East Lancashire Hospitals
NHS Trust
A University Teaching Trust

Blood Sciences Information for users

Contents

Section 1: General Information

Laboratory Locations

Royal Blackburn Teaching Hospital

The laboratory is situated on Level 0, Royal Blackburn Teaching Hospital, Haslingden Road, Blackburn BB2 3HH. During the hours of 9:00 to 17:00 Monday to Friday and Saturday 9:00 to 12:00, the Laboratory Reception is open. Outside these hours the outer doors will be open to Trust staff only to drop off specimens and for the collection of blood for transfusion. Only authorised persons will be allowed access to the laboratory areas. Patients do not attend the department for any blood sampling. Venepunctures are performed in the Out-Patients department.

Burnley General Teaching Hospital

The laboratory is in the Burnley General Teaching Hospital, Casterton Avenue, BB10 2PQ, close to the Elective Centre Entrance B/Endoscopy and Bowel Screening. Core hours are 09:00 to 17:00, Monday – Friday. Patient samples should be delivered to GP Practices where they will be collected by hospital transport. Out of hours there is no access to the laboratory and samples should be delivered to the laboratory at RBTH.

Point of Care Testing

The Point of Care team are based in Room ES1534, Physiotherapy, level 1, at Royal Blackburn Teaching Hospital and can be contacted on 82870 (01254 732870) during the hours of 08:00 to 16:00 (Monday to Friday). Outside these hours support is available from Biochemistry on 84156 or 01254 734156. Spare blood Glucose/ketone meters and a stock of associated consumables are kept in both the Blackburn and Burnley Blood Science Laboratories.

Blood Sciences Opening Hours

The department provides a full 24/7, routine diagnostic service including weekends and all statutory holidays. All samples will be analysed **as soon as possible** on arrival to the Laboratory, irrespective of the time of day or night. Core hours for Blood Sciences are 9 am to 5 pm. The out-of-hours service is manned by a limited number of staff between 5 pm and 9 am. Please keep use of the service to a minimum between these times to enable us to provide the most efficient urgent and emergency service in these periods.

For results and general enquiries please contact the laboratory on:

Blackburn	01254 73 4144	(internal 84144)
Burnley	01282 80 4507	(internal 14507)

For clinical enquiries relating to Biochemistry please contact a Clinical Biochemist:

Jane Oakey/Dr Natalie Hunt/ Chris Hughes	01254 74376	(Internal 84376)

01254 735927 (Internal 85927)

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Key Personnel & Contact Information

Replace leading 8 with 73 for external telephone number. (Regional Code = 01254)

Laboratory Enquiries

Blackburn	Results & Enquiries	84144
	GP Supplies	82974
Burnley	Reception	14507

Clinical Staff

Clinical Director	Dr Yacoob Nakuda	yacoob.nakhuda@elht.nhs.uk
Consultant Clinical Biochemists	Jane Oakey	84153
	Dr Natalie Hunt	85927
	Chris Hughes	84376
Consultant Haematologists	*Contact via switchboard*	

Directorate Staff

Directorate Manager	Amanda Southworth	84162
Pathology IT Manager	Samuel Bolton	82473
Quality Manager	Tina Cuthbertson	82488

Lead Biomedical Scientists

Biochemistry	Diane Giles	82490
Haematology	Bilal Patel	82458
Blood Transfusion	Lee Carter	84190

Transfusion Practitioners	Mary Sokolowski	82498
	Gillian Smith	85760
	Maariyah Anwar	83568

Point of Care Testing Team	Samantha Kelsall	82870
	Jessie Higgins	
	Shamira Valli	

Stephanie Slater

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Request forms and identification policy

To ensure rapid return of results to the originating source, request forms and sample containers must be fully identified. This should include:

Key request form identifiers:

- **Forename and Surname**
- **Hospital or NHS number**
- **Date of Birth**
- Address where possible
- Gender
- **Location**
- **Requestor's name**
- Type of specimen
- **Date and time of sample collection**
- Tests required
- **Ethnic Origin for Family Origin Questionnaires**
- All relevant clinical data

Key specimen container identifiers

- **Forename and surname**
- **Date of Birth**
- **Time and date of collection**

Points indicated in **RED** are mandatory requirements.

The laboratory will not process requests where there is insufficient information for unequivocal identification of the patient. Any sample that does not comply with the specimen acceptance policy and/or require further clarification for testing will be communicated to users. Materials used for sample collection must be disposed of safely in accordance with the ELHT Healthcare Waste Policy. In line with UKAS standards (7.2.3.1), each request accepted by the laboratory for examination(s) shall be considered an agreement to perform analysis and communicate results.

Data protection
All data and patient information will be handled in line with Trust Policies 'Guide to Data Protection' and C077 'Confidentiality of Personal Information'.

Specimen Transport

Air tube system
An air tube system is available for transporting samples to the laboratory's main specimen reception from departments within the hospitals.

Air tube Policy

- All samples must be in a sealed specimen bag attached to a completed request form before being placed in the carriers.
- Carriers must contain bubble wrap and be closed securely at both ends. (Bubble wrap available)
- This system is available for Biochemistry and Haematology and Microbiology samples 24 hrs a day 7 days a week.
- During normal working hours, bulky/heavy samples (e.g. 24 hour collection bottles), patient collected samples (e.g. semen samples) and samples for histology should be delivered by hand to laboratory reception.
- Only one set of Blood Cultures (not glass) should be placed in a carrier at one time.

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Do **not** send any of the following samples via the pneumatic air tube:

- Blood gas samples
- Glass containers
- Any leaking sample
- Items over 1.5kg
- Any sharps
- Any histology samples in formalin
- Cytology samples.
- CSF samples
- Any samples requiring immediate processing (within 30 minutes) e.g. insulin, C-peptide, renin

Due to the pressure and vibration in the air tube, it is important to ensure that tops on bottles are tightened correctly in order that samples do not leak.
It is important that samples are batched where possible to reduce the traffic of carriers in the Pathology Reception.
With the exception of transfusion, there is no need to telephone the laboratory for urgent work sent by the pneumatic air tube system.

Packaging and Transport of Specimens

Biological specimens are a potential hazard to staff, (including GP practice staff, transport drivers, porters, laboratory staff) and the general public if not packaged and transported correctly to the laboratory .

All specimens, including emergency specimens must be transported in the approved manner to conform to Health and Safety requirements (i.e. in sealed plastic bags). Caps/lids on specimen containers must be secure.

When emergency samples are transported out of hours they must be sealed in the polythene sealable bag attached to the request form.

Samples should be transported to the laboratory at a temperature and within a timescale that does not cause degradation of the sample. Unless otherwise noted, samples should be transported at ambient temperature and arrive at the laboratory no more than 10 hours after the sample is collected. For GP surgeries the laboratory has transport runs designed to ensure these parameters are met.

Blood gas samples:

- Must have an identification label or patient's chart with minimum of Hospital number and Surname.
- If sending a sample for blood Gas analysis to the laboratory, print an ICE request form and place the capped sample in specimen bag attached to ICE form, hand deliver, do NOT send via Pneumatic Air Tube.
- Any delays in transporting samples for blood gas ensure sample is capped and placed on ICE/water slurry.
- If analysing Blood Gas at a Point of Care ward analyser: always carry capped sample on a clean blue tray, mix sample well before presenting to analyser for sampling and ensure patient identification is present such as PAS label, patient chart or CAS card. Blue trays must be cleaned and returned to store after use.
- Samples are stable for 15 minutes room temperature and 60 minutes on ice/water slurry.

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High Risk Specimens

For transport of specimens from patients with confirmed or suspected COVID-19 infection, please refer to the latest guidance on the ELHT sharepoint (triple bag and clearly mark as 'COVID-19).

Other high risk are defined as specimens taken from cases of:

- Confirmed or suspected Hepatitis B infection of HBsAg carriers.
- Confirmed or suspected HIV infection.
- Infection or suspected infective disease of the liver.
- Confirmed or suspected enteric fever.
- Confirmed or suspected TB.
- Confirmed or suspected vCJD
- Any other confirmed or suspected high risk disease (if suspected Hazard Group 4 pathogen (e.g. viral haemorrhagic fever ((Lassa, Marburg, Ebola and Congo-Crimean), or Hendra or Nipah viruses, specimens should not be collected without prior consultation with the on-call Microbiologist.

All specimens from known or suspected cases must be sealed within the plastic sample bag or the smaller compartment of a plastic minigrip bag and the request form (if not the attached type) inserted within the larger compartment.

A "Danger of Infection" label must be placed on the request form, specimen and plastic bag. Pins, staples, etc must not be used to seal bags. Please indicate the nature of the risk on the request form. To retain

confidentiality, yet ensure safe handling and analysis, the phrase "Blood Borne Virus Infection" can be used for proven or suspected cases of HIV or Hepatitis B or C infection.

Ward Based Results Access

The majority of wards and departments within the Trust are able to access the Anglia ICE System to enquire on patient's results. Access is only available to staff who have an individual User ID and Password. To obtain a User ID please contact the IT help desk on extension 83135

Patient Search Instruction:

To reduce the risk of errors when searching for patient details and results the following method of searching should be adopted by all staff using the Computer systems:

ICE system:

1. Log into the ICE system
2. Select the patient search option.
3. Enter your patient's RXR, surname, forename. Press ENTER
4. Select the required patient record by clicking on that row.
5. All the results for this patient will now be displayed. Click on the row to display the required results.
6. Note there is also an option to display results by ward/location.

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Accessing Patient's INR Dosage:

1. Use the ICE system as described above to access the patient record.

2. All INR results and patient dosing schedules are directly available in the patient record within the ICE system.

Primary Care Users Results Access

Primary Care results are transmitted to ICE at set times throughout the day. Results are then transmitted from ICE into the practice IT systems.

If a Primary Care result is required **urgently**, please telephone the laboratory to check if the results are available rather than waiting for the results to go back to EMIS.

Critically abnormal results

Critically abnormal results will be phoned back to the requestor in accordance with the Royal College of Pathologists guidance on the communication of critical and unexpected pathology results.

Complaints

Any complaints about the service should be directed to the Lead Biomedical Scientist in the first instance via telephone or email.

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Section 2 – Biochemistry and POCT

Blackburn

Biochemistry Lab 84156 (01254 734156)

Bleep 021

Burnley Site

Biochemistry Lab 13018 (01282 803018)

The following routine biochemical profiles are available using brown top serum tubes:

Profile	Tests in profile
Renal	Sodium, Potassium, Urea, Creatinine
Liver	Total Bilirubin, ALT, Alkaline phosphatase (ALP), Albumin
Bone	Calcium, Adjusted calcium, Alkaline phosphatase (ALP), Albumin, Total protein
Lipid	Cholesterol, Triglycerides, HDL, LDL, total cholesterol/HDL ratio, non-HDL cholesterol

In cases where a previous potassium result is suspected to be falsely raised due to the patient having a high concentration of platelets or white cells, a lithium heparin tube (orange top) may be used. **Please note, however, that this sample type may be unsuitable for other tests and a brown topped serum tube should accompany the lithium heparin sample if other tests are required.**

Common sample types

The vast majority of tests can be performed on serum gel tubes (brown top) with the exception of the following tests:

Glucose: Yellow top (fluoride EDTA)

Lactate: Yellow top (fluoride EDTA)

PTH: Pink top (EDTA)

HbA1c: Purple top (EDTA)

NT-proBNP: Orange top (lithium heparin)

Blood gas (sent to laboratory)

- Use balanced Lithium heparin preservative for capillary or syringe.

- Venous samples for carboxyhaemoglobin should be collected into a lithium heparin tube (orange top)
- For capillaries advise mixing with metal mixer and magnet to prevent clotting

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24 hour urine collection procedure

Patient information leaflets and collection containers are available from Specimen Reception. Sample type required will vary depending on test. Please see 'A to Z of urine tests' for information regarding correct specimen container to use. Please do not discard any liquid or powder which may be in the bottles provided. This acts as a preservative for the sample. Please ensure that the urine bottles are fully labelled with patient identifiers (name and date of birth).

Appropriate use of diagnostic tests

Minimum retesting intervals are defined as the minimum time before a test should be repeated, based on the properties of the test and the clinical situation where it is used. Minimum retesting intervals are in use dependent on local criteria and based on the Royal College of Pathologists National Minimum Retesting (MRI) Intervals. Users are alerted to requests that breach MRIs by prompts when electronically requesting tests. If a MRI prompt is over-ridden, a comment explaining the reason must be provided.

Diagnostic test algorithms are available when electronically requesting certain tests (e.g. Vitamin D). These prompt the requestor to answer questions designed to determine if the request is appropriate.

For further information on minimum retesting intervals and diagnostic test algorithms, please contact the Clinical Biochemists.

Allergy testing

Below is a list of allergens tested at the RBTH Laboratory. Careful history taking (including a food diary where appropriate) should be able to identify a likely cause and specific tests should only be requested if exclusion is not possible. Please do not "blanket" request specific IgE tests and include all relevant clinical details on the form as failure to do so may result in the relevant request not being processed.

- Mixed foods panel: Egg white, milk, cod, wheat, peanut and soya
- Mixed tree panel
- Mixed mould panel
- House dust mite
- Timothy grass
- Egg white
- Egg yolk
- Milk
- Codfish
- Soybean
- Wheat
- Aspergillus fumigatus
- Cat
- Dog

- Peanut
- Latex
- Nut panel (available in children only and referred to Immunology at the Royal Preston Hospital): peanut, hazelnut, almond, cashew nut, brazil nut and walnut.

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Dynamic function testing

A separate guide is available for dynamic function testing and this is available on the intranet in the Pathology section.

Drugs of Abuse

Samples are referred to the Biochemistry Laboratory at Salford Royal Hospital for urine drugs of abuse analysis. Confirmatory testing is performed routinely on every sample. A random sample in a plain container is required.

Opiates / Opioids	**Cut-Off** ***(ng/mL)***	**Benzodiazepines**	**Cut-Off** ***(ng/mL)***
Morphine	300	Diazepam	100
Codeine	300	Nordiazepam	100
6-Monoacetyl Morphine	10	Oxazepam	100
Acetyl Codeine	5	Temazepam	100
Dihydrocodeine	300	Alprazolam	100
Methadone	250	Lorazapam	100
Methadone Metabolite (EI	75	Clonazepam	100
Buprenorphine	5 *	Nitrazepam	100
Norbuprenorphine	5 *		
Oxycodone	100	**Others**	
Norfentanyl	10 *	Cocaine metabolite (BEC)	100
Tramadol	100	THC Cannabis metabolite	15
		Pregabalin	200 *
Amphetamines		Gabapentin	200*
Amphetamine	200	Ketamine	25 *
MDMA	200		
Metamphetamine	200		
		Urine Creatinine	

**Local and literature cut-offs apply*

All drugs in the panel will be reported as 'Detected' or 'Not Detected against cut-off concentrations. New cut-off concentrations will be applied as per **European Workplace Testing Guidelines (EWDTS) unless otherwise indicated (*).** These are detailed alongside the drugs in the table above.

Routine turnaround time= 5 working days from sample receipt.

Extended urine drugs screening or detection of other drugs not included in the standard screen may be possible. Please contact the Clinical Biochemist to discuss further.

All paediatric samples for urine drugs of abuse analysis must be accompanied by a chain of custody form.

For further information, please contact the Clinical Biochemists.

Interpretation of Results

Reference ranges are displayed together with the result on every report. It is important to always refer to ranges provided by the reporting laboratory. In addition, please note that on statistical grounds, 5% of the 'normal' population will have results which lie outside the quoted reference range.

A variety of factors such as age, sex, ethnicity, exercise, diurnal rhythm and drugs can affect biochemical results. The method of collection and storage (e.g. venous stasis on calcium, delayed separation of serum on potassium), can also affect the interpretation. Analytical and biological variation must always be taken into account, especially when determining whether a change over time is significant.

The laboratory can provide advice on the uncertainty of measurement of the tests appearing in the list below, upon request.

Critical results will be telephoned to service users in accordance with local criteria based on the Royal College of Pathologists' guidelines.

Blood Sciences can only accept supplementary test requests on the day of sample collection or on the following day and providing the request is appropriate. This will depend on sample stability, tube type and for some tests including therapeutic drug measurement and Troponin I, there will be timing restrictions.

The following tests CANNOT be added on: lactate, ammonia, bicarbonate and LDH.

To order add on requests send a supplementary request form (a supplementary request form is available on ICE and must be sent to the laboratory). Verbal supplementary requests will not be processed until a suitable supplementary request form has been received.

Please note that supplementary requests will be treated as routine. If the request is urgent, it is recommended that another sample is taken.

Genetic Tests

Genetic testing for a range of conditions may be available through the Regional Genetics Service in Manchester. However, it is advisable to contact the centre directly prior to requesting such tests as access to specific counselling services may be required. It is necessary to complete a specific form for genetic requests (available from the link below) which includes a declaration of consent. Samples will not be forwarded to Manchester for analysis without this form.

Further information on genetic tests and the request forms are available on the Manchester Genetics website:

https://www.mangen.co.uk/order-a-test/

https://mft.nhs.uk/nwglh/documents/

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Faecal tests

Reducing substances

Please collect the stool sample in a blue top stool collection bottle. **Samples must arrive at the laboratory within 2 hours of collection with a clear indication of collection time**. Failure to include this information will result in the test being rejected.

Elastase

Please collect the sample in a blue top stool collection bottle. Interpretation of results is provided by the referral laboratory.

Calprotectin

Please collect the sample in a blue top universal faeces container. Interpretation of results is provided by the referral laboratory.

Faecal Immunochemical Test (FIT)

This test is available to Primary Care requestors and is used to detect haemoglobin in faeces. The special FIT collection tube must be used. The FIT collection tubes and patient instructions on how to collect samples are available from Pathology. It is recommended that patients collect two separate samples from two different stools.

This test is performed within the department. FIT results are reported numerically and as Positive or Negative using a cut-off of 10µg Hb/g faeces. An information sheet on when to request FIT and the interpretation of results has been circulated to all practices.

Samples referred to other laboratories

When the laboratory does not offer a particular test, samples will often be referred to an external laboratory. The laboratory has a list of referral laboratories for each test and this list is available upon request.

For more esoteric tests that do not appear within the ICE requesting system, please ring the Duty biochemist (via the general enquiry number) to discuss the request **BEFORE** arranging to take the sample, so that appropriate instructions can be given.

The majority of laboratories to which samples are referred are UKAS accredited. However, individual circumstances may arise whereby tests are referred to a non-accredited laboratory. This decision will be made at the discretion of the Head of Department or their deputy.

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Point Of Care Testing

Point of Care Testing is defined as “any Clinical Laboratory Medicine test performed for a patient by a healthcare professional outside the traditional centralised laboratory” by the Medicines Health Regulatory Authority (MHRA). ELHT Point of Care Testing policy is available on Trust Intranet Policy CP28.

Golden Rules

- Do not use any Point of Care Device until you have received training from the designated Trainer.
- Always use your own password and never share your password with anyone.
- Always identify your patient correctly on the Point of Care Device – remember to prefix RXR before 7 numerical digits for the hospital number.
- Always follow the latest Standard Operating Procedure (SOP) for the device available from the hospital intranet.
- Do not use any Point of Care testing device which has failed its Quality Control checks.
- Report any device breakdowns or problems to the ELHT Point of Care Team.
- All Patient results are confidential and must be kept securely.
- Any incidents related to Point of Care testing must be recorded on the ELHT incident management system.
- Any new Point of Care Device must be approved by ELHT Point of Care Testing Governance Committee and follow procedure in policy ELHT/C015 (Policy for Introducing New Clinical Techniques or Procedures and new Point of Care testing Devices).

POCT Team Contact Details (Mon – Fri 8am-4pm)

01254 732870 (Ext 82870) pointofcare@elht.nhs.uk

Samantha Kelsall POCT Coordinator samantha.kelsall@elht.nhs.uk

Jessie Higgins POCT Practitioner jessie.higgins@elht.nhs.uk

Shamira Valli POCT Associate Practitioner shamira.khalifa@elht.nhs.uk

Out of Hours contact Biochemistry Ext: 84156 or 01254 734156

Point of Care Testing requirements

POCT Tests	POCT analyser/meter	Preservative	Minimum volume
Blood Gas and cooximetry	Werfen GEM 5000	Balanced Lithium heparin, syringe/capillary	3 mL, syringe 150 µL all tests 150 µL, full capillary 150 µL all tests 150 µL, half full capillary 65 µL all tests *except tHb, O2Hb, COHb, MetHb*
Blood glucose	Nova StatStrip	n/a	1 drop blood
Blood ketone	Nova StatStrip	n/a	1 drop blood from finger prick for POCT meter or send to Lab with ICE form in Li heparin tube minimum 0.5ml venous blood if no meter on department
Blood Haemoglobin	Hemocue analyser	n/a	2-3 drops whole blood from finger prick
Urine Dipstick	Visual read or Sterilab urine analyser	Plain container no preservative	Volume to allow all test pads to be dipped in urine sample
Blood INR	Roche CoaguChek	n/a	1 drop 8 µl
HbA1c	Abbott Afinion 2	Use Afinion sampling device	1.5 µl blood

Point of Care Blood Gas Samples:

- Expel all air and ensure no air bubbles present in sample.
- Ensure samples are mixed well before presenting to the analyser for sampling.
- Samples stable for 15mins room temperature and 60mins on ice/water.
- Note there is no haemolysis detection on point of care blood gas analysers, confirm potassium before clinical decision by venous sample sent to laboratory.
- For capillaries advise mixing with metal mixer and magnet to prevent clotting.
- All users of Point of Care blood gas analysers must have received training and their own user barcode which **must not be shared** with anyone else and must complete required updates at set time periods.
- All point of care blood gas users are responsible for identifying patient blood gas samples on the blood gas analysers and checking the details on the print out.

- Minimum identifiers are hospital number and surname, PAS label, wristband, CAS card labels can be scanned, DO NOT Scan the barcode on ICE Blood request forms (this is not the hospital number).

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Section 3 – Haematology

Routine Investigations *(please refer to Appendix 1 for paediatric full blood count reference ranges)*

Investigation	Reference range	Approximate turnaround time from receipt of sample in the laboratory	Tube type	Comments/ Special Precautions
Full Blood Count		Urgent: 1 hr In patient: 4 hrs GP/OPD: 12 hrs	EDTA (pink)	Please provide clinical details
Haemoglobin	Male 130-180 g/L Female 115-165 g/L			
White cell count (WBC)	4.0-11.0 10*9/L			
Platelets	150-450 10*9/L			
Red cell count (RBC)	Male 4.50 - 6.50 10*12/L Female 3.8 - 5.5 10*12/L			
PCV	Males 0.40 – 0.50 Females 0.36 – 0.46			
MCV	76-100 FL			
MCH	27.0-32.0 pg			

MCHC	310-360 g/L			
Reticulocytes	**20-120** 10*9/L	Urgent: 1 hr In patient: 4 hrs GP/OPD: 12 hrs	EDTA (pink)	Can be analysed on FBC sample
IM Screen		Urgent: 2 Hrs Other: 12 hrs	EDTA (pink)	Can be analysed on FBC sample
Malarial Parasites		Screening Test 2 Hours Confirmation Test 24 Hours	EDTA (pink)	Can be analysed on FBC sample. Please state any countries that the patient has recently visited. Be aware that the screening kit is not reliable for the detection of P.knowlsei.
Haemoglobinopathy Screen	**(Adult Ranges)** **Hb A2 2.2 – 3.5 %** **Hb F 0 – 1.8 %**	72 hours	EDTA (pink)	Can be analysed on FBC sample For antenatal requests please use the family Origin Questionnaire (FOQ). For other requests use the standard blood science request form and ensure that consent is taken.
Hb S Test		2 hours (urgent)	EDTA (pink)	Other than for urgent cases request a Haemoglobinopathy screen
WBC Differential	**(adults** -10*9/L **)** **Neuts 2.0-7.5** **Lymphs 1.5 – 4.0** **Monos 0.5 – 1.5** **Eos 0.1 – 2.5** **Basos 0.0 – 0.1**	72 Hours	EDTA (pink)	This will be reflexed by the laboratory depending on the FBC results. Please provide clinical details
ESR	Male 1-10 mm/hr Female 3-15 mm/hr	Urgent 2 Hours Routine 12 Hours	Purple ESR Tube	These samples must not be under filled Labels must not obscure the read area.
WBC (Fluid) Including Ascitic and pleural fluid		In patient: 4 hrs	EDTA (pink)	Pleural fluids will not be tested on positive COVID samples

Coagulation

Test	Reference Range (Adults Only)	Turnaround Time from receipt of sample in the laboratory	Tube type	Comments/ Special Precautions
Prothrombin Time/INR		Urgent: 1 hrs In Patient: 4 hrs GP/OPD: 12 hrs	Citrate (Green)	These samples must not be underfilled or overfilled Samples to be received within 12 hours of collection

APTT		Urgent: 1 hrs In Patient: 4 hrs GP/OPD: 12 hrs	Citrate (Green)	These samples must not be underfilled or overfilled
Coagulation Screen	INR 0.9 - 1.2 seconds APTT 0.9 - 1.18 seconds	Urgent: 1 hrs In Patient: 4hrs GP/OPD: 12 hrs	Citrate (Green)	These samples must not be underfilled or overfilled Samples to be received within 12 hours of collection • If the patient is on Warfarin please request INR • If the patient is on Heparin please request APTT If Coagulation Screen is requested for patients on Anticoagulants the turnaround times will be affected
D-Dimers	<500 ng/mL Fibrinogen Equivalent Units	Urgent: 1hrs In Patient: 4 hrs GP/OPD: 12 hrs	Citrate (Green)	These samples must not be underfilled or overfilled
FDPs		This assay is no longer available. Use D-Dimer/fibrinogen instead		
Fibrinogen	1.5 – 4.5 g/L	Urgent: 1hrs In Patient: 4 hrs GP/OPD: 12 hrs	Citrate (Green)	These samples must not be underfilled or overfilled
Thrombin time	10 – 16 seconds	Urgent: 1hrs		These samples must not be underfilled or overfilled

EDTA Samples are only stored for 24 hours to allow add on requests. Coagulation samples are stored for 24 Hours.

Thromboelastography

Also known as ROTEM or TEG (Company brand name) is no longer performed in the laboratory at ELHT. This testing is carried out in Theatres, at RBTH, as point of care.

Thrombophilia Screening

Thrombophilia screens for Obs/Gynae and Maternity services are filtered through referrals via Maternity services.

- The patient must not be in the acute phase of any event
- The patient should not be currently pregnant
- The patient should not be on any anti-coagulants

A Thrombophilia screen will consist of:-

Anti-Thrombin III , Protein C, Protein S , Fibrinogen, Lupus Screen, Factor V111, Factor V Leiden, Prothrombin Gene Variant, Cardiolipin Antibodies and Anti-Beta 2 Glycoprotein 1.

Sample requirements for this will be 2 x 7mL Green Citrate (or 5 x 3 mL Green Citrate), 2 x Brown Clotted and 2 x Pink EDTA.

Test	Turnaround Time	Tube type
Lupus Screen only	14 Days	2 x 3ml citrate (Green)
Factor V Leiden only	14 Days	2 x EDTA (Pink)
Prothrombin Gene Variant Only	14 Days	2 x EDTA (Pink)

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Miscellaneous tests

Test	Turnaround Time	Tube type	Comments/ Special Precautions
G6PD	Urgent : 12 hrs Routine : 48 hrs	EDTA (pink)	Can be analysed on FBC sample
Cell marker studies/CD4	10 Days	2x EDTA (Pink)	Samples must be received in laboratory on Monday-Wednesday
Jak2	28 Days	EDTA (pink)	Performed following discussion with Consultant Haematologist
BCR-ABL	28 Days	EDTA (pink)	Performed following discussion with Consultant Haematologist

Plasma Viscosity	14 days Reference range = 1.45 – 1.8	EDTA (pink)	
Anti-Xa	Urgent 4 hours	2 x Citrate (Green)	Pre and post dose should be specified on the form. Test performed at CMFT

Factors Affecting Results

Clotted and haemolysed samples are unsuitable for testing. Lipaemic samples may give erroneous results and therefore may be unsuitable for testing. Small samples may be insufficient for testing but paediatric blood tubes are available for babies and children allowing for a smaller sample of blood to be tested.

Samples stored at temperature outside of 2-25^{o}C may exhibit haemolysis and therefore will be unsuitable for testing.

Anticoagulant Therapy

Follow the Directorate of Medicine protocol –available on all wards

Supplementary Requests

Haematology can only accept supplementary requests on samples previously referred to the laboratory up to 72 hours after receipt of the original request and providing the request is appropriate. This will depend on sample stability and tube type. To order add on requests send a supplementary request form (a supplementary request form is available on ICE and must be sent to the laboratory). Verbal requests for add tests should have a confirmatory ICE supplementary request form sent immediately.

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Section 4 – Blood Transfusion

Blackburn Site

Telephone Transfusion lab	84529 (01254 734529)
Outside core hours	Bleep 019

Burnley Site

Telephone Transfusion Lab:	14318 (01282 804318)
Outside core hours:	Bleep 020

Requesting Procedure

Use blue labelled BTS sample tubes.

For transfusion requests within the hospital, requests should be completed on Cerner and printed. Complete the date/time of collection and taken by signature should be written on the Cerner form by **ballpoint pen.**

Requests from outside the hospital, complete all the patient details on the special blood transfusion request form by **ballpoint pen**. **Blood transfusion fatalities are most often caused by clerical error** - double check that the information on the request form and the blood tube are complete and correct. If the data supplied is incomplete, Blood Transfusion staff cannot accept the blood specimen. **USE ONLY BLOOD TRANSFUSION TUBES.**

The patient's full name, DOB, Hospital number (RXR / MRN) or NHS number and date/time of collection should be on the sample tube and form.

Pre-printed labels must not be used on sample.

Requests for newborn group and DCT may be made using ICE Desktop.

Transfusion indication codes for: red cells, platelets and fresh frozen plasma, are given on the reverse of the manual request form.

Clinical details must be provided on the request.

Both the request form and the sample must be signed by the person taking the blood. Any requests/bottles not meeting this requirement will be rejected and a new request form and sample will be required**.**

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Timing of Requests

Before blood can be issued a group and antibody screen needs to be undertaken. This takes approximately half an hour from the time of receipt into the laboratory.

If atypical antibodies are present the time required will be increased depending on the complexity of the case.

Requests for emergency issues of blood must be made by telephone or removed from the remote issue blood banks, that are located on each hospital site. Blood is issued for definite use only.

Where a patient has had only one grouping episode a second sample should be sent for grouping before blood is issued. Where the subsequent time delay would have clinical implications blood will be issued off a single grouping sample and the compatibility report will have comments to reflect this

Emergency O Negative and O Positive un-crossmatched blood is available for emergency use.

Location of Blood Fridges

Royal Blackburn Teaching Hospital

Pathology Laboratory, Level 0, Royal Blackburn Hospital

Blood room (Opposite Radiology) Level 1, Royal Blackburn Hospital

Burnley General Teaching Hospital

Outside the entrance door to the Blood Sciences Laboratory, Ground floor, Wilson Hey.

Obstetric Theatres – Kiosk fridge. Only houses emergency units, both adult and paediatirc.

Electronic Issue

Blood is only issued for definite use. If the patient has a current valid blood group and antibody screen result on the laboratory system and has no antibodies, group specific blood can be issued in 10 minutes or be collected from the remote issue fridges.

Patients must have a current and valid blood group and antibody screen on the laboratory system (no longer than 3 days ago), before the proposed transfusion date.

If the patient has blood group antibodies at least 24hrs notice is required for compatible units to be issued.

Please note: Group and antibody screen and saved plasma, before surgery, can considerably reduce the time to supply blood, if no blood group antibodies are present. Ideally, a patient's sample will be taken on admission, or as near to the procedure as possible. An exception to the 3 day (72hr) time limit is possible, but only under urgent circumstances. Please consult with the laboratory for guidance.

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What to request

Group and Antibody Screen
A hand written EDTA sample:

- 7.5ml sample for an adult
- 2.7ml or 1.2ml sample for a child/baby.

Factors affecting results: Clotted and haemolysed samples are unsuitable for testing. Lipaemic samples may give erroneous results and therefore may be unsuitable for testing. Small samples may be insufficient for testing but paediatric blood bottles are available for babies and children, allowing for a smaller sample of blood to be tested.

Samples stored at temperature outside of 2^{o}C to 25 ^{o}C may exhibit haemolysis and therefore will be unsuitable for testing. Samples should be tested within 72 hours.

Senior BMS staff can be contacted for further advice on sample testing and factor affecting results. Clinical advice can be obtained from the Haematology Consultants.

Red Cells (Leucocyte depleted)
Each pack contains approximately 350 mL. One donor pack will raise the haemoglobin in an average sized adult by about 10 g/l.

In cases where multiple packs are issued for urgent use i.e. trauma, these can be issued in a specially insulated transport container for local storage up to 1.5 hours before transfusion.

Fresh Frozen Plasma (FFP)
The patient's blood group is required.
This product is stored at below minus 30°C and requires about 40 minutes to thaw out before use.
The volume is 180 mL per pack and should be transfused as soon as possible after thawing.
Coagulation results are usually required before decision on number of units required is taken.
The ward will be informed when the FFP is ready for collection from the appropriate location

Factor VIII and IX
Freeze-dried product is available via the haemophilia centre on a case by case basis. Some other single or combined clotting factor freeze-dried concentrates may be available from Regional Blood Transfusion Centres.

NOVO SEVEN

Activated Factor VII is not held in stock but is available in cases of massive blood replacement after discussion with the Consultant Haematologist on call.

Platelet Concentrates

The blood bank, on the RBTH site, routinely holds one adult therapeutic dose of group A RhD Positive platelets. Specially selected platelets are available on request and are ordered in from NHSBT.

The patient's blood group is required.

Units must be collected directly from Blood Transfusion Laboratory. Platelets are never to be stored in the fridge.

Anti-D

Anti-D is available as follows: Rhophylac (1500IU).

This is the standard dose for both sensitizing events and prophylactic anti-D clinic

Albumin

Human Albumin solution (NB: patient's blood group (Sample) is not required) units will be available from the site specific laboratory. Albumin is stored at 2-25°C.

Albumin is to be requested on a named patient basis only. It is also to be requested for definite use, not for “standby” purposes. It is not to be stored on the wards. Any albumin that is unused must be returned to the laboratory within 24 hours.

Albumin is available in the following concentrations and sizes:

5%	500ml or 250ml
20%	100ml

Note: when completing the transfusion form for an albumin request, please specify:

1. The concentration of albumin required.
2. The volume of albumin, i.e. how many mls
3. The time for when the albumin is required.

Any missing information will cause a delay in the product being issued.

Beriplex

Available in 500IU doses. Dosage is dependent on patient’s weight and INR. See package insert for calculation.

Suspected Transfusion Reactions

If a transfusion reaction is suspected STOP the transfusion immediately.
All suspected reactions must be reported immediately to the Consultant Haematologist or senior Laboratory staff.
The laboratory will issue a form which must be completed and returned immediately to allow full investigation.

Miscellaneous Requests

Tissue Typing/HLA Typing
7.5 ml blood transfusion tube required for HLA B27, HLA Class I and II typing, HLA DQ2/DQ8. Also, 10 ml clotted blood required if for tissue or organ transplant together with a Haematology/Biochemistry combined request form.

Direct Antiglobulin Test (DAT) – also known as Direct Coombs Test (DCT)
An EDTA sample is required together with a fully completed Transfusion request form.

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Kleihauer/Betke (KIB)
Collect a 7.5ml blood transfusion sample from both cord and mother's blood after delivery and send within 12 hours of collection together with a fully completed Blood Transfusion combined request form. Immunoglobulin Anti-D must be administered within 72 hours of delivery. The standard dose of 1500 is suitable for clearance of <12mls of foetal red cells. A Kleihauer is not required for patients under 20 weeks gestation. Turnaround time for Kleihauer is 24 hours.

White Cell Antibodies (Possible Cause of Some Blood Transfusion Reactions)
10 ml clotted blood and a Transfusion Sample and a Transfusion request form.

Platelet Antibodies (Possible Cause of Blood Transfusion Reaction)
Contact Blood Transfusion for request form and sample requirements. Samples should arrive in the Laboratory before 12.00hrs Monday to Thursday only, excluding Bank Holidays, for referral on to the Blood Transfusion Centre.

Foetal DNA

Collect a 7.5mL Blood transfusion sample, together with a request form stating the expected date of delivery (EDD). Turnaround time for Foetal DNA is 2 weeks.

Turnaround Times

Specimen	Frequency of Testing	Time to Result
Group and Save	Daily on request	6 Hours
Cross match	Daily on request	Blood can be provided in an emergency within 15 minutes
Fresh frozen plasma	Daily on request	2 hours

Concentrated platelets	Daily on request	Dependant on onsite stock availability. Otherwise ordered in from NHSBT. If required in an emergency “Blue Light” can be ordered. 80 minute delay.
Direct Antiglobulin Test	Daily on request	6 hours
Non-urgent antibody identification	Daily on request	12 hours
HLA-Typing	Daily on request	21 Days
WBC + Platelet antibody screens	Daily on request	21 Days

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Section 5 – Biochemistry test list A–Z

Blood/serum/plasma

This table covers the majority of available tests that are performed at ELHT; other tests are available but are analysed at other laboratories. Please contact the Blood Sciences department for information regarding any test not listed. Unless specified, the reference ranges supplied in the handbook can be assumed to be for adults. In some cases, age related reference ranges may apply. It should be noted that results outside the reference range do not necessarily indicate disease. Similarly, results within the reference range do not preclude abnormality.

The laboratory will endeavour to meet the turnaround times stated. However, in exceptional circumstances this may be prolonged.

In most circumstances only one tube will be sufficient for all the tests required on that tube type. When requesting tests on ICE the system will indicate the number of tubes required.

Please note that any deviations from the stated sample tube type must be discussed with the laboratory prior to sample collection. Different tube types may not be suitable for the requested tests.

Frequency of testing

The analytes listed in the table below are routinely analysed daily with the exception of the following

ACE, C3, C4 – referred to external lab daily

Growth Hormone – analysed weekly

Protein Electrophoresis, Cryoglobulins – Daily Monday - Friday

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<table>
<tr><th>Analyte</th><th>Reference range</th><th>Approximate turnaround time*</th><th>Tube type (Sarstedt)</th><th>Comments</th></tr>
<tr><td>ALT
(Alanine transaminase)</td><td>7-40 IU/L</td><td>4 Hours</td><td>Brown</td><td></td></tr>
<tr><td>Albumin</td><td><table><tr><th>Age</th><th>Ref. range</th></tr><tr><td><1 yr</td><td>30-45 g/L</td></tr><tr><td>1-16 yrs</td><td>30-50 g/L</td></tr><tr><td>>16 yrs</td><td>35-50 g/L</td></tr></table></td><td>4 Hours</td><td>Brown</td><td></td></tr>
<tr><td>ALP (alkaline phosphatase)</td><td><table><tr><th>Age</th><th>Female Reference Range (IU/L)</th><th>Male Reference Range (IU/L)</th></tr><tr><td>0 - <6 months</td><td colspan="2">145-495</td></tr><tr><td>6 months - <1 year</td><td colspan="2">155-404</td></tr><tr><td>1-9 years</td><td colspan="2">149-349</td></tr><tr><td>10-11 years</td><td colspan="2">186-440</td></tr><tr><td>12-14 years</td><td>76-419</td><td>202-618</td></tr><tr><td>15-17 years</td><td>54-143</td><td>59-294</td></tr><tr><td>>=18 years</td><td colspan="2">30-130</td></tr></table></td><td>4 hours</td><td>Brown</td><td>Age and gender related reference ranges apply</td></tr>
<tr><td>Alpha feto protein (AFP)</td><td>0-6.6 kU/L</td><td>Next day, Mon-Fri</td><td>Brown</td><td></td></tr>
<tr><td>Amikacin</td><td>No reference range quoted.

Refer to Antimicrobial Formulary</td><td>4 hours</td><td>Brown</td><td>For interpretation please refer to Antimicrobial Formulary on the hospital intranet under Clinical Information Prescribing.</td></tr>
<tr><td>Ammonia</td><td>11 - 32 µmol/L</td><td>4 Hours</td><td>Orange</td><td>Send on ice within 15 minutes of collection</td></tr>
<tr><td>Amylase</td><td>30 - 118 IU/L</td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>Angiotensin converting enzyme (ACE)</td><td>13 - 64 IU/L</td><td>Next day, Mon-Fri</td><td>Brown</td><td></td></tr>
</table>

AST (Aspartate transaminase)	13 - 40 IU/L	4 hours	Brown	
B12, vitamin	211 - 911 ng/L	Next day Mon-Fri	Brown	
Bicarbonate	22-29 mmol/L	4 hours	Brown	
Bile acids	0 - 18 µmol/L	Next day, Mon-Fri	Brown	
Bilirubin (total)	≤8 weeks: No reference range >8 weeks: 0-20 µmol/L	4 hours	Brown	
Bilirubin (conjugated)	≤8 weeks: 0-13 µmol/L >8 weeks: 0-5 µmol/L	4 hours	Brown	
NT-proBNP	<400 ng/L	2-3 days	Orange	NT pro-BNP <400 in an untreated patient makes heart failure unlikely
C-reactive protein (CRP)	0-9 mg/L	4 hours	Brown	
CA125	0-34 KU/L	Next day, Mon-Fri	Brown	
CA19-9	0-36 KU/L	Next day, Mon-Fri	Brown	
Calcium	**Age** / **Ref. range** <4 weeks: 2.00-2.70 mmol/L 4 weeks – 16 yrs: 2.20-2.70 mmol/L >16 yrs: 2.20-2.60 mmol/L	4 hours	Brown	
Carbamazepine	4 -12 mg/L	4 hours	Brown	Pre-dose (trough) sample
Carboxyhaemoglobin	<3%	30 minutes	Orange	
CEA	0-5.0 µg/L	Next day, Mon-Fri	Brown	
Chloride	95 - 108 mmol/L	4 hours	Brown	

<table>
<tr><td>Cholesterol</td><td>Desirable range

0-4.0 mmol/L</td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>Cholesterol high density (HDL)</td><td>Desirable range
M >1.0 mmol/L
F >1.2 mmol/L</td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>Cholesterol (non-HDL)</td><td>On high intensity statin treatment, aim for a greater than 40% reduction in non-HDL cholesterol</td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>Cholesterol low density (LDL)</td><td>Desirable range
0-1.9 mmol/L</td><td>4hours</td><td>Brown</td><td></td></tr>
<tr><td>Complement C3</td><td>0.75 - 1.65 g/L</td><td>Next day, Mon-Fri</td><td>Brown</td><td></td></tr>
<tr><td>Complement C4</td><td>0.14 - 0.54 g/L</td><td>Next day, Mon-Fri</td><td>Brown</td><td></td></tr>
<tr><td>Cortisol</td><td>9am reference range 145-619 nmol/L</td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>CK
(creatine kinase)</td><td>Female 25-200 IU/L

Male 40-320 IU/L</td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>Creatinine</td><td>
<table>
<tr><th>Age</th><th>Male Ranges (µmol/L)</th><th>Female Ranges (µmol/L)</th></tr>
<tr><td><14 days</td><td>27-81</td><td>27-81</td></tr>
<tr><td>14 days - < 1 year</td><td>14-34</td><td>14-34</td></tr>
<tr><td>1- <3 years</td><td>15-31</td><td>15-31</td></tr>
<tr><td>3 - <5 years</td><td>23-37</td><td>23-37</td></tr>
<tr><td>5 - <7 years</td><td>25-42</td><td>25-42</td></tr>
<tr><td>7 - <9 years</td><td>30-48</td><td>30 – 48</td></tr>
<tr><td>9 - <11years</td><td>28-57</td><td>28- 57</td></tr>
<tr><td>11 years</td><td>36-64</td><td>36-64</td></tr>
<tr><td>12 years</td><td>36-67</td><td>36-67</td></tr>
<tr><td>13 years</td><td>38-76</td><td>38-74</td></tr>
</table>
</td><td>4 hours</td><td>Brown</td><td></td></tr>
</table>

	14 years	40-83	43-75			
	15 years	47-98	44-79			
	16 years	54-99	48-81			
	>16 years	65-104	49-90			
Cryoglobulins	N/A			14 days	Special flask & tubes	Contact Biochemistry to arrange flask collection for this test
Digoxin	0.5-2.0 µg/L			4 hours	Brown	Pre-dose or at least 6 hours post dose
eGFR *(calculated using the enzymatic creatinine result in the CKD-EPI 2009 equation)*	>90 mL/min/1.73m^2			4 hours		Calculated test reported with all creatinine results
Ethanol	<30 mg/L			4 hours	Brown	Results reported in mg/L
Ferritin	<5 years: 12-150 µg/L 5-16 years: 15-150 µg/L >16 years (males): 22-322 µg/L >16 years (females): 10-291 µg/L			Next day, Mon-Fri	Brown	
FAI (free androgen index)	≤7.0% (females only)			Next day, Mon-Fri	Brown	
Folate	3.0-20.0 µg/l			Next day, Mon-Fri	Brown	

<table>
<tr><td>FSH
(follicle stimulating hormone)</td><td><u>Females < 11 years:</u>
0.5 – 5.0 IU/L

<u>Females ≥11 years:</u>
Follicular 2.5-10.0 IU/L
Mid-cycle 3.4-33.4 IU/L
Luteal 1.5 – 9.1 IU/L

<u>Males</u>
1.4 – 18.1 IU/L</td><td>Next day, Mon-Fri</td><td>Brown</td><td></td></tr>
<tr><td>Gentamicin</td><td>No reference range quoted.

Refer to Antimicrobial Formulary</td><td>4 hours</td><td>Brown</td><td>For interpretation please refer to Antimicrobial Formulary on the hospital intranet under Clinical Information Prescribing.</td></tr>
<tr><td>GGT
(Gamma glutamyl transferase)</td><td><table><tr><td>Age</td><td>Female (IU/L)</td><td>Male (IU/L)</td></tr><tr><td>0-6 months</td><td>0-143</td><td>0-143</td></tr><tr><td>6 months – 11 years</td><td>0-32</td><td>0-32</td></tr><tr><td>11-17 years</td><td>0-21</td><td>0-30</td></tr><tr><td>≥18 years</td><td>0-37</td><td>0-72</td></tr></table></td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>Glucose</td><td>Fasting 3.0 - 6.0 mmol/L

Random 3.0-11.0 mmol/L</td><td>4 hours</td><td>Yellow</td><td></td></tr>
<tr><td>Growth Hormone</td><td>No random growth hormone reference range quoted.

See Dynamic Function Tests handbook for interpretation after stimulation or suppression test</td><td>7 days</td><td>Brown</td><td>Random growth hormone measurements are rarely indicated</td></tr>
<tr><td>HbA1c</td><td>20 – 41 mmol/mol</td><td>Next day, Mon-Fri</td><td>Purple</td><td></td></tr>
<tr><td>HCG</td><td>0-4 IU/L</td><td>4 hours</td><td>Brown</td><td></td></tr>
<tr><td>IgE</td><td><3 months | 0-5 kU/L</td><td>2-3 days, Mon-Fri</td><td>Brown</td><td></td></tr>
</table>

	3-12 months	0-11 kU/L			
	1– 5 years	0-29 kU/L			
	5 – 10 years	0-52 kU/L			
	10– 15 years	0-63 kU/L			
	15 – 20 years	0-75 kU/L			
	>20 years	0-81 kU/L			
Immunoglobulin A	**Age**	**Reference range**	Next day, Mon-Fri	Brown	
	<2 years	0.30 - 1.20 g/L			
	2-3 years	0.30 - 1.30 g/L			
	3-6 years	0.40 – 2.00 g/L			
	6-9 years	0.50-2.40 g/L			
	9-12 years	0.70 – 2.50 g/L			
	12-45 years	0.80 – 2.80 g/L			
	>45 years	0.80 – 2.80 g/L			
Immunoglobulin G	**Age**	**Reference range**	Next day, Mon-Fri	Brown	
	<1 year	3.0 - 10.9 g/L			
	1-2 years	3.1 - 13.8 g/L			
	2-3 years	3.7 – 15.8 g/L			
	3-6 years	4.9 - 16.1 g/L			
	6-15 years	5.4 – 16.1 g/L			
	>15 years	6.0 – 16.0 g/L			
Immunoglobulin M	**Age**	**Reference range**	Next day Mon-Fri	Brown	

	<3 years: 0.5-2.2 g/L 3-6 years: 0.5-2.0 g/L 6-12 years: 0.5-1.8 g/L 12-45 years: 0.5-1.9 g/L >45 years: 0.5-2.0 g/L				
Iron	Male 11.6 – 31.3 µmol/L Female 9.0 – 30.4 µmol/L		Next day, Mon-Fri	Brown	
Lactate	0.1 – 1.9 mmol/L		4 hours	Yellow	*Send samples to the lab immediately after sample collection*
LDH	Age (years) / Males (IU/L) / Females (IU/L) <1: 228-438 1-12: 207-383 12-17: 136-293 / 146–279 ≥18: 120-246 IU/L		4 hours	Brown	
Lithium	0.4 - 1.0 mmol/L		4 hours	Brown	12 hours post dose
LH	<u>Females < 11 years:</u> 0 – 1.0 IU/L <u>Females ≥11 years:</u> Follicular 1.9-12.5 IU/L Mid-cycle 8.7-76.3 IU/L Luteal 0.5-16 IU/L <u>Male</u> 1.5 – 9.3 IU/L		Next day, Mon-Fri	Brown	.
Magnesium	0.70 - 1.00 mmol/L		4 hours	Brown	
Oestradiol	Age (years) / Female reference range / Male reference range 0-10: 0 – 91 pmol/L / 0 – 91 pmol/L		Next day, Mon-Fri	Brown	

	11-14	Comments added: Follicular phase reference range 72 - 529 pmol/L Mid-cycle reference range 235 - 1309 pmol/L Luteal phase reference range 205-786 pmol/L The pre-pubertal reference range is 0 – 91 pmol/L	0-116 pmol/L			
	≥15	Follicular phase reference range 72 - 529 pmol/L Mid-cycle reference range 235 - 1309 pmol/L Luteal phase reference range 205-786 pmol/L	0-146 pmol/L			
Osmolality (serum)	275 - 295 mmol/kg			4 hours	Brown	
Paracetamol	<3 mg/L			4 hours	Brown	Refer to nomogram for treating suspecting overdose
PTH (parathyroid hormone)	2.0-8.5 pmol/L			Next day, Mon-Fri	Pink	
pH	7.35-7.45			30 minutes	Heparinised blood gas syringe or capillary	
pCO2	Male: 4.6-6.4 kPa Female: 4.3-6.0 kPa			30 minutes		
pO2	11.0-14.4 kPa			30 minutes		
Phenobarbitone	10 - 40 mg/L			4 hours	Brown	Pre-dose (trough) sample Out of hours analysis by arrangement only

Phenytoin	5.0-20 mg/L		4 hours	Brown	Pre-dose (trough) sample
Phosphate	**Age**	**Ref. range**	4 hours	Brown	
	<4 weeks	1.3-2.6 mmol/L			
	4 weeks – 1 yr	1.3-2.4 mmol/L			
	>1 yr-16 yrs	0.9-1.8 mmol/L			
	>16 yrs	0.8 - 1.5mmol/L			
Potassium	**Age**	**Ref. range**	4 Hours	Brown	
	<4 weeks	3.4-6.0 mmol/L			
	4 weeks – 1 year	3.5-5.7 mmol/L			
	>1 year	3.5-5.3 mmol/L			
Progesterone	No reference range quoted		Next day, Mon-Fri	Brown	
Prolactin	Females 56-619 mU/L Males 45-375 mU/L Monomeric prolactin (following PEG precipitation): 0-436 mU/L		Next day, Mon-Fri	Brown	
Protein Electrophoresis	N/A		7 Days	Brown	
PSA	<50 years	0-2.5 µg/L	Next day, Mon-Fri	Brown	
	50-59 years	0-3.5 µg/L			
	60-69 years	0-4.5 µg/L			
	≥70 years	0-6.5 µg/L			

Protein (total)	60-80 g/L			4 hours	Brown	
Rheumatoid Factor	0-13 IU/mL			Same day	Brown	
Salicylate	<30 mg/L			4 hours	Brown	
SHBG	Age (years)	Males (nmol/L)	Females (nmol/L)	Next day, Mon-Fri	Brown	
	<50	12-54	18-138			
	≥50	17-72	24-111			
Sodium	133-146 mmol/L			4 hours	Brown	
T3 (free)	3.5-6.5 pmol/L			Next day, Mon-Fri	Brown	
T4 (free)	**Age**		**FT4 Reference Range (pmol/L)**	Next day, Mon-Fri	Brown	
	<1 year		11.8 - 20.7			
	1-5 years		11.2 - 19.3			
	6 - 11 years		10.9 - 19.4			
	≥12 years		10.9 – 21.2			
Testosterone (females)	Age (years)		Testosterone reference range (nmol/L)	Next day, Mon-Fri	Brown	Female samples with results above the reference range will be referred for LC-MS/MS testosterone analysis
	0-11		0.0-0.9			
	12-15		0.0-1.7			
Testosterone (males)	Age (years)		Testosterone reference range (nmol/L)	Next day, Mon-Fri	Brown	
	<1		0.0 – 9.1			
	1-11		0.0-0.9			
	12-39		9.3 – 32.2			
	40 – 49		8.2 – 32.2			
	≥ 50		7.6 – 32.2			
Theophylline	10 -20 mg/L			4 hours	Brown	
TIBC (Total iron binding capacity)	45 - 76 µmol/L			Next day, Mon-Fri	Brown	

TIBC saturation	Females: 20.0 - 45.0 % Males: 20.0 – 50.0 %		Next day, Mon-Fri	Brown	
TSH	**Age**	**TSH Reference Range (mU/L)**	Next day, Mon-Fri	Brown	
	<1 year	0.93 – 7.76			
	1-5 years	1.03 - 6.48			
	6-11 years	0.91 – 5.54			
	≥12 years	0.55 – 4.78			
Thyroid peroxidase (TPO) antibodies	0-60 IU/mL		2-3 days, Mon-Fri	Brown	
Tobramycin	No reference range quoted Refer to Antimicrobial Formulary		4 hours	Brown	For interpretation please refer to Antimicrobial Formulary on the hospital intranet under Clinical Information Prescribing.
Triglycerides	<1.7 mmol/L		4 hours	Brown	
Troponin I (High sensitivity)	Males 0-54 ng/L Females 0-39 ng/L		2 hours	Brown	
Urate (serum)	Male 200-430 µmol/L Female 140-360 µmol/L		4 hours	Brown	
Urea	**Age**	**Ref. range**	4 hours	Brown	
	<4 weeks	0.8 –5.5 mmol/L			
	4 weeks – 1yr	1.0-5.5 mmol/L			
	1-16 yrs	2.5-6.5 mmol/L			
	>16 yrs	2.5-7.8 mmol/L			
Valproate	No reference range quoted		4 hours	Brown	

Vancomycin	No reference range quoted. Refer to Antimicrobial Formulary	4 hours	Brown	For interpretation please refer to Antimicrobial Formulary on the hospital intranet under Clinical Information Prescribing.
Vitamin D (25OH Vit D)	Vitamin D thresholds in respect of bone health: Serum 25-OH vitamin D <25 nmol/L is deficient 25-50 nmol/L maybe inadequate in some people >50 nmol/L is sufficient for almost the whole population	Next day, Mon-Fri	Brown	

Urgent turnaround times have been agreed for the following tests on the Emergency Department (ED) and Neonatal Intensive Care Unit (NICU):

ED (90% of results to be reported within the stated turnaround times)

Within 60 minutes for Renal, Liver, CRP, Coagulation, INR, FBC

Within 90 minutes for Troponin

NICU:

Within 120 minutes for Renal, Bone, Magnesium, Glucose, Ammonia, Lactate, CRP, Coagulation and FBC.

Cerebrospinal Fluid (CSF)

Please see separate document for collection of CSF for Biochemistry/Microbiology tests (on the intranet with the User Guide and BS/B SOP 227 on QPulse).

Test	Reference Range
CSF Protein	0.15-0.45 g/L
CSF Glucose	2.5-4.5 mmol/L (<18 years) 2.2-3.9 mmol/L(≥18 years) *CSF glucose result should be approximately 60% of the plasma glucose result.*

CSF bilirubin	≤0.007 absorbance units *Interpretative comments are added based on the oxyhaemoglobin absorbance and the bilirubin absorbance.*

Other fluids

The following tests may be measured on other fluids (e.g. pleural, ascitic, pancreatic cyst).

Test	Sample Type
Total protein and albumin	Plain container
LDH	Plain container
Triglyceride	Plain container
Amylase	Plain container
Glucose	Yellow top tube (fluoride EDTA)
pH	Orange top blood gas syringe (lithium heparin) Expel all air from the syringe and take to the lab immediately for analysis
CEA and CA 19-9	Plain container

Please note that no tests are accredited for fluid analysis and no reference ranges are available for these tests. The laboratory will endeavor to provide results on all fluid results but it may not be possible if the fluid is very viscous or thick. Please consider this when collecting fluid samples.

Other biochemical tests may be available on fluid samples; please discuss with the Consultant Biochemists.

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Interpretation of results

A clearly low total protein (<25 g/L) or a clearly high total protein (>35 g/L) usually distinguishes between a transudate and an exudate in **pleural fluids**. For borderline results, Light's criteria should be used; a fluid is considered an exudate if any of the following apply:

- Pleural fluid LDH is greater than 2/3 of the upper reference limit for serum LDH
  - This value is >171 IU/L

- Ratio of fluid protein to serum protein >0.5
- Ratio of fluid LDH to serum LDH >0.6

24 hour Urine Tests

Test	Reference range	Approximate turnaround time	Sample container (24 hour collection bottle)	Comments
Calcium	2.5 - 7.5 mmol/24h (on a normal diet)	2 days	Plain	
Creatinine	Males: 7.1-17.7 mmol/24h Females: 5.3-15.9 mmol/24h	2 days	Plain	
Creatinine Clearance	90-130 mL/min	Same day		May be calculated on 24h urine or 6h urine. Paired serum sample for creatinine required to calculate clearance
Magnesium	2.5-8.0 mmol/24h	2 weeks	Acid bottle	*Samples referred for analysis at Wythenshawe Hospital*
Phosphate	15-50 mmol/24h	2 days	Plain	
Potassium	25.0 – 125.0 mmol/24h	2 days	Plain	
Protein	0 – 0.15 g/24h	2 days	Plain	
Sodium	40-220 mmol/24h	2 days	Plain	
Urate	1.5-4.5 mmol/24h	2 days	Plain	
Urea	No reference range quoted	2 days	Plain	
Metadrenaline	0 - 2 µmol/24h	2 weeks	Acid bottle	
Normetadrenaline	Male 0 - 5.3 µmol/24h Female 0 - 4.3 µmol/24h	2 weeks	Acid bottle	
5-hydroxyindole acetic acid (5HIAA)	1 - 45 µmol/24h	2 weeks	Acid bottle	

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Random Urine Tests

Analysis of the following tests is performed on random urine samples. An **early morning urine sample is preferable**. Due to the variability of the random urine sample (e.g. dietary/fluid intake), some tests may not have a reference range and should be interpreted in light of clinical findings.

Test	Reference range	Approximate turnaround time	Sample container	Comments
Albumin : creatinine ratio	0 – 2.9 mg/mmol	2 days	BD Vacutainer	
Amylase	0-650 IU/L	2 days	BD Vacutainer	
Bence Jones Protein	N/A	7 days	BD Vacutainer	
Calcium : creatinine ratio	0.0-0.55 mmol/mmol	2 days	BD Vacutainer	
Chloride	None quoted	2 days	BD Vacutainer	
Drugs of abuse	Reported as Positive or Negative	7 days	Plain Universal	*Samples are referred to Salford Royal Hospital for analysis.*
Osmolality	Urine osmolality may vary between 50 and 1200 mOsm/kg in a healthy individual depending on the state of hydration. The urine osmolality is the best measure of urine concentration with high values indicating maximally concentrated urine and low values very dilute urine. There is no reference range for urine osmolality as interpretation depends on whether the urine is appropriately concentrated or dilute for the clinical state of the patient at that time. A urine osmolality of >750 mOsm/kg excludes diabetes insipidus.	Same day	BD Vacutainer	Interpret with serum osmolality, serum sodium and urine sodium

Phosphate	No reference range quoted. Interpret with other results and clinical presentation	2 days	BD Vacutainer	
Potassium	No reference range quoted. Interpret with other results and clinical presentation	2 days	BD Vacutainer	
Pregnancy Test	Reported as POSITIVE or NEGATIVE	Same day	BD Vacutainer (early morning)	
Protein : Creatinine ratio	0-29 mg/mmol	2 days	BD Vacutainer	
Sodium	No reference range quoted. Interpret with other results and clinical presentation	2 days	BD Vacutainer	
U&E	No reference range quoted. Interpret with other results and clinical presentation	2 days	BD Vacutainer	

Faecal Tests

Test	Reference range
Faecal Immunochemical Test (FIT)	<10 µg Hb/g

Appendix 1 – Paediatric Full Blood Count Reference Ranges

Age	Hemoglobin (g/dl)	RBC ($\times10^{12}$/l)	Hematocrit	MCV (fl)	WBC ($\times10^9$/l)	Neutrophils ($\times10^9$/l)	Lymphocytes ($\times10^9$/l)	Monocytes ($\times10^9$/l)	Eosinophils ($\times10^9$/l)	Basophils ($\times10^9$/l)	Platelets ($\times10^9$/l)
Birth (term infants)	14.9–23.7	3.7–6.5	0.47–0.75	100–125	10–26	2.7–14.4	2.0–7.3	0–1.9	0–0.85	0–0.1	150–450
2 weeks	13.4–19.8	3.9–5.9	0.41–0.65	88–110	6–21	1.5–5.4	2.8–9.1	0.1–1.7	0–0.85	0–0.1	170–500
2 months	9.4–130	3.1–4.3	0.28–0.42	84–98	5–15	0.7–4.8	33–10.3	0.4–1.2	0.05–0.9	0.02–0.13	210–650
6 months	10.0–13.0	3.8–4.9	0.3–0.38	73–84	6–17	1–6	3.3–11.5	0.2–1.3	0.1–1.1	0.02–02	210–560
1 year	10.1–13.0	3.9–5.1	0.3–0.38	70–82	6–16	1–8	3.4–10.5	0.2–0.9	0.05–0.9	0.02–0.13	200–550
2–6 years	11.0–13.8	3.9–5.0	0.32–0.4	72–87	6–17	1.5–8.5	1.8–8.4	0.15–1.3	0.05–1.1	0.02–0.12	210–490
6–12 years	11.1–14.7	3.9–5.2	0.32–0.43	76–90	4.5–14.5	1.5–8.0	1.5–5.0	0.15–1.3	0.05–1.0	0.02–0.12	170–450
12–18 years											
Female	12.1–15.1	4.1–5.1	0.35–0.44	77–94	4.5–13	1.5–6	1.5–4.5	0.15–1.3	0.05–0.8	0.02–0.12	180–430
Male	12.1–16.6	4.2–5.6	0.35–0.49	77–92							

Appendix 2 – Blood Sciences Laboratory Accreditation

East Lancashire Hospitals NHS Trust Blood sciences laboratory Schedule of Accreditation

8355 Blood Sciences Schedule of Accreditation

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