Clinical Biochemistry Handbook

December 2025 rev 24

Clinical Biochemistry Laboratory User Guide **An accredited laboratory under the UKAS ISO 15189 standards**	
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December 2025	L. Rowbottom	

This handbook is designed for clinical use only. Research studies approved by the appropriate research departments of Wirral University Hospital NHS Foundation Trust and Clatterbridge Cancer Centre must contact the laboratory for information regarding blood sampling and reference intervals.

CONTENTS

1 WHERE TO FIND THE LABORATORIES

At **Arrowe Park Hospital** the Clinical Biochemistry Laboratory is located at the western end of the main hospital buildings at the junction of main transverse ground floor corridor with the link corridor to the Cardiovascular department. The main ground floor corridor is accessed at the end of the corridor from the main entrance to the hospital.

At the **Clatterbridge Cancer Centre** the satellite clinical biochemistry laboratory is located on the first floor next to Delamere ward and is accessed by ascending the main stairs just off the main entrance to the Clatterbridge Cancer Centre, signposted Pathology Laboratory.

Address for correspondence :	**Hospital telephone number :**
Arrowe Park Hospital **Arrowe Park Road** **Upton** **Wirral** **CH49 5PE**	**0151 678 5111**

Web address : https://wuth.nhs.uk/

OPERATIONAL HOURS

The Clinical Biochemistry Laboratory operates an essential service 24/7 throughout the year.
Core working hours 9am to 5.00pm
Extended working day 7am-9am and 5.00pm-9pm
Out of hours/night 9pm to 7am

Outside of core working hours there are a smaller number of staff working in the department. Telephone lines are active at all times and the lab staff also carry a bleep to ensure urgent/emergency contact is always available.

For Clinical Biochemistry non-core hours:

a) Non–Hospital IT areas, i.e. GPs, MUST ELECTRONICALLY REQUEST as URGENT

b) Hospital IT linked areas must give requests URGENT status.

c) ***For the IMMEDIATE analysis of life or death results at any time and from any area in the hospital or elsewhere, the laboratory must be contacted BEFORE dispatch of samples by the bleep system 2088.***

d) These rules apply to those tests processed on the equipment used during non-core hours.

In all other cases urgent samples sent to the Laboratory will be processed and results available electronically as soon as possible.

CONTACTING THE LABORATORY:

Position	Senior Staff	Extension	E-mail
Consultant Clinical Scientist and Clinical Service Lead	Dr Lynn Rowbottom	2086	lynn.rowbottom@nhs.net
Principal Clinical Scientist	Mrs Kirsty Flowerday	7969	Kirsty.flowerday1@nhs.net
Principal Clinical Scientist	Dr Niamh Horton	4048	n.horton1@nhs.net
Senior Clinical Scientist and POCT lead	Dr Mansour Sargazi	2830	msargazi@nhs.net
Senior Clinical Scientist	Mr Matthew Curley	7969	matthew.curley@nhs.net
Consultant Chemical Pathologist/Lipid Clinic	Dr Andreas Tridimas Dr Shirley Bowles	7027	a.tridimas@nhs.net shirleybowles@nhs.net
Secretary	Mrs Linda Kennedy	2094	linda.kennedy1@nhs.net
Pathology Manager	Mr Alex Warrington		Alex.warrington@nhs.net
Blood Sciences Service Manager	Mr James Sullivan		James.sullivan12@nhs.net
Clinical Biochemistry Manager	Mrs Dawn Herbert	8280	dawnherbert@nhs.net
Quality Manager	Ms Joanne Evans	7410	joanneevans1@nhs.net
Pre-analytics Manager	Mrs Sue Lee	2032	Susan.lee21@nhs.net
Lab Med Training Manager	Mr Lee Carter		Lcarter2@nhs.net
Results Enquiries		2104	
General Enquiries Arrowe Park (APH)		2088	
General Enquiries Clatterbridge (CGH)		565942	
24/7 Biochemistry Laboratory		8353 Bleep 2088	

Other Useful Numbers:

Switchboards

Arrowe Park Hospital	0151 678 5111
Clatterbridge Hospital	0151 334 4000

2 LABORATORY INFORMATION

ABOUT US

The laboratory services provide a clinical service, consisting of elements of clinical care, consultation, a diagnostic analytical service, point of care testing, quality control, teaching, training, research and development work.

1) Consultative Service

1. Consultation with the Consultant Clinical Scientist, Chemical Pathologist, Principal Clinical Scientist and Senior Clinical Scientist concerning the interpretation of results, and management of patients within the context of their biochemical results, as well as the selection of the most appropriate tests and their arrangement is available by telephone, email and in person.

2. Consultation is available Monday to Friday from 9am-4.30pm (excluding bank/public holidays). There is no consultative service available out of hours.

3. Reports issued to General Practitioners are reviewed by the Clinical Scientist/Chemical Pathologist and clinical interpretation attached when appropriate.

4. All results are checked against pre-set values using the laboratory computer and significantly abnormal results are reviewed and communicated to clinical staff.

5. Weekly Lipid Clinics are conducted either remotely or in the outpatient departments at CGH by Consultant Chemical Pathologists Dr. Andreas Tridimas & Dr. Shirley Bowles (Countess of Chester Hospital).

6. The Laboratory provides guidance for clinical pathways.

2) Analytical Service

1. The department offers a full service, including: General Biochemistry, Tumour markers, Sweat tests, Drugs of abuse screening (non-employment/medico-legal), HbA1c, Urine analyses, Hormones, Therapeutic drug monitoring, Troponin T, NT-Pro-BNP, Osmometry, Faecal analyses and Protein electrophoresis.

2. Modification of the pattern of tests requested by clinicians may occur in the laboratory. The laboratory IT system may make alterations following rules set by the Consultants.

3. All analytes are monitored by extensive external assurance schemes including NEQAS and WEQAS. A full programme of internal quality assurance also operates.

4. Where appropriate the lab may reflex further tests to samples or tests may be added by the Clinical Scientist or Chemical Pathologist in order to aid interpretation or guide management of patients.

3) Analytical Services Outside the Laboratory

1. The laboratory has expertise to advise users concerning the selection and installation of instruments for point of care testing. The laboratory manages POCT through the WHT POCT Committee and through IT monitoring of the operation of these instruments.

4) Teaching, Training and Audit

1. The Clinical Biochemistry Department is accredited to deliver training of IBMS and STP Clinical Scientist and supports all departmental staff in scientific and professional training as well as hosting University placements and work experience students.

2. The laboratory supports an ongoing programme of departmental audit, directorate–wide audit, and regional audit of Clinical Biochemistry clinical and consultative services.

ACCREDITATION AND THE LABORATORY

The laboratory is inspected and accredited by UKAS (United Kingdom Accreditation Service) under the international standard ISO 15189 *Medical Laboratories – Requirements for quality and competence.*

The laboratory was initially accredited in 2016 and undergoes surveillance visits every year. Not all tests performed by the laboratory are accredited by UKAS as they may be awaiting re-inspection following updates to equipment/methods or they are infrequently performed tests and cannot undergo the rigorous testing procedure required for full accreditation status (eg cryoglobulins, xanthochromia). For the most up to date accredited list of tests we offer, please refer to the UKAS website at:

https://www.ukas.com/find-an-organisation/

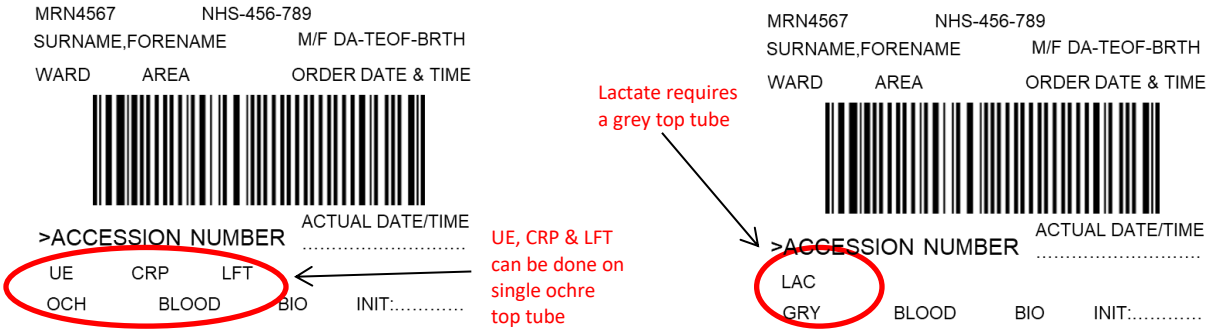
Enter our accreditation number (8835) in the “search box” and press enter.

HOW TO COLLECT A SAMPLE, COMPLETE REQUEST FORMS AND SPECIMEN LABELLING:

If sample request forms are completed manually all users are asked to carefully record the date and time the sample was collected on the request form and the sample tube.

Computer generated requests are produced in primary care through ICE (Sunquest). ICE request forms are either handed to patients by the GP but may also be generated by the phlebotomist following blood sample collection and have the date and time of collection sent electronically to the laboratory IT system along with the electronic test request.

Outpatient requests are generated in Cerner Millennium and request forms may be printed and handed to patients to present when attending Phlebotomy. Orders to be actioned are collected on the system which then prints the required number of barcode labels and indicates the number and type of blood tube required for the ordered tests:



Samples are usually collected in the hospital using Bridge. Bridge bar code labels are printed when samples are collected at the "bedside" and applied to the sample tubes at the "bedside" and contain the date and time of collection.

The process of collecting blood samples follows the Royal Marsden Hospital Manual of Clinical Nursing Procedures. (2004) (6th edition) www.rmmonline.co.uk and WUTH Policy 44 Labelling of Laboratory Specimens. These documents are published and/or are available for download on the Wirral Hospital Intranet site and copies are also available on application to Clinical Biochemistry secretary extension 2094 at Arrowe Park Hospital.

Wirral Hospitals and Primary Care use the Greiner Vacuette system for blood collection. Guidance on the tube top colour and Vacuette system is shown below:

SAMPLE VOLUMES

ADULTS

Blood tubes should always be filled to the "fill line" (black square on vacuette blood tubes) in order to ensure the correct amount of blood is received to cover the tests requested. Vacuette tube volumes are as follows:

SST	Ochre top	4 ml
Lithium Heparin	Green top	4 ml
Sodium Fluoride	Grey top	2 ml
Potassium EDTA	Purple top	4 ml
Clotted serum (gel free)	Red top	4 ml
Trace element	Dark Blue top	6 ml

However it may not always be possible to achieve the **maximum** volume of blood in the blood tube and thus **minimum** acceptable volumes of blood are given in the A-Z test table below. Please note that the minimum volumes listed are for single tests and will not necessarily result in additional sample volumes being required for groups of tests eg U&E (sodium, potassium, urea, creatinine) will require a minimum volume of 2 ml whole blood. However, if several profile combinations are requested, please send more than 1 sample eg. TFT, TRAB.

PAEDIATRICS

All paediatric tubes are designed to hold 1.3 ml of whole blood. In some cases more than 1 tube is required to ensure there is enough serum/plasma for the tests requested.

VACUETTE® SELECTION CHART

Wirral University Teaching Hospitals NHS Trust VAWL02 VERSION: May 2016

Samples must be labelled with surname,given name, DOB and Case Sheet Number

	Item Number	Cap Colour	Cap Ring Colour	Tube Type	Tests	Special Instructions
	TAKE BLOOD CULTURES FIRST, THEN THE REQUIRED TESTS IN THE ORDER SHOWN					
1	KFK 059	Ochre	Ochre	Clotting Accelerator and Separation Gel	**BIOCHEMISTRY:** General profiles, TFT's, CRP, Lithium, Iron, Therapeutic Drug Assays, Electrophoresis, Troponin T, Antibiotic Assays, PTH, B12, Folate, Ferritin, Copper, Zinc, Tumour markers, Pro BNP, Vitamin D, Type III Procollagen amino peptide, Thyroglobulin ANC antenatal screening only (separate tube) **IMMUNOLOGY**: Auto Antibodies (ANA, SMA, AMA, LKM, GPC), ANCA, dsDNA, ENA, GBM, Coeliac screen (tTG, EMA), Intrinsic Factor (IFA), CCP, Skin Abs, Anti Cardiolipin (ACA & B2 glycoprotien), Avian Precipitins, Aspergillus Precipitins, Farmers Lung, Anti Phospholipase A2 Receptor (PLA2R), IgE & RAST. Thrombophilia screen (part of) x 1 **MICROBIOLOGY**: Viral / Serological investigations. Paediatric Viral / Serological investigations. ASO Titre. For Viral Pneumonia screens, contact the Microbiologist. Also for Ante-natal, GUM and Renal units	IMPORTANT After collection ochre tubes need to stand for 30 minutes prior to centrifugation For very urgent samples please use Lithium Heparin Thrombophilia screen: See notes at bottom of chart Full Hepatitis MarkerScreen requires 2 x 4ml tubes ENSURE TUBES ARE FILLED TO THE SPECIFIED MARK
2	KFK 225	Blue	Black	Trisodium Citrate	INR, Clotting Screen, APTT, D-Dimer, Lupus Anticoagulant, Thrombophilia screen (part of), Von Willibrand screen	ENSURE TUBES ARE FILLED TO THE SPECIFIED MARK Thrombophilia screen: See notes at bottom of chart
3	KFK 255	Green	Black	Li Heparin	**URGENT TESTS & RENAL PATIENTS.** Urea and electrolytes, Bilirubin, Calcium, General profiles, Pre-eclampsia profiles, CRP, Drug overdose, Troponin T, Magnesium, Alcohol, Salicylate, Paracetamol.	Remember to mix the sample gently after collection
4	KFK 224	Lavender	Black	EDTA	FBC, ESR, Paul Bunnell, Malaria screen, Plasma Viscosity, Sickle screen, Thalassaemia screen, Kleihauer, Thrombophilia screen (part of), HFE gene, ACTH, Cyclosporin, Tacrolimus, Sirolimus, TPMT, Lead, Cobalt & Chromium Ammonia - contact lab first (ext 2088) collect on ice PCR FOR INFECTIOUS DISEASES. Meningococcal PCR, Pneumococcal PCR, HIV Quantitative PCR, HIV-1 genotype, HIV-1 anti-virogram, CMV PCR, HCV PCR genotyping	Mix six times after collection. Separate tube needed for: ACTH, Cyclosporin, Kleihauer, Sicklescreen Thrombophilia screen: See notes at bottom of chart Hepatitis C PCR x 2 EDTA bottles. HIV-1 genotype x 1EDTA bottle.HIV-1 antivirogram (phenotype) x 1 EDTA bottle. ENSURE TUBES ARE FILLED TO THE SPECIFIED MARK
5	KFK 265	Pink	Black	EDTA for Cross match	Group and Save Serum, Crossmatch, Direct Coombs, Group &Coombs, Cold Agglutinins	Samples must be handwritten and signed or bridge labelled at the bedside. Addressograph labelled samples will not be accepted. Samples must be labelled with surname, full Christian name DOB and case sheet no or NHS no.
6	KFK 226	Grey	White	NaF/EDTA	Glucose, HbA1c, Lactate - contact lab first (ext 2088) collect on ice	
7	KFK 262	Dk. Blue	Black	Sodium Heparin Trace Elements	Aluminium	
8	4ml Red	Lavender	Black	EDTA - Clotting Accelerator (no gel)	**Cryoglobulin** needs 1 x 4ml Red cap / Black ring tube and 1 x Lavender cap / Black ring tube brought to laboratory immediately at 37°C. (Contact ext. 2088 for flask prior to collection)	

Thrombophilia screen needs, 2 Light blue caps,1 Lavender cap and 1 Ochre cap (gel tube)

Joint fluid requires plain universal container and 1.3ml Lithium Heparin

VACUETTE® Products and Accessories

Safety Blood Collection Set + Luer Adaptor / Holder
450085 21G x 19cm (green) KFK137
450086 23G x 19cm (blue) KFK138

Holdex 450263 KFK 111

VISIO PLUS 'Flashback' Needle
21Gx1.5 450040 KFK 023
22Gx1.5 450041 KFK 017

QUICKSHIELD 450230 KFK 287

Disposable Tourniquets 840053 FWJ 013

IMPORTANT: Hold tube in place with thumb until filled to the required level

FOR OTHER TESTS CONTACT THE LABORATORY

Clinical Biochemistry	2088
Haematology	2093
Coagulation	2099
Blood Bank	2100
Microbiology	4511

Paediatric SELECTION CHART

Wirral University Teaching Hospitals NHS Trust

Item Number	Cap Colour	Tests	Specific instructions and Minimum Fill Volumes for Paediatric send away tests
459 092 Serum	Red	**Biochemistry:** Chemistry profile, Urea and Electrolytes, LFT, Bone profile, TFT, CRP, Bilirubin, Calcium/Magnesium, Iron, Therapeutic drugs, Troponin T, Antibiotics, PTH, B12, Folate, Ferritin, Copper/Zinc, Vitamin D, Vitamin A, Vitamin E. **Immunology:** IgE & RAST, ANCA, ANF, ENA, GBMAb, autoantibodies **Microbiology**: Serology.	Androstenedione (1ml), DHEAS (1ml), Insulin/C-Peptide (contact Biochemistry prior to collection), Long chain & very long chain fatty acids (1ml), **VITAMIN SAMPLES MUST BE PROTECTED FROM LIGHT i.e Vitamin A (1ml), Vitamin E (1ml)**
459 036 EDTA	Lavender	**Haematology**: FBC, ESR, Paul Bunnell, Malaria Screen, Sickle screen, Thalassaemia, **Microbiology**: Molecular PCR **Biochemistry**: Ammonia, Lead, ACTH, Cyclosporin, Tacrolimus **Transfusion**: Birth to 4 months: Blood Group and Coombs in paediatric lavender bottle Cord Group and Coombs in adult pink transfusion bottle 4 months onwards: Blood Group and Save in adult pink transfusion bottle (minimum volume: 1ml)	Acylcarnitine (1ml), **ACTH (1ml) (transport to lab immediately),** Alpha-galactosidase (2ml), **White cell enzymes (contact Biochemistry prior to collection),** Lead (1ml), Manganese (3ml) For advice on Molecular Genetics tests, please contact Liverpool Women's Hospital on 0151 702 4228
459 084 Lithium Heparin	Green	**Biochemistry:** Chemistry profile, Urea and electrolytes, LFT, Bone profile, CRP, Bilirubin, Calcium/Magnesium, Salicylate, Paracetamol, Troponin T, Alcohol.	17 OHP (1ml), Amino acids (1ml), Carnitine (1ml), Free fatty acids (1ml), Galactose screen (1.4ml), Phenylalanine (1ml) **VITAMIN SAMPLES MUST BE PROTECTED FROM LIGHT i.e. Thiamine (Vitamin B1) (2.5ml), Vitamin B2 (5ml), Vitamin B6 (5ml), Vitamin K (2ml)** For advice on Cytogenetics tests, please contact Liverpool Women's Hospital on 0151 702 4229
459 085 NAF / EDTA	Grey	Glucose, HbA1c, Lactate contact lab first (ext 2088) collect on ice	
459 075 Trisodium Citrate	Blue	INR, Clotting screen, APTT, D-Dimer, Von Willebrand screen.	Ensure filled to correct level.

greiner bio-one

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www.vacuette.com

VAAS03 VERSION MAY 2016

TRANSPORT OF SAMPLES

Community and GP surgeries

Samples from the community are transported either by a courier, by phlebotomists, or by the hospital transport system. Samples should be packaged according to the instructions below and transported to the laboratory within 4 hours from venepuncture. Samples should be kept at ambient temperature, with avoidance of extreme temperatures, prior to dispatch.

Sample Triple Packaging System

Primary package
This consists of a leak proof receptacle containing the sample.

Secondary package
A second leak proof receptacle is used to enclose the primary receptacle (s) – this may be a plastic bag with zip lok system of closure. Please do not place samples belonging to different patients within secondary packaging (i.e 1 patient per zip lok plastic bag).

Third packaging
The secondary package is placed in an outer shipping package which protects its contents from physical damage. Several secondary packages may be placed in the outer third package.

Hospital

Samples are transported within Arrowe Park Hospital from a variety of locations via a pneumatic tube system. Some samples however are not recommended for delivery by this route eg Blood Gases as sudden acceleration and deceleration may cause haemolysis and CSF which may be unstable. Samples may also be delivered by porters or phlebotomists, particularly if requests are urgent.

Samples are delivered between the Arrowe Park, Clatterbridge Cancer Centre and Microbiology at Bromborough sites by WUTH internal transport on a regular basis during core hours.

Patients

Instructions for the collection of 24 hour urine samples by patients and their delivery to the laboratory are given to patients when they collect the appropriate collection vessels from the laboratory

SENDING BLOOD SAMPLES FROM 'HIGH RISK' PATIENTS:

Samples from known high risk patients should be labelled, prior to dispatch, with high risk stickers (**or MUST be clearly labelled as such**) to prevent unnecessary risk to laboratory staff.
DO NOT USE THE AIR TUBE SYSTEM. Samples must be hand delivered to the Blood Sciences Department. Alert the reception staff that the samples are from a high risk patient.

Samples from patients with known or suspected COVID-19 should be double bagged before transport to the lab.

ADD ON TESTS

It is the preference to analyse samples collected and processed within 24 hours of blood taking. However, serum samples are stored at 4ºC for a maximum of 4 days post receipt and certain tests may be added to these specimens. Note that Green Top samples are not suitable for add on tests after 24 hours post collection.

The table below details some common “add on” tests which have a shorter stable life and the time limits of acceptability:

Test	Time Limit
Calcitonin	Cannot be added
Insulin/C-Peptide	Cannot be added
Lactate	Cannot be added
Metadrenalines (plasma)	Cannot be added
Gut Hormones	Cannot be added
Renin/Aldosterone	Cannot be added
Porphyrins (urine or plasma)	Cannot be added
Reducing substances (urine or faeces)	Cannot be added
ACTH	Cannot be added
Troponin T	24 hours
PTH	48 hours
B12	48 hours
Folate	48 hours
Bilirubin	48 hours
Bicarbonate	48 hours

These time limits are based on a sample being a) received and serum separated from cells promptly, b) being capped promptly after initial analysis and c) storage at 2-5°C. Please contact the clinical laboratory staff to discuss if other tests are required.

Please note that add-on requests for Lactate Dehydrogenase (LDH) are not recommended due to the instability of LDH4 & LDH5 isoenzymes when samples have been refrigerated or frozen.

FACTORS AFFECTING SAMPLE ANALYSIS

Specimen requirements for each test is described in the A-Z index of tests.

Analytical/biological factors affecting the performance of examinations

There are many factors which may cause an interference in the performance of a test including physiological aspects such as age and sex of the patient, whether patient is supine or erect, fasting or non-fasting. In general, reference ranges will allow for these factors.
The table below indicates some common analytical factors which can cause an interference but the list is by no means exhaustive.

Factors	Precautions
Haemolysis	Avoid shaking blood tubes which may cause trauma to the red cells (for tubes containing anti-coagulant, gently invert the tubes 3 times immediately on collection). Never inject a syringe needle into the vacutainer to empty the syringe. Avoid extremes of temperature. Haemolysis badly affects Potassium, Folate, Bilirubin, AST, ALT, LDH, Haptoglobin, CK, Mg and PO_4.
Contamination	Avoid taking blood from the arm where an IV infusion has been set up, which can cause a dilution effect of most analytes. Also depending on the infusion, it may increase glucose, sodium and potassium levels. Do not decant blood from one tube to another. Blood requiring K^+EDTA preservative must be taken after samples for Chemistry tests (serum separator tubes, SST). K^+EDTA will badly affect Potassium, Calcium and ALP.
Venous Constriction	Avoid a tourniquet where possible or at least keep its use to a minimum. Constriction can badly affect Calcium, Lactate, Electrolytes, Proteins.
Icterus	Icterus can badly affect Creatinine, Cholesterol, Ammonia and Triglycerides.
Lipaemia	Lipaemia can badly affect Sodium, Ammonia, ALT, AST and Salicylate.
Drugs	It is not possible to list all the drugs that may cause interference in analysis. Advice can be obtained from the Clinical laboratory staff if required.
Delay in Transit of Specimens (more than 4 hours)	Delays in transit can cause significant changes in analyte concentrations. The most commonly affected analyte is Potassium but others could also be affected.
Incorrect specimen received	Ensure the correct blood collecting tube is used to take the sample. Lithium requests MUST not be taken into a lithium heparin tube (SST tube must be used). Protein electrophoresis requests MUST not be taken into a lithium heparin tube (SST tube must be used)

Biotin – High dose biotin supplements may interfere with some endocrine tests. Samples should not be taken from patients on high dose biotin therapy (> 5 mg/day) until 8 hours post last dose.

Uncertainty of Measurement

Biochemical tests are subject to a degree of uncertainty in their measurement. This may be due to a variety of factors including:

1. Biological variation within individuals
2. Analytical measurement imprecision
3. Pre-analytical factors

Please contact the Clinical laboratory staff if you wish to discuss uncertainty of measurement for analytes measured in the laboratory.

Advice Regarding Repeat Testing Intervals

Users are requested to consider the advice given regarding the frequency of repeat testing through the document “National Minimum Re-testing Intervals in Pathology” produced by the Royal College of Pathologists (RCPath), the Association for Clinical Biochemistry and Laboratory Medicine (ACB/ALM) and the Institute of Biomedical Science (IBMS). Copies of this advice may be found on the RCPath/ALM website or obtained from the laboratory.

UNEXPECTEDLY ABNORMAL RESULTS

The laboratory has a standard operating procedure to ensure that results requiring immediate review are brought to the attention of the doctor requesting the test and where appropriate to the duty Clinical Biochemist. Results are telephoned to the designated individual or location when they fall within telephone alarm levels. This is done in addition to returning the results through the hospital computer system. This procedure does not override requests written on request cards to phone results.

The telephone alarm levels which are used within Wirral Hospitals: –

TEST	UNIT	LOWER THRESHOLD	UPPER THRESHOLD
Sodium	mmol/L	≤120 (130 ≤16yrs)	≥156
Potassium	mmol/L	≤2.5	≥6.5 (≥7.2[a])
Bicarbonate	mmol/L	≤10	-
Urea	mmol/L	–	≥30 (50[a]) (10 ≤16yrs)
Creatinine	µmol/L	–	≥354[a] (200 ≤16yrs)
Glucose	mmol/L	≤3.0	≥25 (15 ≤16yrs)
Amylase	U/L	–	≥480
Calcium	mmol/L	≤1.8[c]	≥3.0[c]
Bilirubin (Paediatric)	µmol/L	–	≥200
ALT	U/L	-	≥525 (all ≤16 yrs)
AST	U/L	-	≥525 (all ≤16 yrs)
Magnesium	mmol/L	≤0.4	-
Phosphate	mmol/L	≤0.3	-
Triglycerides	mmol/L	-	≥30
Paracetamol	mg/L	–	≥30
Salicylate	mg/L	–	≥300
Bile Acid	µmol/L	–	≥14 (antenatal)
Lactate	mmol/L		≥4.0
Ammonia	µmol/L		≥100
Alcohol (≤16 only)	mg/L	–	≥2000
Lithium	mmol/L	–	≥1.5
Digoxin	µg/L	–	≥2.5
Carbamazepine	mg/L	–	≥25 (15 ≤16 yrs)
Phenytoin	mg/L	–	≥25
Theophylline	mg/L	–	≥25 (20 ≤16 yrs)
Valproate	mg/L	–	≥100
Cortisol	nmol/L	≤50*	–
Xanthochromia		–	All positive results

The telephone alarm levels, which are used within primary care: –

TEST	UNIT	LOWER THRESHOLD	UPPER THRESHOLD
Sodium	mmol/L	≤120 (130 ≤16 yrs)	≥156
Potassium	mmol/L	≤2.5	≥6.5
Bicarbonate	mmol/L	≤10	-
Urea	mmol/L	–	≥30 (10 ≤16 yrs)
Creatinine	µmol/L	-	≥354 (200 ≤16yrs)
Glucose	mmol/L	≤3.0	≥25[b] (15 ≤16 yrs)
Amylase	U/L	–	≥480
Calcium	mmol/L	≤1.8[c]	≥3.0[c]
CK	U/L	-	≥5000
CRP	mg/L		≥300
Bilirubin (Paediatric)	µmol/L	–	≥200
ALT	U/L	-	≥750(m) ≥525(f & all ≤16 yrs)
AST	U/L	-	≥750(m) ≥525(f & all ≤16 yrs)
Magnesium	mmol/L	≤0.4[d]	-
Phosphate	mmol/L	≤0.3[d]	
Triglycerides	mmol/L	-	≥30
Paracetamol	mg/L	–	≥30
Salicylate	mg/L	–	≥300
Bile Acid	µmol/L	–	≥14 (antenatal)
Lactate	mmol/L	-	≥4.0
Ammonia	µmol/L	-	≥100
Alcohol (≤16 only)	mg/L	–	≥2000
Lithium	mmol/L	-	≥1.5
Digoxin	µg/L	–	≥2.5
Carbamazepine	mg/L	–	≥25 (15 ≤16 yrs)
Phenytoin	mg/L	–	≥25
Theophylline	mg/L	–	≥25 (20 ≤16 yrs)
Valproate	mg/L	–	≥100
TSH + FT4	mu/L + pmol/L	TSH ≤ 0.01 + FT4 ≥45	TSH ≥150 + FT4 ≤ 5
Cortisol	nmol/L	≤50[d] *	
Troponin T	ng/L		≥14

[a] Dialysis patients = 'Dialysis/Home Wd/Fresenius'
[a] Creatinines ≥354 do not need to be telephoned for dialysis patients – Dialysis/Home Wd/Fresenius (Abdulnabi, Daryanani, Ledson, Naz).
[a] Creatinines on inpatients need only to be telephoned on the first instance ≥354 (does not apply to GP/OPD).
[b] Glucose results ≥25.0 and <30.0 for adults (>16 years of age) can wait until the following day when GP surgery is open (phone to OOH Service at weekends or bank holidays).
[c] Limits apply to calcium if adjusted calcium is not available.
[d] Results breaching these limits can wait until following day when GP surgery open (phoned to OOH at weekend)

* Overnight dexamethasone suppression tests do not need to be phoned.
Ca125/153/199/CEA >500 KU/L and AFP/HCG >20 kU/L or U/L respectively will be reviewed and communicated by the duty biochemist if necessary.

All other abnormal results are transmitted electronically to systems linked to the Laboratory computer. These include the hospital IT system and IT systems in General Practice.

Normal results are also returned in this way.

Requests that are received with a request to be telephoned to a specific location will be telephoned regardless of whether the result is normal or abnormal.

PATIENT CONFIDENTIALITY/PERSONAL INFORMATION

Wirral Hospitals adopts the NHS Information Governance framework to ensure patient, staff and other confidential information is handled securely and safely. The Wirral Hospitals Information Governance policy (ref 095) relates to all information used by the Trust and its employees and to other NHS policies and legislation. Through its mandatory staff induction programme, it ensures staff are made aware and follow procedures documented in this policy and subsequently annual mandatory assessments are required to allow the trust to monitor its compliance.

Consent – It is assumed by the laboratory that by sending specimens for analyses the requester has received consent from the patients.

Clinicians should be aware that the laboratory may reflex tests where clinically indicated or to aid in interpretation.

COMPLAINTS/CONCERNS/COMPLIMENTS

Users wishing to raise a concern, make a complaint or compliment the department are encouraged to contact the Blood Sciences Service Manager, Quality Manager or the Clinical Service Lead to discuss further.

Alternatively, patients or their representatives may raise complaints/concerns/compliments through the Hospitals patient relations team by telephone, letter or e-mail as follows:

Chief Executive or Patient Relations Team
Wirral University Teaching Hospital NHS Foundation Trust
Arrowe Park Road
Upton
Wirral
CH49 5PE
Tel: 0800 432 0251
Email: wuth.patientexperience@nhs.net

TURNAROUND TARGETS

A 24/7 service providing a 1-hour turnaround, from receipt of sample in the laboratory, for essential services/urgent tests is available for all hospital sites on Wirral, and also for General Practitioners.

For other tests, from time of receipt in the laboratory, we provide a 24-hour turnaround time (excluding weekends) for routine GP and out-patient results, and a same day 4-hour turnaround for all secondary care tests processed on site. The exceptions are batch-analysed tests which include ACE, Calprotectin, Serum Electrophoresis and Serum Free Light Chains which have a turnaround time of ≤7 days. ALP Isoenzymes turnaround time is 6 weeks. **Please Note**: Turnaround times may be delayed during times of instrument maintenance/breakdown.

Samples sent to reference centres for processing will take longer. Allowing for sample transport to and receipt of results from the provider sites, there is generally a 7-to-21-day turnaround period. If required, please contact laboratory for details of specific test turnaround times.

3 ALPHABETICAL LIST OF TESTS AND REFERENCE RANGES

TEST	SAMPLE TYPE	PRIMARY SAMPLE VOLUME	TAT	RANGES/units	REMARKS
5HIAA – 24 Hour Collection	Plain container available from the laboratory Acidified on receipt	24 hr urine collection	28 days	<50 µmol/24hr	Dietary and medication restrictions apply. Please contact the laboratory for further information or see patient instructions at the end of this handbook. Sample processed at RLUH
17α Hydroxy–progesterone	Serum Ochre Top Full term baby needs to be 24h old to allow clearance of maternal steroids.	2 ml	2 – 3 weeks	0 – 2.4 nmol/L 0 – 2.6 nmol/L 0 – 2.1 nmol/L 0 – 3.9 nmol/L 1.3 – 6.9 nmol/L 0.9 – 6.3 nmol/L 0.7 – 5.2 nmol/L 0.7 – 4.4 nmol/L 0 – 2.3 nmol/L 0 – 1.9 nmol/L 0 – 1.8 nmol/L 0 – 7.2 nmol/L 0.4 – 5.0 nmol/L 0.4 – 8.3 nmol/L 0.2 – 3.1 nmol/L 0.1 – 2.0 nmol/L	Male 0-1y Male 1-5y Male 5-10y Male 10-15y Male 15-20y Male 20-40y Male 40-60y Male 60-80y Female 0-1y Female 1-5y Female 5-10y Female 10-15y Female 15y+ follicular phase Female 15y+ luteal phase Female post-menopause On oral contraceptives Sample processed at the Central Manchester University Hospitals Add on testing not available

A

ACTH	Plasma EDTA Lavender Top	2 ml	14 days	1.6 – 13.9 pmol/L	9 am reference range. Sample processed at RLUH Send to Laboratory Immediately on collection Add on testing not available
Acylcarnitine	Blood spot (Guthrie card)		14 days	Interpretation on report	Sent to Alder Hey Add on testing not available
AFP	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	≤5.8 KU/L	Males and non pregnant women
Albumin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	35 – 50 g/L 30 – 50 g/L 30 – 45 g/L	Adult 1-16 yr Infant/neonate Pathology Harmonisation ref range
Alcohol	Plasma LiHep Green Top Fluoride/EDTA Grey Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Nil mg/L	>1000 Depression of CNS >4000 Fatalities reported Add on testing not available
Aldosterone/Renin Ratio	Plasma LiHep Green Top	2 ml	28 days	>1700 >850 <680	Conn's very likely Possibly Conn's Conn's unlikely Sample processed at St Mary's Hospital London Send to Laboratory Immediately on collection Add on testing not available
Alkaline Phosphatase Isoenzymes	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	6 weeks	Identifies: Bone Liver Intestinal	Predominant fraction reported
Alkaline Phosphatase	Serum Ochre Top	2 ml	Urgent: 1hour Routine:	30 - 130 U/L 60 – 425 U/L	Adult Infant – 16yr

		Paediatric Minimum volume = 1.3 ml	4 hours GP's: 24hrs	70 – 380 U/L	Neonate Pathology Harmonisation ref ranges
Alpha Galactosidase (Fabry's Disease)	Whole Blood EDTA Lavender Top	5 ml (2x tubes)	14 days	Interpretation on report	Sent to Willink Biochemical Genetics Contact Laboratory for details Add on testing not available
Alpha 1 Acid Glycoprotein (Orosomucoid)	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	21 days	0.6 – 1.2 g/L 0.4 – 1.0 g/L 0.8 – 2.0 g/L	Males 1 – 50 years Females 1 – 50 years Both Genders 50+ years Sent to Northern General, Sheffield Add on testing not available
Alpha 1 Antitrypsin Phenotype	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	21 days	Interpretation on report	Sample sent to Protein Reference Unit, Sheffield Hallamshire Hospital Add on testing not available
Alpha 1-Antitrypsin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24 hrs	1.1 – 2.1 g/L	Phenotype added when A1AT < 1.4 g/L
ALT	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Up to 50 IU/L Up to 35 IU/L	Male Female
Aluminium	Serum Sodium Heparin Dark Blue Top	6 ml	14 days	<0.37 µmol/L	Sample processed at Leeds teaching Hospitals
Amikacin	Serum Ochre Top	4 ml	Contact lab	Interpretation on report	Sent to RLUH

Amino Acids	Serum Ochre Top or Plasma Green Top	2 ml Paediatric Minimum volume = 1.3 ml	28 days	Interpretation on report	Sample Processed at Alder Hey Hospital
Amiodarone	Plasma EDTA Purple Top or Serum Red top	2 ml	14 days	0.5 – 2.0 mg/L	Pre–dose Level Sent to Penarth, Toxicology laboratories, Cardiff
Ammonia	Plasma EDTA Lavender Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	16 – 60 µmol/L 11 – 51 µmol/L <50 µmol/L <100 µmol/L <150 µmol/L	Adult Males Adult Females *Infant-16yrs *Neonates *Pre term and/or sick babies *Pathology Harmonisation ranges Ring Ext. 8353 before collecting. Send to Lab immediately, as levels change on standing. Levels greatly increased by smoking. Add on testing not available
Amylase	Plasma LiHep Green Top Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0 – 96 IU/L	Add on testing not available
Androstenedione	Serum Ochre Tube	2 ml Paediatric Minimum volume = 1.3 ml	14 days	1.0 – 8.5 nmol/L	Sent to Royal Liverpool Hospital
Angiotensin Converting Enzyme	Serum Ochre Top	2 ml	7 days	 20 – 70 U/L 33 – 112 U/L	ACE Adults Children
Anti Mullerian Hormone	Serum Ochre Top	4 ml	28 days	Interpretation on report	Sent to Countess of Chester

					Add on testing not available
AST	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Up to 50 IU/L Up to 35 IU/L	Male Female
B					
Base Excess	Whole Blood Heparinised syringe	1.5 ml	Urgent: 1hour	-3.0 – (+3.0) mmol/L	CMPN range Calculated Value Arterial Specimen. Send to lab immediately. Exclude All air & cap with blind hub. Remove NEEDLES ! Blind Hubs available on Request
Bence Jones Protein	Urine, Universal tube or 24-hour collection	5 ml	7 days	Interpretation on report	Random early morning urine preferred
Beta 2 microglobulin	Serum Ochre Top	2 ml	14 days	1.2 – 2.4 mg/L	Sent to Northern General Hospital Sheffield Add on testing not available
Beta 2 transferrin	Nasal or ear secretion Universal tube AND Serum Ochre Top (paired serum useful for interpretation but not essential)	0.5 ml ear/nasal fluid 2 ml	7 days	Interpretation on report	Identification of CSF leakage. Sent to Walton Centre for Neurology Add on testing not available
Beta HCG	Serum Ochre Top Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0 – 4 U/L	Includes pregnancy detection/ monitoring as well as following some tumours. Contact lab for further information

Bicarbonate	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	22 – 29 mmol/L	Pathology Harmonisation ref range
Bile Acids (total)	Serum Ochre Top or Plasma LiHep Green Top	2 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	≤10 µmol/L	
Bilirubin	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	5 – 21 µmol/L	Adults
Bilirubin (Direct) also known as conjugated bilirubin	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	< 5 µmol/L	Predominantly unconjugated hyperbilirubinaemia is consistent with Gilbert's Syndrome.
Bilirubin in CSF Xanthochromia	CSF Universal container	Minimum volume = 1 ml (approx. 20 drops)	4 hours During core hours.	Interpretation on report	Used to Screen for Subarachnoid Haemorrhage. A serum sample for bilirubin is also required. Send rapidly to lab. Keep sample in the dark. Avoid using air tube.
Biopterin	Blood spot		28 days	Interpretation on report	Sent to Birmingham Children's Hospital Add on testing not available
Biotinidase	Plasma LiHep Green Top	4 ml	28 days	4.0 – 12.0 nmol/min/ml	Sent to Willink Biochemical Genetics Sample to reach Willink within 24hr or send plasma frozen. Contact

					laboratory for advice prior to sampling Add on testing not available
C					
C1 Esterase Inhibitor	Serum Ochre Top or Plasma EDTA Purple Top	2 ml	21 days	Quantitation: 0.08 – 0.24 g/L Functional: >67%	C1 Esterase Inhibitor Sent to RLUH Immunology Add on testing not available
C3	Serum Ochre Top	2 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.75 – 1.65 g/L	Range for 1 – 90 years (PRU) Add on testing not available
C4	Serum Ochre Top	2 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.14 – 0.54 g/L	Range for 1 – 90 years (PRU) Add on testing not available
CA 125	Serum Ochre Top	2 ml	Routine: 4 hours GP's: 24hrs	<35 KU/L	
CA 153	Serum Ochre Top	2 ml	Routine: 4 hours GP's: 24hrs	<30 KU/L	
CA 199	Serum Ochre Top	2 ml	Routine: 4 hours GP's: 24hrs	<40 KU/L	
Caeruloplasmin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	3 days	0.2 – 0.5 g/L 0.2 – 0.3 g/L	Adult female range Adult male range
Calcitonin	Serum Ochre Top	4 ml	21 days	0 – 1.7 pmol/L 0 – 3.7 pmol/L	Female Male Transport to laboratory on ice immediately.

					Sample processed at Christie Hospital NHS Trust
Calcium	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	2.2 – 2.6 mmol/L *2.2 – 2.7 mmol/L *2.0 – 2.7 mmol/L * Total (not adjusted)	Adult Adjusted for albumin Infant-16y Neonate Pathology Harmonisation ref ranges
Calprotectin, faeces	Faeces 25 ml Universal container or silver top sterile pot	Minimum = 5 g faeces	4 days	<100 µg/g 100-250µg/g >250µg/g	Inflammatory bowel disease (IBD) very unlikely IBD unlikely. Recommend repeat in 4 weeks then refer routinely if persistently abnormal. IBD possible, suggest urgent referral if symptoms suggest IBD. Reference ranges are less certain in the paediatric population. Higher levels can be normal in the very young (<4 years old). Consult General paediatrics for advice.
Carbamazepine	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	4 – 12 mg/L	Trough level. Mildly Toxic level > 12 mg/L Severe toxicity likely if level >40 mg/L
Carboxy-haemoglobin	Whole blood Heparinised syringe or Plasma LiHep Green Top	1.5 ml syringe or 4 ml green top tube	Urgent: 1hour Routine: 4 hours GP's: 24hrs	< 1.6%	CMPN range Concentrations up to 9% may be present in the blood of heavy smokers.

					20% or more will usually cause symptoms. 50% or more will cause unconsciousness. Arterial Specimen. Send to lab immediately. Exclude All air & cap with blind hub. Remove NEEDLES ! Blind Hubs available on Request Add on testing not available
Carnitine	Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	28 days	15 – 53 µmol/L	Sent to Alder Hey Hospital Add on testing not available
Carotene	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	21 days	Stated on report	Collect, separate and freeze within 1 hour of collection. Ideally protect from light as soon as collected. Sent to: Carlshalton Hospital Add on testing not available
CEA	Serum Ochre Top	4 ml Minimum volume = 2 ml	Routine: 4 hours GP's: 24hrs	<5 µg/L	Adult non-smoker. Carcinoembryonic antigen.
Chloride	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	95 – 108 mmol/L	Pathology Harmonisation ref range
Cholesterol	Serum Ochre Top	2 ml	Urgent: 1hour Routine: 4 hours GP's:	< 5.0 mmol/L	Refer to NICE NG238 for full guidance

		Paediatric Minimum volume = 1.3 ml	24hrs		
Cholinesterase	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	Interpretation on report	Sent to Penarth, Toxicology laboratories, Cardiff Add on testing not available
Chromium	Whole Blood EDTA Lavender Top	2 ml	14 days	<134.5 nmol/L	Range only applicable to metal-on-metal hip replacements. Sent to Leeds Trace Metal Laboratory Add on testing not available
Ciclosporin A (Cyclosporin)	Whole Blood EDTA Lavender Top	2 ml	5 days	 >200µg/L 100-200µg/L <100µg/L	Ranges based on trough level High Medium Low Sent to Royal Liverpool Hospital Add on testing not available
Citrate	Urine 25 ml Universal container or 24hr container	10 ml urine or 24 hr volume	5 days	Citrate:creatinine ratio 0.04-0.33 mmol/mmol 0.11-0.55 mmol/mmol	Sent to HSL/UCL Male ref range Female ref range Add on testing not available
CK	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	*40 – 320 IU/L *25 – 200 IU/L *White Caucasian. Other ethnic groups may have higher levels	Male Female Pathology Harmonisation ref ranges
Cobalt	Serum Ochre Top	2 ml	14 days	<119 nmol/L	Range only applicable to metal-on-metal hip replacements. Sent to Leeds Trace Metal Laboratory

					Add on testing not available
Copper	Serum Ochre Top Paediatric Minimum volume = 1.3 ml	2 ml	3 days	12.0 – 25.0 µmol/L 12.0 – 25.0 µmol/L	Male Female Different range for neonates & pregnancy. Add on testing not available Sent to RLUH
Copper	Urine 24hr plain bottle	24 hr urine volume	7 days	0.2-0.7 µmol/24h	Sent to Cardiff Add on testing not available
Cortisol	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	140 – 500 nmol/L	9 – 11 am cortisol. Adult values. Increased values may be seen in pregnancy, oral contraception and stress.
C-peptide/insulin	Serum Ochre Top Or Plasma Green Top	2 ml Paediatric Minimum volume = 1.3 ml	21 days	Interpretation on report	Collect on ice and bring to lab immediately Sent to Royal Surrey County Hospital or Alder Hey Children's hospital (if urgent). Interpretation depends on degree of hypoglycaemia and insulin levels Add on testing not available
Creatinine	Serum Ochre Top or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	59 – 104 µmol/L 45 – 84 µmol/L 27 – 87 µmol/L 14 – 34 µmol/L 23 – 68 µmol/L	Adult Male Adult Female Neonate 0–1m Child 1m–1yr 1–16 yrs
Creatinine Clearance	Serum Ochre Top AND 24 hr Urine Plain bottle	2 ml Paediatric Minimum volume = 1.3 ml 24 hr urine volume	24hrs	85 – 125 ml/min 75 – 115 ml/min	Male Female
CRP	Serum	2 ml	Urgent: 1hour	<5 mg/L	Adult range

	Ochre Top or Plasma LiHep Green Top	Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs		
Cryoglobulin Screen	Contact laboratory	1x 4 ml red top 1x 4 ml purple top	May be up to 6 weeks	Interpretation on report	Sample must be kept at 37ºC Contact the laboratory for advice prior to test Analysis of Cryoglobulins not UKAS accredited Add on testing not available
CSF Glucose	Plasma Fluoride/EDTA Grey Top AND CSF Fluoride/EDTA Grey Top	Blood - 2 ml Paediatric Minimum volume = 1.3 ml CSF – 1 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	mmol/L	Usually 2/3 of plasma glucose value, therefore needs simultaneous collection of blood sample for plasma glucose. Add on testing not available
CSF Lactate	Universal tube (25ml size)	CSF – 1ml	Urgent: 1 hour	1.1-6.7 mmol/L 1.1-4.4 mmol/L 1.1-2.8 mmol/L 1.1-2.4 mmol/L	Neonate 3-10 days old >10 days Adult
CSF Oligoclonal Bands	Serum Ochre Top AND CSF Universal tube (25 ml size)	2 ml blood CSF Minimum volume = 2 ml	14 days	Interpretation on report	Blood and CSF required. Sent to Walton Centre for Neurology. Add on testing not available
CSF Protein	Universal tube (25 ml size)	CSF – 1 ml	Urgent: 1hour Routine: 4 hours	<0.4 g/L	
CTX	Plasma EDTA Lavender Top	2 ml	14 days	0.15-0.97 µg/L 0.15-0.64 µg/L 0.13-0.67 µg/L 0.18-1.06 µg/L 0.17-0.97 µg/L 0.15-0.86 µg/L 0.24-1.02 µg/L 0.23-0.94 µg/L	Female <30y Female 30-40y Female 40-50y Female 50-60y Female 60-70y Female >70y Male <30y Male 30-40y

				0.18-0.80 µg/L 0.16-0.74 µg/L 0.13-0.75 µg/L 0.12-0.78 µg/L	Male 40-50y Male 50-60y Male 60-70y Male >70y Fasting sample preferred. Sent to RLUH. Add on testing not available
D					
DHEAS	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	1.9 – 13.4 µmol/L 5.7 – 13.4 µmol/L 4.3 – 12.2 µmol/L 2.4 – 11.6 µmol/L 1.2 – 9.0 µmol/L 1.4 – 8.0 µmol/L 0.9 – 6.8 µmol/L 0.4 – 3.3 µmol/L 1.8 – 10.0 µmol/L 4.0 – 11.0 µmol/L 2.7 – 9.2 µmol/L 1.7 – 9.2 µmol/L 1.0 – 7.0 µmol/L 0.5 – 5.6 µmol/L 0.3 – 6.7 µmol/L 0.3 – 4.2 µmol/L	15-19y Male 20-24y Male 25-34y Male 35-44y Male 45-54y Male 55-64y Male 65-74y Male ≥75y Male 15-19y Female 20-24y Female 25-34y Female 35-44y Female 45-54y Female 55-64y Female 65-74y Female ≥75y Female Sent to RLUH. Add on testing not available
Digoxin	Serum Ochre Top	2 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.5 – 1.0 µg/L 0.5 – 2.0 µg/L	CMPN/Pathology harmonisation range WUTH locally agreed ref range. >2.0 Possible toxicity >3.0 Concern level Do not sample for Digoxin within 6 hours of last dose. The significance of Digoxin level varies with potassium concentration.
Dihydro-testosterone	Serum Ochre Tube	2 ml	35 days	0.4 – 1.9 nmol/L	Male

	Or Plasma LiHep Green Or EDTA lavender	Paediatric Minimum volume = 1.3 ml		<0.5 nmol/L	Female Sent to St. James' Leeds
Downs Syndrome Screen	Serum Ochre Top	Minimum volume = 4 ml	3 days	Results returned from Bolton lab directly to Ante-natal clinic	Also known as Combined or Quadruple test. Sent to Bolton Ante-natal Screening Service. Special arrangement between WUTH ANC and Bolton.
Drug Screen	Urine 25 ml Universal	2 ml random urine	Routine: 4 hours GP's: 24hrs	Neg	Comprises: amphetamine, benzodiazepines, cannabis, cocaine, Methadone metabolite (EDDP), opiates Paediatric out of Hours- will only be undertaken by direct request from a consultant
E					
eGFR	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Part of GP U&E profile. See explanation re eGFR in section 5.	>90 ml/min	Calculated result from serum creatinine value plus age & gender. Values between 60-90 do not indicate CKD unless there is other evidence of this such as proteinuria, hypertension.
Ethylene Glycol	Plasma Fluoride EDTA Grey Top or	Minimum volume = 2 ml	2 hours from Birmingham	None	Out of Hours- will only be undertaken by direct request

	Lithium Heparin Green Top Fluoride oxalate (Grey Top) also acceptable		receiving sample		from a consultant who must phone City assays and speak to the duty Biochemist. Tel: 0121 554 3801 ask to bleep the on-call duty Biochemist. These tests require immediate transport by taxi to Birmingham
Everolimus	Whole Blood EDTA Lavender Top	2 ml	1 week	3 – 8 ng/ml	Collect trough level. Target ranges vary with indication. Sample sent to South Manchester, Wythenshawe Add on testing not available
F					
Faecal Elastase	Faeces 25 ml Universal	3 g faeces	14 days	>200 µg/g	Sample sent to South Manchester, Wythenshawe Add on testing not available.
Faecal Immunochemical Test (FIT)	Faeces Special device		3 days	<10 µg/g	≥10ug/g carries a higher risk of colorectal cancer
Faecal Reducing Substances					See Reducing Substances
Flecainide	Plasma EDTA Purple Top	2 ml	7 days	0.15–0.9 mg/L	Pre–dose. Sent to Penarth, Toxicology laboratories, Cardiff Add on testing not available
Ferritin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	150-973 µg/L* 8-580 µg/L* 14-101 µg/L* 21-173 µg/L* 30-442 µg/L 30-518 µg/L 4-114 µg/L* 30-169 µg/L 30-207 µg/L	<1m Male/Female 1-<6m Male/Female 6m-15y Male/Female Male 15-18y Male 18-39y Male ≥40y Female 15-18y Female 18-39y Female 40-49y

				30-264 µg/L 30-332 µg/L	Female 50-59y Female ≥60y *Caliper (children) Rodgers et al. 2024 Upper limit & CMPN Lower limit Adults
Folate	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	3.9 – 20 µg/L	
Free Fatty Acids	Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	1 month	Interpretation on report	Paediatric test only. Also send a sample for Glucose (Grey Top) analysis Sent to Alder Hey Hospital Add on testing not available
Free Light Chains	Serum Ochre Top	2 ml	7 days	3.30 – 19.40 mg/L 5.71 – 26.30 mg/L 0.26 – 1.65	Kappa Lambda Kappa/Lambda ratio
Free PSA	Serum Ochre Top	2 ml	7 days	<12% >12%	Higher risk Lower risk. General indication only. Urologist interpretation required. Sent to PRU
Free T3	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	3.1 – 7 pmol/L	Adult reference range. Free T3 levels may be higher in children. See tables
Free T4	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	11.5 – 22.7 pmol/L	Adult reference range. Free T4 levels may be higher in children. See tables
FSH	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	U/L	See Age/Gender Table

G

Gastrin	Plasma EDTA Lavendar Top	2 x 4 ml (gut hormone profile) 1x 4 ml for single analyte	21 days	<40 pmol/L	Fasting Sample. Separate within 15 min, freeze and send frozen to Imperial College Hospital Add on testing not available
Gentamycin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Refer to local antibiotic guidelines via Pharmacy mg/L	For clinical advice contact Microbiology
GGT	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	<60 IU/L <40 IU/L	Male Female
Globulin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	21 – 37 g/L	Calculated value From chemistry profiles. Total Protein minus Albumin
Glucagon	Plasma EDTA Lavendar Top	2 x 4 ml (gut hormone profile) 1x 4 ml for single analyte	21 days	<50 pmol/L	Fasting Sample. Separate within 15 min, freeze and send frozen to Imperial College Add on testing not available
Glucose	Plasma Fluoride EDTA Grey Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	3.9 – 5.5 mmol/L 4.0 – 7.7 mmol/L	WHO mean fasting values NW Coast DM network random Add on testing not available
Growth Hormone	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	After stimulation test: > 6.6 µg/L After GTT: < 0.15 µg/L	 Normal response. Excludes acromegaly Sent to RLUH. Add on testing not available

H					
HbA1c	Whole Blood Fluoride EDTA Grey Top	2 ml	Routine: 4 days	<42 mmol/mol 42-47 mmol/mol ≥48 mmol/mol	Non-diabetic Impaired glucose regulation Consistent with Diabetes Mellitus See more information at end of handbook Add on testing not available
Haptoglobin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	0.3 – 2.0 g/L	
HDL Cholesterol	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	>1.0 mmol/L >1.2 mmol/L	Male Female Refer to NICE NG238 for full guidance.
I					
IgA	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	24hrs (may be delayed if associated with electrophoresis quantification)	0.7 – 4.0 g/L	Adult range See tables for age related ranges
IgF1	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	nmol/L	See Age dependant ranges. Sent to Royal Surrey County Hospital. Add on testing not available
IgF2	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	Interpretation on report	Sent to Royal Surrey County Hospital Add on testing not available
IgF-BP3	Serum Ochre Top	2 ml	14 days	Interpretation on report	Sent to Royal Surrey County Hospital Add on testing not available

		Paediatric Minimum volume = 1.3 ml			
IgG	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	24hrs (may be delayed if associated with electrophoresis quantification)	7 – 16 g/L	Adult range See tables for age related ranges
IgG Subclasses	Serum Ochre Top	2 x 4 ml	14 days	Refer to table g/L	Sent to Northern General Hospital. Add on testing not available
IgM	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	24hrs (may be delayed if associated with electrophoresis quantification)	0.4 – 2.3 g/L	Adult range See tables for age related ranges
Insulin/C-peptide	Serum Ochre Top Or Plasma Green Top	2 ml Paediatric Minimum volume = 1.3 ml	21 days	Interpretation on report	Collect on ice and bring to lab immediately. Sent to Royal Surrey County Hospital or Alder Hey Children's Hospital (if urgent). Interpretation depends on degree of hypoglycaemia and insulin levels Add on testing not available
Iron	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	6 - 35 µmol/L	

K

Ketones	Heparinised whole blood	1 ml	1 hour	< 0.6 mmol/L	Add on testing not available

L

Lactate	Whole Blood Heparinised syringe OR Plasma Fluoride EDTA Grey Top	1.5 ml 2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.50 – 2.20 mmol/L	Must be received within 15 minutes. Add on testing not available
LDH	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	135 – 250 IU/L 120 – 300 IU/L 120 – 344 IU/L 120 – 451 IU/L 225 – 600 IU/L No range available	Adults 16y+ 3-16y 1-3y 20-365 days 4-20 days 0-4 days Lactate Dehydrogenase Add on testing not recommended
LDL cholesterol	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	≤2 mmol/L	Calculated value based on Cholesterol, HDL and Triglycerides. Not available when Triglycerides > 4.5 mmol/L Refer to NICE NG238 for full guidance
Lamotrigene	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	3 – 15 mg/L	Trough level required Sample processed at Walton NeuroBiochemistry
Lead	Whole Blood LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	< 0.24 µmol/L	Adults with no industrial lead exposure. Sample sent to Leeds Hospital Laboratory Add on testing not available
LH	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	U/L	See Age/Gender Table

Lithium	Serum Ochre Top	2 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.4 – 1.0 mmol/L	>1.5 mmol/L is likely to produce toxic symptoms. Severe toxicity >2.0. Collect 12 hours post dose. DO NOT send LiHep tubes for lithium analysis Pathology Harmonisation range
M					
Macroamylase	Serum Ochre Top And Urine 25ml Universal	4 ml And 10 ml urine	24hrs	Interpretation on report	Request urine amylase and send paired serum for amylase & creatinine. Add on testing not available
Magnesium	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.7 – 1.0 mmol/L 0.7 – 1.0 mmol/L 0.6 – 1.0 mmol/L	Adults Infant – 16yr Neonate Pathology Harmonisation range
Manganese	Whole Blood EDTA Lavender Top	2 ml Paediatric Minimum volume = 1.3 ml	7 days	73 – 210 nmol/L	Sent to Leeds Add on testing not available
Mast cell trypase	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	2.0 – 14.0 ng/ml	Sent to RLUH Immunology Add on testing not available
MCAD (part of Organic Acids or Acylcarnitine screen)	Urine Universal tube Blood spot Guthrie card	Minimum volume = 10 ml urine	28 days	Interpretation on report	Medium Chain acyl CoA dehydrogenase deficiency Paediatric test. Sent to Alder Hey Add on testing not available
Mercury	Whole Blood EDTA Lavender Top Or Whole Blood	4 ml	14 days	<25 nmol/L	Sent to Leeds Trace metal laboratory Add on testing not available

	LiHep Green Top				
Mercury (urine)	Urine 25 ml Universal	5 ml urine	14 days	<3 nmol/mmol creatinine	Occupational limit < 20 nmol/mmol creat
Metanephrines screen	Urine 24 hr plain bottle, can be supplied by the laboratory	24 hr urine volume	14 days	0.1–2.9 µmol/24hr 0.1–1.2 µmol/24hr 0.1–1.3 µmol/24hr	Normetadrenaline Metadrenaline 3-Methoxytyramine Sent to RLUH.
Metanephrines plasma	Plasma EDTA Lavendar Top	2 ml	7 days	Interpretation on report. <1.18 nmol/L Normet <0.51 nmol/L Met	Must be received immediately, separated and frozen within 1h. Sent to Salford Royal. Add on testing not available
Methanol	Plasma Fluoride EDTA Grey Top or Lithium Heparin Green Top Fluoride oxalate (Grey Top) also acceptable	2 ml	2 hours from Birmingham receiving sample	None	Out of Hours- will only be undertaken by direct request from a consultant who must phone City assays and speak to the duty Biochemist. Tel: 0121 554 3801 ask to bleep the on-call duty Biochemist. These tests require immediate transport by taxi
Methotrexate	Plasma LiHep Green Top Or Serum Non Gel Red Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent results phoned to requester from provider site Routine: 14 days		Target value depends on timing and treatment. Not used for monitoring low dose methotrexate treatment – use LFTs and FBC. Sent to Alder Hey Add on testing not available
Microalbumin (urine)	Urine 25 ml Universal	10 ml	7 days	< 3.0 mg/mmol	Microalbumin/ Creatinine ratio
Mucopoly-saccharides	Urine 25 ml Universal	5 ml	28 days	Interpretation on report	Samples sent to Alder Hey

N

Non Esterified Fatty Acids					(see Free Fatty Acids)

Non HDL Cholesterol	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	≤2.6 mmol/L	Calculated by subtracting HDL cholesterol from total cholesterol. Refer to NICE NG238 for full guidance.
O					
Oestradiol	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	pmol/L	See Age and Gender Reference Ranges
Organic Acids	Urine 25 ml Universal	10 ml	28 days	Interpretation on report	Sent to Alder Hey Add on testing not available
Orosomucoid					See alpha-1-acid glycoprotein
Osmolality	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	275 – 295 mosmol/kg	Pathology Harmonisation ref range
Osmolality (urine)	Urine 25 ml Universal	Minimum volume = 1 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Up to 1100 mosm/kg	
Oxalate	Urine Plain 24 hr urine container	24 hr urine volume	14 days	100 – 460 µmol/24 hr	Sent to HSL/UCL
P					
Pancreatic Polypeptide	Plasma LiHep Green Top	2 x 4 ml (gut hormone profile) 1x 4 ml for single analyte	21 days	<300 pmol/L	Part of gut hormones. Separate within 15 min, freeze and send frozen to Imperial College Add on testing not available
Paracetamol	Plasma LiHep Green Top Or Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Nil mg/L	Refer to BNF for treatment nomogram. Collect samples >4 hours post-ingestion

Parathyroid hormone	Serum Ochre Top	2 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	1.6 – 6.9 pmol/L	PTH
PCP Type III	Serum Ochre Top	2 ml	14 days	Interpretation on report	Procollagen peptide Type III Sent to Warrington
pCO_2	Whole blood Heparinised syringe	1.5 ml	Urgent: 1hour	4.7 – 6.4 kPa Male 4.3 – 6.0 kPa Female	Arterial Specimen. Send to lab immediately. Exclude All air & cap with blind hub. Remove NEEDLES ! Blind Hubs available on Request
pH	Whole blood Heparinised syringe	1.5 ml	Urgent: 1hour	7.35 – 7.45 Hydrogen ion 35 – 45 nmol/L	Arterial Specimen. Send to lab immediately. Exclude All air & cap with blind hub. Remove NEEDLES ! Blind Hubs available on Request
Phenobarbital	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	10 – 40 mg/L	Pre-dose sample Pathology Harmonisation/ referral lab range TOXIC >60 Sent to Alder Hey.
Phenytoin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	5-20 mg/L	Pathology Harmonisation range. WUTH guidance; usually 10-20mg/L. Timing unimportant. Severe toxicity likely if level >40mg/L
Phosphate	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.80 – 1.50 mmol/L 0.9 – 1.8 mmol/L 1.3 – 2.4 mmol/L 1.3 – 2.6 mmol/L	Adults 1-16 yr Infant Neonate Pathology Harmonisation ref ranges
Phytanic Acid					See VLCFA

pO_2	Whole blood Heparinised syringe	1.5 ml	Urgent: 1hour	11.0 – 14.4 kPa	Arterial Specimen. Send to lab immediately. Exclude All air & cap with blind hub. Remove NEEDLES ! Blind Hubs available on Request
Porphyrin profile	Whole Blood EDTA (2x Lavender Tops) Urine 25ml Universal Faeces 25 ml Universal	2 x 4 ml 20 ml 20 g	21 days	Interpretation on report	Requires the collection of blood, urine and faeces. Samples must be protected from light on collection. Samples sent to the Porphyrin reference laboratory at Salford Add on testing not available
Porphobilinogen	Urine 25 ml Universal	10 ml	8 hrs (urgent)	Negative	Only to be used for an urgent screening Test. Protect sample from light at collection. Add on testing not available Samples sent to Salford Royal NHS Foundation Trust
Potassium	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	3.5 - 5.3 mmol/L 3.4 - 6.0 mmol/L 3.5 - 5.7 mmol/L 3.5 - 5.0 mmol/L	Adults (serum) Neonate (plasma) Infant (plasma) 1-16yrs (plasma) Pathology Harmonisation ranges Potassium may be raised due to delay in transit or separation. Samples in green topped tubes requires prompt delivery to the laboratory
Pre-eclampsia screen (sFlt1:PlGF)	Serum Ochre Top	2 ml	4 hours		For short term prediction of pre-eclampsia.

				sFlt1:PlGF ≤38 sfFlt1:PlGF 39-84 sFlt1:PlGF ≥85	Unlikely PEC Elevated risk Very high risk Refer to local guidelines and/or NICE DG49 for further information
Pregnancy testing	Random urine	Minimum vol = 1 ml	Routine: 24hrs	Neg/Pos/Wk Pos	Qualitative test only
Procalcitonin	Serum Ochre Top	2 ml	4 hours	<0.5 µg/L >2.0 µg/L	Low risk of severe sepsis/septic shock High risk of severe sepsis/septic shock
Progesterone	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	> 28 nmol/L	Day 21+/- 1 suggests ovulation has occurred.
Prolactin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	102 – 496 mU/L 86 – 324 mU/L	Females Males
pro-BNP (NT-proBNP)	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	< 300 ng/L	Refer to Trust and/or Regional guidance (Also CG187-Acute & NG107-Chronic HF guidance)
Protein Electrophoresis	Serum Ochre Top	2 ml	7 days	g/L	Text Report
PSA Prostatic Specific antigen.	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	<4 ng/ml	See Age Related Table Significance depends on prostate examination. Note that urinary infection and urinary retention may also cause raised PSA levels.
R					
Reducing substances (lactose,maltose,	Faeces 25 ml universal	5 g faeces	28 days	Interpretation on report	This is no longer available for adults. Sample must reach the laboratory within

sucrose,glucose, galactose,fructose)					24 hrs of collection (For freezing) to avoid false negative results. Sent to Alder Hey Hospital Add on testing not available
Reducing substances (lactose,maltose, sucrose,glucose, galactose,fructose)	Urine 25 ml universal	10 ml urine	28 days	Interpretation on report	Sample must reach the laboratory within 24 hrs of collection (For freezing) to avoid false negative results. Sent to Alder Hey Hospital Add on testing not available
Rheumatoid Factor	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	< 14 IU/ml	
S					
Salicylate	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Nil mg/L	Therapeutic ranges 30-100 mg/L for anti-pyretic/ analgesia conditions. 150-300 mg/L for anti-inflammatory/ rheumatic fever conditions. Toxic range >300mg/L & Potentially lethal >600mg/L
Selenium	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	0.6 – 1.5 µmol/L	Sent to RULH Add on testing not available
Sex Hormone Binding Globulins	Serum Ochre Top	2 ml	Routine: 4 hours GP's: 24hrs	18 - 54 nmol/L 21 - 77 nmol/L 32 - 128 nmol/L	Male 20-49 years Male ≥50 years Female 20-49 years (non-pregnant)

		Paediatric Minimum volume = 1.3 ml		27 - 128 nmol/L	Female ≥50 years
Sirolimus	Whole Blood EDTA Lavender Top	2 ml Paediatric Minimum volume = 1.3 ml	> 24hrs	Interpretation on report	Sent to Harefield Hospital Add on testing not available
Sodium	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	133 – 146 mmol/L	Pathology Harmonisation range
Somatomedin C (IgF1)	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	21 days	nmol/L	See Age dependant ranges. Sent to Royal Surrey County Hospital. Add on testing not available
Standard Bicarbonate	Whole blood Heparinised syringe	1.5 ml	Urgent: 1hour	22 – 29 mmol/L Calculated value	Arterial Specimen. Send to lab immediately. Exclude All air & cap with blind hub. Remove NEEDLES ! Blind Hubs available on Request
Sweat Testing	Sweat Conductivity	15 ul	4 hrs	< 50 mmol/L 50 – 90 mmol/L > 90 mmol/L	CF unlikely Intermediate level. Conductivity should not be used alone to diagnose CF. Supports a diagnosis of CF. Confirmation by sweat chloride and/or genotyping required.
	Sweat Chloride Concentration			< 30 mmol/L (<6months old) < 40 mmol/L (6 months and older)	CF unlikely but requires genetic and clinical correlation.

				30 - 60 mmol/L (<6months old) 40 - 60 mmol/L (6 months and older) > 60 mmol/L (all ages)	Intermediate level. Requires further CF assessment. Supports a diagnosis.of CF Book by appointment Ext. 2088 (Arrowe Park) Add on testing not available
Synacthen Test	Serum Ochre Top	2 ml at each time point Paediatric Minimum volume = 1.3 ml at each time point	Routine: 4 hours	Cortisol measurement nmol/L	30 minute value needs to be > 450 nmol/L and to have increased by 200 nmol/L or more than baseline. Add on testing not available
T					
Tacrolimus	Whole Blood EDTA Purple Top	2 ml	3 days	 Levels >20 mg/L may be associated with toxicity.	Ranges based on trough levels Refer to local guidance as target levels depend on transplant type, dual therapy and time post-transplant. Sent to RLUH Add on testing not available
Teicoplanin	Serum Ochre Top	2 ml	48 hrs	Refer to Microbiology/ Pharmacy	Sent to Chester Biochemistry Department Add on testing not available
Thiopurine Methyl Transferase Activity (TPMT)	Whole Blood EDTA Lavender Top	2 ml	14 days	68 – 150 mU/L 20 – 67 mU/L < 10 mU/L	Normal range Carrier range Deficiency range Sent to City Hospitals Birmingham

					Add on testing not available
TGN (6TGN)	Whole Blood EDTA Lavender Top	2 ml	14 days	235 – 450 pmol 6TGN/8x10^8 RBC	Therapeutic range Other information may be given on reports Sent to City Hospitals Birmingham Add on testing not available
Testosterone	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	8.6 – 29 nmol/L 6.7 – 25.7 nmol/L 0.3 – 1.7 nmol/L 0.1– 1.4 nmol/L	Males 20-49 years Males ≥50 years Female 20-49 y Female ≥50y
Theophylline	Serum Ochre Top Or Paediatric serum Paed Red top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	10 – 20 mg/L	Pathology Harmonisation range. Adults: Toxicity most frequent at > 20mg/L
Thiamine (Vit B1)	Whole blood EDTA Lavender Top	Minimum volume= 2.5 ml	14 days	78 – 143 nmol/L	Sent to Royal Liverpool Hospital Add on testing not available
Thyroglobulin	Serum Ochre Top	2 ml	14 days	0 – 78 µg/L	Sent to Northern General Hospital. Add on testing not available
TPO – anti thyroid peroxidase antibody	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	0 – 34 IU/ml	
TIBC	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	45 – 72 µmol/L	
Tobramycin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 24h Routine: 7 days	Refer to local antibiotic guidelines via Pharmacy	Sent to Alder Hey For clinical advice contact Microbiology
Total Protein	Serum Ochre Top	4 ml	Routine: 4 hours GP's:	60 – 80 g/L	Pathology Harmonisation reference range

		Minimum volume = 1.3 ml	24hrs		
TRAB	Serum Ochre Top	2 ml	14 days	≤1.8 U/L	Sent to RLUH Add on testing not available
Transferrin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	2.0 – 3.2 g/L	Sent to Northern General Hospital. Add on testing not available TIBC correlates to transferrin (reported within iron profile)
Troponin T (hsTnT)	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	<14 ng/L	Remains raised up to 14 days after MI.
Triglyceride	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	0.8 – 1.8 mmol/L	12 h fasting sample required.
TSH	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	0.3 – 5.5 mU/L	Adult reference range. TSH levels may be higher in children. See tables
U					
Urate	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	200 – 430 µmol/L 140 – 360 µmol/L	Male Adults Female Adults Pathology Harmonisation ref range
Urea	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	2.5 - 7.8 mmol/L 2.5 - 6.5 mmol/L 1.0 - 5.5 mmol/L 0.8 – 5.5 mmol/L	Adults 1-16yr Infant Neonate Pathology Harmonisation ref ranges
Urine Albumin	Urine 24hr plain bottle	24 hr urine volume	3 days	< 30 mg/24 hrs	

Urine Albumin Excretion	Urine 25 ml Universal	2 ml	3 days	<20 µg/min 20 – 200 µg/min 30 – 300 mg/24hr	Normal (Tietz 2018) High albuminuria Needs timed 12 h collection for monitoring
Urine Amino Acids	Urine 25 ml universal	5 ml	28 days	Levels and interpretation on report	Send fresh random urine promptly to lab.
Urine Calcium	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	2.5 – 7.5 mmol/24 hr	Sample must be received promptly in the laboratory otherwise acidification is required
Urine Calcium /Creatinine ratio	Urine 25 ml universal	2 ml	Routine: 4 hours GP's: 24hrs	< 0.56 mmol/mmol creatinine	Adult level (Metz 2006) Age related reference intervals. See table
Urine Chloride	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	110 – 250 mmol/24hr	Tietz 2018 Random samples may also be sent
Urine Free Cortisol	Urine 24 hr plain bottle	24 hr urine volume	14 days	< 165 nmol/24hr	Sent to RLUH..
Urine Microalbumin	Urine 25 ml universal	2 ml	3 days	< 3.0 mg/mmol	
Urine Creatinine	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	7 – 14 mmol/24hr 9 – 21 mmol/24hr	Females Males
Urine Organic acids	Urine 24 hr plain bottle	24 hr urine volume	28 days	Interpretation on report	Sent to Alder Hey Hospital Add on testing not available
Urine Phosphate	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	15–50 mmol/24 hr	Pathology Harmonisation range
Urine Porphyrin	Urine 25 ml Universal	10 ml	8 hrs (urgent)		Urgent screening samples sent to Salford Royal NHS Foundation Trust. Protect sample from light at collection. See Porphyrin profile for the preferred test

					Add on testing not available
Urine Potassium	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	25 – 125 mmol/24 hr	Tietz 2018 Random samples may also be sent
Urine Protein	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	< 150 mg/L < 140 mg/24h	
Urine Protein/creatinine ratio	Urine 25 ml Universal	2 ml	Routine: 4 hours GP's: 24hrs	<100 mg/mmol	
Urine Sodium	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	40 – 220 mmol/24hr	Random samples may also be sent
Urine Urate	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	1.5 – 4.5 mmol/24hr	Pathology Harmonisation ref range
Urine Urea	Urine 24 hr plain bottle	24 hr urine volume	Routine: 4 hours GP's: 24hrs	428-714 mmol/24h 286-595 mmol/L	
V					
Valproate	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	50 – 100 mg/L	Levels of no use for TDM as therapeutic range is not well defined
Vancomycin	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Urgent: 1hour Routine: 4 hours GP's: 24hrs	Refer to local antibiotic guidelines via Pharmacy General information: 10 – 15 mg/L 15 – 20 mg/L	For clinical advice contact Microbiology General information: Pre-dose Complicated infection
Very Long Chain Fatty Acids	Plasma LiHep Green Top Or Plasma EDTA lavender top	2 ml Paediatric Minimum volume = 1.3 ml	28 days	Interpretation on report	Sent to Sheffield Children's Hospital Add on testing not available

VIP	Plasma LiHep Green Top	2 x 4 ml (gut hormone profile) 1x 4 ml for single analyte	21 days	< 30 pmol/L	Vasoactive intestinal peptide. Part of Gut hormone profile. Separate within 15 min, freeze and send frozen to Imperial College Add on testing not available
Vitamin A	Serum Ochre Tube	2 ml Paediatric Minimum volume = 1.3 ml	14 days	1.1– 2.5 µmol/L	Ideally protect from light. Sent to RLUH.
Vitamin B1	Whole Blood EDTA Lavender Top	2 x 4 ml	14 days	78 – 143 nmol/L	Thiamine. Sent to RLUH. Add on testing not available
Vitamin B2	Whole Blood LiHep Green Top	2 x 4 ml	21 days	1.0-3.4 nmol FAD/g Hb	Riboflavin. Protect from light Sent to Royal Infirmary Glasgow Add on testing not available
Vitamin B6	Whole Blood LiHep Green Top	2 x 4 ml	21 days	250-680 pmol PLP/g Hb	Pyridoxine. Protect from light Sent to Royal Infirmary Glasgow Add on testing not available
Vitamin B12	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	197-771 ng/L	Ref ranges may be higher in Black ethnicity compared to White/Asian ethnicity. Oral contraceptives can lower total B12 without causing deficiency. Active B12 should be considered in pregnancy. Homocysteine and/or Methylmalonic Acid may be considered when investigating B12 deficiency.

					These are available as sendaway tests.
Vitamin D	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	Routine: 4 hours GP's: 24hrs	50 – 125 nmol/L <26 nmol/L 26-50 nmol/L >50 nmol/L >150 nmol/L	Adequate range Deficient Insufficient Sufficient Refer to local Trust and PAN Mersey Guidance Potentially toxic if sustained long-term
Vitamin E	Serum Ochre Top	2 ml Paediatric Minimum volume = 1.3 ml	14 days	12 – 46 µmol/L	Protect from light Sent to RLUH.
W					
White Cell Enzymes	Whole Blood EDTA Lavender top	2 x 4 ml	28 days	Interpretation on report	Sample must arrive at provider site within 72 hours of blood sampling Sent to Willink Biochemical Genetics Add on testing not available
Z					
Zinc	Serum Ochre Top Or Plasma LiHep Green Top	2 ml Paediatric Minimum volume = 1.3 ml	7 days	12 – 25 µmol/L	Circadian rhythm, collect sample before 12 noon. Add on testing not available Sent to RLUH

Reference ranges quoted are either manufacturer-stated or those provided by referral laboratories, unless otherwise stated.

Definitions
Neonate: 0-28 days old.
Infant: 4 weeks-1 year old.
Paediatric/child: <16 years old.

4 BLOOD GASES

Blood gas syringes must be sent to the laboratory with the needle removed from the syringe and replaced with a blind hub before dispatch. The air tube system should not be used to transport blood gas samples as results may be affected.

Blood gas reference ranges

An arterial blood sample is the traditional sample associated with blood gas analyses and the only reference ranges applied in Cerner Millennium relate to arterial blood samples. However, due to the difficulty of obtaining an arterial sample, in many cases a venous sample obtained from a peripheral vein or from a central venous catheter will suffice. It has now been accepted that venous blood may be used as an alternative in most cases for the assessment of ventilation and acid-base status (pH, pCO2, bicarbonate) but is unable to provide information about oxygenation status in which case an arterial sample must be provided. There are also some contra indications to relying on venous blood as opposed to arterial blood eg haemodynamically unstable patients, hypotensive patients, severe circulatory failure and patients in shock eg cardiac arrest.
In addition, the laboratory is not usually informed which sample type they have been given to analyse.

At this point in time, there are no defined reference ranges within Cerner Millennium for POCT analysers. Users should be aware of the sample type and age-related differences. In addition to this, there may also be differences between eg peripheral and central venous blood. The following ranges are provided as a guide.

Ranges quotes were derived by POCT Cheshire and Merseyside Pathology Network with the exception of Total Hb (source below):

1. Kratz et al., NEJM 2004;351:1548-63

Blood gas/acid-base	Units	Arterial blood	Venous/capillary blood
pH		7.35-7.45	7.32-7.43 Adult 7.31-7.41 Paediatric
pCO_2	kPa	4.3-6.0 Adult Female 4.7-6.4 Adult Male 3.6-5.5 Paediatric	3.8-6.5 Neonate 5.3-6.8 Age 28d-5y 5.5-8.1 Age 5-16y
pO_2	kPa	11.0-14.4	4.3-8.2 Neonate 3.3-6.5 Age 29d-5y 2.0-6.9 Age 5-16y
HCO_3	mmol/L	19-24	22-29 Adult 19-28 Paediatric
Base excess (ecf)	mmol/L	-3 to +3	-3 to +3

Electrolytes	Units	Arterial blood	Venous/capillary blood
Sodium	mmol/L	133-146	133-146
Potassium	mmol/L	3.5-5.3 Adult 3.4-6.0 Neonate 3.5-5.7 Age 29d-1y 3.5-5.0 Age 1-16y	3.5-5.3 Adult 3.4-6.0 Neonate 3.5-5.7 Age 29d-1y 3.5-5.0 Age 1-16y
Ionised Ca	mmol/L	1.15-1.33 Adult 1.06-1.34 Neonate 1.19-1.33 Paediatric	1.15-1.33 Adult 1.06-1.34 Neonate 1.19-1.33 Paediatric
Chloride	mmol/L	95-108 Adult 96-108 Age <1y 101-111 Age 1-5y 101-107 Age 5-16y	95-108 Adult 96-108 Age <1y 101-111 Age 1-5y 101-107 Age 5-16y

Metabolites	Units	Arterial blood	Venous/capillary blood
Glucose	mmol/L	4-11	4-11
Lactate	mmol/L	≤2.0	≤2.0
Bilirubin	µmol/L	<21 Age 28d-Adult	<21 Age 28d-Adult

Oximetry	Units	Arterial blood	Venous/capillary blood
sO_2	%	94-98	
O_2Hb	%	90-95	90-95
COHb	%	0.5-1.5 Adult 0.4-1.6 Age 0-5y 0.5-0.9 Age 5-16y	0.5-1.5 Adult 0.4-1.6 Age 0-5y 0.5-0.9 Age 5-16y
MetHb	%	0.0-1.5	0.0-1.5
Total Hb	g/L	135-175 g/L Adult Males, 120-160 g/L Adult Females[1]	

5 AGE AND GENDER REFERENCE RANGE TABLES AND SPECIAL TEST GROUPS

Glucose Tolerance Test
(Non-pregnant and male criteria)

Diabetes Mellitus	: If fasting Venous Plasma Glucose ≥7.0 mmol/L or 2 hour Venous Plasma Glucose ≥11.1 mmol/L
Impaired fasting glycaemia	: If fasting Venous Plasma Glucose ≥6.0 and ≤6.9 mmol/L and 2 hour Venous Plasma Glucose <7.8 mmol/L
Impaired glucose tolerance	: If fasting Venous Plasma Glucose <7.0 mmol/L and 2 hour Venous Plasma Glucose ≥7.8 – 11.0 mmol/L

(Gestational criteria)

Gestational Diabetes Mellitus	: If fasting Venous Plasma Glucose ≥5.6 mmol/L or 2 hour Venous Plasma Glucose ≥7.8 mmol/L

HbA1c

HbA1c is an indication of a person's glucose control and used to monitor changes in diabetes management and associated risk of complications. The guidelines for **monitoring** HbA1c are currently as follows:

HbA1c mmol/mol	Target
≤48	T2 Diabetes (Single OHA & no hypo risk)
≤53	T1 Diabetes & T2 Diabetes (Max dose single OHA or more)
≤64-69	T2 Diabetes (Special considerations)

Refer to current NICE (NG28) & Northwest Coast Adult Diabetes Guidelines for targets when on hypoglycaemic agents or in pregnancy.

The WHO have now adopted the use of HbA1c in the diagnosis of Diabetes and the recommendations are as follows:

HbA1c mmol/mol	Interpretation	remarks
<42	Non Diabetic levels	
42 - 47	Impaired glucose regulation/prediabetes	Suggests high risk of developing diabetes
≥48	Consistent with diabetes	Asymptomatic patients should be confirmed with repeat tests or glucose tests

Note:

A value <48 mmol/mol does not exclude diabetes diagnosed using glucose tests.
HbA1c cannot be used for diagnosis of children, pregnant women or in anaemias, haemoglobinopathies, acute illness, on drugs that lead to rapid rises in glucose eg steroids/antipsychotics. Care should also be taken with age and ethnicity, renal failure & liver disease.

Common Hb variants are unlikely to interfere in the HbA1c immunoassay method, though caution should be used in interpretation if a variant may be present. Lower/higher values may be seen in conditions that shorten/lengthen erythrocyte lifespans. (Note: HbF and HbSS cause significantly lower HbA1c values).

IGF1 (Somatomedin C)

Age Years	Male nmol/L	Female nmol/L
0 - 3	1.7 – 27.6	2.1 – 23.1
3 - 6	3.6 – 41.1	3.3 – 31.7
6 - 10	6.0 – 57.6	5.1 – 48.2
10 - 11	9.8 – 61.0	8.7 – 52.9
11 - 12	10.8 – 63.7	9.8 – 57.2
12 - 13	11.7 – 65.7	10.7 – 60.7
13 - 14	12.5 – 66.8	11.6 – 63.4
14 - 15	13.1 – 67.1	12.2 – 65.1
15 - 16	13.5 – 66.6	12.7 – 65.7
16 - 17	13.9 – 65.3	13.1 – 65.3
17 - 18	14.2 – 63.4	13.3 – 64.1
18 - 19	14.2 – 61.4	13.4 – 62.1
19 - 20	14.2 – 58.9	13.3 – 59.9
20 - 21	14.0 – 56.2	13.0 – 57.3
21 - 26	12.6 – 53.4	11.2 – 54.5
26 - 31	10.9 – 40.7	9.6 – 41.5
31 - 36	10.0 – 32.5	9.0 – 33.8
36 - 41	9.4 – 29.3	8.5 – 30.7
41 - 46	8.5 – 27.3	7.7 – 28.0
46 - 51	7.7 – 26.0	7.0 – 25.9
51 - 56	7.0 – 25.6	6.2 – 24.3
56 - 61	6.2 – 25.2	5.6 – 22.9
61 - 66	5.9 – 25.0	5.1 – 22.1
66 - 71	5.6 – 25.4	4.8 – 21.6
71 - 76	5.2 – 25.2	4.6 – 21.6
76 - 81	4.9 – 24.6	4.4 – 21.8
81 - 85	4.8 – 23.8	4.6 – 22.9
>85	4.6 – 23.4	4.0 – 22.8

Immunoglobulins

Age	Gender	IgG g/L
<14 days	Male/Female	3.2 – 12.1
15 days – 1 year	Male/Female	1.48 – 6.31
1-4 years	Male/Female	3.17 – 9.94
4-10 years	Male/Female	5.01 – 11.7
10-19 years	Male/Female	5.95 – 13.1
Adults >19 years	Male/Female	7 – 16

Age	Gender	IgA g/L
0 - <1 year	Male/Female	<0.14
1 year – <3 years	Male/Female	<0.80
3 years – <6 years	Male/Female	0.11 – 1.42
6 years – <14 years	Male	0.34 – 2.22
6 years – <14 years	Female	0.34 – 2.20
14 years – <19 years	Male/Female	0.4 – 2.93
>19 years	Male/Female	0.7 - 4

Age	Gender	IgM g/L
<14 days	Male/Female	0.03 – 0.32
15 days – <13 weeks	Male/Female	0.10 – 0.67
13 weeks – <1 year	Male/Female	0.14 – 0.82
1- <19 years	Male	0.36 – 1.44
1- <19 years	Female	0.45 – 1.78
>19 years	Male/Female	0.4 – 2.3

IgG Subclasses (g/L)

Age in years	IgG1	IgG2	IgG3	IgG4
6 months	1.5 – 3.0	0.3 – 0.5	0.1 – 0.6	< 0.5
2 yrs	2.3 – 5.8	0.3 – 3.9	0.1 – 0.8	<0.5
5 yrs	2.3 – 6.4	0.7 – 4.5	0.1 – 1.1	<0.8
10 yrs	3.6 – 7.3	1.4 – 4.5	0.3 – 1.1	<1.0
15 yrs	3.8 – 7.73	1.3 – 4.6	0.2 – 1.2	<1.1
Adult (>15 yrs)	3.2 – 10.2	1.2 – 6.6	0.2 – 1.9	<1.3

Infertility & Menopause

	Oestradiol pmol/L	LH U/L	FSH U/L
Males	< 159	1.7 – 8.6	1.5 – 12.4
Females			
Post Menopausal	< 505	7.7 – 58.5	25.8 – 134.8
Follicular	76 – 858	2.4 – 12.6	3.5 – 12.5
Mid–cycle	222 – 2212	14.0 – 95.6	4.7 – 21.5
Luteal	111 – 1123	1.0 – 11.4	1.7 – 7.7

PSA Age Related Ranges

Age	ng/ml
<40	Use clinical judgement
40 – 49	0 – 2.5
50 – 59	0 – 3.5
60 – 69	0 – 4.5
70 – 79	0 – 6.5
80+	Use clinical judgement

Source: Tietz textbook of Clinical Chemistry & NICE CKS.
PSA levels may be reduced by ~50% in men taking finasteride. As per NICE guidelines, re-baseline PSA after 6 months of treatment, then interpret future results relative to this new baseline.

Thyroid Hormones

Age	FT3 pmol/L	FT4 pmol/L	TSH mU/L
< 6 days	2.6 – 9.7	11.0 – 32.0	0.70 – 15.0
6 days – 3 months	3.0 – 9.3	11.5 – 28.3	0.72 – 11.0
3 month – 12 months	3.3 – 8.9	11.9 – 25.6	0.73 – 8.35
1 year – 6 years	3.7 – 8.5	12.3 – 22.8	0.70 – 5.97
6 years – 11 years	3.9 – 8.0	12.5 – 21.5	0.60 – 4.85
>11 years	3.1 – 7.0	11.5 – 22.7	0.30 – 5.5

Urine Calcium/Creatinine ratios

Age	Range mmol/mmol creatinine
0 – 1 year	<1.50
1 – <2 yrs	<1.25
2 – <5 yrs	<1.00
5 – <10 yrs	<0.70
10 – 18 yrs	<0.60

Metz, 2006. Annals of Clinical Biochemistry

6 INFORMATION DOCUMENTS FOR PATIENTS

COLLECTION OF 24 HOUR URINE SAMPLES FOR CATECHOLAMINES

What is the Catecholamines test?

This test measures the amount of substances called catecholamines in the urine. It is sometimes requested when patients have symptoms such as persistent hypertension, headaches, sweating and palpitations. These symptoms may be due to overproduction of catecholamines in a condition called phaeochromocytoma. This test will help to diagnose this condition. Sometimes it may be necessary to perform more than one collection as catecholamines may not always be produced in high quantities all the time.

A special bottle has been provided to collect your urine.

1. Urine collection:

Any container of your own used to transfer urine to the special bottle must be clean and well rinsed.

Store the collected urine in a cool place during the period of collection.

If you pass enough urine to fill the supplied 24 hour collection bottle before the end of the 24 hours period, stop the collection at that time. Carefully note the date and time of finishing on the container. There is no need to alter your normal fluid intake during the 24 hour collection period

> **DAY 1:** After rising from bed, urine should be passed but NOT collected in the container. This is the starting time of the collection; please write this time on the container label along with your name. You should collect all urine passed during the next 24 hours into the container. This includes any urine you need to pass during the night.
>
> **DAY 2**: After rising from bed, you should empty your bladder into the container. This is the finishing time; please write this time on the container label.

Please ensure that your full name, date of birth and the date and time of collection are written on the container label.

2. At the end of the collection:
The urine container should be taken to the laboratory as soon as possible. The laboratory opening times are as follows:

	Arrowe Park Hospital
Monday to Friday	8.00 am – 8.00 pm
Saturday	9.00 am – 5.00 pm

3. Please hand in the request form along with your urine collection. If you do not have a form, tell the reception staff when handing in your urine.

4. If you have been asked to collect more than one 24 hour urine sample:
Please ensure that you keep each individual 24 hr urine separate from the next. Also remember to carefully date and time the container labels so that it is clear which bottle corresponds to each 24 hr period. If necessary you can leave a few days between each 24 hr collection, but please bring the samples to the laboratory as soon as possible after collection.

If you have any questions regarding the test please telephone 0151 678 5111, extension 2088.

URINE COLLECTION FOR "5HIAA" TESTING

What is the 5HIAA test?

This test measures the amount of a substance called 5-hydroxyindole acetic acid (5-HIAA) in the urine. It is helpful to measure when a patient has symptoms similar to these: flushing, diarrhoea, wheezing. These symptoms may suggest the presence of a condition called carcinoid syndrome. In this syndrome excess 5-HIAA is found in the urine. This test may also be ordered at intervals to help monitor the effectiveness of treatment in those patients who have previously been diagnosed with and treated for this condition.

What foods should I avoid?

Foods such as avocados, bananas, pineapples, red plums, walnuts, tomatoes, kiwi fruit, aubergine and health food supplements containing 5-hydroxytrytophan can increase 5-HIAA and should be avoided for three days prior to and during urine collection.

How do I collect my urine?

A special bottle has been provided to collect your urine.

Urine collection:

Any container of your own used to transfer urine to the special bottles must be clean and well rinsed.

Store the collected urine in a cool place during the period of collection.

DAY 1: After rising from bed, urine should be passed but NOT collected in the container. This is the starting time of the collection; please write this time on the container label along with your name.

You should collect all urine passed during the next 24 hours into the container. This includes any urine you need to pass during the night.

DAY 2: After rising from bed, you should empty your bladder into the container. This is the finishing time; please write this time on the container label.

If you pass enough urine to fill the supplied 24 hour collection bottle before the end of the 24 hours period, stop the collection at that time. Carefully note the date and time of finishing on the container. There is no need to alter your normal fluid intake during the 24 hour collection period

Please ensure that your full name and date of birth and the date and time of collection are written on the container label.

At the end of the collection: The urine container should be taken to the laboratory as soon as possible. The laboratory opening times are as follows:

	Arrowe Park Hospital
Monday to Friday	8.00 am – 8.00 pm
Saturday	9.00 am – 5.00 pm

Please hand in the request form along with your urine collection. If you do not have a form, tell the reception staff when handing in your sample.

If you have any questions regarding the test please telephone 0151 678 5111, extension 2088.

COLLECTION OF A 24 HOUR URINE SAMPLE

Why 24 hour Urine tests are necessary

Urine, which is made by the kidneys, contains many substances made in other parts of the body. Laboratory testing of urine collections can therefore help to identify and manage many medical conditions. In order to monitor certain medical conditions it may be necessary to measure some of these substances in the urine over a longer period of time, such as 24 hours

A special bottle has been provided to collect your urine.

1. Urine collection: Any container of your own used to transfer urine to the special bottle must be clean and well rinsed.

Store the collected urine in a cool place during the period of collection.

If you pass enough urine to fill the supplied 24 hour collection bottle before the end of the 24 hours period, stop the collection at that time. Carefully note the date and time of finishing on the container. There is no need to alter your normal fluid intake during the 24 hour collection period

DAY 1: After rising from bed, urine should be passed but NOT collected in the container. This is the starting time of the collection; please write this time on the container label along with your name.

You should collect all urine passed during the next 24 hours into the container. This includes any urine you need to pass during the night.

DAY 2: After rising from bed, you should collect any urine passed in the container. This is the finishing time; please write this time on the container label.

Please ensure that your full name and date of birth and the date and time of collection are written on the label.

2. At the end of the collection: The urine container should be taken to the laboratory as soon as possible. The laboratory opening times are as follows:

	Arrowe Park Hospital
Monday to Friday	8.00 am – 8.00 pm
Saturday	9.00 am – 5.00 pm

PLEASE NOTE : If you are attending one of the **renal clinics , please bring your 24 hr urine collection to your appointment

3. Please hand in the request form along with your urine collection. If you do not have a form, tell the reception staff when handing in your urine.

4. Please check if a blood sample is also required. Certain tests require both urine and blood samples (creatinine clearance tests)

If a blood test is required you will already have been given a blood test request form. If you attend clinic your blood sample will be taken at clinic. If not, please telephone the Phlebotomy department on 0151 604 7382 to book an appointment to have your blood taken (within 7 days of your urine collection)

5. If you have been asked to collect more than one 24 hour urine sample: Please ensure that you keep each individual 24 hr urine separate from the next. Also remember to carefully date and time the container labels so that it is clear which bottle corresponds to each 24 hr period. If necessary you can leave a few days between each 24 hr collection, but please bring the samples to the laboratory as soon as possible after collection.

If you have any questions regarding the test, please telephone
0151 678 5111, extension 2088.

COLLECTION OF AN EARLY MORNING (RANDOM) URINE SAMPLE

Why random urine tests are necessary

An early morning random urine test may be all that is required to diagnose and monitor kidney function and some medical conditions such as diabetes mellitus.

An early morning urine sample is requested as this sample is likely to be the most concentrated sample passed during the day and the more concentrated the sample, the easier it is to measure the substances requested by your doctor.

A special bottle has been provided for you to collect your urine.

1. Urine collection:

• Any container of your own used to transfer urine to the special bottle must be clean and well rinsed.

• Store the collected urine in a cool place.

2. After rising from bed:

• You should collect the first urine that you pass into the bottle provided.

Please ensure that your full name, date of birth and the date of collection are written on the label.

3. At the end of the collection:

The urine container should be taken to the laboratory as soon as possible.

The laboratory opening times are as follows:

	Arrowe Park Hospital
Monday to Friday	8.00 am – 8.00 pm
Saturday	9.00 am – 5.00 pm

4. Please hand in the request form along with your urine collection.

- If you do not have a form, tell the reception staff when handing in your urine.

If you have any questions regarding the test please telephone
0151 678 5111, extension 2088.

PORPHYRIN PROFILE INSTRUCTIONS

What is porphyria?

Porphyria is an uncommon condition that can affect the skin, nervous system or both. People with porphyria usually have no symptoms and only experience symptoms during a flare up of the condition. Porphyria is usually an inherited condition but sometimes it can be acquired as a result of conditions such as alcoholism and overload of the body with iron (haemochromatosis).

The type of porphyria which affects the skin such as porphyria cutanea tarda and erythropoietic protoporphyria can cause sensitivity to the sun.

The type of porphyria which affects the nervous system, such as acute intermittent porphyria, sometimes might cause pain in the abdomen but may also cause other symptoms such as muscle weakness, breathing difficulties, confusion and palpitations. This type of porphyria may be triggered by certain drugs, hormones, dieting, stress, infections, surgery or accidents.

For this test it is necessary to collect a sample of urine, a sample of faeces and two samples of blood.

1. Urine collection: A volume of at least 20mls is needed (use the line on the side of the bottle as a guide).

- Please ensure that your full name, date of birth and the date of collection are written on the container.
- Place the sample into a dark plastic bag (to protect it from any exposure to light) and store in a cool place until you return it to the hospital.

2. Faeces collection:
A small portion of faeces should be placed into the pot using the wooden spatula provided.

- Please ensure that your full name, date of birth and the date of collection are written on the container.
- Place the sample into a dark plastic bag (to protect it from any exposure to light) and store in a cool place until you return it to the hospital.

3. Blood collection:
Before returning samples to the hospital, please ensure that you have blood samples taken. Please telephone the Phlebotomy Department on 0151 604 7382 to book and appointment to have your blood taken

4. At the end of the collection:
Samples should be taken to the Clinical Biochemistry Department as soon as possible. The laboratory opening times are as follows:

	Arrowe Park Hospital
Monday to Friday	8.00 am – 8.00 pm
Saturday	9.00 am – 5.00 pm

If you have any questions regarding this test, please telephone
0151 678 5111, extension 2088.

8 MISCELLANEOUS INFORMATION

GLUCOSE TOLERANCE TEST (WARD PROTOCOL)

Patients must be on a normal diet for at least 3 days prior to test.

The patient should have had nothing by mouth other than water for the previous 10 to 14 hours (overnight). Patient should remain seated throughout the test and refrain from smoking.

1. Take a **fasting** plasma **glucose sample**

2. The patient is then given 113 ml of Polycal, diluted to 250–300 ml with water and asked to drink it within 5 minutes.
(This is equivalent to 75g anhydrous glucose).

3. Exactly **two hours** after Polycal take a further plasma glucose sample. Early or late collection of the 2 hour blood sample may lead to incorrect interpretation of results.

Please note that this dose of Polycal (equivalent to 75g anhydrous glucose) applies to adults only. For children, a dose related to the weight of the child will be provided by pharmacy on request.

SCREENING FOR DRUGS OF ABUSE

Sample: Urine - 25 ml Universal

Should be labelled with **name and date of collection.** Unlabelled samples are not analysed. For a drug screen send 20 ml of urine. Special care should be taken to make sure the urine specimen is freshly voided and unadulterated.

Storage
Samples should be sent to the laboratory as soon as possible but store at 4°C if kept over the weekend. Negative samples will not become positive but some samples containing borderline levels of opiates, amphetamine or cocaine may assay negative if stored in excess of three days.

Request
Request should be made on the correct date and identify any currently prescribed drugs

Detection Limits Screening ng/ml	
Amphetamine	500
Opiates	300
Methadone metabolite EDDP	100
Benzodiazepines	200
Cocaine Metabolite	150
Cannabis	50

Our detection limits are in line with those currently recommended by the European Workplace Drug Testing Guidelines.

Positive screening results for opiates and amphetamines may require confirmation and identification by a secondary laboratory using more specific detection methods. Note: If a drug confirmation is required you must contact the laboratory to request this. It may take up to 3 weeks to obtain confirmation from the referral laboratory (Cardiff or Birmingham).

Time Tests Stay Positive

Alcohol	Up to 1 day
Amphetamine	1-3 days
Metamphetamine	1-3 days
Opiates	2-3 days
Methadone	2-3 days
Cocaine Metabolite	2-3 days
Benzodiazepines	2-7 days depending on usage
Cannabis	Up to 14 days depending on usage

Interference in Tests

1) False Positives may occur with the following compounds:
Amphetamine Screen ephedrine, L– amphetamine (Vick Inhaler), phenylpropanolamine, pseudofed, MDMA.

Opiate Screen Also detects codeine, pholcodine, dihydrocodeine

2) Adulteration Addition of lemon juice, vinegar, bleach, soap and salt may interfere with screening tests.

3) Manipulation The urine may be diluted. The pH may be manipulated to increase the effect of the drug, e.g. at acid pH >74% Amphetamine is excreted in 24 h. At alkaline pH 1% Amphetamine is excreted in 24h.

All urines are visually inspected and have pH and creatinine measured as part of the analysis.

pH should be between 4-9 and creatinine should be >2 mmol/L for valid screening test results.

Note that the laboratory provides a clinical service for drugs of abuse testing and does not undertake pre-employment, employment, insurance or medico-legal drug screens.

INFORMATION REGARDING EGFR (ESTIMATED GLOMERULAR FILTRATION RATE)

eGFR:

The laboratory reports eGFR on GP patients using the CKD-EPI 2009 equation (without ethnicity adjustment) as below:

This CKD-EPI equation calculation should be used when S_{cr} is reported in µmol/L. This equation is recommended when eGFR values above 60 ml/min/1.73m^2 are desired.

$$GFR = 141 \times \min(S_{cr}/\kappa, 1)^{\alpha} \times \max(S_{cr}/\kappa, 1)^{-1.209} \times 0.993^{Age} \times 1.018 \text{ [if female]}$$

Where:

S_{cr} is serum creatinine in µmol/L,

κ is 61.9 for females and 79.6 for males,

α is -0.329 for females and -0.411 for males,

min indicates the minimum of S_{cr}/κ or 1, and

max indicates the maximum of S_{cr}/κ or 1

The equation does not require weight because the results are reported normalised to 1.73m^2 body surface area, which is an accepted average adult surface area.

The laboratory currently does not report eGFR routinely on inpatients/outpatients. This is because estimating GFR is not suitable nor recommended in patients with unstable creatinine concentrations. Clinical judgement should be exercised when attempting to estimate GFR in such patients and where a reliable GFR is needed creatinine clearance (by measuring 24 hour urine creatinine and a paired serum creatinine) should be considered. For further information go to National Institute of Diabetes and Digestive and Kidney Diseases (https://www.niddk.nih.gov/health-information/professionals/clinical-tools-patient-management/kidney-disease) or https://www.niddk.nih.gov/health-information/professionals/clinical-tools-patient-management/kidney-disease/laboratory-evaluation/estimated-gfr-calculators/previous

Directory of Addresses for Reference Laboratories

Biochemistry Department
Alder Hey Children's NHS Foundation Trust
Eaton Road
West Derby
Liverpool
L12 2AP

Department of Newborn Screening and Biochemical Genetics
Birmingham Children's Hospital NHS Foundation Trust
Steelhouse Lane
Birmingham
B4 6NH

Department of Biochemistry
City Hospital **Birmingham**
Dudley Road
Winson Green
Birmingham
B18 7QH

Biochemistry Department
Central Manchester University Hospitals NHS Foundation Trust
Clinical Sciences (Building 3)
Oxford Road
Manchester
M13 9WL

The SAS Laboratories
Clinical Biochemistry & Medical Oncology
Ground Floor
Charing Cross Hospital
Fulham Palace Road
London
W6 8RF

Biochemistry Department
Christie Hospital
Wilmslow Road,
Withington
Manchester,
M20 4BX

Department of Clinical Immunology
Churchill Hospital
Old Road
Headington
Oxford
OX3 7LE

Blood Sciences
Countess of Chester NHS Foundation Trust
Liverpool Road
Chester
CH2 1UL

Department of Clinical Biochemistry
Glasgow Royal Infirmary University NHS Trust
84 Castle Street,
Glasgow
G4 0SF

Department of Chemical Pathology
Camelia Botnar Laboratories (Level 5)
Great Ormond Street Hospital for Children
Great Ormond Street
London,
WC1N3JH

Immunosuppression Monitoring Service,
Immunology Department
Royal Brompton & Harefield NHS Trust
Harefield Hospital
Hill End Road,
Harefield,
Middlesex,
UB9 6JH

Cheshire & Merseyside Regional Cytogenetics/Molecular Genetics Laboratory
Liverpool Women's Hospital
Crown Street
Liverpool
L8 7SS

Toxicology Laboratory
The Academic Centre
Llandough Hospital
Penarth
CF64 2XX

Supraregional **Protein Reference**
Department of Immunology
Northern General Hospital
P.O. Box 894
Sheffield
S5 7YT

Royal Devon & Exeter Molecular Genetics Laboratory
Barrack Road
Exeter
EX2 5DW

Clinical Chemistry
Royal Hallamshire Hospital
Glossop Road
Sheffield
S10 2JF

Clinical Biochemistry/Immunology/Microbiology Department
Royal Liverpool University Hospital
Liverpool Clinical Laboratories
LCL Clinical Support Services Building
Mount Vernon Street
Liverpool
L7 8YE

Department of Blood Sciences
Royal Victoria Infirmary
Queen Victoria Road
Newcastle Upon Tyne
NE1 4LP

Department of Clinical Biochemistry
Salford Royal NHS Foundation Trust
Level 2 Turnberg Building
Stott Lane
Salford
M6 8HD

Department of Clinical Chemistry
Sheffield Children's Hospital NHS Trust
Western Bank
Sheffield
S10 2TH

Southampton General Hospital
SAS Unit for Trace Elements
Chemical Pathology
Mail Point 804, Level D
Tremona Road
Southampton
SO16 6YD

Southmead Hospital
Blood Sciences & Genetics/ Microbiology Lime Walk Building
Westbury-on-Trym
Bristol
BS10 5NB

Department of Chemical Pathology & Metabolism
St Helier Hospital
Wrythe Lane
Carshalton
Surrey,
SM 1AA

Pathology Reception
Block 46
St James' University Hospital
Beckett Street
Leeds,
LS9 7TF

SAS Peptide Hormones
15 Frederick Sanger Road
Surrey Research Park
Guildford
Surrey
GU2 7YD

Synnovis
Central Specimen Reception
Friars Bridge Court
41-43 Blackfriars Road
London
SE1 8NZ

Synnovis (Viapath),
Kings College
Denmark Hill
London
SE5 9RS

Synnovis (Viapath),
Purine Research Lab
4th Floor North Wing
St. Thomas' Hospital
Lambeth Palace Road
London
SE1 7EH

Department of Clinical Biochemistry
UCL Hospitals 3rd Floor
60 Whitfield Street
London,
WIT 4EU

Department of Medical Biochemistry
University Hospital of Wales
Heath Park
Cardiff
CF14 4XW

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