SOUTH GLASGOW BIOCHEMISTRY

LABORATORY HANDBOOK FOR SERVICE USERS

Contents

Outline of services

The main Biochemistry service for South Glasgow runs from the Biochemistry Laboratory at the Queen Elizabeth University Hospital, located in the new laboratory block. Specialist Metabolic and Toxicology services for Greater Glasgow and Clyde (NHSGG&C) are now centralised within this department.

An in-house diagnostic service is also available at the New Victoria Ambulatory Care Hospital (ACH), to support the on-site clinics. This comprises a satellite Blood Science lab and operates between 9am-5pm only. Any requests generated outside these hours are sent to the QEUH Biochemistry Department.

South Glasgow Biochemistry service is accredited by the United Kingdom Accreditation Service (UKAS). UKAS Medical accreditation number 9569 (Accredited to ISO 15189:2012). Certificate Issue date: 23/06/23. A full list of tests in scope can be found on our schedule of accreditation:

https://www.ukas.com/wp-content/uploads/schedule_uploads/00007/9569-Medical-Multiple.pdf

Due to the limitations of the LIMS systems in use within South Sector Biochemistry the Laboratory is not able to fully comply with UKAS publication GEN 6 regarding the use of UKAS Symbols or reference to accreditation when reporting test results. Including these references to accreditation within results / comment fields where limited additional text is supported could have a negative clinical impact if interpretative comments are unable to be included in full or if they are included after the references to accreditation have been added. This has been internally risk assessed by the department and has deemed that including the references to accreditation at the expense of interpretative result comments poses a risk to patient care. All assays that are not included within the departments scope (and are therefore not accredited by UKAS) are highlighted with an asterisk (*) within the Reference Ranges section starting on page 11 of this handbook. We will update our service users appropriately when any assays are added or removed from our laboratories scope of accreditation.

Senior Staff

A consultant is always available for clinical advice and outside normal working hours he/she may be contacted via the switchboard (0141 201 1100).

Consultant Clinical Scientist and Clinical Lead

Dr Ian Godber Ext 89032

Consultant Medical Biochemist and Head of Service

Dr Iain Jones Ext 89035

Consultant Medical Biochemist

Dr Giles Aldworth Ext 89033

Consultant Clinical Scientist

Dr Allan Dunlop Ext 89043

Consultant Clinical Scientist
Dr Jane McNeilly Ext 89047

Consultant Medical Biochemist
Dr Rajeev Srivastava Ext 89030

Consultant Medical Biochemist
Dr Shona Twaddle Ext 89036

Technical Services Manager
Ms Clare Menzies Ext 89031

Laboratory Sector Manager
Ms. Louise Boughen Ext 89025

Quality Manager
Ms Louise Grant Ext 89053

Laboratory Hours

*Routine Service:	Weekdays 09.00 – 17.00 hrs	
Restricted Service:	Saturdays, Sundays, and Public Holidays	09.00 – 12.45 hrs
Out with Routine/Restricted Service:	Monday-Friday: 17:00 – 09:00 hrs	
	Saturday, Sunday and Public Holidays:	12:45 – 09:00 hrs

** Primary Care requests for core chemistry analyses are now processed up to 19:00 hrs on a Friday (analysed till 17:00 hrs Monday-Thursday)*

Please note sample preparation and analyses take time. During Routine Service try to ensure samples reach the laboratory before midday. At times of Restricted Service, where only essential tests will be carried out, specimens should reach the laboratory before 11.00 hours.

Out with Routine/Restricted Service

Out with the Routine/Restricted Service hours a limited repertoire of urgent analyses (listed below) can be undertaken as an emergency.

Blood: All “core” clinical chemistry assays, alcohol, ammonia, antibiotics, betahydroxybutyrate, carbamazepine, carboxyhaemoglobin, digoxin, gases, iron, lactate, lithium, osmolality, paracetamol, phenobarbitone, phenytoin, salicylate, theophylline and valproate.

Urine: Osmolality, sodium, potassium.

CSF: Protein, glucose

Note: If you wish any other tests to be performed outside normal working hours, then the requestor will be referred to the on-call consultant for further discussion regarding the clinical necessity of the test. The test will not be performed unless it has been authorised by the consultant, but the sample will be stabilized. Until the consultant contacts the BMS with further advice, the BMS is not permitted to perform the test.

The Biomedical Scientist (BMS) on duty can be contacted through switchboard or by paging 17684.

Victoria ACH Satellite laboratory

Biochemistry requests generated at the Victoria ACH site are analysed and reported at the QEUH laboratory with the exception of urgent requests (within the operating hours of 9am-5pm) for a limited test repertoire, which are analysed at the Victoria ACH satellite laboratory. The test repertoire at this site is designed to cover all analytes which may be expected to be required urgently, including Bone profile, Liver function tests profile, U&E, CRP, Gentamycin, Glucose, Urate and Vancomycin.

Telephone and Result Enquiries

Telephoning for results can waste valuable time, both in the ward and in the biochemistry department. Before telephoning the department users should ALWAYS search for results electronically via TrakCare, Clinical Portal or SCI Store. If they are not there it is likely that the analyses are not complete. Only as a last resort should users telephone the department for results. Remember that all severely abnormal results (according to preset criteria) will be phoned to the requesting service, **as long as a named requesting clinician and source location has been provided for the request.**

The department has an Auto Attendant Telephone System in place between 0900 and 1700 weekdays and 0900-1300 weekends and public holidays. Please dial 0141 354 9060 (89060) and select correct option.

Option 1 ***All results, general enquiries and add-on requests***
Option 2 ***Advice on sample requirements***
Option 3 ***For enquiries regarding Blood Gas or Blood Glucose analysers***
Option 4 ***Interpretation of results, clinical advice, adult emergency requests***

Out-of-hours requests: QEUH: Page 17684, or page on-call BMS via switchboard

Department Fax numbers: QEUH: 0141 232 4049

All staff are reminded to help prevent unauthorised access of confidential data.

Do not allow unauthorised persons to see data on screens. Log off after use. Do not allow, by action or inaction, the disclosure of information to any unauthorised person. Note that an audit trail of your access is retained on the system.

For non-urgent enquiries regarding Blood Gas or Blood Glucose analysers you can also email the department on SouthGlasgow.BiochemistryPOCT@ggc.scot.nhs.uk

For non-urgent clinical enquiries you can email ggc.qeuhbiochemistsggc@nhs.scot, please include your query as well as the full patient details

Requests for Analysis

For requests originating within the hospitals wherever possible these should be made electronically via TrakCare, to facilitate the requesting process and maintain an electronic patient record.

Results from non-electronic requests will not be available in TrakCare. Non–TrakCare hospital requests must be made using a biochemistry request form. Non–TrakCare hospital requests must be made using a combined/Haematology request form (order via PECOS, part no. G100456).

GP requests should be made via GP order comms where available.

All results will be available electronically on Clinical Portal, SCI store (if CHI number is provided) and TrakCare where appropriate.

We aim to process in-patient requests for core chemistry analyses within 90 minutes of receipt of the sample.

We aim to receive and report results for the majority of referred tests within 2 weeks of receipt of sample. If you have not received results within this time period you may contact our laboratory for further information.

TrakCare requests will direct a sample appropriately to one of two reception locations within South Glasgow Biochemistry (by way of a specific banner printed at the top of the request form). The Specialist/Paediatric Section handles all paediatric core tests, all metabolic tests requiring specialist preparation and all unstable samples where rapid intervention is required to stabilise the sample as required. Core Reception will deal with initial sample processing for all other specimens.

Note that most afternoon specimen collections from primary care do not arrive in the lab until late afternoon. Samples will be stabilised on receipt, then usually analysed the following day.

Urgent Requests

All requests considered urgent by clinicians, including those from primary care, must be referred to 89060 option 4 during the working day, for discussion with the Duty Biochemist. Out with these hours, the on-call BMS should be contacted via page and the mechanism for reporting results (e.g. telephone or page number) supplied.

Add-On requests

The laboratory cannot handle large numbers of requests to add on tests to samples we have already received. However we will endeavour to do so if essential and unavoidable. Try to add the test onto your next request where possible. Samples may need to be retrieved from automated storage, which can take several hours. If a result is required urgently it may be quicker to send a fresh sample urgently to the laboratory.

Samples for core serum Biochemistry analyses are typically stored for up to 3 days and add-on requests may be made within this time-frame, where appropriate.

Add-on requests to samples already received by the laboratory can be requested via email: SouthGlasgow.BiochemistryAddOn@ggc.scot.nhs.uk

When using this service please include the following in your email:

- CHI number/DOB
- Surname
- Date & Time of original sample
- original location of sample
- Analysis to be added on

Request Intervention

Request intervention (RI) procedures have been set up for a number of tests to facilitate more appropriate testing and help reduce unnecessary repeat testing. Appropriate time intervals for repeat testing have been discussed with clinical colleagues before being introduced. Requests for repeat analyses for a limited set of tests are held for viewing by the duty Biochemist and may be over-ridden if deemed appropriate. Comprehensive clinical details assist the Biochemist in this task. Note requests from relevant clinics/consultants will be exempted from RI and full details of clinic, location and specific consultant code should be provided on all requests.

Analyte	**Request Intervention interval**
Faecal Calprotectin	4 months
Cholesterol/Triglycerides	28 days
Lipid profile	28 days
Protein electrophoresis	90 days
Prostate Specific Antigen (PSA)	90 days
Thyroid Function Tests (TFT)	30 days
Total T3	30 days
Vitamin D	340 days
Ferritin	28 days
B12	28 days
Serum folate	28 days

General Specimen Requirements

In the interests of patient safety and diagnostic management it is essential that:

- Requests and samples are correctly identified and details on the request (electronic/paper) and sample must match.
- Consent should be obtained from the patient where required
- Samples are collected into the correct container
- There is sufficient sample volume
- The sample lid is secure to prevent leakage
- The specimen should be placed in a sealed plastic bag. Any request forms should be put in the separate wallet section of the specimen bag. It is advisable to use different bags for each different request form.
- The sample is delivered to the laboratory within a time frame that ensures the integrity of the sample. This will be test-dependent.

Minimum Identification Criteria for Samples and Forms

The minimum requirements for sample acceptance criteria are:

- **CHI number/Unique Identifier** (e.g. TJ number etc) ***or*** **DOB if no unique identifier available**
- **Surname**
- **Forename**

A combination of the above three identifiers is required in all instances, to meet legislative requirements.

All Patient Identification Data shown on the form must be consistent with all Patient Identification Data on the specimen label.

Potentially Infectious Specimens

Clinical staff need no longer use “DANGER OF INFECTION” stickers to highlight samples containing (or suspected of containing) blood borne viruses (BBV) such as HIV and hepatitis B or C. It is not necessary to alert the laboratory about potential infectivity of such samples since the laboratory observes standard precautions.

Users MUST alert relevant the laboratory by phone (89060 option 4 within normal working hours, on call consultant via switchboard out of hours) for the following samples:

i) Body fluids containing group 4 hazard grade pathogens, namely from patients with confirmed or high possibility viral haemorrhagic fevers (VHF). (Refer to VHF guidance).

ii) CSF from patients with tuberculous meningitis (or high suspicion of).
(CSF spectrophotometry would **not** be performed on such samples).

The above samples in (i) and (ii) MUST NOT be transported via pneumatic tube.

Clinical Information

Please provide relevant clinical information and medication history for each request. Information on symptoms and working diagnosis are essential because they enable the Biochemist to check result validation and to provide appropriate interpretation of results and clinical advice. It can also minimise unnecessary repeat requesting. In some instances the laboratory may initiate further tests on the same specimen(s) to assist diagnosis. Important points might, for example, include fasting status, height and weight (for clearances), time of last drug dose and gestation.

Specimens and Containers

Blood Collection Tubes

The Greiner “Vacuette” system is in use in South Glasgow. Information on the containers required for the common analytes are specified in TrakCare. Specimens should be clearly labelled and securely sealed in the plastic bag.

When different types of Vacuette bottle are used at the same venepuncture, it is ESSENTIAL that plain tubes (including serum gel tubes) are filled first to avoid cross-contamination e.g. with K EDTA. All tubes should be gently inverted several times to ensure adequate mixing. Note vigorous shaking of the sample can cause haemolysis.

As a general working rule, serum gel tubes are suitable for blood specimens for the majority of routine biochemical analyses with the exception of samples intended for troponin, glucose, selenium and manganese, lead, complement, and certain specialist assays (e.g. PTH, ACTH, renin, gut hormones). TrakCare guides the number and type of tubes required. Please attach labels with the long axis of the label parallel to the long axis of the bottle.

For any test not mentioned the laboratory may be consulted as to the appropriate container (89060, option 2).

Sample containers of any type should be obtained through normal supply routes for consumables. The Biochemistry Department does not supply containers or packing materials except by special arrangement.

Sample Volume

In most samples it is only the serum (or plasma) which is being analysed. It is impossible to use all of the sample as analytes have a minimum dead volume. A compromise in minimum sample volume versus efficient use of service allows electronic requesting to both identify sample type and number of tubes required. Multiple tubes may be required for this reason.

Due to limitations in blood available from neonates and children, generally lithium heparin tubes (1.8ml) are used. For neonates we try to minimize sample volume requirements and should be able to perform electrolytes, CRP and LFT in 600 microlitres of lithium heparin blood. This requirement will increase in samples with a higher haematocrit as a larger blood volume is required to get the same amount of plasma.

CSF Analysis

CSF should be taken into a white-top plain container. A minimum of 1mL is required. A separate aliquot for glucose, if required, should be taken into a fluoride/EDTA (Grey top) tube.

Samples for **spectrophotometry** should only be requested where the patient is suspected to have had a sub-arachnoid haemorrhage but has a negative CT scan. **These specimens should be centrifuged within 15 minutes of sampling, and it is essential that the sample is sent to the Laboratory immediately after collection.** Full sample collection instructions are detailed below. The analysis service is currently available from 9am to 8pm. Outside normal working hours, only clearly negative reports are released by Biomedical scientists. All others are left until the following morning reporting session for review.

Sampling and specimen requirements for CSF spectrophotometry:

- The CSF sample for biochemical analysis should always be the **least blood stained fraction (usually the last) to be withdrawn** and the volume of CSF must be a **minimum of 0.5 ml**.
- Record the time of withdrawal of the CSF sample on the request form.
- Record the time of onset of symptoms on the request form.
- **Send the sample to your local hospital Biochemistry Department immediately after withdrawal so that the sample arrives there within 15 minutes of withdrawal** [1, 2].
- **Protect the CSF sample from light by placing it in a brown paper envelope** [3].

Note 1. *If a specimen has been contaminated with blood at the time of withdrawal (significant contamination is not always obvious until after centrifugation) haemoglobin may begin to leak in vitro from erythrocytes after some 15 minutes. This can be confused with that produced in vivo as a result of a SAH. For this reason it is important that the CSF is centrifuged at your local laboratory and the supernatant removed within 15 minutes of withdrawal.*
Note 2. *On occasion a longer delay than 15 minutes may prove unavoidable. However, the shorter the delay, the more likely it will be that results obtained can be interpreted and will be clinically significant.*
Note 3. *To avoid the breakdown of bilirubin in daylight, samples of CSF should be stored in the dark and transported in a brown paper envelope.*

Urine analyses

For the majority of tests on random urine specimen:

Collect urine in plain, white-capped universal container (No preservatives, as these interfere with cortisol, electrolyte, Drugs of Abuse and osmolality analyses).

For the majority of timed (usually 24h) urine collections:

Different preservatives are required for certain specialized tests. Contact 89060 (option 2) as required, for advice on containers for specialist urine tests and to organize issue of appropriate containers. Collection of these from the laboratory should be arranged by contacting the hospital portering service.

Transport of Specimens

General Health & Safety requirements

- specimens must only be submitted to the laboratory in approved containers
- **never send** needles and other sharps to the laboratory
- The outside of containers must be free from contamination.
- each specimen container should be sent in a sealed plastic specimen bag

Transport of samples to the laboratory may be via the pneumatic tube system (available at certain locations at QEUH), portering services within the hospital site and by a van service (primary care). Ward/clinic collections by the portering service are made at regular intervals throughout each day. The van service follows a timetable of regular pickups from primary care locations at specified times, Monday-Friday. Transport is under the responsibility of Facilities Management (FM) and any issues/enquiries should be directed to FM through switchboard.

To avoid blood specimens being rejected, specimens should be left for 30 minutes to settle before centrifuging then stored at room temperature prior to pick up. Do not store blood samples in the fridge. For transport, specimens should be placed into green bags for Biochemistry testing.

Results Reporting

Results are available electronically via TrakCare (if requested throughTrakCare), Clinical Portal and SCI Store (G.P's). Access to these systems is by password only. Application forms and instructions for use may be obtained from the Hospital IT department.

Hard-copy reports are collected by the portering staff from the Biochemistry Departments once daily.

Significantly abnormal results will be telephoned following our departmental protocol **as long as a named requesting clinician and source location has been provided for the request.** Other results will be phoned only in exceptional circumstances.

Reference Ranges

Reference ranges listed below are for guidance only and cover common analytes and some specialised ones. Appropriate reference ranges and/or interpretative comments will be provided with your results, where available, on printed reports, TrakCare, Clinical Portal and SCI Store. If you cannot find a test you are looking for in this table or require further information please contact the reporting biochemist by phoning the laboratory.

Sample requirements are provided below, again for guidance. When ordered electronically via TrakCare or ICE, information on the appropriate sample type will be given on the labels provided.

Note it is particularly difficult to derive reference ranges for neonates, children and in pregnancy.

Uncertainty of measurement relates the result the laboratory provides to the range of values the result could represent. Information regarding uncertainty of measurement of specific analytes can be provided to users of the laboratory on request – please contact the duty Biochemist to discuss.

Less frequently requested tests may be sent to other laboratories for analysis both within Glasgow and across the UK.

Results are issued with reference ranges. Please contact the laboratory if in difficulty and we will endeavour to help. Reference ranges listed below are for guidance only. There may be very significant differences between ages, genders and different populations etc.

Stated **Result Times** apply to **Acute Inpatient Locations**. Results for non acute locations and Primary Care will have longer turnaround times.

MOST DRUG LEVELS ARE GENERALLY MEASURED AS TROUGH LEVELS. FOR MOST THIS IS EASIEST JUST BEFORE THE NEXT DOSE. DIGOXIN MUST BE AT LEAST 6 HOURS POST DOSE.– see timing required below.

Sample type (**S**) denoted below as Blood (**B**), Urine (**U**) or Cerebrospinal fluid (**CSF**)

Test	S	Container	Vol (ml)	Reference range (adult)	Result Time	Comments
ACE		†Yellow	2	<88 u/L	1 week	
ACTH	B	††Purple	2	< 20 mU/L (7-9 am) unstressed	2 weeks	Must reach lab rapidly for separation and freezing, as **unstable**
*Adalimumab	B	Yellow	2	Refer to NHSGGC Biochemistry web pages	2 weeks	
Adrenalines	U	Plain 24 hr urine	24 hr urine	VMA 0-35 µmol/24h 5HIAA 0-50 µmol/24h HVA 0-40 µmol/24h Noradr 0-900 nmol/24 Adren 0-230 nmol/24h Dopamine 0-3300 nmol Free normetadr 0-650 nmol Free met 0-350 nmol	2 weeks	No longer requires acid container but must reach lab promptly, as **unstable**
Albumin(serum)	B	Yellow	2	35-50 g/L	6 hours	
Alanine aminotransferase (ALT)	B	Yellow	2	<50 IU/L	6 hours	
Albumin/creatinine ratio (urine) ACR	U	White Universal	10	M <2.5 F <3.5	3 days	Early morning urine required
*Aldosterone	B	Yellow	2	See report, >300 pmol/L may need investigating	1 week	Measure with renin for ration aldo/renin ratio >35 may need investigation

Test	S	Container	Vol (ml)	Reference range (adult)	Result Time	Comments
Alkaline phosphatase (ALP)	B	Yellow	2	30 – 130 IU/L	6 hours	
*Alkaline Phosphatase Isoenzymes	B	Yellow	2		1 week	Total Alp must be > 250 IU/L or test will not be performed
Aluminum	B	†††Green	2	<0.2 µmol/L	2 weeks	
Amikacin	B	Yellow	2		6 hours	Interpretative advice provided by Microbiology
AFP	B	Yellow	2	<6 kU/L	3 days	
*Alpha – 1 - antitrypsin	B	Yellow	2	1.0 – 2.0 g/L	1 week	
Ammonia	B	Green	2	< 4 weeks old <100 µmol/L >4 weeks old 20 – 50 umol/L	6 hours	**Unstable** Must reach lab ASAP, certainly within 1 hr of sample collection. Haemolysis may affect the result.
Amphetamines	U	White universal	10	Qualitative	1 week	
Amylase	B	Yellow	2	<125 IU/L	6 hours	
Amylase (urine)	U	White universal	2	<600 U/L (amylase/creat clearance 1-5%)	3 days	Clearance ratio for detecting macroamylasaemia.
*Antimullerian hormone (AMH)	B	Yellow	2	No reference range provided	1 week	Consultant gynaecologist request only
*Androstenedione	B	Yellow	2	18-40y <5.5 nmol/L >41 y F <3 nmol/L M <5.5 nmol/L	2 weeks	
Anti thyroid peroxidase antibody	B	Yellow	2	<6 IU/L	1 day	
Aspartate aminotransaminase (AST)	B	Yellow	2	<40 IU/L	6 hours	
Bence Jones Protein	U	White universal	20		1 week	Early morning urine best as more concentrated
Benzodiazepines	U	White universal	10	Qualitative	1 week	
Bicarbonate	B	Yellow	2	22 – 29 mmol/L	6 hours	**Unstable** prior to centrifugation
Bile acids	B	Yellow	2	<6 µmol/L	1 day	For cholestasis of pregnancy – d/w lab for other indications. Clinical decision point in RCOG guidance is > 19 umol/L
Bilirubin (total)	B	Yellow	2	<20 µmol/L	6 hours	
Bilirubin (conjugated)	B	Yellow	2		6 hours	
*Blood gases (arterial)	B			H^+ 36-44 nmol/L pCO_2 4.6-6.0 kPa pO_2 10.5-14 kPa	POC	
*Blood gases (venous)	B			H^+ 42-48 nmol/L pCO_2 5.6-6.7 kPa	POC	
BNP(NT-pro-BNP)	B	Purple	2	Refer to appropriate GGC pathway	3 days	Only available for use in approved pathway
Bromide	B	Green	1	Therapeutic Range 10-20 mmol/L	7 days	
Buprenorphine	U	White universal	10		1 week	Not part of routine DOA screen. Available by specific request.
CA 125	B	Yellow	2	Female Pre- meno <35 kU/L Post meno <25	3 days	See NICE CG122
*CA 15.3	B	Yellow	2	<32 U/L	1 week	Specialist use only
*CA 19.9	B	Yellow	2	<34 U/L	1 week	Specialist use only

Test	S	Container	Vol ml	Reference range (adult)	Result Time	Comments
Calcium(adjusted)	B	Yellow	2	2.20 – 2.60 mmol/L	6 hours	
Calcium (urine)	U	White universal	2	0.04-0.7mmol/mmol Creat	3 days	Used in the investigation of renal calculi and familial hypocalciuric hypercalcaemia
*Calprotectin	F	White universal	20g	10 – 50 µg/g faeces	1 week	To assist in diagnosis of IBD.
*Caeruloplasmin	B	Yellow	2	0.16-0.47 g/L	1 week	Low in Wilson Disease
*Cannabinoids	U	White universal	10	Qualitative	1 week	
Carbamazepine	B	Yellow	2	4 – 12 mg/L	6 hours	Levels usually pre-dose
*CarboxyHb	B	Heparin		Non-smokers 0.5-1.5%	POC	**Unstable Much higher levels (up to 15%) in smokers.**
CEA	B	Yellow	2	<5 µg/L	3 days	Not a screening test
Chloride	B	Yellow	2	95 – 108 mmol/L	6 hours	
Chloride (urine)	U	White universal	10		1 day	
Cholesterol Triglycerides LDL/HDL/VLDL cholesterol	B	Yellow	2	Refer to GGC cholesterol guidelines Triglycerides: 0.2-2.3 mmol/L (fasting) HDL: >1.0 mmol/L	6 hours	Request Lipid profile if HDL + LDL + VLDL required.
*Cholinesterase	B	Purple	2	>5300 IU/L	6 weeks	
*Chromium	B	Purple	2	<40 nmol/L	2 weeks	Implant monitoring with cobalt
Ciclosporin	B	Purple	2		1 day	Individual targets vary so please discuss with appropriate clinician
Cocaine	U	White universal	10	qualitative	1 week	
*Cobalt	B	Purple	2	< 50 nmol/L	2 weeks	Implant monitoring with chromium
*Copper	B	Green	2	M 10 – 22 µmol/L F 11 – 25 µmol/L	1 week	Yellow (ochre) samples not acceptable
Cortisol	B	Yellow	2	240-600 nmol/L (7-9 am) 50-290 (9pm-12am)	6 hours	Can be suppressed by steroid inhalers. Not a screen for Cushings
*Cortisol/creatinine ratio	U	White universal		<40 nmol/mmol creat <165 nmol/24h	1 week	Screening for Cushings Early morning urine required
*C – peptide	B	Green	2	0.36-1.12 nmol/L fasting	2 weeks	Must measure with insulin and glucose, rapid transit to lab as **unstable**
CRP	B	Yellow	2	< 10 mg/L	6 hours	
CK	B	Yellow	2	M 40-320 IU/L F 25-200 IU/L	6 hours	
Creatinine	B	Yellow	2	40 – 130 µmol/L	6 hours	Note eGFR is not validated for use in AKI
Creatinine (urine)	U	White universal	2		1 day	
*Cryoglobulin	B	Yellow	2	Normally absent	1 week	Contact lab to arrange **sample collection and transport at 37°C**
CSF glucose	CSF	Grey	1	2.5 – 4.5 mmol/L	1 day	
CSF xanthochromia	CSF	White universal	1		1 day	Must reach lab within 30 minutes, protect from light in brown envelope

Test	Sp	Container	Vol ml	Reference range (adult)	Result Time	Comments
CSF protein	CSF	White universal	1	0.1-0.5 g/L	1 day	Presence of red cells can give falsely high result.
*DHAS	B	Yellow	2	M 16-50yr 2.5-16umol/L F 16-50yr 2-12.5	1 week	
Digoxin	B	Yellow	2	0.5 – 2.0 µg/L	6 hours	At least 6 hours after dose.
*Drug of abuse screen	U	White universal	10		1 week	
eGFR	B	Yellow	2	90 – 120 ml/min	6 hours	For staging of CKD
Elastase (faecal)	F	White or blue cont	10	> 200 µg/g	2 weeks	Separate tube for each faecal test required
Ethanol (alcohol) plasma	B	Grey	2		6 hours	
*Ethanol (urine)	U	White universal	10		1 week	Qualitative optional screen that can be performed alongside a DOA screen- available by specific request only.
*Ethylene Glycol	B	Grey	2		1 day	Urgent requests will be analysed the same day, by request.
*Ferritin	B	Yellow	2	M 20 – 300 µg/L F 15 – 200 µg/L	3 days	Raised by acute inflammation
FSH	B	Yellow	2	M 1.0 – 12.0 u/L	3 days	
FAI (free androgen index)	B	Yellow	2	F < 7	1 week	
GammaGT	B	Yellow	2	M < 70 IU/L F < 40	6 hours	Request separate to LFT if required.
*Gases	B			See blood gases	Poc	
*Gastrin	B	Green	2	<120 ng/L	2 weeks	Must be fasting & off acid blockers for ≥ 2 weeks**. unstable**
Gentamicin	B	Yellow	2		6 hours	Interpretative advice provided by Microbiology
Globulins	B	Yellow	2	23 – 38 g/L	6 hours	Request separately if required
Glucose	B	Grey	2	3.5 – 6.0 mmol/L	6 hours	
*Growth hormone	B	Yellow	2		1 week	Fasting. <0.4 ug/L may exclude acromegaly.
*Gut hormones	B	Trasylol Tube	3.5	Please contact lab to arrange	6-8 weeks	**Unstable. Fasting. Off PPI for two weeks. D/w lab to supply tube.**
*Haptoglobin	B	Yellow	2	0.3 – 2 g/L	1 week	Levels fall with intravascular haemolysis.
HbA1c	B	Purple	2	20–42 mmol/mol Hb	3 days	
HCG	B	Yellow	2	< 5 u/L	12 hours	
*IGF-1	B	Yellow	2	See GRI age related ranges	2 weeks	Appropriate ref range will be on report.
Immunoglobulin IgA IgG IgM	B	Yellow	2	 0.8 – 4.0 g/L 6.0 – 16.0 g/L 0.4 – 2.4 g/L	1 day	
*Immunoreactive trypsin	B	2xguthrie card spots			1 week	2 cards 24 hours apart before six weeks of age.
*Infliximab	B	Yellow	2	Refer to NHS GGC Biochemistry web pages	2 weeks	
*Insulin	B	Green	2	<13 mU/L	2 weeks	Must be fasting. **Unstable. Send a paired glucose sample.**

Test	Sp	Container	Vol ml	Reference range (adult)	Result Time	Comments
Iron Transferrin Transferrin saturation	B	Yellow	2	10 – 30 µmol/L 2 – 4 g/L 25 – 50 %	1 day	Please use ferritin to assess iron deficiency. Saturation useful to detect iron overload.
Itraconazole	B	Yellow	5		1 week	Hydroxyitraconazole is the active metabolite of the parent drug. This is not routinely reported, but available on request.
Lactate	B	Grey	2	0.6 – 2.2 mmol/L	6 hours	Grey preferred but green lith heparin tube WITHOUT gel is also acceptable.
LDH	B	Yellow	2	80 – 240 IU/L	6 hours	**Unstable once refrigerated**
*Lead	B	Purple	2	< 0.5 µmol/L	1 week	
Lithium	B	Yellow	2	0.4 – 1.0 mmol/L	6 hours	12 hours post dose
LH	B	Yellow	2	M 1.0 – 12.0 U/L	3 days	
Magnesium	B	Yellow	2	0.7 – 1.0 mmol/L	6 hours	
Magnesium (urine)	U	24 hour urine	2	2.4 – 6.5 mmol/24h	1 week	White universal acceptable for paediatric requests
Metabolic Bone Screen	U+B	White universal(U) +Yellow(B)	10		3 days	Calculation requiring urine and blood creatinine and phosphate
Methadone	U	White universal	10	Qualitative	1 week	
*Methaemoglobin	B	POC only		0.5 – 1.5%	POC	6 – 7 % may be acceptable with dapsone
*Methanol	B	Grey	2		1 day	
Methotrexate	B	Yellow	2		1 day	Only for patients on methotrexate infusion.
Oestradiol	B	Yellow	2		3 days	
Opiates	U	White universal	10	Qualitative	1 week	
Osmolality	B/U	Yellow(B)/ White universal (U)	2 2	B 275 – 295 mOsmol/L U 50 – 1200	1 day	
Paracetamol	B	Yellow	2	Nomogram in BNF	6 hours	
PTH	B	Purple	2	1.6 – 7.5 pmol/L	1 day	**Unstable beyond one day**
Phenobarbitone	B	Yellow	2	15 – 40 mg/L	12 hours	Usually predose, not critical
Phenytoin	B	Yellow	2	5 – 20 mg/L	12 hours	Usually predose, not critical
Phosphate	B	Yellow	2	0.8 – 1.5 mmol/L	6 hours	
Phosphate (urine)	U	White universal	2	<16y 15 – 50 mmol/24h	3 days	
Porphobilinogen	U	White universal	10		1 week	Screen for acute intermittent porphyria. Protect from light. **Unstable. DW LAB IF NEEDED URGENTLY**
Porphyrins	B/U/F	Purple (B) White Universal(U	2/10 ml/10 g of faeces		2 weeks	Protect samples from light. Best to send blood and urine if porphyria suspected. Only request faecal porphyrins on specialist advice.
Potassium	B	Yellow	2	3.5 – 5.3 mmol/L	6 hours	
Potassium (urine)	U	White universal	2		1 day	
Posaconazole	B	Yellow	5		1 week	Serum samples required for both adult and paediatric requests
PSA	B	Yellow	2	<60yrs < 3.0 µg/L <70yrs < 4.0 µg/L >=70yrs < 5.0 µg/L	3 days	Routine screening not advised.

Test	Sp	Container	Vol ml	Reference range (adult)	Result Time	Comments
*Procollagen III N terminal popeptide	B	Yellow	2		1 week	Methotrexate monitoring. Dermatology only.
Progesterone	B	Yellow	2	>20 nmol/L confirms ovulation	3 days	Mid luteal sample needed
*17OH Progesterone	B	Yellow	2	Adults <6 nmol/L	1 week	Used in screen for congenital adrenal hyperplasia.
Prolactin	B	Yellow	2	M <400 mU/L male F <630 mU/L female	3 days	Macroprolactin excluded by PEG precipitation.
Protein	B	Yellow	2	60 – 80 g/L	6 hours	
Protein/creatinine ratio (urine) PCR	U	White universal	10	< 20 mg protein/mmol creatinine	1 day	
Protein electrophoresis	B	Yellow	2	Qualitative	1 week	Note Secondary tests(e.g. immunofixation and immunotyping) may take longer
*Renin concentration	B	Purple	2	<40 mIU/L supine <52 ambulant	2 weeks	Rapid transfer to lab needed as **unstable**
Salicylate	B	Yellow	2		6 hours	Levels may continue to rise for several hours
Sex hormone binding globulin (SHBG)	B	Yellow	2	M 13 – 70 nmol/L F 20 – 155	3 days	
Sirolimus	B	Purple	5		1 week	
Sodium	B	Yellow	2	133 – 146 mmol/L	6 hours	
Sodium (urine)	U	White universal	2	<16y 40 – 220 mmol/24h		
Tacrolimus	B	Purple	2		1 day	
Testosterone	B	Yellow	2	M 10 – 36 nmol/L F <3.2 nmol/L	3 days	
Theophylline	B	Yellow	2	adult 10-20 mg/L 1month – 1year 5-15 mg/L	6 hours	GGC Medicines handbook advises 8-12 hr post dose. BNF advises 4 -6 hours post dose for slow release preparations.
*6-TGN (6-Thioguanine Nucleotides) & 6-MMPN (6-Methylmercaptopurine Nucleotides)	B	Purple	2	Maximum drug efficacy in inflammatory bowel disease 235 – 450pmol 6TGN/8x108 cells Associated with increased risk of hepatotoxicity >5700pmol 6MMPN/8x108 cells.	1 week	Azathioprine metabolites - recommended for monitoring patients on azathioprine.
TPMT (Thiopurine methyl transferase)	B	Purple	2	Normal 35 – 79 nmol/gHb/hr	1 week	Recommended to check levels before starting azathioprine.
TSH	B	Yellow	2	0.35 – 5.0 mu/L	6 hours	See below for pregnancy levels
Thyroxine (FT4)	B	Yellow	2	9 – 21 pmol/L	6 hours	
T3 (total)	B	Yellow	2	0.9 – 2.5 nmol/L	12 hours	
Tobramycin	B	Yellow	2		1 day	Interpretative advice provided by Microbiology
Troponin (high sensitivity)	B	Green gel tube (IP/OP), Yellow (GP)	2	F ≤16 ng/L M ≤34 ng/L	6 hours	Measure in accordance to local protocol
Urate	B	Yellow	2	M 200 – 430 umol/L F 140– 360	6 hours	
Urate (urine)	U	White universal	2	<16y 1.5 – 4.5 mmol/24h	1 day	
Urea	B	Yellow	2	2.5 – 7.8 mmol/L	6 hours	
Urea (urine)	U	White universal	2		1 day	

Test	Sp	Container	Vol ml	Reference range (adult)	Result Time	Comments
Valproate	B	Yellow	2		1 day	Only useful to detect toxicity or non compliance.
*Vedolizumab	B	Yellow	2	Refer to NHSGGC Biochemistry web pages	5 weeks	
Vitamin D	B	Yellow			1 day	Do not repeat for at least 6 months (half life 30 days)
*Vitamin E /cholesterol	B	Green	2	3.5-9.5 µmol/mmol cholesterol	1 week	Protect from light
*Vitamins (other)	B	Green (Vits A,C,E,K) Purple (Vits B1,B2,B6)	10	Please refer to GRI handbook – **vitamin C rarely needed and must reach GRI within 4 hours**		
*VMA	U	24 hr plain urine	24h vol		2 weeks	Acid container no longer required. **Sample should reach lab promptly. Unstable beyond same day**
Voriconazole	B	Yellow	5		1 week	
Xanthochromia	CSF	White universal	2			
*Zinc	B	Green	2	M 11 – 18 µmol/L F 10 – 18 µmol/L	1 week	Yellow (ochre) samples not acceptable

† Serum separator tube , †† Potassium EDTA tube, ††† Lithium Heparin tube

**test not accredited by UKAS*

Clinical Advice

During normal laboratory working hours, please contact the Duty Biochemist for advice and results interpretation. Out of hours, the hospital switchboard (0141 201 1100) will be able to forward any calls concerning clinical queries to the on-call consultant.

Computer Failure

The Biochemistry Laboratory relies heavily on I.T. systems to improve data transfer and failure of the computer system can have major effects on the flow of information. In the event of computer system failure:

- Manual backup systems will be instituted and special written reports will be sent to the wards.
- Tracking and finding samples and results in the system will be complex and laborious.
- Please keep the requests for urgent results to those required only for true clinical emergencies.
- Do not send “routine” screens, which could be collected the following day.

Only by approaching the problem in a spirit of co-operation can the laboratories hope to cope with the loss of I.T. services and still offer a reliable service.

Pre-Analytical Issues

In the Biochemistry Department, a variety of quality assessment procedures are in place to check and maintain the accuracy of the analytical service, but it must be remembered that errors can arise before specimens reach the laboratory:

Common Sources of Pre-analytical Error

- Incorrect preparation (eg not fasted, not rested) or timing (eg interference from administered drugs, specimen collected at wrong time for therapeutic drugs)
- Incorrect patient identification or details
- Incorrect labelling in ward or wrong tube used
- Specimen collection site inappropriate eg. vein near IV infusion site or capillary from area of poor peripheral circulation
- Difficult specimen withdrawal (eg Haemolysis, upper arm occlusion)
- Contamination of sample by anticoagulant (e.g. EDTA from purple top tube or sodium citrate from cogulation tube)
- Delay in transport to laboratory (can cause artefactual increases in Potassium and Phosphate)
- Exposure to warmth or cold – (some enzymes and Potassium are affected)
- Exposure to light (e.g. Bilirubin and Porphyrins may be affected)
- Urine collection - wrong bottle, incorrect or lack of preservative, wrong time on label, failure to empty bladder completely

Interferences

Drugs & vitamins can affect certain assays. Details should be submitted particularly for chromatographic techniques e.g. paracetamol interference in urine catecholamine assay.

Heparin can interfere with some antibody assays e.g. TRAB. In addition, heterophilic antibodies and binding protein anomalies can interfere with endocrine assays.

Results not fitting the clinical picture should be discussed with a biochemist. Where doubt exists, analysing the sample by another method often clarifies the problem.

Specific Metabolic Advice

There are over 600 inherited metabolic disorders plus metabolic changes resulting from drugs and different pathophysiological states. A separate metabolic guidance handbook is available for further advice from the Metabolic Consultants (Dr Srivastava and Dr McNeilly) or the metabolic duty biochemist during normal working hours (mobile 07511 154412)

Toxicology Advice

Drugs of Abuse

The basic Drugs of Abuse screening panel currently comprises *amphetamines, benzodiazepines, cocaine, methadone and opiates.* This panel is performed on all GP samples requesting a 'drugs of abuse screen'. A screen for cannabinoids is also performed on specimens from certain locations, e.g. hospital inpatients and psychiatric units, or if specifically requested on GP samples.

Where clinical suspicion is raised, specific requests for *buprenorphine, cannabinoids and alcohol* can be performed on urine.

When a urine sample is obtained, please put it into a plain universal container.

Sample collection:

Supervise the collection of 25 ml of urine in a sterile universal with no preservative. Requests should include

- Clinical situation (e.g. drug treatment programme, i.v abuse, psychosis etc).
- Drugs taken (particularly if patient is on methadone) in the previous 2 weeks and whether their administration was supervised.
- Whether collection has been supervised or non-supervised
- The sample should be left at room temperature, or in the refrigerator, and delivered to the laboratory within normal working hours.

For further advice please contact the Duty Toxicologist via 0141 354 9060 (option 4) or directly (mobile 07930867777) during normal working hours, and the on-call consultant (via switchboard) out with that period.

Poisons

In any suspected poisoning, it is good practice to collect 20ml of urine in a plain universal container and store it at 4°C in case subsequent toxicological analysis is required.

A service for plasma **Ethylene Glycol** and **Methanol** (both Grey top Fluoride/Purple top EDTA tube) is available by arrangement only during weekday routine laboratory opening hours. Please contact the laboratory for advice on 0141 354 9060 (option 4). For requests made out with normal lab opening hours, please contact the consultant on-call.

Therapeutic Drug Monitoring (TDM)

There is a service for therapeutic drug monitoring (TDM) covering anticonvulsants, digoxin, theophylline, lithium, immunosuppressants (ciclosporin, tacrolimus, sirolimus) and the antifungal drugs itraconazole and voriconazole. Safe and efficient use of this service requires that the date and time of sample, the dose, the time of last dose and duration of dose are available at the time of analysis and should be filled in on the appropriate section of the request form. For useful advice regarding TDM, refer to the Prescribers handbook available on Staffnet (http://www.ggcmedicines.org.uk/). Please refer to the list below for a guide to analysis times for our service.

Therapeutic Drugs

Ciclosporin:	Monday to Friday – 9am to 5pm Saturday + Sunday- morning only **
Tacrolimus:	Monday to Friday – 9am to 5pm Saturday+ Sunday-morning only **
Sirolimus:	Monday & Thursday***** – morning only
Itraconazole:	Wednesday***** – morning only
Voriconazole:	Wednesday***** – morning only
Posaconazole:	Wednesday***** – morning only

***** Analysis days may change depending on workload.
Samples must reach the QEUH laboratory before 9:30am on the day of analysis.

** Samples must be received in the QEUH laboratory before 09:30am to be analysed that **day.**

- Samples should be taken at steady-state or earlier if:
  - Suspected overdose or toxicity
  - Poor clinical response despite high dose
  - Unstable clinical condition (particularly changing renal function)
  - Potential/ suspected drug interactions

- Drug analysis is not recommended in the following circumstances:
  - Routine analysis of anticonvulsants and digoxin when clinical control is satisfactory
  - Valproic acid therapy (poor correlation between serum concentration and clinical effect)
  - Digoxin within 6 hours of oral dose

Lithium monitoring
  - 3 monthly Lithium levels
  - Annual TFTs, calcium and UEs

Phenytoin
- Non-linear rise in serum concentration with increasing dose.
  - Toxicity may develop with small dose adjustments or with interacting drugs.
- Free (active) phenytoin concentrations can increase when:
  - Serum albumin concentration is low (caution interpreting when albumin <32g/L)
  - Phenytoin can be displaced from albumin with co-administered drugs.
  - Care should be taken in interpreting in renal failure

Digoxin

- Results from samples taken <6 hours of an oral dose are unreliable.
- Hypokalaemia, hypomagnesaemia and hypercalcaemia potentiate digoxin toxicity
- Unexpected results in hepatic and renal failure should be interpreted with caution

Target Ranges for Therapeutic Drugs

Drug	Time to steady state	Ideal sample time	Target range
Carbamezapine	2-3 weeks (new therapy) 1-4 days (dose change)	Pre-dose or 12 hours post dose (not critical)	4-12mg/L
Phenytoin	2-3 weeks	Pre-dose (not critical)	Adults 5-20mg/L
Theophylline	2-3 days	Pre-dose (not critical)	Adults 5-20mg/L (5-10mg/L adequate in some circumstances)
Digoxin	7-10 days	6-24 hours post dose	0.5-2ug/L
Lithium	5 days	12 hours post dose	0.6-1mmol/L (03.4-0.8mmil/L for prophylaxis and older patients)

Biological Therapy Monitoring

A service for the Biological therapies Adalimumab and Infliximab service is now provided on site at Biochemistry, QEUH. A completed proforma is required to be submitted with each request. Further details on the service are provided on the NHS GG&C website

https://www.nhsggc.scot/staff-recruitment/staff-resources/laboratory-medicine/biochemistry/biological-therapy-monitoring/

Complaints and Feedback

The Department shares the corporate objectives of NHS Greater Glasgow and Clyde (GGC) and commits to provide a comprehensive and efficient analytical, interpretative, clinical advisory and educational service of the highest quality to the Hospitals and General Practitioners within NHSGGC.

The Department constantly strives to improve its service. If we fail to provide the service that you expect, please get in contact with our Quality Manager or Head of Technical Services. Should you wish to make a complaint about a clinical issue or our reporting, please contact our Lead Clinician.

- Lead Clinician: Dr Ian Godber Tel. **354 (8)9032**
- Head of Technical Services: Ms Clare Menzies Tel. **354 (8)9031**
- Quality Manager: Ms Louise Grant Tel **354 (8)9053**

We investigate all complaints, in line with the NHSGGC Complaints policy and procedure, and will inform complainants of any outcomes. Complaints are investigated, reviewed monthly at management meetings and general feedback is given to all our staff daily.