicated with requestor. • If results becomes available out of hours for outpatient/GP, please validate and refer to phone queue to be phoned the next morning unless it's a weekend or bank holiday when you should refer to Chemical Pathologist on call.	**Thyroid Function Test scenario 1** **Thyroid Function Test scenario 2**
TSH		≤1		
Thyroid Function Test scenario 2 **fT4**		≤7		
TSH		≥40		
Troponin		≥52	Acute Coronary Syndrome (ESC Guidelines 2015)	
Urate (Antenatal)		≥340µmol/L	Only phone for antenatal patients – PE risk.	340 µmol/L
Urea: Adult (>16 yrs) **Children (≤16 yrs)**		≥30.0 ≥10	Acute kidney failure	>10mmol/L if <16yr

Critical results require urgent medical attention to avoid potential patient harm and are defined according to: the given alert thresholds for designated tests; any result of a critical test; or any marked, rapid or unexpected change in serial results which could signify a potentially critical clinical problem. Any such results should be communicated without delay and this should be recorded. It is acceptable to take account of previous results or an obvious clinical explanation which may make communication unnecessary or counterproductive. However, if there is any doubt then telephone. If there is difficulty getting through this should be recorded and repeated attempts made at intervals and / or advice sought from the on-call Chemical Pathologist. The record should remain on the telephone list until the matter is satisfactorily resolved. Results or messages should never be left on an answer machine.

Appendix 13:

Hypopack Request Form

ATTACH LABEL OR USE BALL POINT PEN

First name_____ **Ward**_____ **Hospital**_____

Surname_____ **Consultant**_____

Date of birth DD/MM/YYYY **Consultant HCP code**_____

H&C* _____

*(*or hospital no. if not available)*

STICK CAT 3 HAZARD STICKER HERE

****VERY IMPORTANT ****

Date samples collected:_____ **Time samples collected:**_____

*****Refer to local ED guideline for investigation/management of hypoglycaemia*****

CLINICAL INFO	**Point of care glucose:**	
	Point of care ketones:	
	Point of care lactate (if available)**:**	
	Samples taken before dextrose:	**YES / NO**
	Vomiting and/or diarrhoea?	**YES / NO**
	Prolonged fast?	**YES / NO**

RED FLAGS **YES / NO**

- ☐ No precipitant history
- ☐ <1 year or >5 years old
- ☐ Hyperpigmentation
- ☐ Hepatomegaly
- ☐ Other - provide details:
- ☐ Presentation disproportionately severe
- ☐ Recurrent/unexplained episodes
- ☐ Abnormal growth/development
- ☐ Concerning family history

FOR LOCAL LABORATORY USE

Date/time separated in local lab: (Insulin must be separated & frozen within 4 hours)	
Laboratory results:	**Lab Glucose =**
(if analysed)	**Lab Lactate =**
(if analysed)	**Lab 3OH Butyrate =**

FOR RVH LABORATORY USE

Date/time received RVH:	**Date:**		**Time:**	
Received separated/frozen? (please tick)	**Separated**		**Frozen**	

PLEASE SEND COMPLETED FORM AND ALL HYPOPACK BLOOD SAMPLES IN THE SAME BAG IMMEDIATELY TO:

Clinical Biochemistry, Kelvin Building, Royal Hospitals, Belfast.

To order Hypopacks telephone 028 961 51480 (Metabolic Laboratory)
For clinical advice telephone 028 961 51462 (Metabolic Clinical Scientist),
028 961 51487 (Endocrine Clinical Scientist).

Appendix 13: Cont.

HYPOPACK PROTOCOL

Refer to local ED guideline for investigation and management of non-diabetic hypoglycaemia. Samples should be taken prior to treatment, especially dextrose infusion.

DO NOT DELAY CORRECTING HYPOGLYCAEMIA IF THE BLOOD IS DIFFICULT TO OBTAIN

Please note:

1. All specimens and the Hypopack form must be clearly labelled. Please **complete in full the time and date of the specimens**.
2. Samples containing less than the volumes indicated may be insufficient for complete analysis.
3. **Please check expiry dates on specimen bottles**
4. Useful information and interpretation guide can be found on the MetBioNet website:https://metbio.net/best-practice-guidelines/#9-investigation-of-hypoglycaemia-in-infants-and-children

BLOOD The following samples **MUST BE** obtained immediately:-

	Minimum Volume	Test	Tube
Bottle A Grey Top	1.0 mL	Glucose 3OH Butyrate Lactate	
Bottle B Green Top	3.0 mL	Insulin Cortisol Growth Hormone Amino Acids	
Blood Spot Card	2-3 filled spots **Allow to air dry** Avoid layering	Acylcarnitine Profile	

URINE A urine sample **MUST BE** obtained as soon as possible after a hypoglycaemic episode. Catheterisation may be required.

	Minimum Volume	Test	Tube
Bottle C (Plain universal)	2.0 mL	Urine Organic Acids	

Appendix 14:

Clinical follow-up guidelines for Serum Protein Electrophoresis and Immunoglobulin analysis

Monoclonal proteins (previously known as paraproteins)

Disorders characterised by the production of a monoclonal protein include multiple myeloma (MM) and Waldenström's macroglobulinaemia. Monoclonal proteins may also occur in CLL, NHL or AL amyloidosis. Monoclonal protein may also be detected in patients with chronic infection, inflammation, and post bone marrow transplant. In the absence of these conditions, Monoclonal Gammopathy of Undetermined Significance (MGUS) is most likely.

MGUS is a diagnosis of exclusion: 3% of over-70s have monoclonal proteins which are frequently found incidentally and not associated with symptoms or physical findings. The overall risk of MGUS progression to myeloma is around 1% per year – this remains constant over time.

When a monoclonal protein band is detected for the first time, the laboratory will also measure and report serum free light chains.

Referrals to haematology should not be made for patients with raised immunoglobulin levels in the absence of a monoclonal paraprotein band on serum electrophoresis. Polyclonal gammopathy is reactive and is not caused by primary haematological malignancies.

The following should be referred urgently for outpatient assessment:

- Any new paraprotein **(including BJP)** with accompanying features suggestive of multiple myeloma or other haematological malignancy these include:
    - Hypercalcaemia
    - Unexplained renal impairment
    - Non-specific proteinuria
    - Bone pain or pathological fracture
    - Radiological lytic lesions indicative of myeloma
    - Anaemia or other cytopenia
    - Hyperviscosity symptoms -headache, visual loss, acute thrombosis
    - Lymphadenopathy or splenomegaly lymphocytosis

Patients with suspected spinal cord compression should be discussed with duty haematologist to arrange urgent direct assessment

Referral for specialist opinion should be considered for:

- Other newly-identified paraproteins not meeting the above criteria for urgent referral

Abnormal Serum Immunoglobulin Results (IgA, IgG, IgM)

In some cases an elevated serum Immunoglobulin concentration can be a sign of underlying lymphoproliferative disease. If abnormal Immunoglobulin results are obtained or MM/B cell lymphoproliferative disorder is suspected, a serum sample should be sent for protein electrophoresis (SPE).

Bence Jones Protein (BJP)

Samples for BJP should not be sent in isolation. Accurate diagnosis of BJP requires an early morning sample of urine for BJP and a serum sample for SPE analysis.

Appendix 15:

Investigation of Recurrent Renal Calculi

- Send plasma sample bone profile, electrolyte profile, urate (gel tube).
- Send one MSSU sample to Microbiology Laboratory. The forms should be labelled for **Renal Stone Analysis**
- Send a fresh urine sample (Random) with no preservatives to Biochemistry Laboratory to check for pH and cystine. The form should be labelled **Renal Stone Profile 1.**
- At the end of the consultation each patient should receive two 24h urine bottles with thymol preservative. The patient should be advised that the urine collection bottles contain thymol and should be handled with care. The thymol bottles will be provided by your local Biochemistry Laboratory. The forms as well as collection bottles should be labelled for **Renal Stone Profile 2**. When requesting Renal Stone Profile 2 the following tests will be completed alongside calculated output over 24 hours: Protein, Sodium, Creatinine, Urea, Calcium, Phosphate, Oxalate, Citrate and Urate. No individual tests can be requested without full profile being analysed.
- Two urine samples should be collected on at least two separate occasion of at least one week interval and sent to biochemistry laboratory. Urine can be stored at room temperature (preferable) or refrigerated at 4$_{o}$C. Please state storage conditions on request form.
- 24hr urine samples must have a sample date on the form (the date collection was started).
- **When 24 hour urine samples for renal stone profiles are taken less than one week apart, the second sample will be rejected.**

Also update to by-line on page 94:

RENAL STONE PROFILE (Protein, Sodium, Creatinine, Urea, Calcium, Phosphate, Oxalate, Citrate and Urate)

Cystine and pH

Appendix 16:

Occupational Exposure Lead Monitoring

Occupational exposure monitoring Category	Blood Lead (µg/dL)	µmol/L	Maximum interval between blood lead measurements
A	under 30	under 1.44	12 months
B	> 30 < 40	>1.44 <1.92	6 months
C	> 40 < 50	>1.92 <2.40	3 months
D	> 50 < 60	>2.40 <2.88	3 months
E	60 and over	2.88 and over	at the doctor's discretion but not more than 3 months

Women of reproductive capacity and young persons whose exposure to lead is significant should have their blood lead concentrations measured at intervals of at least every three months.

Appendix 17:

Newborn Blood Spot Screening Programme

TEST	SAMPLE REQUIREMENTS	COMMENT	REFERENCE RANGE	EXPECTED TAT
Newborn blood spot screening programme. (Neonatal screening/ Guthrie card) Conditions screened for: **PKU** **MCADD** **HCU** **MSUD** **IVA** **GA1** CHT CF Sickle cell disorders Conditions in **bold** are IMD.	**ROUTINE SAMPLING** Heel prick blood* collected directly onto a bloodspot card. 4 circles filled and evenly saturated with a single drop of blood. Blood must completely soak through the filter paper. Clean the heel by washing thoroughly with plain water using cotton wool/gauze. The water should not be heated and the baby's foot should not be immersed. Warming of the foot is not required. If faecal matter cannot be removed from the foot with water, use a mild, unperfumed soap to clean away the faecal matter and then rinse the foot thoroughly. **Do not** use alcohol or alcohol wipes. The heel should be completely dry before taking the sample. Soft paraffin solutions such as Vaseline® should not be used for heel punctures. Obtain the sample using an age-appropriate automated incision device (different lancets are available for different ages).There is evidence that an arch-shaped incision device is more effective in providing a good quality sample. Manual lancets **must not** be used. A single hanging drop of blood of adequate size to fill the	Blood should be applied to the front of the card only and the blood should penetrate through to the back of the paper. Small samples (<8mm diameter), multi-layering, multi-spotting or compression of the specimens can adversely affect the concentration of the analytes leading to inaccurate results– **this means that babies with a condition might be missed or babies without a condition might be referred for further tests unnecessarily.** Blood spots must be allowed to air-dry away from direct sunlight or heat before being placed in the glassine envelope. Samples must NOT be placed in plastic bags. Faecal, urine, or feed contamination of blood samples may cause inaccurate screening results. The card must be within the expiration date. **TRANSFUSIONS** Where the first full blood spot card has not already been taken, when carrying out the first blood transfusion, **including red blood cell, exchange, platelet and fresh frozen plasma transfusions**, take a **pre-transfusion Sickle Cell Disorder (SCD) sample (2 blood spots) BEFORE** commencing blood transfusion. An interval of **at least three clear days** is required between transfusion (**including red blood cell, exchange, platelet and fresh frozen plasma transfusions**) and taking a **full blood spot card**. In the event of multiple blood transfusions, the full blood spot card MUST be taken on Day 8 of life (DOB = Day 0), even where the time-interval	**SCREEN NEGATIVE RESULTS** Screening results are not 100% conclusive. Instead they provide presumptive results. A screen-negative result suggests that the child does not have the condition for which they are being screened. **SCREEN POSITIVE RESULTS** Screening results are not 100% conclusive. Instead they provide presumptive results. A screen-positive result is a result which shows that the child is likely to have the condition for which they are screened. Positive screening results are then confirmed using diagnostic tests.	A health professional will usually inform parents of the screening results and record them in the personal child health record ('Red Book') before the baby is eight weeks old. Ensure that parents know to contact their health visitor if results are not received within eight weeks.

printed circle (10mm) should be applied to the filter paper as over or under filling the pre-printed circle affects the volume of blood in the sub-punch that is used for analysis.

Accurate and complete demographic information (including infant health and care number) must be provided in the appropriate fields on the sample card.

The routine blood spot sample should be taken on day 5 of life (day of birth = day 0).

Requested repeat samples should be taken as soon as possible (unless otherwise specified by newborn screening laboratory).

BABIES IN HOSPITAL
Babies admitted to neonatal units are likely to have multiple blood samples taken. Blood spot screening should be coordinated with other tests when possible. Venepuncture or venous / arterial sampling from an existing line can be used to collect the blood spot sample onto the card*. This is providing the sample is not contaminated with citrate/EDTA/heparin and the line is cleared of infusate. Do not use heparinised capillary tubes.

OLDER BABIES
Babies under a year of age who become the responsibility of the provider organisation should be offered screening by a healthcare professional if there are no documented UK newborn screening laboratory results (or declines) for PKU, MCADD, HCU, MSUD, IVA, GA1, CHT, CF, Sickle Cell Disorders (or all conditions from completion of the latest blood transfusion is less than 3 clear days.

Always record the **date and time of completion** of the latest blood transfusion on blood spot cards submitted.

DECLINES
Parents can decline screening for SCD, CF and CHT individually but the six IMDs can only be declined as a group.

If screening is declined for all conditions, complete the blood spot card (adding the reason for the decline if stated) and send marked **'Decline – all**

conditions' to the laboratory without the blood spot sample.

If screening is declined for only one or some of the conditions, arrange for the blood spot sample to be taken. The blood spot card should be completed and marked **'Decline – XX'** (where XX is the condition(s) declined – add the reason for the decline if stated).

FOR MORE DETAILED GUIDANCE ON NEWBORN BLOOD SPOT SAMPLING SEE FOLLOWING DOCUMENT:



NBSP Guidelines for NBS Sampling (Adap

	except CF if the baby is over 56 days of age). *For older babies either a capillary or venous sample can be spotted onto the blood spot card. If an automated incision device is used, ensure it is age-appropriate. * Blood containing citrate/EDTA cannot be used due to chelation of the europium label used in the TSH & IRT assays. Lithium heparin can inhibit the DNA assays.			

Appendix 18:

Regional Clinical Biochemistry Paediatric Reference Intervals [PLASMA]

Test Description	Test Units	Gender	Agreed regional age-Interval (where applicable)	Lower	Upper	Source / Reference
Potassium	mmol/L	M/F	0 to <1wk	3.5	6.2	AACB publication Adult Interval: *J Lab Med* 2010; 34(1):39-44
		M/F	1wk to <26wks	3.8	6.4	
		M/F	26wks to <2yrs	3.5	5.4	
		M/F	2yrs to <18yrs	3.3	4.9	
		M/F	18yrs and over	3.5	4.6	
Urea	mmol/L	M/F	0 to <15 days	1.1	7.9	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult Interval – Pathology Harmony
		M/F	15 days to <1yr	1.3	5.8	
		M/F	1yr to < 10yrs	3.2	7.6	
		F	10yrs to <19yrs	2.6	6.5	
		M	10yrs to <19yrs	2.6	7.2	
		M/F	19yrs and over	2.5	7.8	
Creatinine	µmol/L	M/F	0 to <15 days	35	86	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Roche Kit Insert 2023-08 v14
		M/F	15 days to <2yrs	15	38	
		M/F	2yrs to <5yrs	24	43	
		M/F	5yrs to <12yrs	33	59	
		M/F	12yrs to <15yrs	45	77	
		M/F	15yrs to <19yrs	48	79	
		F	19yrs and over	45	84	
		M	19yrs and over	59	104	
Bicarbonate	mmol/L	M/F	0 to <15 days	10	20	Paed (up to & inc. 18 yr) - Caliper (Abbott Architect) NOTE: Low limit of 10 mmol/L agreed by regional NICU team (differs from Caliper). Adult – Pathology Harmony
		M/F	15 days to <1yr	10	24	
		M/F	1yr to <5yrs	14	24	
		M/F	5yrs to <15yrs	17	26	
		F	15yrs to <19yrs	17	26	
		M	15yrs to <19yrs	18	28	
		M/F	19yrs and above	22	29	

Test Description	Test Units	Gender	Agreed regional age-Interval (where applicable)	Lower	Upper	Source / Reference
Alkaline phosphatase (ALP)	U/L	M/F	0 to <15 days	83	248	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Pathology Harmony
		M/F	15 days to <1yr	122	469	
		M/F	1yr to <10yrs	142	335	
		M/F	10yrs to <13yrs	129	417	
		F	13yrs to <15yrs	57	254	
		M	13yrs to <15yrs	116	468	
		F	15yrs to <17yrs	50	117	
		M	15yrs to <17yrs	82	331	
		F	17yrs to <19yrs	45	87	
		M	17yrs to <19yrs	55	149	
		M/F	19yrs and above	30	130	
Albumin	g/L	M/F	0 to <15 days	33	45	Paed (up to & inc. 18 yr) - Caliper (Roche Modular) [BCG method]. Adult – Pathology Harmony
		M/F	15 days to <1yr	31	50	
		M/F	1yr to <8yrs	40	49	
		M/F	8yrs to <15yrs	42	51	
		F	15yrs to <19yrs	40	53	
		M	15yrs to <19yrs	43	53	
		M/F	19yrs and over	35	50	
Total Bilirubin	µmol/L	M F	0 to <15 days	0	250	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Pathology Harmony
		M/F	15 days to <1yr	0	10	
		M/F	1yr to <9yrs	0	5	
		M/F	9yrs to <12yrs	0	8	
		M/F	12yrs to <15yrs	0	10	
		M/F	15yrs to <19yrs	0	12	
		M/F	19yrs and above	0	21	
Direct Bilirubin	µmol/L	M/F	0 to <15 days	4.3	9.4	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult Interval – Roche Kit Insert
		M/F	15 days to <1yr	0	3.9	
		M/F	1yr to <9yrs	0	2.4	
		M/F	9yrs to <13yrs	0	3.7	
		F	13yrs to <19yrs	0	5.1	
		M	13yrs to <19yrs	1.2	5.4	
		M/F	19yrs and over	0	3.4	
ALT	U/L	M/F	0 to <1yr	0	25	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Roche Kit Insert
		M/F	1yr to <13yrs	0	19	
		F	13yrs to <19yrs	0	17	
		M	13yrs to <19yrs	0	18	
		F	19yrs and over	0	33	
		M	19yrs and over	0	41	
AST	U/L	M/F	0 to <15 days	0	155	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Roche Kit Insert
		M/F	15 days to <1yr	0	63	
		M/F	1yr to <7yrs	0	41	
		M/F	7yrs to <12yrs	0	33	

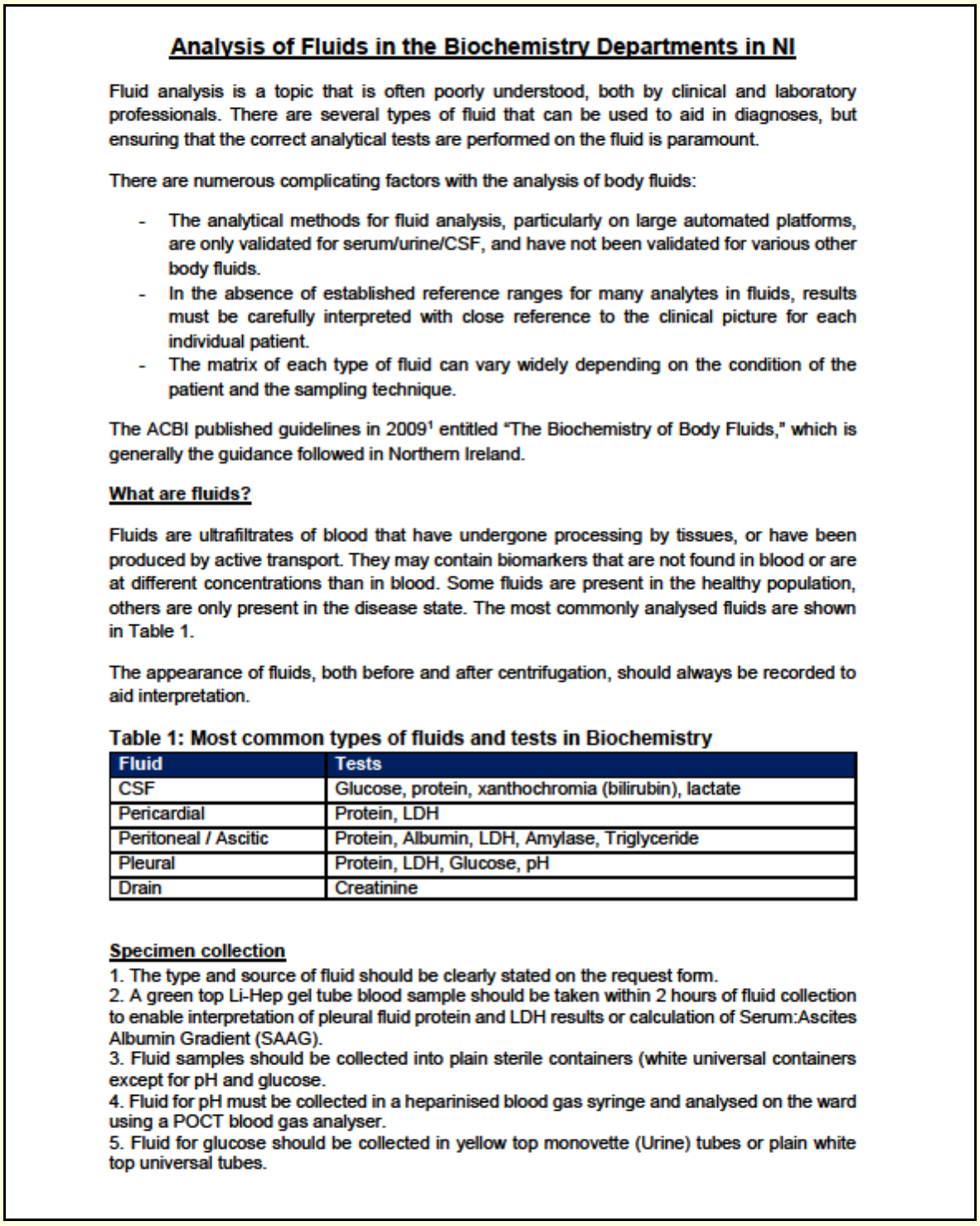
Test Description	Test Units	Gender	Agreed regional age-Interval (where applicable)	Lower	Upper	Source / Reference
		F	12yrs to <19yrs	0	23	
		M	12yrs to <19yrs	0	32	
		F	19yrs and over	0	32	
		M	19yrs and over	0	40	
GGT	U/L	M/F	0 to <15 days	17	175	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Roche Kit Insert
		M/F	15 days to <1yr	5	101	
		M/F	1yr to <11yrs	4	12	
		M/F	11yrs to <19yrs	4	16	
		F	19yrs and over	6	42	
		M	19yrs and over	10	71	
Calcium (inc. adjusted Ca)	mmol/L	M/F	0 to <1yr	2.16	2.74	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult - Pathology Harmony
		M/F	1 to <19yrs	2.31	2.64	
		M/F	19yrs and over	2.2	2.6	
Phosphate	mmol/L	M/F	0 to <15 days	1.71	3.15	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult - Pathology Harmony
		M/F	15 days to <1yr	1.47	2.54	
		M/F	1yr to <5yrs	1.33	2.06	
		M/F	5yrs to <13yrs	1.28	1.82	
		F	13yrs to <16yrs	1.00	1.70	
		M	13yrs to <16yrs	1.11	1.88	
		M/F	16yrs to <19yrs	0.94	1.55	
		M/F	19yrs and over	0.8	1.50	
Total Protein	g/L	M/F	0 to <15 days	51	80	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult - Pathology Harmony
		M/F	15 days to <1yr	43	69	
		M F	1yr to <6yrs	59	73	
		M/F	6yrs to <9yrs	62	75	
		M/F	9yrs to <19yrs	63	78	
		M/F	19yrs and over	60	80	
Magnesium	mmol/L	M/F	0 to <15 days	0.82	1.62	Paed (up to & inc. 18 yr) - Caliper (Abbott) Adult Interval – Pathology Harmony
		M/F	15 days to <1yr	0.81	1.27	
		M/F	1 to <19yrs	0.86	1.17	
		M/F	19yrs and over	0.7	1.0	
Total Cholesterol	mmol/L	F	0 to <15 days	1.3	3.2	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Regionally agreed
		M	0 to <15 days	1.2	2.8	
		M/F	15 days to <1yr	1.7	6.1	
		M/F	1yr to <19yrs	2.9	5.4	
		M/F	19yrs and over	2.8	5.0	
Triglycerides	mmol/L	M/F	0 to <15 days	1.02	3.25	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Regionally agreed (Biochemistry Forum)
		M/F	15 days to <1yr	0.65	3.24	
		M/F	1yrs to <19yrs	0.54	2.47	
		M/F	19yrs and over	0.40	1.70	

Test Description	Test Units	Gender	Agreed regional age-Interval (where applicable)	Lower	Upper	Source / Reference
HDL Cholesterol	mmol/L	M/F	0 to <15 days	0.18	1.01	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Regionally agreed
		M/F	15 days to <1yr	0.0	1.95	
		M/F	1yr to <4yrs	0.72	1.68	
		M/F	4yrs to <13yrs	0.81	1.99	
		F	13yrs to <19yrs	0.70	1.96	
		M	13yrs to <19yrs	0.69	1.85	
		M/F	19yrs and over	1.00	2.50	
Iron	µmol/L	M/F	0 to <14yrs	5	25	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Regionally agreed – Iron overload audit
		F	14yrs to <19yrs	6	30	
		M	14yrs to <19yrs	8	31	
		M/F	19yrs and over	10	30	
Ferritin	µg/L	M/F	0 to <1mth	150	973	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult Intervals – Roche Method insert BSG Guidelines for the management of iron deficiency anaemia (*Gut*; 2021: 2030-2051)
		M/F	1mth to <6mths	8.5	580	
		M/F	6mths to <15yrs	14	101	
		F	15yrs to <19yrs	3.9	114	
		M	15yrs to <19yrs	21	173	
		F	19yrs to <60yrs	15	150	
		M	19yrs to <60yrs	30	400	
		F	60 years and over	15	330	
		M	60 years and over	30	400	
Transferrin	g/L	M/F	0 to <9wks	1.11	2.43	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Roche kit insert
		M/F	9wks to <1yr	1.15	3.52	
		M/F	1yr to <19yrs	2.38	3.66	
		M/F	19yrs and over	2.00	3.60	
Transferrin Saturation	%	M/F	0 to <1yr	4.1	59	Paed (up to & inc. 18 yr) - Caliper (Abbott Architect). BJH Good Practice Papers – Fletcher A, *et al*. 2022; 196: 523-529 BJH - Fitzsimons E *et al*. 2018; 181: 293-303
		M/F	1yr to <14yrs	6.5	39	
		F	14yrs to <16 yrs	5.2	44	
		M	14yrs to <16yrs	9.6	58	
		F	16 years and over	16	40	
		M	16 yrs and over	16	50	

Test Description	Test Units	Gender	Agreed regional age-Interval (where applicable)	Lower	Upper	Source / Reference
NTproBNP	ng/L	M/F	<1yr			Note – no ref Interval available / quoted for < 1 yr old Roche Kit Insert 2023-12 v4
		M/F	1yr to 3yrs		<320	
		M/F	4yrs to 6yrs		<190	
		M/F	7yrs to 9yrs		<145	
		M/F	10yrs		<112	
		M/F	11yrs		<317	
		M/F	12yrs		<186	
		M/F	13yrs		<370	
		M/F	14yrs		<363	
		M/F	15yrs		<217	
		M/F	16yrs		<206	
		M/F	17yrs		<135	
		M/F	18yr		<115	
		M/F	19yr to 34yrs		<115	
		F	35yrs to 44yrs		<237	
		M	35yrs to 44yrs		<115	
		F	45yrs to 54yrs		<284	
		M	45yrs to 54yrs		<173	
		F	55yrs to 64yrs		<352	
		M	55yrs to 64yrs		<386	
		F	65yrs to 74yrs		<623	
		M	65yrs to 74yrs		<879	
		F	75yrs and over		<1800	
		M	75yrs and over		<1800	
Lactate Dehydrogenase (LDH) IFCC	U/L	M/F	0 to <15 days	0	1128	Paed (up to & inc. 18 yr) - Caliper (Roche Cobas) Adult – Roche kit insert
		M/F	15 days to < 1yr	0	424	
		M/F	1yr to <10 yr	0	305	
		F	10 yr to <15 yr	0	260	
		M	10 yr to <15 yr	0	270	
		M/F	15 yr to <19yr	0	240	
		F	19 yr and over	135	214	
		M	19 yr and over	135	225	

Appendix 19:

Analysis of Fluids in the Biochemistry Departments in NI



Analysis of Fluids in the Biochemistry Departments in NI

Fluid analysis is a topic that is often poorly understood, both by clinical and laboratory professionals. There are several types of fluid that can be used to aid in diagnoses, but ensuring that the correct analytical tests are performed on the fluid is paramount.

There are numerous complicating factors with the analysis of body fluids:

- The analytical methods for fluid analysis, particularly on large automated platforms, are only validated for serum/urine/CSF, and have not been validated for various other body fluids.
- In the absence of established reference ranges for many analytes in fluids, results must be carefully interpreted with close reference to the clinical picture for each individual patient.
- The matrix of each type of fluid can vary widely depending on the condition of the patient and the sampling technique.

The ACBI published guidelines in 2009[1] entitled "The Biochemistry of Body Fluids," which is generally the guidance followed in Northern Ireland.

What are fluids?

Fluids are ultrafiltrates of blood that have undergone processing by tissues, or have been produced by active transport. They may contain biomarkers that are not found in blood or are at different concentrations than in blood. Some fluids are present in the healthy population, others are only present in the disease state. The most commonly analysed fluids are shown in Table 1.

The appearance of fluids, both before and after centrifugation, should always be recorded to aid interpretation.

Table 1: Most common types of fluids and tests in Biochemistry

Fluid	Tests
CSF	Glucose, protein, xanthochromia (bilirubin), lactate
Pericardial	Protein, LDH
Peritoneal / Ascitic	Protein, Albumin, LDH, Amylase, Triglyceride
Pleural	Protein, LDH, Glucose, pH
Drain	Creatinine

Specimen collection

1. The type and source of fluid should be clearly stated on the request form.
2. A green top Li-Hep gel tube blood sample should be taken within 2 hours of fluid collection to enable interpretation of pleural fluid protein and LDH results or calculation of Serum:Ascites Albumin Gradient (SAAG).
3. Fluid samples should be collected into plain sterile containers (white universal containers except for pH and glucose.
4. Fluid for pH must be collected in a heparinised blood gas syringe and analysed on the ward using a POCT blood gas analyser.
5. Fluid for glucose should be collected in yellow top monovette (Urine) tubes or plain white top universal tubes.

****Double Click On Image to Enlarge****

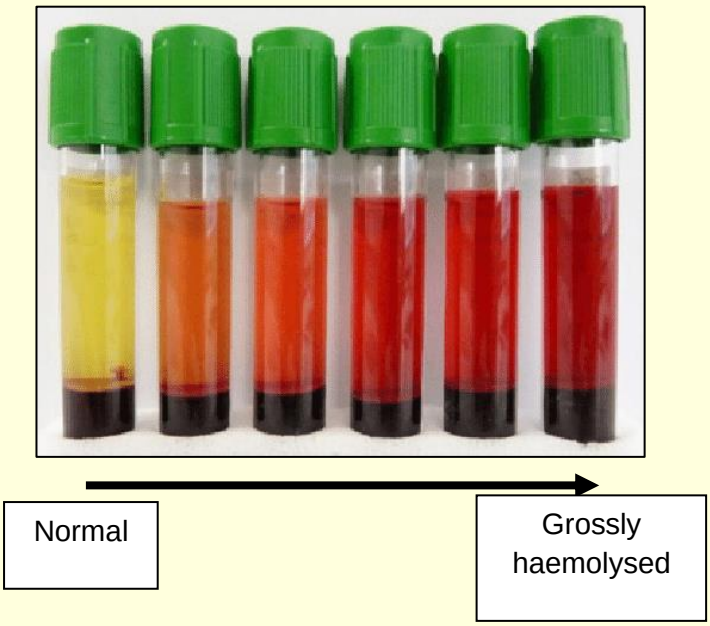
Appendix 20:

Hints and Tips for Avoiding Haemolysis

Haemolysis is the breakage of the red blood cell's membrane, causing the release of haemoglobin and other internal components into the surrounding serum/plasma. Test results from all laboratory disciplines can be affected by haemolysis but Biochemistry is particularly affected. Haemolysis can lead to incorrect results by a number of different mechanisms:

- Components in plasma increased due to leakage of red cell constituents (e.g. LDH and potassium)
- Spectral interference in the test method (e.g. Direct Bilirubin)
- Directly interfere with some of the chemical reactions involved during analysis.

The amount of interference will depend on the degree of haemolysis. This is measured automatically on all Clinical Biochemistry samples and may also be seen visually as a red discolouration of plasma/serum upon centrifugation – as illustrated below.



Depending on the degree of haemolysis some (or in extreme cases, all) test results will not be reported and a comment will be added highlighting that the sample is haemolysed.

Increased rates of in vitro (i.e. in sample tube) haemolysis may be caused by poor venepuncture technique. The following may lead to increased levels of haemolysis:

1) Venepuncture from sites other than antecubital region of arm
2) Prolonged tourniquet time (>1min)
3) Fist pumping during venepuncture
4) Cleansing the venepuncture site with alcohol and not allowing site to dry
5) Sluggish blood flow during venepuncture
6) Inappropriate use of small-bore or large bore needles
7) Use of wing sets (especially those designed for IV infusion)
8) Syringe draws (Not recommended)
9) Transferring blood into sample tube by pushing down on the syringe plunger
10) Vigorous mixing or shaking of a specimen (samples should mixed gently)
11) Under filled tubes (as a result of higher relative concentration of anticoagulant)
12) Delay in transfer of sample to the laboratory
13) Exposure to excessive heat or cold

Good venipuncture technique and appropriate transport are therefore essential in preventing haemolysis.

Appendix 21:

Service: *Clinical Biochemistry*
Filename: *CB-INF-PREGLIVRR*
Version: *01*
Date of Issue: *October 2022*
Owner: *Naomi Carne*
Page 1 of 1

S-H-Y-P-S
Scarborough, Hull and York Pathology Service
NHS York and Scarborough Teaching Hospitals NHS Foundation Trust

Liver Function Test Reference Ranges in Normal Pregnancy

The following trimester-specific reference ranges are recommended for use in normal pregnancy when reviewing results of liver function tests. Non-pregnant ranges are provided for reference.

	Non-pregnant	1st Trimester	2nd Trimester	3rd Trimester
ALT U/L	0 - 34	3 - 30	2 - 33	2 - 25
GGT U/L	0 – 38	2 – 23	4 – 22	3 – 26
AST U/L	0 - 31	3 – 23	3 – 33	4 – 32
ALP U/L	30 – 130	17 – 88	25 – 126	38 – 229
Total bilirubin umol/L	< 21	1.7 – 6.8	1.7 – 13.7	1.7 – 18.8