Beaumont Hospital Clinical Directorate of Laboratory Medicine

Guide to Use of Laboratory Services by Beaumont Hospital Users

(Including Referring Laboratories)

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DEPARTMENTAL INFORMATION

DEPARTMENT	INFORMATION
Blood Transfusion	Clinical Guidelines Laboratory Information
Haematology & Coagulation & Flow Cytometry	Clinical Guidelines Laboratory Information
Chemical Pathology	Clinical Guidelines Laboratory Information
Immunology	Clinical Guidelines Laboratory Information
Microbiology	Clinical Guidelines Laboratory Information
Histopathology, Cytology, Neuropathology	Clinical Guidelines Laboratory Information
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Near Patient Testing	Clinical Guidelines Laboratory Information

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1 INTRODUCTION

This user guide is designed to enable Laboratory users to obtain the maximum benefits from the services provided by the Clinical Directorate of Laboratory Medicine in Beaumont Hospital.

The information provided is a broad guideline to the use of more commonly used tests. However, the Consultant Pathologists and staff of the individual Laboratory Departments are always happy to discuss the service & individual patients in more detail.

1.1 UPDATES OF USER'S HANDBOOK

This Handbook is available on the Hospitals Internet and Intranet sites, and will be updated on a regular basis. If you have any suggestions for improvements, please contact the Laboratory Manager or Quality Manager.

Please note the most up to date version of this manual will be available online.

Notification of updates to this manual will be placed on the News section of the Beaumont Hospital Intranet page.

Changes between revisions of the user guide will be highlighted in grey text to alert users of changed information.

2 TESTING GUIDELINES

2.1 BLOOD TRANSFUSION & HAEMOVIGILANCE

Beaumont Hospital Blood Transfusion Department is fully licensed by the Health Products Regulatory Authority (HPRA). The Blood Transfusion Department is also accredited to ISO 15189 by the Irish National Accreditation Board (INAB). It incorporates the Blood Transfusion Laboratory, the Haemovigilance Office and Traceability functions.

The department supplies blood components and blood products on site to patients and red blood cells to off-site Beaumont Hospital patients in St Joseph's Raheny. It also supplies red cells to St Francis Hospice (Raheny & Blanchardstown) and to St Luke's Radiation and Oncology Centre on Beaumont Hospital campus.

NOTE: Comprehensive policies and procedures are available on the Blood Transfusion intranet page.

Related documents: available on hospital intranet

BTD-HVO-041:	Indications for Blood components and blood products.
BTD-HVO-026	Patient Identification
BTD-HVO-004	Pre-Transfuison Group & Screen Sampling
BTD-HVO-007	Prescription of Blood Components and Products
BTD-HVO-039	Ordering Blood components and products from the Blood Bank
BTD-HVI-001:	Quick Reference Blood Transfusion Product Administration Guidelines
BTD-HVO-009:	Administration.
BTD-HVO-008	Care and monitoring of Transfusion recipents
BTD-HVO-011	Fateing/Disposal of Blood Components and Products
BTD-HVI-007	Guidelines for use of CMV and irradiated Blood Components
BTD-HVI-008:	Maximum Surgical Blood Ordering Schedule
BTD-HVO-042:	Emergency/Massive transfusion protocol (MTP) MTP Poster
BTD-F-0283:	MTP Poster
BTD-HVO-040:	Blood Track for Users.
BTD-HVO-031:	Transport of Blood Components and products from the Blood Transfusion Department
BTD-HVO-015:	Serious Adverse Reactions (Clinical Areas)
BTD-HVO-016	Serious Adverse Events (Clinical Areas)
BTD-HVO-002	Haemovigilance Management of Serious Adverse Events (Including Reporting to the NHO)
BTD-HVI-005	Non Blood Transfusion staff required training

*2.1.1 **Service provision hours and contact details:***

- Routine hours: 8am to 5pm Monday to Friday, 9am to 1pm Saturday. Ext: 2705
- Emergency out of hours: 5pm to 8am Monday to Friday, 1pm Saturday to Monday 8am. Bleep: 252

Contact details:

- Consultant Haematologist: Dr Philip Murphy
  Email: philipmurphy@beaumont.ie

- Chief Medical Scientist: Janice O Shaughnessy. Ext: 2705
  Email: janiceoshaughnessy@beaumont.ie

- Haemovigilance. Ext: 2034
  Email: haemovigilance@beaumont.ie

Training:

Blood Transfusion training is mandatory in order to partake in any aspect of transfusion. Details of staff specific training can be found on BORIS and the hospital Intranet Blood Transfusion page. (See BTD-HVI-005)

*2.1.2 **Blood Products/ components Available***

- Red Blood Cells
- Platelets
- Frozen Plasma
- Fibrinogen
- Flexbumin 20% and Albumin 5%
- Factor Concentrates (human & recombinant) e.g. factor VIIa, factor VIII, factor VIII/ human von Willebrand factor, factor IX, Prothrombin Complex Concentrate, PCC.
- Other Products on request

See BTD-HVO-041 Indications for Blood components and blood products

*2.1.3 **Turnaround Times***

On receipt, specimens are logged into the LIS by the receiving Scientist. Turnaround Times are defined as the length of time taken from receipt of the sample to release of the report /product. This may be a manual report, electronic report visible on the LIS or verbal report via phone call. Turnaround time for products requested by users will be reflected by clinical need. If the patient has

an antibody, turnaround time will vary from above depending on the serological investigations required to identify the antibody.

*2.1.4 **Patient identification***

All patients admitted to Beaumont Hospital require a patient identification band applied to their dominant wrist (and ankle where patients are admitted to theatre) by the admitting Registered Nurse. In the event of removal of an ID Band, it is the responsibility of the person who removed it to ensure that the patient is re-identified and the ID Band is repositioned on the patient as per PPCC-NCAR-080

*2.1.5 **Positive Patient Identification (PPID)***

Ask the patient to state, without prompting, his/her full name and date-of-birth and verify these details with the patient's ID band. If the patient is unable to state their name, etc, then verify the patient's full name, date-of-birth and Medical record Number in the patient's Healthcare Record/Emergency Department notes with the patient's ID Band and verify these details with parent/ guardian/ nurse/carer if present.

If any of the information does not correspond, the attending nurse must be contacted to clarify and amend the details before any blood transfusion transactions occur.

PPID must be carried out by an appropriately trained member of Beaumont Hospital staff:

- Before a Beaumont Hospital ID Band is placed on a patient's wrist or ankle.
- Before taking a blood specimen for Group and Screen testing (manual / Bridge Specimen Collection Device). This procedure is described in the SOP BTD-HVO-004 Pre-transfusion Group & Screen Sampling.
- At the start of the Pre-transfusion Checking Procedure, (manual/ Blood Track™ PDA Device). This procedure is described in the SOP BTD-HVO-009 Administration of Blood Components and Products.
- After a transfusion is stopped due to a suspected Serious Adverse Reaction or suspected Serious Adverse Event, in order to determine that the correct blood has been given.

*2.1.6 **Unidentified Patient***

A list of unique identification codes will be maintained by the managers and supervisors in the emergency department designed for use in correlating positive

identification for blood transfusion purposes, of an unidentified patient. These are designed for use in an emergency/life threatening situation for an unidentified patient(s) Where details are unknown, a unique computer generated ID is entered as a first name, 'Trauma' is entered as the surname and the pseudo DOB is 01/01/1901as per ED-SOP-1.

*2.1.7 **Beaumont Hospital Major Emergency Plan***

In the event of a Major Incident where there are multiple unidentified casualties, pre assigned hospital records will be used.

On being advised that the Beaumont Major Incident Plan is in operation, patients will initially be assigned Medical Record Numbers and pseudonyms on admission into the Emergency Department using the Major Emergency Patient Identification Pack (MEPIP). This contains a pre-printed ID Bracelet as per PPCC-ED-11.

The Bridge PDA/Desktop device, where possible, should be used to label Group&Screen sample and for transfusion purposes, scanning the 2D barcode on patients wristabnd band that they are wearing.

*2.1.8 **Patient Information / Consent:***

Signed consent for transfusion is not a legal requirement in the UK and Ireland. However, the patient should be informed of the reason for transfusion and associated risks / benefits. A record of this discussion should be documented in the patients' medical notes. The blood transfusion prescription (BTD-HVF-018) question on consent should also be answered by the prescribing Doctor. Patient Information leaflets are available in all wards and on the Hospital intranet site and on the HSE website in various languages. Patient's decision to refuse transfusion should also be documented in the medical notes.

*2.1.9 **Group and Screen Sample:***

- A Group and Screen determines the patients' blood group (Group) and if they have any antibodies in their plasma (Screen).
- A G/S is required if a patient needs: Red Cells, Platelets, Plasma or granulocytes.
- Once processed a G/S is valid for 72 hours
- Check if patient already has an in-date G/S to save time and avoid unnecessary phlebotomy.
- In emergencies, G/S should be hand delivered to avoid delays.
- You should only order a G/S if your patient is likely to require transfusion within the next 3-6 days (please refer to the Maximum Surgical Blood

Ordering Schedule for pre-operative patients and the GAIN Guidelines for Red Cell Transfusion for haemoglobin transfusion triggers. All guidelines are available on the Hospital intranet under Blood Transfusion Department.

2.1.10 ***Extending a GS***

A G/S is valid for:

1. 72 hours

2. 7 days - Once a Doctor has confirmed that a patient has not had a transfusion or pregnancy within the last 90 days, they can phone the Blood Transfusion Laboratory with this information whereby the GS can be extended.

2.1.11 ***Pre-Transfusion Type and Screen Sampling***

The Blood Transfusion Dept. has strict sample acceptance criteria for Group & Screen samples.

Group & Screen sampling must be performed as one continuous, uninterrupted procedure at the patient's bedside by a fully trained member of staff. (BSH 2017). The Patient must be wearing a Beaumont Hospital ID band or St Francis Hospice ID band. ***Please do not take a GS sample if patient is not wearing an ID band or if ID band details are incorrect****. See SOP BTD-HVO-4 Pre-Transfusion Group and Screen sampling*

The GS requests from GPs are not tested in the BTD as they do not satisfy patient identification criteria as detailed in ISO15189.

2.1.12 ***Electronic Results:***

2.1.13 ***Blood Transfusion Widget on PowerChart***

The BTD widget is viewable in the MedLIS summary view in PowerChart which is supplementary to results review - see below.

It displays the following data items:

- Blood Group
- Antibodies.

Transfusion Requirements.

Requirements	Purpose	When is it added
2nd Specimen needed if blood required	Informs users on PowerChart that a 2nd specimen is required (first time non-O)	BTD staff add requirement on first time non-O patient
Previous Transfusion Reaction	Inform users that patient has a TRX	BTD add requirement when patient has had a TRX as a final result when HVO complete investigation- Previous Transfuion reaction
HLA platelets		Clinician can add requirement at time of ordering or can be added by BTD
Serological XM: expect red cell delays	Informs users patient is not eligible for computer crossmatch	
Use CMV negative		Clinician can add requirement at time of ordering or can be added by BTD
Use Irradiated		Clinician can add requirement at time of ordering or can be added by BTD
CMV- Pregnancy		Added by clinician when they select pregnant when ordering or can be added by BTD

- Antigens.
- Specimen availability: 72hrs from date/time collected (unless changed in the BTD).
- A history of blood bank products within the last 3 months in various states up to transfused.
    - Assigned: **not used in BTD**
    - Crossmatched: should be no products here as all products dispensed
    - Dispensed: products in Issue Fridge
    - Products transfused within the past 3 months: as per description.

2.1.14 Blood Transfusion Test Requests Reports on Powerchart

All specimens with test requests are received in lab. Specimen status is visible once received in lab from collected to verified. All results are viewable on Powerchart in Results Review. All report results are printable from Powerchart. SFH report will be emailed.

2.1.15 ***Group & Screen Results (Including Antibody ID)***

Computer Crossmatch Eligible:

- In **Results Review test comments** it will NOT state serological crossmatch required on test and a date/time will appear in specimen availability
- In **Blood Bank Overview at Transfusion Requirements**: will either be blank or say "2nd Specimen needed if blood required" for first time non O Patients
- Blood can be crossmatched in 20 minutes in urgent situations with product requisitions.

Serological Crossmatch required on current specimen:

- In **Results review** the following test comment will state "*A serological crossmatch is required. Please give at least 3 hours' notice prior to transfusion or surgery"*.
- In **Blood Bank Overview at Transfusion Requirements** it will state Serological XM: expect Red Cells delay.

A Serological Crossmatch is required due to the patient having clinically significant antibody.

- In **Results review** the following comment will state: "*A serological crossmatch is required due to the patient having clinically significant antibody. Please give 24 hours' notice prior to transfusion or surgery"*
- In **Blood Bank Overview at Transfusion Requirements** it will state Serological XM: expect Red Cells delay **AND** antibodies will be visible in widget.

Specimen referred to the IBTS for further serological investigations and crossmatching and other

- Group & Screen test will have a Ref Lab test added on. Generally the GS will be cancelled with reason.
- In **Results Review** the Reference Laboratory results test comments are variable but generally contain one or more of the following:
    - *"A serological crossmatch is required due to the patient having clinically significant antibody. Please give 24 hours' notice if red cells are required."*
    - *"Testing performed in the IBTS. IBTS are not accredited to ISO15189:2022. The results of these tests referred to the IBTS are*

not covered by the scope of the Blood Bank Departments ISO15189 accreditation"

- A scanned copy of IBTS ref lab report will be viewable on Powerchart.

- In **Blood Bank Overview at Transfusion Requirements** it will state Serological XM: expect Red Cells delay where applicable.
- In **Blood Bank Overview Antibodies** will be present where applicable
- IBTS reports are signed by IBTS Medical Scientist. Where the IBTS issues cross-matched blood the final compatibility report is signed by the IBTS Medical Scientist and subsequently reviewed by an IBTS Consultant Haematologist.

2.1.16 Direct Antiglobulin Test (DAT)

- DAT Results are available on Powerchart
- In **Results Review** test results will be viewable along with any comments added.

2.1.17 ABO Titrations

- ABO Titrations results are available on Powerchart
- Clinical Staff will see Result in **Results Review** Section where any comments attached will be visible also
- Critical Results: An IgG and/or an IgM ABO Titre result of >1:32 post-transplant is deemed a critical result and will be phoned to Colm Magee, Renal Consultant, through switch. If unable to contact Colm Magee, the result will be phoned to the transplant Coordinators office on Ext 4884. Transfusion Reaction Investigation

2.1.18 Transfusion Reactions

A transfusion reaction workup should be ordered when a transfusion reaction is suspected after a patient has been transfused with a blood transfusion product. Sample(s) will be collected from the patient as per BH protocol.

Reporting is in two forms on Powerchart;

- Preliminary Transfusion Reaction Result: details the conclusion of serological work-up in text format. Transfusion Reaction Report (Final): contains full details of the reaction with NHO and Consultant Haematologist sign-off. Final reports will be attached to the result.

2.1.19 ***Cold Agglutinins***

Cold agglutinins tests are not carried out in the hospital Blood Bank and are referred to the IBTS. The result is reported on Powerchart.

The scanned result from IBTS is viewable in results review.

2.1.20 ***Unsuitable specimen reports for Rejected Specimens***

- If the quality of the specimen received renders it unsuitable for analysis/duplicate e.g. haemolysed, no PPID, insufficient etc the specimen will be rejected

- Rejected specimens will be reported with an accession add-on of **Test Not Done**. ***Rejected***: Reason for rejection will be stated in a comment.

2.1.21 ***Second Sample Policy***

A second sample is only required when the patient is for red cell transfusion, is not group O and has no other historical group on file, however group O compatible red cells can be issued without delay. This applies exclusively to 1st time non-blood group O patients (i.e. group A, B and AB) requiring a transfusion. A second sample is required for group verification and must be taken independently of 1st TS sample. Duplicate sample taken at the same time will be rejected.

2.1.22 ***Crossmatch***

A valid GS is required for red blood cell crossmatch, a historical GS is required for platelets and plasma.

There are two types of red cell crossmatch performed in the lab:

Computer crossmatch/Issue: Computer cross-match is the selection and issue of red cell units where compatibility is determined by the laboratory information systems (LIMS) without serological testing of donor cells against patient plasma. This allows for the immediate issue of blood and applies to patients who have a valid TS and have no history of antibodies and no blood group anomalies.

Serological crossmatch is carried out when patients has or had antibodies/blood group anomalies: red cells may take from 60 minutes up to 24 hours. The indirect antiglobulin test is used to detect ABO and non ABO antibody incompatibility between donor red cell and patient plasma.

2.1.23 ***Ordering and Prescribing Blood Components and Products***

Decision to transfuse:

The decision to transfuse should be based on the clinical assessment of the patient and individual needs. Promotion of a single unit transfusion policy is recommended by National Institute of Health and Care Excellence (NICE) 2015 in adult non bleeding patients – "Don't give two without review"

The clinical assessment of the patient should include an evaluation of risk factors when determining whether to transfuse, for example, risk of transfusion-associated circulatory overload (TACO) in vulnerable patient groups e.g. low body weight, patients > 70 years of age, pre-existing conditions, such as cardiac failure or renal impairment (British Society for Haematology 2017)

Please consider the patient's body weight when prescribing red cells to prevent over-transfusion and to minimize the risk of overload. One unit of red cells gives an increment of approximately 1 g/dl Hb in a 70-80 kg patient. For patients of lower body weight the prescription should be based on the following calculation (BCSH 2012).

Very small / Underweight / Paediatric:

Calculate using desired Hb g/dl (9 g/dl is the default desired Hb used in the calculation examples below), minus the current Hb g/dl, multiply by patient weight Kg, multiply by 3, equals volume to be transfused.

Examples based on a 35kg patient

- Pre transfusion Hb 6.9 g/dl; 9 – 6.9 x 35 x 3 = volume of blood for transfusion should be 220 ml

- Pre transfusion Hb 8.2 g/dl; 9 – 8.2 x 35 x 3 = volume of blood for transfusion should be 84 ml

The prescribing Doctor is responsible for checking the patient's previous transfusion history and any special requirements, such as CMV-/ Irradiated. They are also responsible for checking whether the patient has a valid G/S prior to transfusion

All blood products should be ordered electronically on Powerchart see SOP on hospital intranet BTD-HVO-039 Ordering Blood Components/Products from Blood Bank, and followed up with a phone order to the Hospital Blood Bank.

Ensure:

- Prescription is filled out completely. Details when ordering should include all patient details (*name, MRN number and location*), blood product and quantity required, Doctors full name, IMC and contact number. .
- Consent: it is a general ethical principle that valid consent is obtained from a patient before they receive a blood transfusion. Verbal consent suffices and can be documented in chart. Patient information leaflets are available on each ward.
- Special requirements are considered. Pre-meds for patients with history of previous transfusion reactions, fluid overload etc.
- Maximum Surgical Blood Ordering Schedule is referred to: This is a guide to blood ordering for routine/elective surgical procedures.
- Risk of Transfusion Associated Circulatory Overload (TACO) has been assessed: patient weight, cardiac history, fluid balance, etc.
- Once prescription is completed, an electronic request from the clinical area must be followed up with a verbal request by phoning the Blood Bank.

St Francis Hospice:

- Symptoms suggestive of anaemia noted and Palliative care Outcome Score (POS) recorded for dyspnoea and fatigue in patient's healthcare record.
- Once prescription is completed, email the request for red cells to bloodbank@Beaumont.ie. This must be followed up with a verbal request by phoning the Blood Bank.

*2.1.24 **Requesting of Blood Products with Special Requirements***

See guidelines for use of CMV- and/or Irradiated blood components on hospital intranet refer to BTD-HVI-007

*2.1.25 **Maximum Surgical Blood Ordering Schedule***

The Maximum Surgical Blood Order Schedule (M.S.B.O.S) should be adhered to when taking TS samples and ordering Blood for surgical procedures. The M.S.B.O.S is available for review as a Clinical Policy on Hospital intranet. Each member of staff has a professional responsibility to avoid over exposure of patients to blood / blood products. Over ordering of blood / blood products and unnecessary GS sampling should be avoided in order to prevent wastage and over phlebotomising patients. Blood / Blood Products are extremely costly and are frequently in short supply. Where a patient has allo-antibodies, please give the Hospital Blood Bank 24 hours' notice prior to surgery. (Refer to BTD-HVI-008).

The MSBOS is a guide only and should never replace expert clinical judgement.

*2.1.26 **BloodTrack***

Bloodtrack is used to monitor and record all transactions in the relation to movement of Red Cells, Platelets, Plasma and Granulocytes. It allows a full electronic audit trail of these components. Users of the BloodTrack System must be trained in such prior to use.

All blood components and products are processed for electronic move out / move in to fridges / platelet agitators respectively via the Blood Track system. If Blood Track is non-functional all products must be manually signed out of the Blood and Blood Products register. (Refer to BTD-HVO-040 on hospital intranet).

*2.1.27 **Emergency Issue of Blood components and products***

If no GS or testing is incomplete and patient is unable to wait for compatible red blood cells, the lab can issue uncrossmatched RCCs immediately once requested by clinician.

- O NEG uncrossmatched units are available in the Blood Transfusion Issue fridge for use in emergencies.
- Ensure a Group and Screen specimen is taken before the O NEG uncrossmatched units are transfused.
- O NEG uncrossmatched units are not antigen negative specific to antibodies that a patient may have and therefore may result in incompatible units being transfused.
- O NEG stock is limited. Once these stocks are depleted it may be necessary to switch to O POS if patient is
  - Male
  - Female > 55 years

*2.1.28 **Massive Transfusion Protocol***

A successful Massive Transfusion Protocol can provide a timely, coordinated, delivery of blood products to the bleeding patient refer to BTD-HVO-042 Emergency/Massive transfusion protocol (MTP) and MTP Poster BTD-F-0283

- Accurate patient identification is of paramount importance. Every patient must wear an identification wristband (beware of external wristbands!).
- The Serious Hazards of Transfusion (SHOT) report suggests that the risk of error may be particularly high in an emergency situation. It is important that a correctly labelled TS specimen is taken before any blood products are administered. Use ED TRAUMA numbers if required and PDA device to ensure safe transfusion.
- One person should be nominated to liase with the BTD ensuring clear communication and to avoid confusion and unnecessary phone calls.

- When the MTP has ceased, communicate this to the Blood Bank.
- Traceability of blood products is a legal requirement – ensure traceability has been recorded / maintained for all blood products transfused or discarded in the event.
- Early administration of Tranexamic acid (Crash2 study)
- The use of rapid infusers / blood warmers are recommended for RCCs and fluids in major haermorrhage to avoid hypothermia which can exacerbate the clinical situation.

Bleeding in patients on anticoagulant therapy. **Discuss with Consultant Haematologist**. (Refer to Q pulse document PPCC-HAEM-24)

A&E / Pharmacy:

- Dabigatran- specific reversal agent Praxbind (Idarucizumab)
- Direct Factor-Xa Inhibitors (Rivaroxaban, Apixaban) – Ondexxya (Andexanet Alpha).

Bloodbank:

- In life threatening bleeds the products available from the BTD are PCC, rFactor VIIa - under the direction of the haemotology team.

2.1.29 Collection from the Blood Transfusion Laboratory

Only collect the Components/Products from the Hospital Blood Bank when required, as Components/Products must not be stored outside strictly controlled storage conditions or in areas such as ward refrigerators

Theatre are the only department with a remote temperature controlled fridge to store crossmatched red cells only.

Blood components and products are transported within Beaumont Hospital and St Lukes Radiation Oncology Centre by trained porters and healthcare assistants. Blue cabs transfer to St. Francis Hospice sites & St. Joseph's Hospital Raheny refer to BTD-HVO-031

2.1.30 Blood / Blood Product Administration

Bloodtrack PDAs are used to transfuse Red cells, platelets and plasma. The product barcodes and patient ID band are scanned on commencement of transfusion of Red cells, Platelets and plasma to a patient. Any discrepancies will be highlighted on PDA device and the transfusion cannot proceed. Contact the Blood Transfusion Dept for any alerts / alarms.

The manual method is used for all other blood products or can used for blood and platelets if bloodtrack is unavailable or undergoing upgrade. This requires 2 fully

trained staff members checking and signing transfusion documentation independent of each other.

**See quick reference blood transfusion product administration guidelines on hospital Intranet refer to BTD-HVI-001 and BTD-HVO-009 Blood Administration.

2.1.31 ***Traceability***

It is a legal requirement to maintain 100% traceability of all blood components. If Bloodtrack is used, traceability is electronically updated. Following commencement of transfusion the labels generated should be placed in the patient transfusion record.
For manual transfusions, the middle pink portion of the compatibility label must contain the signatures of both administrators and the date and time of transfusion. This section is then removed and placed in the designated traceability box in the clinical area and / or returned to the blood bank as soon as possible for fating of the product. The lower portion of the compatibility label is also signed by both administrators, including the date and time. This lower portion is then placed in the patient's medical record. The patient transfusion record must also be signed and updated by both staff members with record of the transfusion.

2.1.32 ***Management of Transfusion Reactions***

Serious adverse Events & Reactions
It is mandatory to report all serious errors, incidences and reactions related to transfusion to Haemovigilance / Blood Transfusion Department. This data is then reviewed by the Consultant Haematologist and Hospital Transfusion Committee and may be submitted to the NHO (National Haemovigilance Office) in collaboration with the HPRA (Health Products Regulatory Authority) for further review.

Please refer to Transfusion reaction information on the Hospital intranet site refer to BTD-HVF-023 Transfusion Reaction Notification Form.

Also: BTD-HVO-015 Serious Adverse Reactions (Clinical Areas) –Mandatory Reporting including Rapid Alert Procedure), BTD-HVO-016*:* Serious Adverse Events (Clinical Areas) –Mandatory Reporting including Rapid Alert Procedure), Guidelines on the investigation and management of acute transfusion reactions, British Society of Haematology, 2023 (BSH website).

2.1.33 ***Clinical Advice***

A Consultant Haematologist with Administrative Charge for the Blood Transfusion Department is in place. This Consultant Haematologist provides an

extensive advisory service and clinical advice. Examples include indications for platelet transfusion, management of massive transfusion and the appropriate use of blood products.

Issues relating to Haemovigilance policies and protocols are referred to the Haemovigilance officers. Examples include sample labelling and management of transfusion reactions.

Comments or suggestions relating to the service should be addressed to the Chief Medical Scientist

Further information on all aspects of Blood Transfusion including blood product information, administration guidelines, relevant policies and procedures, forms etc are all available on the Beaumont Blood Transfusion Intranet page. Please email haemovigilance@beaumont.ie with any questions or queries.

2.1.34 *Blood Transfusion Test Repertoire and TAT*

Test	**Sample Type**	**Minimum Volume**	**TAT**	**Comment**	**Mnemonic**
Group & Screen	4.9ml EDTA Specimen bottle labelled: "EDTA - FOR BLOOD BANK" (PalePink top tube)	2.5ml	**Routine:** Same day if received before cut off time of 17:00 during routine hours. **Emergency:** 1 hour	GS specimens should be taken using the Bridge Medical devices/Powerchart for OPD either desktop or PDA. Equipment must be brought to patient bedside. When the Bridge medical device is not available the patient details must be handwritten on the specimen bottle. Unavoidable delays in the provision of results can occur when a patient has a positive antibody screen and/ or when a specimen is referred to the IBTS.	Group and Antibody screen
Direct Antiglobulin Test	EDTA Specimen (2.7 ml)	2.5ml	**Routine:** Same day if received before cut off time of 17:00 during routine hours. **Emergency:** 1 hour	DAT specimens should be taken using the Bridge Medical devices either desktop or PDA/Powerchart for OPD. Equipment must be brought to patient bedside. When the Bridge medical device is not available the patient details must be handwritten on the specimen bottle.	DAT
Transfusion Reaction Investigation	4.9ml EDTA Specimen + 7.5ml clotted serum specimen	2.5ml	Depends on the complexity of investigation.	Should be sent to the hospital Blood Bank as soon as possible after taking the specimens.	TRX

Test	**Sample Type**	**Minimum Volume**	**TAT**	**Comment**	**Mnemonic**
ABO Antibody titration	4.9ml EDTA Specimen.	4.0ml	**Routine:** 24 hours from time of receipt during routine hours **Urgent:** Same day if received before 1400.	This test is requested only under the instruction of the Nephrology team. Specimens should be taken using the Bridge Medical devices either desktop or PDA/Powerchart for OPD. Equipment must be brought to patient bedside. When the Bridge medical device is not available the patient details must be handwritten on the specimen bottle.	Anitbody TITR
Cold Agglutinins	2 X 4.9ml EDTA specimen bottle.	4.9ml.	5 working days from sample receipt by NHSBT As per Specimen User Manual IBTS	Referred to IBTS Specimens should be taken using the Bridge Medical devices either desktop or PDA/Powerchart for OPD. Equipment must be brought to patient bedside. When the Bridge medical device is not available the patient details must be handwritten on the specimen bottle.	COLDAGGS
ABO Rh D grouping for Living donor and H&I	4.9ml EDTA Specimen.	2.5ml.	**Routine:** Same day if received before cut off time of 17:00 during routine hours. **Emergency:** 1 hour		Ext Blood Group

*2.1.35 **Blood Components/Products Available***

Power chart Mnemonic	**Turnaround Time**	**Comment**
Red Blood Cells	With valid TS: 15 mins to 3hours * From receipt of TS: up to 4 hours* Emergency • Uncrossmatched RC: <10 mins • Crossmatched RC: 60 min from receipt of GS*	
Frozen Plasma	40min to 3 hours	
Platelete Concentrate	15mins to 12hours **	The blood bank strives to maintain 2 stock platelets at all times for emergency issue. However this depends on demand and supply. Non-emergency orders should be placed prior to 14:00 hrs during routine working hours and will be available from 16:30 hrs the same day and before 22:00 hrs for approx. 11am next day delivery.
Fibrinogen Product	15min to 60mins	
Albumin 5% Albumin 20%	15min to 60mins	
Factor Concentrates • Novoseven	15 mins to 60 mins	Discussion with Haematology Medical Team required

• Factor VIII (Altuvoct and Elocta) • vWF • Factor IX • Prpthrombin Concentrate • Factor XIII		A longer half- life Factor VIII (FVIII) product known as Altruvoct will be available in Ireland from March 2025. Discussion with Haematology Medical Team required.
Other Anti-D Anti-Thromin Granulocytes	60min to 4 hours	Discussion with Haematology Medical Team required

*Turnaround Time provided the patient has no Antibodies or blood group discrepancies. **Availability is dependent on national supply

Specimens referred to the IBTS for antibody investigation, serological crossmatch or/and Cold Agglutinins, the results of these tests are not covered by the scope of Beaumont Hospital Blood Bank Department ISO15189 accreditation

2.1.36 ***Specialised Tests Referred to the National Histocompatibility and Immunogenetics Reference Laboratory (NHIRL)***

Test Referred	Power chart Mnemonic	Specimen Required
Human Leucocyte Antigen (HLA Typing) for Matcheded platelets	Ref Lab HLA typing for matched platetes	5-10mls EDTA
Screening for Platelet Allo-antibodies	Ref lab platelet allo Ab investigation	5-10mls clotted
Human Platelet Antigen Typing (HPA) (Genotyping)	Ref Lab HPA genotyping	5mls EDTA
Platelet Refractoriness	Ref Lab platelet refractoriness	5-10mls EDTA and Citrate
HLA Class 1&11 typing of transplant patients and family for BMT	Not on Powerchart	5-10mls EDTA

These samaples must be accompanied by form BT255-6 for reference lab send out.

2.2 HAEMATOLOGY

2.2.1 Thrombophilia Screening

Beaumont Hospital's specialist coagulation laboratory has a test repertoire which includes **Inherited Thrombophilia Screens, Lupus Anticoagulant, Clotting Factor Assays and von Willebrand Screens**. In the majority of cases, patients do not meet the clinical criteria for testing.

The Hematology Department has introduced a demand management protocol to limit access to these specialised tests.

- The following tests are discussed with and sanctioned by the Haematology Consultant before being processed:
- **Inherited Thrombophilia Screen** (Antithrombin, Protein C, Protein S, Activated Protein C Resistance (+/-Factor V Leiden Mutation and Prothrombin Gene Mutation if required)
- **Lupus Anticoagulant**
- **Clotting Factor Assays** (Factors II, V, VII, VIII-c, IX, X, XI and XII)
- **von Willebrand Screen** (VWF:Ag and Factor VIII-c)
- **anti Xa/ Rivaroxaban**

Testing will be reserved for specific patients who are deemed to meet the clinical criteria after being reviewed and sanctioned by the Haematology team.

If you believe your patient meets the criteria for testing, they should be referred to the relevant specialist, e.g.:

- If you suspect your patient has a bleeding disorder or an inherited thrombophilia, they can be referred to Dr Karl Ewins' Specialist Coagulation Clinic (Department of Haematology).
- If the patient has a family member with a known bleeding disorder who already attends the National Coagulation Centre (NCC) in St James's Hospital, they should be referred directly to the NCC for family screening.
- Please note that Antiphospholipid Syndrome is not an inherited disorder, so family screening is not required.
- Please note that recurrent miscarriage is not an indication for inherited thrombophilia testing and such requests will not be processed.

If you believe your patient warrants urgent investigation, please contact the Haematology Registrar on consults via the Hospital switch 01-8093000.

The current national thrombophilia laboratory testing guideline can be accessed at:
https://www.hse.ie/eng/about/who/cspd/ncps/pathology/resources/national%20laboratory%20handbook.html

NB. All requests must first be discussed with the Haematology SpR, Haematology Registrar, or Haematology consultants (Prof. Philip Murphy, Dr. John Quinn, Prof. Patrick Thornton, Prof. Siobhan Glavey, Dr Jeremy Sergeant or Dr Karl Ewins) available via the hospital switchboard.

POTENTIAL INDICATIONS

- Patients with a family history of inherited thrombophilia
- Patients with a family history of venous thrombo-embolism (VTE)
- Patients who have developed a venous thrombosis with no obvious precipitating cause or at a relatively young age (<50 years of age)
- Women with a history of recurrent miscarriages should be screened for the presence of antiphospholipid antibodies.
- Neonates with purpura fulminans and adults developing skin necrosis in association with vitamin-K deficiency (i.e. warfarin therapy)
- Other requests will be dealt with on a cases by case basis after discussion

THROMBOPHILIA SCREENING - TIMING

- Screening should be done as soon as any of the risk factors above are identified
- Thrombophila screening should not be done during the acute phase after the patient presents with a thrombosis.
- Patients should be tested after the acute event and after any anticoagulation therapy

- **Please note:** Anti Cardiolipin Antibodies are processed by Immunology and are not part of this screen.
- **'Thrombophilia and Lupus screenswhich have NOT been sanctioned by the Haematology Team will be rejected and not processed by Scientific Staff.**
- **If a patient is on anticoagulation at the time of testing, certain assays within the Thrombophilia profile may be rejected, see above.**

Attending Phlebotomy:

Should a patient require a Thrombophilia or Lupus screen to be taken in Phlebotomy, the Thrombophilia/lupus care set should be ordered in Powerchart , as part of this the Thrombophilia / Lupus questionnaire must be completed in full in the clinic (including patient consent obtained) . All referrals which require a form to be sent to the referral hospital must also be printed and completed in clinic and given to the patient to take to phlebotomy when getting the bloods taken.

*2.2.2 **Lupus Anticoagulant***

Screening Test:

- Two tests based on different principles must be performed.

- Dilute Russel Viper Venom (DRVV) should be the first test considered
- The second test must be a sensitive APTT (low phospholipids and silica as activator).
- LA should be considered as positive if one of the two tests gives a positive result.

Confirmatory Test:

- Confirmatory test(s) must be performed by increasing the concentration of the phospholipid of the screening test.

Mixing Studies:

- CommercialPooled Normal Plasma (PNP) is used.A 1:1 proportion of patient: PNP should be used without preincubation.

INTERPRETATION OF RESULTS

Expression of Results;

- Tests should be reported with a quantitative result, whereby tests are expressed as ratio of patient-to-PNP for all procedures
- In addition an interpretative comment that indicates whether there is the presence or absence of LA is included.

British Committee for Standards in Haematology (BJH, 2012, 157, 47-58)
"Guidelines on the investigation and management of antiphospholipid syndrome"

2.2.3 Anti Xa and Rivaroxaban Anti Xa

Anti Xa assays will be processed in house if sanctioned by the Haematology Team and can be ordered on Powerchart. For patients on LMWH order the generic Anti Xa assay but for patients on Rivaroxaban a dedicated Anti Xa assay is required.
The mnemonic for generic LMWH Anti Xa is **ANTIXA**
The mnemonic for Rivaroxaban Anti Xa is **RIVAROX**

NOTE: Routine Monitoring is not recommended as there is no 'therapeutic range'. Therefore these tests cannot be ordered on a routine basis. The request is only indicated in exceptional clinical circumstances. The timing of which, the clinical indication and the clinical interpretation must be discussed with the Haematology team.

2.2.4 ESR

ESR

The clinical Haematology team have listed the following conditions as the only times an ESR is indicated. In all other cases, C - reactive protein (CRP) is the preferred test.

- *Giant cell arteritis, Temporal arteritis*
- *Polymyalgia rheumatica.*
- *'Suspected myeloma'*
- *Hodgkins Lymphoma*
- *Prosthetic joint infection,*
- *Osteomyelitis,*
- *Rheumatoid Arthritis*

*2.2.5 **Haematology Molecular Tests***

- **Changes to Genetic consent for all haematology molecular tests (HFE, Factor V Leiden and PT mutation)**.

  From the 04/07/2022, the laboratory will no longer take receipt or store the form containing patient genetic consent. It is the responsibility of the ordering clinician to obtain and file a copy of genetic consent in the patient's record.

- HAEMP-LF-003 "*Haematology Genetic Consent Form"* is available on the Beaumont Hospital Internet/Intranet site and must be printed and kept in the patient's record by the ordering clinician.

If this form is received in the lab it will be disposed and not returned to the sender.

2.2.5.1 Haemochromatosis Testing

Due to the significant increase in orders for Haemochromatosis HFE genotypes, the Haematology Department is introducing a demand management protocol to address unnecessary ordering of this test. From the 04/07/2022 all HFE test requests **must** fulfill the following criteria:

- Testing of adult siblings (brothers and sisters) and adult offspring of **p.C282Y homozygotes** is recommended owing to increased risk of p.C282Y homozygosity and related increased morbidity. **Please indicate on the form if there is a First Degree Relative (SIBLING/PARENT) with p.C282Y homozygosity. Stating both relationship and genotype.**

- The results of iron studies: Iron, Ferritin and Transferrin Saturation (%) are available and meet certain criteria. In particular, the Transferrin Saturation should be raised (> 45%).

- **It is required to confirm elevated Transferrin Saturation on <u>two</u> occasions before HFE genetic diagnosis testing.**
- **Note: if Transferrin Saturation <45% and/or no first degree relative with p.C282Y homozygosity, the sample will not be processed.**
- Samples must be sent to the laboratory with the updated form *HAEMC-LF-077 "Haemochromatosis Genetic Screening Request Form" Version 3.* **If any form other than this version is sent to the laboratory, the samples will be rejected and not processed.**

Note: these guidelines are formed in line with Best Practice Guidelines "EMQN best practice guidelines for the molecular genetic diagnosis of hereditary haemochromatosis (HH) European Journal of Human Genetics (2016) 24, 479–495".

2.2.5.2 Flow Cytometry

Peripheral blood immunophenotyping (lymphoproliferative screen) is not performed on samples with a lymphocyte count $<5x10^9/l$.

Immunophenotyping is not performed for diagnosis of myeloproliferative neoplasms. For potential MPN transformations please document this in the clinical details.

2.2.6 Haematology Clinical Advice & Laboratory Test Interpretation

Interpretation of Laboratory Tests / procedures may be obtained by phoning any of the telephone numbers in section 3.1.2 and asking for the Chief Medical Scientist or by requesting a senior member of staff 09:00- 17:00 Mon-Fri excluding Bank Holidays

2.2.7 Emergency Out-Of-Hours Services

The Medical Scientist on call can only be contacted by bleeping 852
The following emergency tests will be processed

- Full blood count -FBC
- Reticulocyte
- Coag screen / INRs
- D-Dimer
- Fibrinogen
- Infectious Mononucleosis (IM) screen
- Malaria screen

- ESR (only where temporal arteritis is suspected)
- Sickle screen (urgent theatre cases only)
- Other tests in special circumstances may be arranged with the Laboratory.

2.2.8 Urgent Blood Film Reports Out of Hours/Weekends

- Blood films are not routinely examined or reported on a Saturday or Sunday.
- Should a clinician request an urgent blood film to be examined, please do the following:
- Contact the laboratory staff member on-call to see if a current blood film report is on the system or is awaiting reporting.
- If a film has not been made, please request and check if a fresh sample is required to be sent to the laboratory to make this blood film. The cut-off time for an add-on blood film to a FBC is 8 hours.
- If this is an urgent request and the clinical treatment of the patient depends on the result of the blood film, the requester must contact the Haematology team to review the film.
- One of the Haematology team generally performs a ward round at 11am on Saturday and Sunday and they will review the slide.
- **NOTE:** For certain specimens the analyser is unable to give an accurate white cell differential. This means that a film must be made and the differential must be counted manually. This is not performed at the weekend, unless it has been discussed with the Haematology team.
- **If a WBC < 2.0 x 10^9/L, please assume neutropenia.**

2.2.9 Sample Collection & Labelling Guidelines for Bone Marrow Aspirates

These are processed during routine hours only. Incorrectly or inadequately labelled specimens are not processed. Inform the laboratory if samples need to be processed urgently. The clinician is responsible for the correct labelling of specimens.

All specimens received in the laboratory must be labelled with a minimum of two unique patient identifiers on the specimen container/slides. Unique patient identifiers include name, date of birth and MRN number. All Bone Marrow samples delivered to the laboratory are signed in to the Bone Marrow receipt log.

2.2.9.1 Bone Marrow Careset

In Powerchart order a Bone marrow carset.The care set includes the Bone Marrow Aspirate and optional orders for FBC and Blood Film, Immunophenotyping, Cytogenetic & Molecular testing.

Select the additional required orders by placing a check in the box beside the required test. Once the appropriate orders have been checked then click ok at the bottom right hand of the care set.

Note that orders for tests routed externally must be accompanied by the requisite form. The form can either be printed from the pop-up link in the alert message that appears when the order is placed. The bone marrow requisition form prints in the Haematology laboratory.

2.2.9.2 BONE MARROW ASPIRATE SAMPLE REQUIREMENTS FOR HAEMATOLOGY:

- A minimum of 5 slides should be taken
- Slides must be labelled legibly in pencil with the patients' Surname and second unique identifier either D.O.B/MRN number.
- Slides must be transported in a slide transport container (obtained from Haematology Lab)

2.2.9.3 BONE MARROW SAMPLE REQUIREMENTS FOR FLOW CYTOMETRY:

- Bone Marrow for flow cytometry testing must be taken into RPMI & Sodium Heparin tubes, which can be obtained from the Haematology Laboratory.
- These must be labelled with patient name, DOB and must be transported in a biohazard bag.
- Flow Cytometry must be pre-arranged with the Flow Cytometry staff at 2763/2703
- Note: The Flow Cytometry laboratory operates 9am-5pm Mon-Thur and 9am -3pm Friday. The reason for early cut-off on Friday is to allow completion of sample processing and acquisition which may take up to 3 hours. There is no flow Cytometry service at weekends.

2.3 IMMUNOLOGY

2.3.1 Rheumatoid Factor

INDICATIONS

- Inflammatory arthritis
- Suspected vasculitis
- Interstitial lung disease
- Pleural/pericardial effusions

INTERPRETATION OF RESULTS

Negative rheumatoid factor, <14 IU/mL: A negative Rheumatoid factor makes diagnosis of Rheumatoid disease less likely, however as 10% of patients are RF negative, it does not exclude this diagnosis. Where there is a strong clinical suspicion of Rheumatoid Disease anti-CCP should be ordered.

Weak positive, 14-70 IU/mL: Some patients with Rheumatoid Disease will be only weakly positive and will fall into this range. However at this level Rheumatoid Factor is not specific for a diagnosis of Rheumatoid disease and a number of patients with weakly positive Rheumatoid Factor will have other inflammatory conditions. Anti-CCP will automatically be ordered and this will give more specific information. We generally suggest that you repeat the test in approximately 3-6 months time if clinical symptoms have persisted and only RF is positive. In Rheumatoid disease the assay should remain consistently positive, or may even be more strongly positive. However infection induced Rheumatoid Factor usually clears within weeks following successful treatment of the infection.

Significantly positive rheumatoid factor, 71-250 IU/mL: In an appropriate clinical setting a significantly positive Rheumatoid Factor is consistent with diagnosis of Rheumatoid disease. Anti-CCP will automatically be ordered.

Strongly positive rheumatoid factor, >250 IU/mL: Strongly positive Rheumatoid Factor is suggestive of Rheumatoid disease. The presence of a high level of Rheumatoid Factor at presentation is considered an adverse prognostic marker. Patients with Sjogren's syndrome may have very high levels of RF despite only minor joint symptoms. Occasionally a similar level may be seen in patients with cryoglobulinaemia and if features suggestive of this disorder are present an appropriate sample should be sent to the Proteins Laboratory in Clinical Chemistry. Anti-CCP will automatically be ordered.

Serial measurement of Rheumatoid factor is generally not useful in monitoring the response to therapy. Measurement of acute phase reactants e.g. CRP are more useful.

2.3.2 Anti-Cyclic Citrullinated Peptide antibodies (CCP)

INDICATIONS

- Inflammatory Arthritis
- Interstitial lung disease
- Suspected extra-articular rheumatoid disease

INTERPRETATION OF RESULTS

If result is <7 U/ml = Negative CCP

Anti-CCP has a sensitivity of 80% for detection of Rheumatoid arthritis (RA). It appears less sensitive for detection of extra-articular disease. If RA is strongly suspected, RF should be measured, as at least 10% of RA patients are negative for CCP, but positive for RF.

If result is 7 – 10 U/ml = Equivocal

If patient has evidence of an inflammatory arthropathy, suggest referral to Consultant Rheumatologist.

If result is >/= 11 U/ml = Positive CCP

Anti-CCP antibodies appear to be relatively specific for rheumatoid disease (Specificity 96%). Suggest referral to Consultant Rheumatologist

To date it is unclear whether monitoring changes in anti-CCP antibody levels is helpful. However, given that the half-life of IgG is 3 weeks, we do not recommend repeat testing more frequently than 3-monthly.

*2.3.3 **Connective Tissue Disease (CTD) Screen***

INDICATIONS

- Inflammatory arthritis
- Suspected vasculitis/ connective tissue disease
- Photosensitive/other typical skin rash
- Pleural/pericardial effusions.
- Query autoimmune haemolytic anaemia, ITP, leucopenia
- Renal impairment, proteinuria, haematuria
- Unexplained CNS disease

The CTD Screen by EliA was introduced in February 2014 as an alternative method for the detection of anti-nuclear antibodies (also referred to as ANA). The CTD screen tests for anti-DNA and clinically relevant anti-ENA such as anti-Ro, anti-La, anti-Sm, and anti-RNP. CTD screen by EliA is carried out as part of the vasculitis screen panel, the inflammatory arthritis antibodies panel and for "stand-alone" ANA and connective tissue disease screen requests. For assessment of liver autoimmune diseases, the Liver Disease Associated Antibodies panel is recommended and the ANA component of this panel will remain tested using immunofluorescence (IIF) method.

Our validation analysis confirmed that the CTD screen assay has comparable performance with the immunofluorescence method for ANA in screening for anti-DNA, and clinically relevant anti-ENA including anti-Ro, anti-La, anti-Sm, and anti-RNP. As the number of anti-Scl-70 sera in our validation panel was small, we recommend that anti-Scl-70 is specifically requested in addition to CTD screen if scleroderma is clinically suspected. Additionally if myositis is clinically suspected, we recommend that anti-Jo-1 is specifically requested in addition to CTD screen. With the introduction of the CTD method for ANA analysis the table below outlines the appropriate test requests as guided by clinical history.

Clinical indication	Suggestions	Comments
Connective tissue disease screen Excluding connective tissue disease in patients with low clinical suspicion	CTD screen C3 C4	Positive CTD screen samples will be tested for ENA and DNA
Scleroderma	CTD screen ENA (for anti-Scl-70)	If scleroderma suspected, consider rheumatology opinion, regardless of results
Myositis	CTD screen ENA (for anti-Jo1)	If negative Jo-1 but clinical suspicion high with a raised CK, please discuss with laboratory (details as below)
Raynaud's with suspicion of connective tissue disease	CTD screen, C3, C4 ANA	ANA: ANA will be tested by indirect Immunofluorescence on HEP 2 cells
Monitoring lupus	DNA, C3, C4	
Patients with negative CTD screen but strong clinical suspicion	Liaise with lab : ANA by immunofluorescence is available if clinically indicated	immunologylab@beaumont.ie Lab extension 2635 Clinical team bleep 797
Autoimmune liver disease	Liver antibodies panel	ANA component is tested by immunofluorescence on HEP 2 cells

In most cases, a positive CTD screen result would also yield a positive result for anti-DNA and/or anti-ENA. The lab will automatically test for anti-DNA and anti-ENA on all equivocal & positive CTD screen results.

Once a diagnosis of connective tissue disease has been made, repeated measurement of CTD (or ANA) is rarely helpful in monitoring disease activity. In particular, for patients with SLE, we recommend that anti-dsDNA antibodies and complement levels (C3 & C4) be used for follow-up.

INTERPRETATION OF CTD RESULTS

If CTD screen is negative, connective tissue disease is unlikely.

If CTD screen is positive or equivocal, follow on testing for anti-ENA and anti-DNA will be done.

*2.3.4 **Anti-Nuclear Antibodies (ANA) by Immunofluorescence***

INDICATIONS

- Autoimmune liver disease
- Suspected vasculitis/ connective tissue disease**

ANA (also known as anti-nuclear antibody) is one of the main serological markers for autoimmune hepatitis and most data in the literature is based on the immunofluorescence method. Therefore we have retained the immunofluorescence method (using Hep2 cells as substrate) as the ANA method for Liver Disease Associated Antibodies panel.

***From February 2014, we introduced the CTD screen by EliA as the method for the detection of anti-nuclear antibodies for connective tissue disease and vasculitis screens. Please refer to section 2.3.3 for information on CTD screen.*

INTERPRETATION OF RESULTS

Negative ANA: ANA is the commonest autoantibody found in autoimmune hepatitis but a negative ANF does not exclude the diagnosis.

Positive ANA (titre >1:80): A positive ANA is one of the serological markers for autoimmune hepatitis. Results should be interpreted within the context of clinical history, imaging and other laboratory parameters.

PATTERNS OF ANA

Both the homogenous and the speckled pattern are commonly seen in patients with autoimmune hepatitis. Anti-nucleolar pattern which is typically associated with scleroderma, is also frequently seen in autoimmune hepatitis.

Anti-Centromere antibody pattern is seen in about 13% of patients with primary biliary cirrhosis (also known as primary biliary cholangitis/PBC). Anti-centromere antibody is also typically found in CREST syndrome (Calcinosis, Raynaud's phenomenon, Oesophageal dysmotility, Sclerodactyly & Telangiectasia).

*2.3.5 **Anti-Double-Stranded-DNA Antibodies***

INDICATIONS

- Strong clinical suspicion of SLE
- Positive CTD Screen
- Strongly positive ANA
- Follow-up of known SLE patients

INTERPRETATION OF RESULTS

Strongly positive anti-dsDNA is suggestive of SLE, but may also be found in autoimmune hepatitis. Weakly positive anti-dsDNA antibodies may also be found in patients with other connective tissue diseases, and occasionally in non-autoimmune inflammatory disorders. Anti-dsDNA is useful in monitoring activity of SLE. As the half-life of IgG is 3 weeks, it is seldom helpful to measure more frequently than monthly. However, when patients are undergoing plasmapheresis we are happy to receive daily samples to monitor therapy. In September 2014 dsDNA by Crithidia Luciliae IIF was repatriated as a confirmatory assay for new patients with dsDNA EliA results >10 IU/mL. The dsDNA Crithidia assay is highly specific but is less sensitive than the EliA method for dsDNA antibodies. The EliA method is highly sensitive but has reduced specificity, possibly related to detection of low-affinity antibodies. The IIF method is less useful for monitoring disease activity & patients will continue to be monitored using the EliA assay.

Negative EliA Result (<10 IU/mL): SLE unlikely, however a small number of SLE patients may be negative when first tested. Therefore if clinical suspicion is high, serology should be repeated in 3-6 months.

Equivocal EliA Result (10-30 IU/mL): Most patients with non-inflammatory disorders have values less than 30 IU/mL. At this level, if connective tissue disease remains a clinical possibility we suggest repeating serology in 3-6 months to exclude an evolving process, unless an alternative diagnosis is established in the meantime.

Negative DNA by crithidia & DNA EliA <30 IU.mL: Equivocal anti-dsDNA by EliA with negative crithidia is of uncertain clinical significance & may not reflect lupus. If lupus is still part of the differential diagnoses suggest retesting in 3-6 months.

Negative DNA by crithidia & DNA EliA >30 IU/mL: Positive anti-dsDNA antibodies by EliA but negative crithidia has low specificity for lupus compared with dual positivity by dsDNA EliA & dsDNA crithidia. If there is a strong clinical suspicion of lupus please discuss.

Positive DNA by crithidia: Positive anti-dsDNA by EliA & crithidia is consistent with lupus in the appropriate clinical context.

2.3.6 Anti-ENA (Extractable Nuclear Antigen) Antibodies

This test includes: Anti-Ro, Anti-La
Anti-RNP, Anti-Sm
Anti-Jo-1, Anti-Scl-70

INDICATIONS

- ANA positive 1:160 or greater
- Clinical suspicion of SLE/CTDs with ANA of 1:100/1:200
- Clinical & Biochemical evidence Polymyositis
- Suspected Sjogren's syndrome
- DLE/Subacute cutaneous lupus
- Congenital heart block – test mother & child

INTERPRETATION OF RESULTS

Antibodies to extractable nuclear antigens (ENA) refer to antibodies to a group of antigens found within the nucleus (+/- cytoplasm), which are associated with connective tissue diseases. While approximately 70 such antigens have been described, only antibodies to 6 are routinely available, and play a well-validated role in patient management.

The majority of patients who are anti-ENA positive will also have a positive ANA. However as both Ro and Jo-1 are primarily located in the cytoplasm occasionally patients with these antibodies may have a negative ANA.

Anti-ENA antibodies are useful in diagnosis, but not follow-up of patients. There is little indication for repeated measurement of these antibodies as the assays are qualitative, and antibody levels have never been shown to reflect disease activity. The only exception is when a patient is seen with a short history, and serology is negative – on repeat some months later, the picture may be more helpful. Additionally in view of the obstetric implications, it is reasonable to repeat an ENA when a patient with SLE or other connective tissue disease becomes pregnant.

ANTI-SM

This antibody is found in 30% of patients with SLE, and is regarded as specific for this diagnosis.

ANTI-RNP

This antibody is typically seen in mixed connective tissue disease. This is an overlap syndrome with features of SLE, polymyositis and scleroderma, in varying

proportions. Anti-RNP may also be significantly positive in patients with SLE, however in this group anti-dsDNA will also be elevated. Weakly positive anti-RNP may be found in other connective tissue diseases.

ANTI-RO

Anti-Ro antibodies are found in 70% of patients with Sjogren's syndrome and 30% of patients with SLE. This antibody is also often found in subacute cutaneous lupus erythematosus (SCLE). Anti-Ro is often present in lupus patients with photosensitivity.

Antibodies cross the placenta from early in the second trimester, and anti-Ro cross-reacts with the fetal cardiac conducting system. A minority of babies born to anti-Ro-positive mothers may develop congenital heart block. The birth of a baby with congenital heart block may be the presenting feature of SLE, and both mother and baby should be screened. Congenital heart block may cause a late intrauterine death or a stillbirth.

ANTI-LA

Anti La antibodies are usually found in association with anti-Ro, and are rarely found alone. It is found in approximately 30% of Sjogren's patients and 10% of lupus patients.

ANTI-JO-1

Anti-Jo-1 is found in 30% of patients with polymyositis (anti-synthetase syndrome). Typically anti-Jo-1 positive patients have or will develop interstitial lung disease, Raynaud's phenomenon, and thickened, sausage shaped fingers.

ANTI-SCL-70

Anti-Scl-70 is found in 30% of patients with scleroderma, and when significantly positive is regarded as specific for this condition. The antibody may predate clinical signs of disease. The presence of anti-Scl-70 is regarded as a poor prognostic marker.

*2.3.7 **Anti-Nucleosome Antibodies***

INDICATIONS

- Strong clinical suspicion of SLE
- Suspected Sjogrens syndrome
- Suspected Systemic Sclerosis

INTERPRETATION OF RESULTS

Negative: Normal value. This does not exclude systemic Lupus as the sensitivity of this assay is 97%. Results should be considered in conjunction with anti-

dsDNA, anti-ENA and complement C3 and C4 levels. If all of these are negative/normal, systemic lupus is highly unlikely. If clinical suspicion of lupus remains high, particularly with recent onset symptoms, serology should be repeated in 6 months.

Positive: A positive anti-nucleosome antibody is strongly suggestive of Lupus, even in the absence of anti-dsDNA antibody. The blot we use is 2nd generation with specificity of > 95% for Lupus, which is considerably higher than early reports with 1st generation assays. Very occasionally false positives have been described in Sjogrens syndrome and Systemic Sclerosis, even when using 2nd generation assays. Anti-nucleosome antibodies can be ordered following discussion with the Immunology team.

2.3.8 Anti-Histone Antibodies

INDICATIONS

- Suspected drug-induced SLE (90% Positive)
- Felty's Syndrome (70% Positive)
- Juvenile Chronic Arthritis

INTERPRETATION OF RESULTS

Anti-histone antibodies were originally thought to be markers for drug-induced lupus. However following more intensive investigation it was found that although present in 90% of patients with drug-induced lupus, they are also found in 40% of idiopathic lupus patients. Hence they are not specific for drug-induced disease.

Anti-histone antibodies are positive in a high proportion of patients with Felty's syndrome and ANA-positive juvenile chronic arthritis. If these conditions enter the differential diagnosis for a patient, the poor specificity of anti-histone antibodies should be considered.

2.3.9 Anti-Ribosomal-P-Protein antibodies

INDICATIONS

- High index of suspicion of SLE and routine serology negative (i.e. dsDNA, ENA)

This test is performed infrequently, and is only available after detailed discussion, and when the results of routine serology are known.

This antibody was initially thought to be relatively specific for cerebral lupus. This has not been confirmed. Anti-Ribosomal-P-Protein antibodies are found in 20-40% of patients with definite SLE. Anti-ribosomal-P-Protein appears to be relatively specific for SLE, although it does NOT appear specific for any particular clinical manifestation. We have retained this test in our repertoire

because of a small number of reports of positivity in patients with lupus when the anti-dsDNA and anti-ENA are negative.

INTERPRETATION OF RESULTS

Negative: Negative result does not exclude SLE, as this antibody is only present in a minority of patients.

Positive: Anti-ribosomal-P-Protein is thought to be specific for SLE. Previously reported associations with cerebral lupus have NOT been confirmed.

*2.3.10 **Anti-Neutrophil Cytoplasm Antibodies (ANCA)***
Anti-Myeloperoxidase Antibodies (Anti-MPO)
Anti-Proteinase 3 Antibodies (Anti-PR3)

Urgent service and plasmapherisis monitoring available.

INDICATIONS

- Suspected vasculitis
- Renal impairment, haematuria
- Haemoptysis, pulmonary nodules
- Chronic upper respiratory tract inflammation
- Unexplained CNS disease, painful neuropathy

In December 2022, the Immunology Department updated our ANCA testing algorithm in line with the current International Consensus for ANCA testing. As per the consensus, we now carrying out anti-MPO and anti-PR3 antibody tests as the first line test when ANCAs are requested.

There was no change in the requesting pathway. The test code for requesting the test remains the same as before i.e. ANCA. However the sample is processed for the more specific anti-MPO and anti-PR3 immunoassays as the first line tests instead of ANCA by Indirect Immunofluorescence (IIF). Any new positives for anti-MPO and anti-PR3 will also be tested by IIF.

ANCA by IIF is still be available in the laboratory and can still be specifically requested if required for individual patients. The test code for requesting ANCA by IIF is IIFANCA.

In patients who are known to be ANCA positive, in whom their autoantibody specificity has previously been documented as MPO-ANCA or PR3-ANCA, follow-up samples for the purpose of disease monitoring will be tested by EliA for the relevant antibody only.

A strongly positive ANCA particularly with specificity for PR3 is highly suggestive of vasculitis. However because of the implications of this diagnosis, it is preferable where possible to obtain biopsy confirmation of the diagnosis.

Occasionally biopsy may not be possible, due to the rapidity of disease progression or in the case of neurological disease. In such cases it is particularly important to consider and eliminate possible causes of a false positive ANCA. False positivity is less common with PR3-ANCA than with MPO-ANCA. ANCA positivity in the absence of vasculitis is most frequently seen in:

- Chronic and granulomatous infection (includingTB)
- Inflammatory Bowel Disease
- Autoimmune hepatitis
- Connective tissue diseases

False positive results are fare less common with the new assay than was previously seen.

We are frequently asked about the relationship of EliA results to ANCA patterns. When ANCA were first described in the late 1980s, a number of patterns which could be distinguished subjectively when looking at IIF on ethanol-fixed neutrophil slides were described. These included cytoplasmic or C-ANCA, perinuclear or P-ANCA and atypical ANCAs. Initial studies were based on these appearances as the precise antigens had not been identified. However, it should be remembered that the patterns are artefacts due to redistribution of charged proteins within the neutrophil following fixation. The same sera can produce a different pattern on different preparations of neutrophils, and even on different batches of neutrophils prepared in a similar way, as subtle changes in fixation may affect results. It is therefore much more reliable to classify patients according to the EliA results rather than IIF pattern. However, **C-ANCA patterns** are most commonly seen in patients with antibodies directed against PR3, with only about 10% of C-ANCA patterns subsequently identified as an MPO-ANCA or occasionally a minor specificity**. P-ANCA patterns** are due to antibodies to MPO in approximately 50% of cases with 20-30% being due to antibodies to PR3. Other P-ANCAs are due to antibodies to a variety of minor antigens including elastase, lysozyme, Cathepsin G and occasionally BPI or lactoferrin.

Atypical ANCAs produce a variety of patterns of positivity on immunofluorescence and are negative for antibodies to MPO and PR3. These patterns may be seen with antibodies to BPI, elastase, Cathepsin G, lysozyme and lactoferrin, as well as other neutrophil proteins. The clinical relevance of these antibodies is uncertain. Anti-BPI have frequently been reported in patients with cystic fibrosis and non-CF bronchiectasis, but there is no evidence to suggest that measurement of these antibodies provides useful clinical or prognostic information. **Atypical ANCAs are NOT specific for vasculitis**.

When a positive antinuclear factor is present it is impossible to exclude the presence of an additional perinuclear ANCA by immunofluorescence. In these cases we report the **ANCA (immunofluorescence) as OBSCURED**. However with the current testing algorithm, this scenario will be less frequently

encountered as antinuclear factor does not interfere with the specific MPO and PR3 immunoassays.

INTERPRETATION OF RESULTS

Negative MPO & PR3: Active vasculitis is highly unlikely in patients with negative MPO-ANCA and PR3-ANCA.

Weak MPO – first testing (MPO 3.5 to 10 IU/mL): Weakly positive MPO-ANCA is frequently not associated with vasculitis and may be seen in a variety of inflammatory conditions, including infection. However, patient should be thoroughly reassessed, including urinalysis, to exclude a vasculitis. Weakly positive MPO-ANCA may be associated with renal-limited disease. ANCA by immunofluorescence to follow.

Weak PR3 –first testing (PR3 2 to 10 IU/mL): Weakly positive PR3-ANCA may NOT be associated with vasculitis, however patient should be thoroughly reassessed, including urinalysis, to exclude evidence of a vasculitis. Weakly positive PR3 may be associated with limited disease. ANCA by immunofluorescence to follow.

Positive MPO – first testing (>10 IU/mL): Positive MPO-ANCA is suggestive of vasculitis, which may be renal limited. Occasionally MPO-ANCA may be seen in other inflammatory conditions. ANCA by immunofluorescence to follow.

Positive PR3 – first testing (>10 IU/mL): Significantly positive PR3-ANCA is suggestive of vasculitis, particularly Granulomatosis with polyangitis (GPA). However false positives do occur- hence the result is not entirely specific. ANCA by immunofluorescence to follow.

IIFANCA: ANCA is positive in over 90% of patients with generalised Granulomatosis with polyangitis (GPA) or microscopic polyarteritis (MPA). If result is positive / equivocal / obscured, please refer to the results for anti-MPO and anti-PR3. If ANCA is negative these conditions are less likely, however it does not completely exclude them. For positive / equivocal / obscured ANCA with a negative anti-MPO and PR3 results, then this is not usually associated with systemic vasculitis. Non specific ANCA positivity may be found in other inflammatory conditions including intercurrent infection.

Monitoring disease activity – Serial Measurement of Anti-MPO or Anti-PR3: Serial measurement of anti-MPO or anti-PR3 can be helpful in monitoring response to treatment or disease activity in patients who have ANCA associated vasculitis. The frequency of testing should take into account of the half life of IgG which is 3 weeks. Therefore the test is slow to respond, unless the patient is undergoing plasmapheresis. In the early stages of treatment, frequent measurement of CRP is often helpful in monitoring disease control.

The majority of patients will become antibody negative on treatment. However a proportion of patients in remission, with no clinical or biochemical evidence of inflammation, may continue to be positive, usually at a much lower plateau antibody level than when disease was diagnosed.

A rise in antibody level is followed by relapse in about two thirds of patients, and therefore is an indication for close monitoring and assessment. However ANCA levels alone should not be used to adjust therapy.

*2.3.11 **Anti-Glomerular Basement Membrane Antibodies (Anti-GBM)***

Urgent service and Plasmapheresis monitoring available.

INDICATIONS

- Pulmonary Haemorrhage
- Acute Renal Failure
- Haematuria of renal origin

INTERPRETATION OF RESULTS

Negative anti-GBM: Active anti-GBM disease extremely unlikely. Even without treatment patients with anti-GBM disease usually become antibody negative within 6-24 months of onset of disease.

Positive (>10 U/mL): Suggestive of anti-GBM disease. Urgent renal consultation should be arranged, and renal biopsy is usually indicated.

Equivocal (7-10 U/mL): Active anti-GBM disease is usually associated with substantially higher levels of antibodies. False positive results may be seen in this range, but are unusual. Urgent assessment of renal function and urinalysis is indicated, together with nephrology consult.

Treatment of anti-GBM disease usually involves rapid removal of pre-formed antibodies by plasmapheresis, as well as steroids and cyclophosphamide to minimise further production of antibody. Monitoring antibody levels is useful to determine the duration of plasmapheresis.

A minority of patients with anti-GBM disease are also positive for ANCA (usually MPO). These patients appear to have a vasculitic component to their disease, and some studies suggest that these patients may respond better than patients with anti-GBM alone to aggressive immunosuppression.

In June 2023, received a Field Safety Notice regarding the EliA anti-GBM assay that we use from the reagent manufacturer. There has been reports of false positive anti-GBM results with this EliA method. Investigations by the manufacturer suggest that the false positive results were due to cross reactive antibodies i.e. not due to antibody to the GBM antigen. The Field Safety Notice we received is specific to the EliA anti-GBM assay. For any positive anti-GBM results, we will continue to contact the clinical team as we currently do and will issue a preliminary result. We have identified an external laboratory abroad for secondary confirmatory testing for positive results. Should you have a patient with previously positive anti-GBM results that did not fit their clinical context and you wish to organise repeat testing done, please contact us. The Immunology Clinical Team is also available should you wish to discuss a specific patient's anti-GBM result (Bleep 797 or via email immunologydepartment@beaumont.ie).

Should you have any further queries, please do not hesitate to contact the laboratory on (01) 8092635.

2.3.12 Anti-Cardiolipin Antibodies (IgG and IgM)

INDICATIONS

- *Arterial or venous thrombosis
- Pregnancy associated Morbidity:
- Recurrent miscarriage (x 3)
- Mid or third trimester fetal loss
- Severe pre-eclampsia or intrauterine growth retardation requiring delivery before 36 weeks
- Known SLE
- Thrombocytopenia
- Ischaemic stroke <50 years
- Transverse myelopathy
- Mesenteric infarction
- Myocardial infarction in the absence of risk factors

DIAGNOSIS OF ANTI-PHOSPHOLIPID SYNDROME (APS)

Establishing a diagnosis of the anti-phospholipid syndrome requires demonstration of a diagnostic clinical manifestation, together with a diagnostic laboratory abnormality, which must be demonstrated on at least two occasions, 12 weeks apart.

Diagnostic clinical manifestations are:

- Arterial or venous thrombosis
- Pregnancy associated morbidity (outlined above)

Other clinical features, mentioned above, are associated with the APS, but are not considered specific enough to establish the diagnosis.

Laboratory diagnostic criteria are:

- Moderately positive (>40) IgG or IgM anti-cardiolipin
- Lupus anticoagulant
- Anti- Beta 2 glycoprotein 1 antibody

While many patients with APS will have abnormal results in both tests, approximately 10% of patients are positive for lupus anticoagulant only with normal anti-cardiolipin antibodies. Therefore when APS is suspected **both** anti-cardiolipin and lupus anticoagulant should be routinely requested. When clinical suspicion of APS is high, β2Glycoprotein 1 should also be requested. Lupus anticoagulant test is offered by the Haematology (Coagulation) laboratory, please refer to the relevant section with regards to test / specimen requirements.

INTERPRETATION OF RESULTS

Negative IgG and IgM anti-cardiolipin antibodies: Antiphospholipid syndrome (APS) unlikely, however lupus anticoagulant testing could be considered if APS strongly suspected.

Weak positive (IgG and/or IgM anti-cardiolipin >=10 <=40 GPLU/mL or MPLU/mL): Weakly positive Anti-Cardiolipin Antibodies which do not fulfill the laboratory criteria for antiphospholipid syndrome. A moderate or high titre Anticardiolipin IgG and/or IgM antibody of ≥40 GPL units or MPL units is considered to be positive in this institution. To fulfill the laboratory criteria for antiphospholipid syndrome, a patient must have persistent positivity of one or more antiphospholipid antibodies on 2 or more occasions, at least 12 weeks apart.

Positive (IgG and/or IgM anti-cardiolipin >=40 GPLU/mL or MPLU/mL): Positive Anticardiolipin IgG and/or IgM antibodies. A moderate or high titre Anticardiolipin IgG and/or IgM antibody of ≥40 GPL units or MPL units is considered to be positive in this institution. To fulfill the laboratory criteria for antiphospholipid syndrome, a patient must have persistent positivity of one or more antiphospholipid antibodies on 2 or more occasions, at least 12 weeks apart. Both clinical criteria (e.g. thrombosis or pregnancy morbidity) and laboratory criteria need to be fulfilled to make a diagnosis of APS.

*2.3.13 **Antibodies to Beta 2 Glycoprotein 1***

INDICATIONS

Suspected Antiphospholipid syndrome
See Section 1.1.1

The antiphospholipid syndrome (APS) is defined by two major components. Firstly, the presence of at least one type of antiphospholipid antibody (aPL) which are antibodies directed against phospholipid-binding plasma proteins. Secondly, the occurrence of at least one clinical feature:

- **Clinical** — One or more episodes of venous, arterial, or small vessel thrombosis and/or morbidity with pregnancy.
- **Thrombosis** — Unequivocal imaging or histologic evidence of thrombosis in any tissue or organ, OR
- **Pregnancy morbidity** — Otherwise unexplained death at ≥10 weeks gestation of a morphologically normal fetus, OR
- One or more premature births before 34 weeks of gestation because of eclampsia, preeclampsia, or placental insufficiency, OR

- Three or more embryonic (<10 week gestation) pregnancy losses unexplained by maternal or paternal chromosomal abnormalities or maternal anatomic or hormonal causes.
- **Laboratory** — The presence of antiphospholipid antibodies (aPL), on two or more occasions at least 12 weeks apart and no more than five years prior to clinical manifestations.

Although the clinical manifestations of APS occur in other disease populations, in the APS they occur by definition in the context of aPL. APL may be detected by:

- Lupus anticoagulant tests
- Anticardiolipin antibody
- Anti-ß2 glycoprotein antibodies

INTERPRETATION OF RESULTS

Negative: Antiphospholipid syndrome (APS) unlikely, however lupus anticoagulant testing could be considered if APS strongly suspected.

Weak Positive Anti B2 glycoprotein IgG Antibodies >=10 & <40: Weakly positive Anti-β2–glycoprotein I IgG antibody which does not fulfill the laboratory criteria for antiphospholipid syndrome. An Anti-β2–glycoprotein I IgG antibody titre > the 99th centile is considered to be positive (i.e. ≥40 U/mL in this institution). To fulfill the laboratory criteria for antiphospholipid syndrome (APS), a patient must have persistent positivity of one or more antiphospholipid antibodies on 2 or more occasions, at least 12 weeks apart. Both clinical criteria (e.g. thrombosis or pregnancy morbidity) and laboratory criteria need to be fulfilled to make a diagnosis of APS.

Positive Anti B2 glycoprotein IgG Antibodies >=40: Positive Anti-β2–glycoprotein I IgG antibody. An Anti-β2–glycoprotein I IgG antibody titre > the 99th centile is considered to be positive (i.e. ≥40 U/mL in this institution). To fulfill the laboratory criteria for antiphospholipid syndrome (APS), a patient must have persistent positivity of one or more antiphospholipid antibodies on 2 or more occasions, at least 12 weeks apart. Both clinical criteria (e.g. thrombosis or pregnancy morbidity) and laboratory criteria need to be fulfilled to make a diagnosis of APS.

Weak Positive Anti B2 glycoprotein IgM Antibodies >=10 & <17: Weakly positive Anti-β2–glycoprotein I IgM antibody which does not fulfill the laboratory criteria for antiphospholipid syndrome. An Anti-β2–glycoprotein I IgM antibody titre > the 99th centile is considered to be positive (i.e. ≥17 U/mL in this institution). To fulfill the laboratory criteria for antiphospholipid syndrome (APS), a patient must have persistent positivity of one or more antiphospholipid antibodies on 2 or more occasions, at least 12 weeks apart.

Both clinical criteria (e.g. thrombosis or pregnancy morbidity) and laboratory criteria need to be fulfilled to make a diagnosis of APS.

Positive Anti B2 glycoprotein IgM Antibodies >=17: Positive Anti-β2–glycoprotein I IgM antibody. An Anti-β2–glycoprotein I IgM antibody titre >the 99th centile is considered to be positive (i.e. ≥17 U/mL in this institution). To fulfill the laboratory criteria for antiphospholipid syndrome (APS), a patient must have persistent positivity of one or more antiphospholipid antibodies on 2 or more occasions, at least 12 weeks apart. Both clinical criteria (e.g. thrombosis or pregnancy morbidity) and laboratory criteria need to be fulfilled to make a diagnosis of APS.

*2.3.14 **Anti-Smooth Muscle Antibodies***

INDICATIONS

- Persistently abnormal Liver Function Tests
- Other signs of chronic liver disease
- Investigation of hypergammaglobulinaemia

INTERPRETATION OF RESULTS

Negative: Normal result

Weak Positive 1/40: Weak positive anti-smooth muscle antibody is of doubtful clinical significance. Common in the elderly or in patients with infection/inflammation of any cause.

Positive 1/80: Weak positive value, not specific for autoimmune hepatitis.

Positive 1/160: Moderate positive value is consistent with but not specific for autoimmune hepatitis. Other causes of liver disease should be excluded.

Strong Positive 1/320 or greater: Strongly positive value is suggestive of autoimmune hepatitis.

*2.3.15 **Anti-Liver-Kidney Microsomal (LKM) Antibodies***

Note: When IIF results demonstrate an anti-LKM antibody, the specificity of this result is confirmed by an immunoblotting system using the specific antigen cytochrome P450.

INDICATIONS

- Persistently abnormal Liver Function Tests
- Other signs of chronic liver disease
- Investigation of Hypergammaglobulinaemia

Type II autoimmune hepatitis (associated with LKM antibodies) can progress rapidly. The history is often considerably shorter than with Type I autoimmune hepatitis, which is much more common and associated with the presence of anti-smooth muscle antibodies.

INTERPRETATION OF RESULTS

Negative: No serological evidence of type II autoimmune hepatitis.

Positive IIF, Positive Immunoblot: The presence of anti-LKM antibodies is associated with type II autoimmune hepatitis or hepatitis C. The titre of the antibody is not helpful in distinguishing these disorders, and hepatitis serology should be performed.

Positive IIF, Negative Immunoblot: There are a small number of antibodies which generate a pattern (positivity) on IIF which is indistinguishable from LKM antibodies, but the staining is due to binding to antigens other than cytochrome P450. Such antibodies include anti-endoplasmic reticulin antibodies. The clinical significance, if any, of such antibodies is uncertain.

Serial measurement of anti-LKM titre can be useful in monitoring a patients response to therapy.

Because of the rapidity with which Type II autoimmune hepatitis progresses, it is departmental policy to telephone clinicians when a new positive result is detected and contact details are available.

*2.3.16 **Anti-Liver Cytosol 1 Antibody (LC1)***

Note: When IIF results demonstrate an anti-LC1 antibody, the specificity of this result is confirmed by an immunoblotting system.

INTERPRETATION OF RESULTS

Negative: No serological evidence of autoimmune hepatitis.

Positive IIF, Positive Immunoblot: 'Positivity for anti-LC1 antibody is suggestive of autoimmune hepatitis. Please correlate with clinical features, virology, other serology markers and histology features'

*2.3.17 **Anti-Mitochondrial Antibody & M2 subtyping***

All newly detected anti-mitochondrial antibodies are tested for reactivity to pyruvate dehydrogenase (M2 subtype) using an ELISA system. M2 type anti-mitochondrial antibodies are highly specific for primary biliary cirrhosis (also known as primary biliary cholangitis/PBC).

INDICATIONS

- Persistently abnormal Liver Function Tests
- Other signs of chronic liver disease
- Investigation of hypergammaglobulinaemia
- Pruritis

INTERPRETATION OF RESULTS

Negative: Normal value

Positive IIF, Positive M2: Suggestive of PBC. Occasionally may be seen in undifferentiated connective tissue disease. The titre of the anti-mitochondrial antibody is usually high (1/320 or greater). However even when the antimitochondrial antibody titre is lower, detection of the M2 subtype is suggestive of PBC. Occasionally M2 positive anti-Mitochondria can be seen in undifferentiated Connective Tissue Disease

Positive IIF, Negative M2: The IIF pattern of staining is frequently atypical (less granular than an M2 type, and with different staining of tissues). This combination of results is not specific for PBC, and may be seen in a wide variety of conditions including undifferentiated connective tissue disease, anti-phospholipid syndrome, infections and other inflammatory conditions.

Note: When an anti-mitochondrial antibody is present granular staining of mitochondria in the liver, kidney tubules and gastric parietal cells is seen. In the presence of a strong anti-mitochondrial antibody, it is not possible to exclude the presence of an anti-gastric-parietal cell antibody, which is obscured.

2.3.18 Anti-Gastric-Parietal Cell Antibodies (Anti-GPC)

INDICATIONS

- Low B12
- Macrocytic anaemia
- Suspected subacute combined degeneration of the spinal cord

INTERPRETATION OF RESULTS

Negative: Normal value

Positive: Anti-GPC antibodies are present in about 90% of people with atrophic gastritis or pernicious anaemia, however these antibodies are relatively non-specific. Anti-GPC antibodies are present in 20% of relatives of patients with pernicious anaemia, 20% of patients with other autoimmune endocrine disease, as well as 25% of patients with iron deficiency anaemia. They are also present in 16% of females over the age of 60 years.
It is recommended that vitamin B12 levels be checked. Sera in which anti-GPC antibodies are found are automatically tested for antibodies to intrinsic factor.

Obscured: When an anti-mitochondrial antibody is present granular staining of mitochondria in the liver, kidney tubules and gastric parietal cells is seen. In the presence of a strong anti-mitochondrial antibody, it is not possible to exclude the presence of an anti-gastric-parietal cell antibody, which is obscured. If pernicious anaemia is suspected, an anti-intrinsic factor antibody should be requested.

2.3.19 Anti-Intrinsic Factor Antibodies

INDICATIONS

- Low B12
- Macrocytic anaemia
- Suspected subacute combined degeneration of the spinal cord

INTERPRETATION OF RESULTS

In September 2020 we changed the method for anti-intrinsic factor antibodies from ELISA to EliA. The Intrinsic Factor assay will continue to be reported qualitatively with the introduction of an equivocal range in addition to negative & positive. Interpretative comments will be added on all reports.Negative: Negative anti-Intrinsic Factor antibody does not exclude a diagnosis of pernicious anaemia, as this antibody is only found in approximately 60% of subjects with pernicious anaemia.

Equivocal: The clinical significance of intrinsic factor results that fall in the equivocal range is uncertain. Correlation with clinical history and B12 level is advised.

Positive: Positive result is suggestive of pernicious anaemia, and measurement of vitamin B12 is recommended. Patients with a normal vitamin B12 may have latent pernicious anaemia, and follow-up with at least annual measurement of Vitamin B12 level is recommended.

*2.3.20 **Anti Thyroid Peroxidase Antibodies (anti-TPO)***

INDICATIONS

- Hypothyroidism
- Hyperthyroidism
- Goitre
- Other autoimmune endocrinopathy

TPO is the specific antigen causing reactivity in the anti-thyroid microsomal assays. In line with current recommendations we now use this more sensitive and specific assay for all requests.

INTERPRETATION OF RESULTS

In October 2020 we changed the method for anti-TPO antibodies from EliA to Immunoassay. Both assays use the same units but the Immunoassay method uses a different reference range for reporting results, these are included on all reports. Both methods are calibrated to the same International Standard (MRC 66/687) with results given in International Units (IU/mL).

Changes to basic parameters of the assay:

	Negative result	**Equivocal Result**	**Positive Result**
OLD EliA ASSAY IU/mL	<25	25-35	>35
CURRENT Immunoassay ASSAY IU/mL	<=34		>34

Negative (Anti-TPO <= 34 IU/mL): Autoimmune thyroid disease unlikely.

Positive (Anti-TPO > 34 IU/mL): Positive anti-TPO antibodies indicate current or future risk of autoimmune thyroid disease. Thyroid function should be checked now and at 1-2 year intervals.

*2.3.21 **Anti-Adrenal Antibodies***

INDICATIONS

- Hypocortisolaemia
- Other autoimmune endocrinopathy
- Hyperpigmentation

INTERPRETATION OF RESULTS

Negative: Negative result does not exclude autoimmune adrenalitis, as antibodies are detected in approximately 70% - 80% of these patients.

Positive: Suggestive of autoimmune adrenalitis. However anti-adrenal antibodies are found in about 5% of patients with adrenal destruction due to non-immunological disease. Anti-adrenal antibodies may indicate future risk of developing autoimmune adrenalitis.

Patients with autoimmune Adrenal Disease should be screened for other autoimmune endocrinopathies (thyroid, ovarian, testis and islet cell antibodies). There may also be an association with other non-endocrine organ specific disorders including Pernicious Anaemia and rarely Myasthenia Gravis. Testing for rare associations is only indicated when symptoms are present.

2.3.22 Anti- Tissue Transglutaminase Antibodies (anti-tTG)

Please note that anti-tTG is the appropriate screening test for coeliac disease. Equivocal or positive sera will be automatically tested for anti-endomysial antibodies. Our assay and reference ranges have been extensively validated internally, to ensure that an appropriately low threshold for triggering anti-endomysial antibody testing is in place.

INDICATIONS

- Suspected coeliac disease
- Malabsorption (including low iron, Vit B12 or albumin)
- Anaemia
- Gastrointestinal symptoms
- Down's syndrome (increased risk of coeliac disease)
- IDDM (increased risk of coeliac disease)
- Dermatitis Herpetiformis
- Osteoporosis & Osteomalacia
- Peripheral Neuropathy
- Unexplained Infertility
- Unexplained weight loss

In addition to classical presentations with GI symptoms and malabsorption, coeliac disease is found in about 3.4% of those with osteoporosis, 12% of those with Type I diabetes mellitus and up to 1% of the general population.

tTG has been identified as the target antigen against which anti-EMA is directed. The anti-tTG EliA is used as an initial screening test and all equivocal/positive sera will be further tested for EMA antibodies. IgA deficiency is excluded by using the background reading on the EliA or measurement of total IgA. Total IgA is measured on all children with a negative TTG. In cases of IgA deficiency, IgG EMA testing or other IgG serological testing is performed. Anti-tTG has a high sensitivity for untreated coeliac disease, while the anti-endomysial antibody is more specific. Sequential testing offers optimal diagnostic utility.

Please refer to NCPP Serological Testing for Coeliac Disease Guideline from National Laboratory Handbook for further guidance available on www.beaumont.ie.

INTERPRETATION OF RESULTS

Negative (<4 U/ml): Coeliac disease unlikely if the patient is on a normal diet. If clinical suspicion is high, should be repeated in 3-6 months, ensuring that the patient is on a diet with a normal gluten content.

Equivocal 4-10 U/ml: All equivocal results will be further tested for IgA anti-EMA.

Positive >10 U/ml: Suggestive of Coeliac Disease. However false positives may occur therefore all samples with positive anti-tTG by EliA will be further tested for EMA antibodies by indirect immunofluorescence.

2.3.23 IgA Anti-Endomysial Antibodies (EMA)

INDICATIONS

- Positive anti-tTG (automatically added as reflex test)
- Biopsy suggestive of coeliac disease, despite negative tTG**
- Strong clinical suspicion of coeliac disease, despite negative tTG**

** Discussion with clinical team essential to have test performed for these indications.

In patients with normal levels of IgA, IgA anti-endomysial antibodies are more than 90% sensitive (up to 98% sensitive in some studies) and relatively specific (>95%) for coeliac disease. When an anti-endomysial antibody request is received in this laboratory, we also measure IgA levels to exclude IgA deficiency. If IgA deficiency is identified serum is sent to the Proteins Laboratory in Clinical Chemistry for further assessment of immunoglobulins.

IgA deficiency is present in about 1:30 patients with coeliac disease (and about 1:600 of the general population). When IgA deficiency is present serology is less helpful in assessing the likelihood of coeliac disease. However in patients with IgA deficiency we perform an IgG anti-endomysial antibody which if strongly positive is suggestive of coeliac disease.

INTERPRETATION OF RESULTS

Negative IgA anti-endomysial antibodies: Coeliac disease is unlikely if patient is on a normal diet. However false negative results may be seen in IgA deficiency, and also in patients on a gluten free diet. The clinical significance of a negative EMA in a patient with a positive anti-tTG is uncertain, however an expert GI opinion should be sought in this situation, as biopsy may still be indicated.

Positive IgA anti-endomysial antibodies: Suggestive of coeliac disease

Negative IgA anti-endomysial antibodies, Low IgA: In this setting, negative anti-endomysial antibody does not exclude coeliac disease. If there is a high clinical suspicion of coeliac disease, or if the IgG anti-endomysial antibody is strongly positive, biopsy is indicated.

Negative IgA and IgG anti-endomysial antibodies, Low serum IgA: The negative predictive value of serology in this setting is not well established, and if there is

a strong clinical suspicion of coeliac disease, biopsy is necessary to exclude coeliac disease.

If a low IgA is detected, we suggest measurement of immunoglobulins and SPEP. This is to exclude a more extensive hypogammaglobulinaemia. However patients with isolated IgA deficiency are at risk of infections, allergy and autoimmune disease. You may wish to arrange for a Clinical Immunology appointment for further assessment.

*2.3.24 **Anti-Neuronal Antibodies***

INDICATIONS

- Suspected paraneoplastic neurological syndromes, Esp – acute or subacute cerebellar syndromes
- Encephalomyelitis
- Sensory & autonomic neuropathy
- Axial ataxia
- Opsoclonus-myoclonus

A screening indirect immunofluorescence assay is performedwith a follow up confirmatory Immunoblot. The presence of an ANA renders the IIF test difficult to interpret. ANA positive specimens are also run on the Immunoblot. . Not all antibodies available on the Immunoblot have concurrent specific Immunofluorescent staining patterns. Both IIF and Immunoblot results must be interpreted in the clinical context. If you are concerned about some of the more recently described antibodies please discuss the case with Senior Laboratory Staff or Prof. Keogan/Dr Khalib/Dr Cox.

INTERPRETATION OF RESULTS

Negative anti-Neuronal antibodies:: Negative results do not exclude a paraneoplastic syndrome. Correlation with other clinical findings is advised.

Positive anti-Hu: Also known as Type I anti-neuronal nuclear antibody (ANNA-1) is associated with Cerebellar ataxia, paraneoplastic encephalomyelitis and sensory neuropathy. It has been reported in patients with Small cell lung carcinoma and neuroblastoma. Correlation with other clinical findings is advised.

Positive anti-Yo: Also known as Anti-Purkinje cell antibody is associated with Paraneoplastic Cerebellar Degeneration. It has been reported in patients with Breast and Ovarian carcinoma. Correlation with other clinical findings is advised.

Positive Anti-Ri: Also known as Type II anti-neuronal nuclear antibody (ANNA-2) is associated with Cerebellar degeneration and paraneoplastic opsoclonus myoclonus ataxia (POMA). It has been reported in patients with neuroblastoma

(children) and fallopian, breast and small cell lung carcinoma (adults). Correlation with other clinical findings is advised.

Positive Anti-Amphiphysin: Associated with Stiff person's syndrome (5%) and paraneoplastic encephalomyelitis. It has been reported in patients with breast and small cell lung carcinoma. Correlation with other clinical findings is advised.

Positive Anti-Cv2/CRMP5: Associated with Paraneoplastic encephalomyelitis/sensory neuropathy. It has been reported in patients with thymoma and small cell lung cancer. Correlation with other clinical findings is advised.

Positive anti-PNMA2: (also known as anti-Ma2 or anti-Ta) is associated with cerebellar, limbic or brainstem encephalomyelitis. It has been reported in patients with testicular tumours. In a proportion of patients, there is co-existing anti-Ma1 antibody which has been associated with brainstem / cerebellar syndromes and various non-testicular tumours. Correlation with other clinical findings is advised.

Positive Anti-Recoverin Antibody: Anti-recoverin antibody is significant for tumour-associated retinopathy; a paraneoplastic syndrome mostly reported in patients with small-cell lung carcinoma but has also been reported in patients with thymoma, endometrial and prostate carcinoma. NOTE: These antibodies are not detected by IIF on cerebellum tissue as these antigens are not normally expressed in cerebellum, so Immunoblot results cannot be verified by IIF testing. Correlation with other clinical findings is advised.

Positive Anti-SOX1 Antibody: Anti-SOX1 antibody is associated with Lambert-Eaton Myasthenic syndrome (LEMS) with a specificity of up to 95% for small cell lung carcinoma in LEMS. It has also been reported in paraneoplastic cerebellar degeneration as well as paraneoplastic and non-paraneoplastic neuropathy. Correlation with other clinical findings is advised.

Positive Anti-Zic4 Antibody: Anti-Zic4 antibody is associated with paraneoplastic cerebellar degeneration and is often indicative of small-cell lung carcinoma. Up to 82% of patients can have positivity for other antibodies such as anti-Hu and anti-CV2/CRMP5 antibody. Correlation with other clinical findings is advised.

Positive Anti-Titin Antibody: Anti-Titin antibodies target Titin; a filamentous protein of striated muscle. These antibodies occur in myasthenia gravis alongside acetylcholine receptor antibodies. In many patients they are indicative of the additional presence of thymoma. Anti-Titin serum titre is thought to correlate with the severity of Myasthenia gravis. NOTE: These antibodies are not detected by IIF on cerebellum tissue as these antigens are not normally expressed in cerebellum, so Immunoblot results cannot be verified by IIF testing. Correlation with other clinical findings is advised.

Positive Anti-GAD65 Antibody: Anti-GAD65 antibody is associated with Stiff-person syndrome and paraneoplastic cerebellar ataxia. Small cell lung carcinoma, breast carcinoma and colon carcinoma are the most frequent tumours associated with anti-GAD antibodies. Correlation with other clinical findings is advised.

Positive Anti-Tr Antibody: Anti-Tr antibody is also known as Anti-PCA-Tr, and anti-DNER (Delta/Notch-like epidermal growth factor related receptor), and are associated with paraneoplastic cerebellar degeneration. These are mostly associated with Hodgkin's lymphoma but have also been reported in non-Hodgkin's lymphoma. Correlation with other clinical findings is advised.

Paired Serum/CSF samples will be accepted for this screening test, results will be reported accordingly & must be interpreted within the clinical context. If you wish to discuss, please contact Senior Laboratory Staff or Prof. Keogan/Dr Khalib/Dr Cox.

While the above paragraphs outline the classical associations, recent data suggest that the neurological associations are less clear-cut, and this should be considered when ordering tests.

2.3.25 ***Autoimmune Encephalitis Panel & Anti-NMDA Antibodies***

Autoantibodies against neuronal surface antigens are found in patients with autoimmune encephalopathies. The antibodies are directed against glutamate receptors (type NMDA and type AMPA), $GABA_B$ receptors, Voltage gated potassium channels or VGKC associated proteins (LGI1, CASPR2 and DPPX). The frequency of an underlying tumour ranges depending on the type of antibody. Early diagnosis can support a favourable prognosis. Prognosis for patients is improved with appropriate immunomodulatory therapy, and, in paraneoplastic syndrome, tumour detection and resection as early as possible. Antibodies can be either determined in Serum or CSF. In certain cases Plasma samples are acceptable. Paired CSF/Serum samples are the preferred sample type for this type of investigation since intrathecal synthesis of antibodies can occur even when the serum titre is low/absent. This is particularly the case with anti-glutamate receptor antibodies (type NMDA and AMPA) and also $GABA_B$ receptor antibodies. A positive serum result with an associated CSF negative results have been reported in the literature, particularly where the autoantibody is a paraneoplastic one. If you are concerned about some of the more recently described antibodies please discuss the case with Senior Laboratory Staff or Prof. Keogan/Dr Khalib/Dr Cox.

INDICATIONS:

- Suspected Limbic Encephalitis
- Seizures
- Neuropsychiatric symptoms
- Suspected Paraneoplastic syndrome
- Neuromyotonia

INTERPRETATION OF RESULTS:

Normal result: Negative

Negative result: does not exclude these conditions, particularly where serum only has been tested. If clinical suspicion remains high please contact the Immunology laboratory on (01) 8092635 to discuss.

NMDA: N-methyl-D-aspartate

NMDA antibodies are found in patients with behavioural cognitive problems and seizures. These can commonly progress over time to a movement disorder, autonomic fluctuations and coma.

With the NMDA fixed assay, up to 14% of patients with anti-NMDA encephalitis have been reported to have anti-NMDA antibodies in CSF only. Therefore if serum is negative suggest sending a CSF sample if clinical suspicion remains high. Additionally, if both serum and CSF are negative by NMDA fixed assay please contact the Immunology lab on (01) 8092635 to discuss further testing if anti-NMDA encephalitis remains a diagnostic possibility.

AMPA: α-amino-3-hydroxy-5-methyl-4-isoxazol-propionic acid

Anti-AMPA antibodies to the GluR1/GluR subunits of glutamate receptors type AMPA 1&2 have been reported in patients with limbic encephalitis. A significant number of patients with AMPA associated encephalitis have also been found to have tumours (Breast, Lung, Thymoma). Results should be interpreted in the context of clinical findings

$GABA_B$: γ-amino-butyric acid

Anti-$GABA_B$ receptor antibodies have been reported in patients with limbic encephalitis. It is also associated with a paraneoplastic syndrome in up to 47% of patients. Results should be interpreted in the context of clinical findings

DPPX: dipeptidyl aminoperoxidase like protein 6.

This protein is mainly produced in the brain tissue and interacts with the voltage-gated K+ channel Kv4. Anti-DPPX antibodies have been seen in patients with encephalitis with prominent delirium, GI symptoms, and movement disorders. Results should be interpreted in the context of clinical findings.

LGI1: Leucine-rich glioma inactivated protein 1

Anti-LGI1 antibodies are found in patients with limbic encephalitis with a low plasma sodium. These antibodies have also been seen in patients with seizure disorders (particularly facrobrachial dystonic seizures). Results should be interpreted in the context of clinical findings.

CASPR2: Contactin-associated protein 2

Anti-CASPR2 antibodies have been found in patient with neuromyotonia, limbic encephalitis and/or epilepsy and more recently in patients with cerebellar ataxia. There is also an association with a paraneoplastic syndrome in up to 30% of cases. Results should be interpreted in the context of clinical findings.

Positive anti-CASPR2 in Serum at 1:10 dilution ONLY: 'Anti-CASPR2 antibodies POSITIVE at 1:10 dilution, indicating this is a **BORDERLINE POSITIVE** result. Positive results at this titre should be interpreted with caution, within the clinical context.'

*2.3.26 **Anti-Skin Antibodies***

INDICATIONS

- Blistering skin disorders –pemphigus & pemphigoid

Pemphigus is associated with antibodies to the epidermal intercellular substance (ICS). Anti epidermal ICS is thought to be pathogenic in this condition, and serial measurement of antibody titre is of value in monitoring the disease and response to therapy.

Pemphigoid is associated with antibodies to basement membrane zone (BMZ). Although antibodies of some IgG subclasses are thought to be pathogenic, the total IgG antibody titre does not reflect disease activity. We therefore do not offer titration of this antibody.

INTERPRETATION OF RESULTS

Negative: Negative result does not exclude these conditions as the sensitivity of antibodies is only about 80% in systemic disease. It is considerably lower in patients with localised forms of pemphigoid.

Positive anti-epidermal ICS: Suggestive of pemphigus, particularly when strongly positive. Occasionally weak positive results may be found as a non-specific feature, particularly in burns and SLE.

Positive anti-BMZ: Suggestive of bullous pemphigoid, or rarely epidermolysis bullosa acquisita or herpes gestationis.

2.3.27 ***Total IgE and Allergen Specific IgE***

INDICATIONS – TOTAL IGE

- Suspected allergic bronchopulmonary aspergillosis (ABPA)
- Suspected Churg-Strauss Syndrome
- Possible hyper-IgE Syndrome – (immunodeficiency with eczema, recurrent Staph Aureus infections, boils & abscesses coarse facial features)
- Suspected parasitic infection

INDICATIONS – ALLERGEN SPECIFIC IGE

- Known allergic disease, to identify allergens
- Suspected allergic bronchopulmonary aspergillosis (ABPA)

Allergen specific IgE (sIgE) should be requested for limited number of allergens suggested by history. Disease specific profiles of suggested allergens are listed in Section 3.4.7.1

If history is vague, skin testing is more useful to test for large number of allergens. When skin tests cannot be performed due to extensive skin disease/dermographism/patient unable to stop antihistamines/unacceptable risk of anaphylaxis, a more extensive range of sIgE testing may be ordered after discussion with Senior laboratory or Medical staff.

INTERPRETATION OF RESULTS

Interpretation of allergen-specific IgE is linked with the level of total IgE, as well as the class of allergen specific IgE. Interpretation of both types of tests are considered below.

Normal Total IgE: Excludes atopy. However, a normal IgE does not exclude sensitisation to individual allergens. As a general rule even weakly positive allergen-specific IgE may be clinically relevant in patients with a low normal IgE. However the relevance of allergen specific IgE must be carefully assessed in the context of the clinical history.

Raised Total IgE: Consistent with atopy. Atopy denotes a genetic susceptibility to make IgE responses. This does not imply that atopic disease is present. The possible role of atopy in the patients clinical presentation should be carefully assessed. False positive results for allergen-specific IgE, particularly of class 1 & 2 become more common the higher the total IgE. In patients with a raised IgE >1000kUA/L, even class 3 allergen-specific IgEs may be false positives. The clinical relevance of allergen-specific IgE measurements must be considered in the clinical context. If uncertain, you may consider referring the patient to the immunology clinic.
Raised IgE may also be due to parasitic infection (eosinophilia usually also present) and Churg-Strauss syndrome.

Total IgE > 5000kUA/L: If patient has infections consider the Hyper-IgE syndrome. If this is a diagnostic possibility, please contact the Immunology Department to arrange accurate quantification of level (and clinical consultation if required).

Values of IgE > 5000kUA/L are not uncommon in patients with atopic eczema alone. In such patients allergen-specific IgE results must be assessed with extreme caution.

*2.3.28 **Complement - C3 and C4***

INDICATIONS

- Diagnosis of suspected immune complex disease
- Monitoring immune complex disease including cryoglobulinaemia and SLE
- Angioedema (without urticaria)
- Glomerulonephritis
- Suspected anaphylactoid reaction eg to IVIg, colloid infusions

Complement components act as acute phase reactants, and thus inflammation causes a rise in levels. Activation of the complement cascade causes depletion of C3 and C4 (classical and lectin pathways) or C3 alone (alternative pathway). However in most circumstances when complement is consumed, inflammation also occurs and so the opposing acute phase response may mask complement consumption. In difficult cases we can send serum to the UK for measurement of complement activation products. Please discuss any difficult cases with Prof. Keogan/Dr Khalib/Dr Cox.

Complement levels are normally increased in pregnancy, and this may also mask a fall in complement levels due to disease. Complement is activated during dialysis and plasmapheresis and therefore samples should be collected before these procedures are undertaken.

Measurement of C3 and C4 is not the investigation of choice when complement deficiency is suspected (because of recurrent infections, repeated neisserial infections, immune complex disease at a young age, personal or family history of combinations of these features). The appropriate test is the CH100, which tests the functional integrity of the entire classical pathway. However if the functional CH100 assay is abnormal, measurement of individual components is advised. It is important to remember that complement deficiency results both from protein deficiency as well as production of normal amounts of dysfunctional protein. The standard C3 and C4 assays do not distinguish between normal functional and abnormal dysfunctional protein.

The reference range for C4 levels in particular is broad. This is because C4 is encoded by 4 different genes. Null genes are present quite commonly, and the

normal population includes people with one, two or three null genes. If you are a person with 4 functional genes, your "normal" C4 level will be in the higher quartile of the reference range. Even with significant complement consumption the C4 level may remain within the reference range for the population. Therefore a fall in C4 levels within the reference range may be clinically very significant.

INTERPRETATION OF RESULTS

In October 2020 we changed the method for C3 & C4 from Nephelometry to Immunoturbidimetry with updated reference ranges as outlined in the table below.

Assay	Old Reference Range	New Reference Range
C3	0.75-1.65 g/L	0.9-1.8 g/L
C4	0.14-0.54 g/L	0.1-0.4 g/L

Raised C3, raised C4 or raised C3 and C4: These are common findings during an acute phase response. However measurement of complement is not recommended to assess the acute phase response – CRP is the most valuable marker.

Reduced C3 but Normal C4: Suggestive of complement activation usually via the alternative pathway. This is typical of post-streptococcal glomerulonephritis and Type II membranoproliferative glomerulonephritis (associated with the presence of nephritic factor). However this pattern may be due to complement consumption via the classical pathway in a patient who usually runs a high normal C4 level (see above).

Reduced C3 and C4: Indicates complement consumption via the classical pathway, usually associated with immune complex disease. Occasionally low levels may be seen in the absence of complement consumption when hepatic synthetic function is seriously impaired.

Reduced C4, Normal C3: Typically this pattern is seen with activation of the early classical pathway (usually due to fluid phase activation of the classical pathway). If the patient has angioedema or abdominal pain, C1-Inhibitor deficiency should be considered. Cryoglobulinaemia may also be associated with similar findings. This pattern may reflect conventional activation of the classical pathway in patients who normally run a high normal C3, particularly when the C3 is in the lower quartile of the reference range.

2.3.29 ***Complement C1 Esterase Inhibitor (C1INH)***

INDICATIONS

- Angioedema of skin, gastrointestinal or respiratory tract without Urticaria

Hereditary angioedema (HAE): deficiency of C1 esterase inhibitor is the most frequent of the inherited complement component deficiencies. The condition is inherited as an autosomal dominant trait and several members of a family are usually affected. The commonest symptoms are episodes of swellings on the limbs or trunk which subside in 24-48 hours. Recurrent abdominal pain or respiratory obstruction, which can be fatal, may also form part of the clinical picture.
In view of the autosomal dominant inheritance of this condition full family studies are recommended in all cases where the diagnosis is proven. The investigation can initially be restricted to quantitation of C3 and C4 levels. Antigenic and functional assay of C1INH can be reserved for those family members who have been shown to have C4 concentrations <0.2 g/L with normal concentrations of C3.

Two forms of the inherited deficiency exist. In the classic **Type 1**, low concentrations of C1 INH are found by both antigenic and functional assay. **Type 2** is characterised by normal or elevated concentrations of C1 INH by the antigenic assay but absent functional activity. The assay of functional C1 INH is essential for this diagnosis.

Acquired C1 inhibitor deficiency: There is a rare form of C1 INH deficiency which presents for the first time in adult life. Most reported cases have been secondary to lymphoma or myeloma. This is a consumptive rather than a synthetic defect and is associated with low concentrations of C1Q.

In October 2020 we changed the method for C1 inhibitor from Nephelometry to Turbidimetry with updated reference ranges as outlined in the table below.

		Normal Range
C1 Inhibitor	Old assay	0.21-0.39 g/L
	Current assay	0.21-0.38 g/L

INTERPRETATION OF RESULTS

C1 INH Low <0.15g/L): Significant reduction in C1 inhibitor may be due to consumption, but deficiency cannot be excluded. Please discuss. C1 inhibitor should be measured if patient has angioedema, abdominal pain or low C4.

C1 INH Borderline (0.15-0.21 g/L): Borderline C1 INH is commonly seen with activation of complement via the classical pathway, or in patients on treatment for hereditary angioedema. Profound reduction in C1 INH is usually seen in untreated C1 INH deficiency. However please discuss if patient has angioedema or low C4.

C1 INH Normal (0.21-0.38 g/L): Normal levels of C1 INH. However a small number of cases of C1 INH deficiency are due to a dysfunctional protein with normal or high C1 INH levels. If a patient has angioedema in the absence of urticaria further testing of functional C1 INH may be indicated. C1 INH testing is not indicated in patients with urticaria or without angioedema.

C1 INH raised (> 0.38 g/L): A small number of cases of C1 INH deficiency are due to a dysfunctional protein with normal or high C1 INH levels. If a patient has angioedema in the absence of urticaria further testing of functional C1 INH may be indicated. C1 INH testing is not indicated in patients with urticaria or without angioedema.

*2.3.30 **Anti-Streptolysin-O Titre (ASOT)***

INDICATIONS

- Suspected current or recent streptococcal infection
- Possible rheumatic fever
- Glomerulonephritis & acute renal failure
- Reactive arthritis

Anti-streptolysin-O antibodies may be produced following infection with Group A Streptococci. Only a proportion of the subtypes of group A Strep can cause rheumatic fever or glomerulonephritis in genetically susceptible individuals, usually with an onset 2-4 weeks after the infection. The ASOT does not distinguish between nephritogenic and non-nephritogenic strains – a positive result merely indicates current or recent infection with streptococcus.

If rheumatic fever is suspected, evidence of recent streptococcal infection is required for diagnosis. If cultures and ASOT are negative, it may be of value to measure anti-DNAase, an additional antibody which may be produced following a Streptococcal infection.

INTERPRETATION OF RESULTS

In October 2020 we changed the method for ASOT from_Nephelometry to Immunoturbidimetry. There was no change in reference range.

Negative ASOT (<200 IU/mL): Negative result does not exclude Group A Streptococcal infection as this antibody is present in only 80-85% of patients with Streptococcal pharygitis. A smaller proportion of patients with skin infection are antibody positive.

Positive ASOT (>200 IU/mL): Indicates current or recent infection with Group A Streptococci.

2.3.31 ***Tryptase***

INDICATIONS

Assessment of possible anaphylaxis (Requires serial samples: following resuscitation, 4-6 hours and >24 hours after the event)

- Systemic mastocytosis – diagnosis & monitoring
- Hypereosinophilic syndromes
- Post-Mortem assessment of sudden death, if anaphylaxis considered likely/possible

Tryptase is released following mast cell degranulation, and while elevated levels indicate that mast cell degranulation occur, this test provides no information about the cause of mast cell degranulation. Following an anaphylactic reactions levels typically peak within an hour, remain elevated for about 6 hours and return to baseline by 24 hours.

In systemic mastocytosis, levels are typically raised, and levels may be useful to monitor disease burden. In localised or cutaneous limited mastocytosis, tryptase levels may be within the normal range. Hence persistent elevation of tryptase supports a diagnosis of mastocytosis, however normal levels do not exclude this diagnosis.

In the hypereosinophilic syndromes, there is some data to suggest that an elevated tryptase may be a poor prognostic factor.

Post-mortem levels of tryptase are affected by factors such as time between death and blood sampling, trauma, use and duration of CPR. Hence the interpretation of post-mortem samples is undertaken by the Consultant immunologist, in consultation with the Consultant pathologist who undertook the post mortem.

INTERPRETATION OF RESULTS

Serial samples, Post-resuscitation or 2nd sample elevated, normal levels at 24 hours: Indicates mast cell degranulation has occurred. While this is usually due to a severe IgE mediated allergic reaction, similar results may be seen following administration of drugs which cause direct mast cell degranulation such as contrast media.

Serial samples: all normal: No evidence to support anaphylaxis, however results do not exclude this diagnosis. Tryptase is not a sensitive marker of anaphylaxis due to food allergy. Elevations are more likely to be seen following reactions to parenteral administration of drugs and venom allergy.

Persistently elevated levels: Mastocytosis or hypereosinophilic syndrome should be considered. If no evidence of disease at present patient should be monitored,

with repeat bone marrow and other appropriate biopsies in the future. In the setting of documented hypereosinophilic syndrome, persistently elevated tryptase appears to be a poor prognostic marker.

Normal single level: Systemic mastocytosis unlikely, however limited disease cannot be excluded. Tryptase is not useful in the diagnosis of hypereosinophilic syndrome, hence normal level does not exclude this condition.

*2.3.32 **Specific IgGs***

INDICATIONS

- Suspected APBA
- Suspected extrinsic allergic alveolitis eg
- Farmer's Lung or Bird Fancier's Lung

2.3.32.1 Specific IgG to Aspergillus

Measured to assess immunological reactivity to aspergillus in the assessment of allergic bronchopulmonary aspergillosis, especially in patients with asthma or cystic fibrosis

INTERPRETATION OF RESULTS

Normal Value (<40 mgA/l): Negative

Weakly positive 40-90 mgA/L: IgG Apergillus at this level may be clinically significant in non - Cystic Fibrosis patients. However, in patients with CF this level may not be significant. Suggest clinical correlation with clinical, microbiological and serological factors.

Strongly positive > 90mgA/L: Raised level of specific IgG to aspergillus suggests an immunological reactivity to aspergillus. Possibility of allergic bronchopulmonary aspergillosis should be considered.
Specific IgG to Micropolysporia Faeni Measured to assess immunological reactivity to micropolyspora faeni in the assessment of possible extrinsic allergic alveolitis.

INTERPRETATION
Normal Result <22 mgA/l: Negative
High > 22mgA/l: Raised level of specific IgG to micropolyspora faeni suggests an immunological reactivity to micropolyspora faeni. The possibility of Farmer's Lung should be considered.

2.3.32.2 Specific IgG to Budgie or Pigeon

Measured to assess immunological reactivity to avian antigens in the assessment of possible extrinsic allergic alveolitis.
INTERPRETATION
High Specific IgG to Budgie > 30 mgA/l: Raised levels suggest an immunological reactivity to avian antigens. Possibility of Bird Fancier's Lung should be considered.
High Specific IgG to Pigeon > 38 mgA/l: Raised levels suggest an immunological reactivity to avian antigens. Possibility of Bird Fancier's Lung should be considered.

*2.3.33 **Myositis Screen***

INDICATIONS

- Suspected dermatomyositis or polymyositis
- Suspected idiopathic myositis

The myositis screen includes antibodies to Mi-2α, Mi-2β, Ku, PM-Scl 100, PM-Scl 75, SRP, Ro-52, T1F1γ, MDA5, NXP2, SAE1, HMGCR, cN1A and the anti – synthetase antibodies; Jo-1, PL-7, PL-12, EJ, and OJ.

INTERPRETATION OF RESULTS

Normal Value: Negative

Positive Anti-Mi-2α Antibody: This antibody is highly specific for dermatomyositis. It can be found in 15% – 20% of dermatomyositis patients and in 8%- 12% idiopathic myositis. Please correlate with clinical details.

Positive Anti-Mi-2β Antibody: This antibody is highly specific for dermatomyositis. It can be found in 15% – 20% of dermatomyositis patients and in 8%- 12% idiopathic myositis. Please correlate with clinical details. This antibody may be associated with malignancy induced dermatomyositis. Please correlate with clinical details.

Positive Anti-Ku Antibody: This antibody can be associated with myositis, scleroderma, SLE or overlap syndromes. Please correlate with clinical details.

Positive Anti – PM-Scl 100 Antibody: This antibody is associated with an overlap syndrome with a combination of symptoms associated with polymyositis/ dermatosynovitis and systemic sclerosis. Please correlate with clinical details.

Positive Anti PM-Scl 75: This antibody is associated with diffuse systemic sclerosis. It can also be associated with an overlap syndrome with a combination of symptoms associated with polymyositis/ dermatosynovitis and systemic sclerosis. Please correlate with clinical details.

Positive Anti SRP Antibody: Antibodies against the Signal Recognition Particle (SRP) occur in 4% - 5% of myositis patients. Please correlate with clinical details.

Positive Anti Ro-52 Antibody: Anti-Ro positivity detected on Immunoblot. Antibodies to Ro52 are not Lupus specific & can be detected in samples from patients suffering from myositis, scleroderma, Sjogrens & other autoimmune diseases. Please correlate with clinical details.

Positive Anti T1F1γ Antibody: This antibody is highly specific for dermatomyositis. It can be found in approximately 15% of patients with

dermatomyositis. Anti-TIF1-gamma positive dermatomyositis has been strongly associated with malignancy. Please correlate with clinical details.

Positive Anti MDA5 Antibody: This antibody occurs in 13-26% of patients with dermatomyositis, in particular amyopathic dermatomyositis and dermatomyositis associated with interstitial lung disease. Please correlate with clinical details.

Positive NXP2 Antibody: This antibody occurs in 18-25% of patients with juvenile dermatomyositis. It is associated with calcinosis and severe disease. It is rare in adult onset dermatomyositis where it may be associated with malignancy. Please correlate with clinical details.

Positive Anti SAE1 Antibody: This antibody is highly specific for dermatomyositis. It can be found in approximately 8% of patients with dermatomyositis. It may occur in dermatomyositis associated with interstitial lung disease. Please correlate with clinical details.

Positive anti-HMGCR antibody: This antibody has been reported in up to 60% of patients with necrotising myopathy. Approximately 30 – 60% of these patients have been reported to have previous statin exposure. This antibody has also been reported with a high frequency of malignancy in this condition. Close correlation with clinical history, physical findings, muscle enzyme CK levels and histology is advised.

Positive anti- cN1A antibody: This antibody has been reported in 30 – 60% of patients with sporadic inclusion body myositis.However close correlation with clinical history, clinical findings, muscle CK enzyme and histology is strongly advised, as this antibody has also been reported in other patient cohorts such as Sjogrens Syndrome and SLE, other inflammatory myopathies and other non-autoimmune neuromuscular conditions. This antibody has also been reported in up to 5% of healthy population.

Poitive Anti Jo – 1 Antibody: Anti-Jo-1 is associated with the anti-synthetase syndrome – polymyositis, Raynaud's and interstitial lung disease. Please correlate with clinical details.

Positive Anti – PL-7 Antibody: This antibody occurs in 3 - 6 of patients with anti-synthetase syndrome. Please correlate with clinical details.

Positive PL-12 Antibody: This antibody occurs in up to 3% of patients with anti-synthetase syndrome

Positive anti – EJ Antibody: This antibody occurs in 1% of patients with anti-synthetase syndrome. Please correlate with clinical details.

Positive anti OJ Antibody: This antibody occurs in 1% of patients with anti-synthetase syndrome. Please correlate with clinical details.

2.3.34 ***Scleroderma Blot***

INDICATIONS

- Suspected Systemic sclerosis

The Scleroderma Immunoblot screens for antibodies against the Systemic Sclerosis associated antigens Scl-70, CENP A, CENP B, RP11, RP155, Fibrillarin, NOR90, Th/To, PM-Scl100, PM-Scl75, Ku, PDGFR and Ro-52.

INTERPRETATION OF RESULTS

Normal Value: Negative

Positive Anti-Scl-70 Antibody: Anti-Scl-70 is found in 30% of patients with scleroderma, and when significantly positive is regarded as specific for this condition. The antibody may predate clinical signs of disease. The presence of anti-Scl-70 is regarded as a poor prognostic marker. Please correlate with clinical details.

Positive Anti-CENP A Antibody: This antibody is found in patients with Limited Cutaneous Systemic Sclerosis (lcSSc), & pulmonary arterial hypertension. Please correlate with clinical details.

Positive Anti-CENP B Antibody: This antibody is found in patients with Limited Cutaneous Systemic Sclerosis (lcSSc), & pulmonary arterial hypertension. Please correlate with clinical details.

Positive Anti-RP11 Antibody: This antibody is a RNA Polymerase III subunit, associated with Diffuse Cutaneous Systemic Sclerosis (dcSSc), renal crisis, synovitis & tendon friction rubs. Please correlate with clinical details.

Positive Anti-RP155 Antibody: This antibody is a RNA Polymerase III subunit, associated with Diffuse Cutaneous Systemic Sclerosis (dcSSc), renal crisis, synovitis & tendon friction rubs. Please correlate with clinical details.

Positive Anti-Fibrillarin Antibody: This antibody is found in patients with Diffuse Cutaneous Systemic Sclerosis (dcSSc), renal crisis, cardiac involvement. Please correlate with clinical details.

Positive Anti-NOR90 Antibody: This antibody is found in patients with mild internal organ involvement. Please correlate with clinical details.

Positive Anti-Th/To Antibody: This antibody is found in patients with Limited Cutaneous Systemic Sclerosis (lcSSc), pulmonary fibrosis & renal crisis. Please correlate with clinical details.

Positive Anti-PM-Scl100 Antibody: This antibody is found in patients with an overlap syndrome with a combination of symptoms associated with polymyositis/ dermatosynovitis and systemic sclerosis. Please correlate with clinical details.

Positive Anti-PM-Scl75 Antibody: This antibody is found in patients with diffuse systemic sclerosis. It can also be associated with an overlap syndrome with a combination of symptoms associated with polymyositis/ dermatosynovitis and systemic sclerosis. Please correlate with clinical details.

Positive Anti- Ku Antibody: This antibody is found in patients with myositis, scleroderma, SLE or overlap syndromes. Please correlate with clinical details.

Positive Anti-PDGFR Antibody: Platelet-derived growth factor receptor (PDGFR) antibodies are hypothesized to have a pathogenic role in Systemic Sclerosis however this requires further investigation. Please correlate with clinical details.

Positive Anti- Ro-52 Antibody: Anti-Ro positivity detected on Immunoblot. Antibodies to Ro52 are not Lupus specific & can be detected in samples from patients suffering from myositis, scleroderma, Sjogrens & other autoimmune diseases. Please correlate with clinical details.

2.3.35 IgG Subclasses

INDICATIONS

- Suspected Humoral Immunodeficiency i.e. Recurrent bacterial infections

A patient with recurrent infections or severe infections and a low total IgG or IgG subclass may have a humoral immunodeficiency. Suggest discussion with or referral to a Clinical Immunologist.

IgG subclasses measured in Immunology only includes IgG1, IgG2 & IgG3. The rationale is that IgG 1, 2 & 3 are indicated for investigation of patients with recurrent bacterial infections.

In recent years, there has been increasing literature regarding IgG4 involvement in autoimmune pancreatitis & a distinct population with fibrosing disease. Since the emergence of information regarding IgG4 related conditions we get occasional requests for IgG4 and send these to a UK Referral laboratory.

If you wish IgG4 to be measured in patients suspected of IgG4 related conditions please order IgG4 separately & not IgG subclasses. In the OPD setting please specify IgG4 on the request form. For in patients, IgG4 can be ordered directly on Powerchart IgG Subclass 4.

INTERPRETATION OF RESULTS

In October 2020 we changed the method for IgG Subclasses from Nephelometry to Turbidimetry with updated reference ranges as outlined in the table below.

Assay	Old Reference Range	New Reference Range
IgG1	3.2-10.2 g/L	3.824 - 9.286 g/L
IgG2	1.2-6.6 g/L	2.418 - 7.003 g/L
IgG3	0.2-1.9 g/L	0.218 - 1.761 g/L
Total IgG	6-16 g/L	7 - 16 g/L

Normal Total IgG, IgG1, IgG2, IgG3: This does not exclude humoral immunodeficiency. If there is clinical concern regarding recurrent infection, suggest referral to clinical immunology as further investigations may be indicated.

Low Total IgG: A low total IgG requires further investigation with serum electrophoresis and quantification of IgG, IgA and IgM. This sample will be sent to the proteins laboratory for further evaluation.

Low IgG1: IgG1 deficiency can be associated with recurrent infection.

Low IgG2: IgG2 deficiency can be associated with recurrent sinopulmonary infection, particularly when it occurs with IgA deficiency or other immune defects.

Low IgG3: The clinical significance of low IgG3 is controversial. While this is occasionally seen in healthy adults, it may be clinically relevant, particularly if other immune defects are present.

2.3.36 Anti- SARS-CoV-2 Antibodies

Method: Roche Elecsys Anti-SARS-CoV-2 which uses a recombinant protein representing the nucleocapsid (N) antigen for the determination of antibodies against SARS‑CoV‑2. In April 2021 we added a quantitative assay for Anti-Spike S RBD antibody as part of of our serology service for Anti-SARS-CoV-2 antibdies. These antibody tests are now both available as a panel, measured by Electrochemiluminescence Immunoassay (ECLIA) on the Roche cobas e immunoassay platform.

The Anti-Nucleocapsid antibody tests are reported as either Not Detected, Equivocal or Detected.

The reference range for the Anti-Spike antibody test is as follows

<0.8 U/ml – Anti-SARS CoV-2 S antibody not detected
≥0.8 U/ml – Anti-SARS CoV-2 antibody detected

Interpretive comments will be added on all reports

2.3.37 ***Immunology Consult/ Referral (Specific IgE)***

INDICATIONS

- When uncertain about the most helpful investigations and/or unable to contact us

We are always happy to discuss patients however it may not always be convenient to interrupt a busy clinic. For convenience we have included the 'Immunology Consult order (IMMCON)' formerly known as "Query Test/QT" which facilitates sending serum together with clinical details, and ensures that the most helpful investigations are chosen for your patient.

If you require a specific IgE request for an allergen that is not directly orderable please order the Referral (Specific IgE) SIGEREFERRAL order may be used, it is important that clinical details are included so that the appropriate allergen can be ordered if relevant & available in our referral laboratory.

2.3.38 ***Direct Immunofluorescence (DIF) on Skin Biopsies***

INDICATIONS

DIF should be considered when a skin biopsy is being taken for the following conditions:

- Blistering skin disorders – such as pemphigus & pemphigoid
- Dermatitis Herpetiformis
- Lupus Erythematosus
- Vasculitis

Direct immunofluorescence (DIF) is a technique for assessing deposition of immunoglobulins and complement in tissues. This technique is part of the routine investigation of selected skin biopsies.

INTERPRETATION OF RESULTS

Normal fixation techniques degrade complement and some epitopes on immunoglobulins, therefore fresh tissue samples must be submitted to the laboratory. The tissue is rapidly frozen and thin sections cut. Sections are incubated with FITC-conjugated antibodies (to C3, C4, IgA, IgG, IgM, Fibrin, Kappa & Lambda.) washed and any staining assessed by microscopy. Slides are interpreted by a trained pathologist and the immunofluorescence pattern must be interpreted in the context of the morphology in the biopsy.

Some immunoreactants are relatively rapidly degraded. Biopsies must be taken directly to the laboratory for processing. Classical findings in many skin diseases are dependent on a biopsy taken from the correct site and at the correct time. Optimum biopsy sites for some common conditions are outlined in the table below.

False negative results may be seen in many skin conditions and it is usually advisable to request appropriate serology at the time of biopsy, as this may be sufficient to confirm a diagnosis in the presence of typical histology, even if DIF is negative.

A biopsy for DIF should always be accompanied by a sample for routine histology as DIF must be assessed by an experienced pathologist in the context of the histological appearances. False positive findings may be seen, particularly in the presence of dermal inflammation.

Condition	**Typical Finding**	**Site to Biopsy**	**Age of lesion**	**Accompanying Serology**
Pemphigus	Linear IgG positivity in a chicken-wire pattern in the epidermis	Perilesional skin	Close to new lesion	Antibodies to epidermal intercellular substance
Pemphigoid	Linear IgG (+/- C3) along the dermoepidermal junction.	Perilesional skin	Close to new lesion	Antibodies to epithelial basement membrane
Dermatitis Herpetiformis	IgA (+/- C3 & fibrin) in granular or fibrillary pattern in the papillary dermis	Peri-lesional, non-erythematous skin	Close to new lesion	Anti-endomysial antibody.
Vasculitis	Granular deposition of C3 (+/- C4) with at least one isotype of immunoglobulin in dermal vessels	Lesion	Fresh, preferably <24 hours	C3, C4. Cryoglobulins ANA + follow ANCA RF
DLE	Granular deposition of one or more immunoreactants along the dermoepidermal junction (lupus band)	Lesion	>3 months	ANA, Anti-DNA Anti-ENA

2.4 MICROBIOLOGY

2.4.1 General Sample Collection Guidelines (pre-examination)

- Specimens should be collected using aseptic techniques to minimise contamination by normal flora. A sufficient volume of material must be submitted (See Section 3.6)
- Specimens should be taken before administration of antimicrobials if possible.
- Specimens should be transported to the laboratory as soon as possible to prevent samples becoming compromised and rejected.
  Swabs in transport media are acceptable for throat, eye, ear, vaginal and urethral specimens. Otherwise pus, fluid or tissue is preferable to a swab. Swabs with special transport media are available, e.g. viral transport swabs, Copan Liquid Amies Elution Swab (ESwab) for use in carbapenemase producing *Enterobacteriales* (CPE) screens of rectal swabs, and chlamydia transport swabs.
- If a diagnosis of a viral haemorrhagic fever (Lassa, Ebola, Marburg, Congo-Crimean fever), or CJD is suspected, the consultant microbiologist must be informed before any specimens are collected.
- If a potentially cytotoxic specimen is being sent, the chief or senior medical scientists in microbiology must be informed.
- Specimens which are collected in the operating theatre, endoscopy, interventional radiology or podiatry departments must be ordered electronically.
- Specimens which are being sent to an external laboratory for virology/ serology tests must be ordered electronically
- Specimens sent to the laboratory from Outpatient clinics must be ordered electronically

2.4.2 Guidelines for Critical/Urgent Specimens

BLOOD CULTURES

- Blood cultures can be collected at any time but must be transported to the laboratory **within 4 hours of collection.** Blood cultures received in the laboratory >4 hours after collection will have a disclaimer added on MedLIS to the report reflecting this delay. Comment is: *THIS COMMENT APPLIES TO BLOOD CULTURE BOTTLES THAT HAVE A NEGATIVE RESULT AFTER CONTINUOUS MONITORING* Blood cultures received in the laboratory more than four hours after collection may incur a falsely negative result. Hence a pathogen may not be recovered from a bacteraemic patient or the positive result may be delayed. Due consideration should be applied when interpreting the result.

- For an incomplete set of Blood Cultures received, the following comments will be added to the report on MedLIS

BC aerobic bottle only sent: Incomplete blood culture set received. Aerobic bottle only processed. Please repeat if still required

BC anaerobic bottle only sent: Incomplete blood culture set received. Anaerobic bottle only processed. Please repeat if still required

BC incorrect bottle sent: Incorrect blood culture bottle(s) received for test requested. Please repeat if still required.

- **The patient label must never obscure the barcode section on the bottle label**
- **Routine blood culture bottles (Blue/Pink)** are plastic and **can be sent in the pneumatic chute** system. If there is no access to the chute system, transport the bottles to the laboratory by means of the portering service. Bleep the porter desk on 2032.
- **Mycobacterial blood culture bottles (Red)** are plastic and **can be sent in the pneumatic chute** system transport bottles via the portering service (see above).
- The blood should be collected in accordance with 'Taking a blood culture' guidelines located on the hospital intranet.
- See table 2 and 3 below for specimen acceptance and rejection

Target Organism	Bottle Required	Colour	Computer Order
Bacteria/Yeast	Plus Aerobic/F	Blue	Bloodculture
	Plus Anaerobic/F	Pink	
Mycobacteria	Myco/F Lytic	Red	Bloodculture

CSF

- CSF can be collected at any time. Take as much as is practical and safe. Make the request on Powerchart and indicate the site as appropriate.
- Ensure to put the CSF into the correctly numbered container

- Note the container number is on the labels printed e.g 1, 2, 3 etc. Ensure all appropriate containers are labelled correctly with patient details. If more than 1 test is required on sample, ensure appropriate containers are labelled correctly with patient details and test required

- If the containers are not numbered a comment will be added to the microscopy report and appears on Powerchart as: 'Order of collection not indicated'

Split samples for CSFs (e.g Oligoclonal bands, Immunology hold, xanthachromia and other tests

If more than one test required on the CSF sample and it must be split,

- Ensure all appropriate containers are used as outlined by relevant laboratory.

- Ensure all containers are labelled correctly with patient details and test required

- Out of hours, contact the medical scientist on-call through the switch board or bleep 869 to request an examination.
- Always transport CSF samples to the laboratory by means of the portering service. **Never send a CSF sample in the pneumatic chute system.**

CSF specimens should be transported to the laboratory immediately, as cells start to lyse within 2 hours so an accurate cell count cannot be performed after this. CSFs received >2 hours after collection will have a disclaimer added to the report to reflect this delay. The comment will appear on the report 'The white cell count on a CSF received in laboratory 2 hours or more after collection may not be accurate due to cell lysis'

- CSF should **never** be stored at 4°C, and those collected in theatre should be transported to the laboratory immediately
  If a serial red cell count is required, the laboratory must be notified. This will not be done routinely except from the Emergency Department
  See table 2 and 3 below for specimen acceptance and rejection

THEATRE AND RADIOLOGY SPECIMENS, STERILE SITE SPECIMENS AND FLUIDS

- During working hours (8am-8pm) please phone 2971 to alert the laboratory to an imminent urgent specimen.
- After 8pm and at weekends, please contact the medical scientist on call via the switch or bleep 869
- Biopsies and surgical specimens for culture should be sent in a sterile container. **Do not** use formal-saline.
- Specimens of fluid or pus which are drained in the radiology department n**eed to** be transported **immediately** to the laboratory for urgent microscopy and culture.

Split samples for fluids: If more than 1 test required on sample and it must be split, ensure all appropriate containers are used as outlined by relevant laboratory and that all containers are labelled correctly with patient details and test required

- See table 2 and 3 below for specimen acceptance and rejection

*2.4.3 **Guidelines for Routine Specimens***

See table 2 and 3 below for specimen acceptance and rejection

PUS

- Pus sent in sterile containers gives the best results for both Gram stain and culture and is essential for the diagnosis of TB or actinomycosis. If a swab is taken, it should be sent in transport medium, after it has been thoroughly soaked in the pus or exudate.

ULCERS

- For the best results, ulcers should be cleaned with sterile saline to remove surface contamination, prior to obtaining the sample.

EYES

- Discharging eyes should be swabbed for bacterial culture in the usual way.
- When viral conjunctivitis or corneal lesions are suspected, a swab must be collected using viral transport medium.
- If fungal or amoebic infections are suspected, please contact the clinical microbiology team.

THROAT SWABS

- Even though viruses account for over 70% of sore throats, the most common bacterial cause of sore throat in this country is group A β-haemolytic streptococcus.
- Throat swabs should be taken from the tonsillar region.
- If a throat swab is being taken for other pathogens e.g. *C. diphtheriae, N. gonorrhoea* or *N. meningitidis*, it must be clearly requested.
- If whooping cough is suspected (*Bordetella pertussis*), please send a nasopharyngeal swab.
- Specimens for virology should be taken early in the course of a suspected viral illness. Virus transport medium should be used.

NASAL/THROAT SWABS FOR COVID-19 AND FLU A/B TESTING

- Specimens for on-site COVID-19 PCR testing should be sent using the'UTM/VTM viral swabs or the PrimeStore® Lysis MTM swabs which both contain one swab**.**

Note: The Swabs and tubes are separate for the Lysis MTM swabs and both must be collected from the laboratory if required for testing

- The small cotton tipped swab in the VTM/UTM kit or the PrimeStore® Lysis MTM swabs is rubbed against the back of the throat first and then rubbed against and above the nasal passage
- For the VTM/UTM kit, the swab is then placed into the red capped tube of viral transport medium liquid and the top end is snapped off the swab
- For the PrimeStore® Lysis MTM swab, the swab is placed into the smaller orange capped tube

COPAN ESWABS FOR MOLECULAR CPE TESTING

- All wards are required to send a white topped Copan Eswab for molecular CPE screening

FAECES - ENTERIC PATHOGENS

- Faecal culture assay now includes *Cryptosporidium parvum/hominis and Giardia lamblia* as standard
- Testing for enteric pathogens is not part of a routine septic screen and faeces specimens should only be sent when gastrointestinal infection is suspected.
- Faeces investigation for enteric pathogens is only performed on specimens which take the shape of the container. (www.hpsc.ie)
- It is important that clinical details or suspected diagnoses are included on Powerchart. Relevant information includes: travel history, prolonged diarrhoea, antibiotic use and suspected outbreak. Investigations for pathogens such as *Yersinia, Vibrio, or Aeromonas* etc only be performed if indicated by clinical details.
- Specimen may be passed into a clean, dry, disposable bedpan or similar container and transferred into an appropriate CE-marked leak-proof container and place in sealed plastic bags.
- Ensure samples are in the laboratory early to ensure they are put up for processing that day.

3 day rule: All faecal samples received from a patient, sent within the first 3 days of admission will be processed. If a sample is received after 3 days, only the first sample will be processed.

FAECES - CLOSTRIDIOIDES DIFFICILE

- Only freshly collected samples can be examined.
- Do not request repeat specimens on previously positive stools as toxin positivity may persist for **3 months,** unless a patient's symptoms from an earlier episode had resolved and recurrent infection is suspected.
- Testing for *Clostridioides difficile* is performed on all faecal samples except in the following cases:
  - Specimens that do not take the shape of the container
  - If specimen was positive for *C. difficile* within the last 14 days,

These criteria are in compliance with national guidelines (www. hpsc.ie)

FAECES – OVA AND PARASITES

- As these tests are both time consuming and expensive, specimens received for examination for ova and parasite, which do not match the processing criteria, **must be approved by the** clinical microbiology team prior to processing the request.
- Patients must have a history of travel or other relevant clinical details.

- For ova and parasites, three specimens should be collected over no more than a 10-day period. It is recommended that specimens are collected every other day.
- Unless the patient has severe diarrhoea or dysentery, no more than one specimen should be examined within a single 24-hour period, as shedding of cysts and ova tends to be intermittent.

- Faecal culture assay now includes *Cryptosporidium parvum/hominis and Giardia lamblia* as standard

Note: All faeces samples should be collected in the correct container. See Table 1 below

NOROVIRUS

- In the event of a suspected outbreak- contact the IPCT

- Send a separate specimen for Norovirus testing, as this test is performed by an external laboratory.

RESPIRATORY

- Sputum/BALs/EBUS/ Tracheal aspirate samples should be transported to the laboratory as soon as possible after taking the sample.
- A good quality purulent or mucopurulent sputum specimen should be obtained, preferably before antimicrobial therapy, although antimicrobial therapy should not be delayed unnecessarily while awaiting a sputum specimen.
- **Sputum** - Ideally, a minimum volume of 1mL.
- **BAL/EBUS** - It is difficult to be specific on volume required; in principle, as large a volume as possible is preferred.
- Numbers and frequency of specimens collected are dependent on clinical condition of patient.
- Transport the specimen to the laboratory within 2 hours.
- Salivary sputum specimens are rejected except for the following:

    - ITU/RTU
    - Haematology/ Oncology/ Radiation
    - For culture of *Legionella* and *Mycobacterium* species
    - Cystic fibrosis

- If transport is delayed up to 24 hours, refrigeration is preferable to storage at ambient temperature. Specimens are not processed if they are >48hours old at time of receipt in laboratory (with the exception of samples from patients with CF, which can be processed >48hours from collection)

- Collect specimens in appropriate CE marked leak proof containers and transport in sealed plastic bags. See Table 1 below
- Galactomannan assay can be performed on BAL samples.
- SARS-CoV-2 testing can be performed on BAL samples.

TB CULTURE

Sputum/ BALs/Tracheal aspirates for investigation of *Mycobacterium* spp.:

- BAL and associated specimens need specialist collection according to local protocols.
- Sputum specimens should be relatively fresh (less than 1 day old) to minimise contamination. Purulent specimens are best.
- Two to three samples of ≥5mL should be collected approximately 8-24 hours apart with at least one from early morning
- Samples taken early morning (that is, shortly after patient waking) have the greatest yield.
- When the cough is dry, physiotherapy, postural drainage or inhalation of nebulised saline ('sputum induction') before expectoration may be helpful.

URINES

- Urine specimens should be collected in the early morning on three consecutive days in a CE-marked leak-proof container (that does not contain boric acid), and placed in a sealed plastic bag. If there are no appropriate containers for a whole Early Morning Urine (EMU) sample, a midstream EMU sample is an acceptable, but not an ideal alternative.
- Contact the clinical microbiology team before sending a urine to the laboratory (Ext: 3320)

CSFs/Tissues/Fluids/Other Samples

- CSFs- Ideally 1ml of sample is required for an auramine and TB Culture.

HIGH VAGINAL SWABS:

Obtain a high vaginal swab by use of a speculum and a trans swab and submit to the laboratory.

URINE SPECIMENS:

What type of specimen should you send?

MSU: Send a mid-stream specimen of urine (MSU) where possible. Patients should be instructed to pass a little urine into the toilet first, and then pass enough urine into the specimen container to half fill it and finish urinating into the toilet. If transport to the laboratory has to be delayed, the specimen can be stored at 4°C for up to 48 hours.

Urines for culture and sensitivity (Urine culture with Microscopy) are now collected via the The Sarstedt NFT (Needle Free Transfer) system. This consists of a 100ml NFT primary container (Sarstedt Product Reference 75.562.900) and a 10mL Monovette tube (Sarstedt Product reference 10.252)

This system allows for the spill free collection and transfer of urine samples to the required 10mL Monovette tube (Table 1).

- The 10mL Monovette **tube** is to be sent to the Microbiology lab for microbiology urine investigations (URCULT).
- ONLY 10mL Monovette tubes will be accepted and other container types will be rejected
- Both products are available from the Stores Department, Beaumont Hospital

Urines for pregnancy test (hCG), Legionella and Streptococcal Urinary antigen are now collected via the The Sarstedt NFT (Needle Free Transfer) system also

CLEAN-CATCH URINE: A reasonable alternative to MSU.
Periurethral cleaning is recommended. The whole specimen is collected and then an aliquot sent for examination in a CE marked leak proof container (the monovette container as stated above).

CATHETER URINE (CSU)
The sample may be obtained either from a transient ('in and out') catheterisation or from an indwelling catheter. In the latter case, the specimen is obtained aseptically from a sample port in the catheter tubing or by aseptic aspiration of the tubing. The specimen should not be obtained from the collection bag.Use aseptic technique and collect specimens in appropriate CE marked leak proof containers and transport in sealed plastic bags. (See Table 1)

All specimens received in the laboratory should already be ordered up and labelled on MedLIS. If a specimen is received on a request form the ordering clinician or ward should be contacted to order on MedLIS.

Exceptions to this are during MedLIS downtime or the test request is laboratory order only.

There are three request forms that inpatient or outpatient specimens may arrive on: Blue virology form (LF-MIC-VIR), Green Theatre specimen form (LF-MIC-CRIT) and MedLIS Downtime request form (LF-GEN-0047). The specimen and

form are transported to the laboratory in a sealed biohazard bag, by the porter, through the chute system or by courier to pathology specimen reception.

Table 1: Approved urine, faeces and respiratory sample containers for microbiology investigations

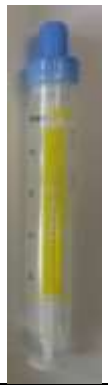
Department	Test	Container
Microbiology	**Non-Urine Samples** Eg: -Faeces samples -Sputum/Respiratory samples -Sterile fluids -Tips -Theatre samples/miscellaneous Ref. 75.9922.745	
Microbiology	-Urine culture & sensitivity -Urine hCG (pregnancy test) -Urinary Legionella/ Streptococcal Antigen Sarstedt Product reference 10.252)	
Microbiology	-Urine culture and sensitivity Catheter Stream Urines (CSU) only	

Table 2: Specimen acceptance criteria

Label	Test ordered	Container	Volume	Stability	Comments
Urine					
C Urine	Urine culture with microscopy	10 ml Monovette tube, 60 ml sterile container with red sticker on the lid	2 mls	4 hours at room temperature48 hours at 4℃	**Exception:**Nephrostomy and Theatre urines always processed
C HCG	HCG Pregnancy	10 ml Monovette tube60 ml sterile container	2 mls	4 hours at room temperature48 hours at 4℃	
Leg Ur Ag	Legionella urinary antigen	10 ml Monovette tube, 60 ml sterile container	2 mls	4 hours at room temperature, 48 hours at 4℃	
S pneum Ag	Streptococcus pneumoniae antigen	10 ml Monovette tube, 60 ml sterile container	2 mls	4 hours at room temperature, 48 hours at 4℃	
C TB	TB culture	60 ml sterile container	10 mls	24 hours at room temperature, If delay store at 4 ℃	
C O&P	Ova and Parasites	60 ml sterile container	10 mls	1 hour without the addition of undiluted formalin	
Faeces					
C diff toxin & Enteric Path	C diff and Enteric Path	60 ml sterile container	1-2 ml/g	48 hours at 4℃	Liquid or semi-formed samples only processed
C diff toxin PCR	C diff toxin PCR	60 ml sterile container	1-2 ml/g	48 hours at 4℃	Liquid or semi-formed samples only processed
EntericPath	Enteric Path	60 ml sterile container	1-2 ml/g	48 hours at 4℃	Liquid or semi-formed samples only processed
ROT/ADV	Rotavirus/Adenovirus combi test	60 ml sterile container	1-2 ml/g	48 hours at 4℃	
C O&P	Ova and Parasites	60 ml sterile container	1-2 ml/g	24 hours at room temperature 48 hours at 4℃ without addition of 10% formalin-water	Travel details essential or CMT Request

Label	Test ordered	Container	Volume	Stability	Comments
H. pylori Ag	Helicobacter pylori antigen	60 ml sterile container	1-2 ml/g	48 hours at 4 ℃	
Norovirus RNA	Norovirus	60 ml sterile container	1-2 ml/g	48 hours at 4 ℃	Dispatched to NVRL
		Respiratory			
C BAL/C Respiratory /C Sputum/C CF Resp	Respiratory culture BAL/Sputum/TASP/EBUS	60 ml sterile container	15 mls	48 hours at 4℃	CF specimens can be processed >48 hours after collection
GALAGB	Galactomannan-BAL	60 ml sterile container	1 ml	5 days at 4℃ 14 days at -20℃	
C TB	TB culture	60 ml sterile container	1 ml	24 hours at room temperature, If delay store at 4 ℃	
COVID 19/FLU	SARS-CoV-2/Influenza A/B	VTM/UTM viral swab containing one swab or PrimeStore® Lysis MTM swabs	N/A	48 hours at room temperature > 48 hours at -70 ℃	Copan viral swabs (pink) can be sent to NVRL for processing
COVID TRANS	SARS-CoV-2 Transplant	VTM/UTM viral swab containing one swab or PrimeStore® Lysis MTM swabs	N/A	48 hours at room temperature > 48 hours at -70 ℃	Processed immediately on receipt
		Fungal			
C Fungal	Fungal culture (Skin scrapings/Nail clippings/Hair)	Dermapak 60 ml sterile container	As much as possible	Several months stored at room temperature	Any hair specimens must contain root of the hair
C GALAGS	Galactomanna-Blood	White Topped Serum Tube	7.5 ml	5 days at 4℃ 14 days at -20℃	
		Screens			
C MRSA	MRSA Screen Culture	Charcoal Transswab (Nasal, Groin or Wound site)	N/A	24 hours at room temperature 72 hours at 4 ℃	
C VRE	VRE Screen	Charcoal Transswab (Rectal swab)	N/A	24 hours at room temperature 72 hours at 4 ℃	
C CPE	CPE Screen	Charcoal Transswab (Rectal swab)	N/A	24 hours at room temperature 72 hours at 4 ℃	

Label	Test ordered	Container	Volume	Stability	Comments
CPE Mol. Scrn	CPE Molecular Screen	Liquid Amies eSwab (Rectal swab) Charcoal Transswab (Rectal swab)	N/A	24 hours at room temperature 72 hours at 4 ºC	Charcoal Transswab with CPE Mol. Scrn orders can be accepted. In GenLab result as "See Culture"
Swabs					
C Swab/C Wound/C Eye/C Ear/C Throat/C Mouth/C Nasal/C Pus	Swab/Wound/Eye/Ear/Throat/Mouth/Nasal/Pus culture	Charcoal Transswab (Wound, Eye, Ear, Throat, Mouth, Nasal, Pus),NT swab (orange)For ear, nose, throat only	N/A	24 hours at room temperature 72 hours at 4 ºC	
C Genital	Genital culture	Charcoal Transswab (Cervical/Endocervical/Urethral/ Throat/Rectal/Pus or Discharge from penis	N/A	24 hours at room temperature 72 hours at 4 ºC	
C GC	GC Direct plate culture	VCAT plate already inoculated	N/A	N/A	
C HVS	HVS Culture	Charcoal Transswab (HVS)	N/A	24 hours at room temperature 72 hours at 4 ºC	
Fluids					
C Abd Fl,C Ascitic fl,C Bile fl,C Drainage fl,Pancreatic fl,C Peritoneal fl,C Pleural fl,C Perf/Ves. Perf. Fl,C Pericardial fl,C Joint fl,C Fl/Asp	Abdominal fluid culture,Ascitic fluid cultureBile fluid culture,Drainage fluid culture,Pancreatic fluid culture,Peritoneal fluid culture,Pleural fluid culture,Perfusion fluid,Pericardial fluid culture,Joint fluid culture,Fluid/Aspirate culture	60 ml sterile container Aerobic and Anaerobic blood culture bottles	Minimum of 1 ml in 60 ml sterile container Minimum of 2 mls in blood culture bottles	24 hours at room temperature 48 hours at 4 ºC for 60 ml sterile container ≤ 4 hours at room temperature for blood culture bottles	> 4 hours for blood culture bottles are processed with "BC DELAY" comment
C PD fl	PD fluid culture	Aerobic and Anaerobic blood culture bottles Rocket tube	Minimum of 2 mls	≤ 4 hours at room temperature	> 4 hours for blood culture bottles are processed with "BC DELAY" comment
Fluid Cell Ct	Fluid microscopy (cell count)	EDTA tube (pink top)	1 ml	24 hours	

Label	Test ordered	Container	Volume	Stability	Comments
C TB	TB culture	60 ml sterile container	1 ml	24 hours at room temperature,If delay store at 4 ℃	
Theatre					
C Theatre	Theatre culture	60 ml sterile container	As much as possible	24 hours at room temperature If delay store at 4 ℃	Perfusion fluids from theatre can be processed with C Perf/Ves. Perf. Fl orders
C TB	TB culture	60 ml sterile container	1 ml	24 hours at room temperature,If delay store at 4 ℃	
Pus					
C Pus	Pus culture	60 ml sterile container	1 ml	24 hours at room temperature If delay store at 4 ℃	
Tip					
C Cath Tip	Catheter Tip Culture	60 ml sterile container	4-5 cm length	24 hours at room temperature If delay store at 4 ℃	
CSF					
C CSF BH	CSF culture & microscopy	Clear sterile universal container	Minumum of 600 µl	2 hours	Comment “Order of collection not indicated” if received in the lab >2 hours after collection
C TB	TB culture	Clear sterile universal container	500 µl	24 hours at room temperature If delay store at 4 ℃	
Blood culture					
C Blood	Blood culture	Aerobic and Anaerobic blood culture bottles	8-10 mls	4 hours	Comment “BC DELAY” if received in the lab >4 hours after collection Comment if incomplete/incorrect BC set received. See 2.4.2 above
C TB Blood	TB Blood culture	Mycobacterium blood culture bottle	1-5 mls	4 hours	Comment “BC DELAY” if received in the lab >4 hours after collection

Label	Test ordered	Container	Volume	Stability	Comments
		Quantiferon			
Quantiferon TB	Quantiferon	QuantiFERON®-TB Gold blood collection tubes	1 ml x 4 tubes (fill to black line on tube)	16 hours at room temperature	MF-MIC-55 request form must be filled out with MedLIS sticker and Date & time bloods taken
		Cryptococcal antigen			
Crypto Ag	Cryptococcal antigen	CSF	100 µl	72 hours at 4 ℃ Longer at -20 ℃	
Crypto Ag	Cryptococcal antigen	White Topped Serum Tube	7.5 ml	72 hours at 4 ℃,Longer at -20 ℃	
		Virology (External laboratories)			
AmikR	Amikacin levels	White Topped Serum Tube	7.5 ml	Separated at 4 ℃ within 48 hours	Dispatched to Biochemistry MMUH
ADVADNA VRL ADVDNAL VRL	Adenovirus PCR	EDTA tube (pink top)	2.6 ml	Separated at -20 ℃ within 24 hours	Dispatched to NVRL State clearly on label Serum or Plasma
CMVDNA VRL	CMV PCR	EDTA tube (pink top)	2.6 ml	Separated at -20 ℃ within 24 hours	
EBV DNA VRL	EBV Serology	EDTA tube (pink top)	2.6 ml	Separated at -20 ℃ within 24 hours	
HBVL VRL HBGER VRL	Hep B Viral Load/PCR/DNA	White Topped Serum Tube	7.5 ml	Separated at -20 ℃ within 24 hours	
HCVGE VRL HCVVL VRL	Hep C PCR/Genotype/DNA/Viral Load	White Topped Serum Tube	7.5 ml	Separated at -20 ℃ within 24 hours	
HIVGER VRL	HIV Viral Load/PCR	White Topped Serum Tube	7.5 ml	Separated at -20 ℃ within 24 hours	
HIV1VL VRL	HIV Viral Load/PCR	EDTA tube (pink top)	2.6 ml	Separated at -20 ℃ within 24 hours	
B-D GLUCAN	Beta-D-glucan	White Topped Serum Tube	7.5 ml	Separated at 4 ℃ for 15 days Separated at -20 ℃ for 27 days	Dispatched to Southmead, Bristol
NORXPERT VRL	Norovirus	60 ml sterile container	1-2 ml/g	48 hours stored at 4℃	

Label	Test ordered	Container	Volume	Stability	Comments
PARVDNA VRL	Parvovirus PCR	White Topped Serum Tube	7.5 ml	Separated at -20 ℃ within 24 hours	Dispatched to NVRL,State clearly on label Serum or Plasma
Teicoplanin Level	Teicoplanin levels	White Topped Serum Tube	7.5 ml	Separated at 4 ℃ within 48 hours	Dispatched to Eurofins Biomnis
Tobra Trough	Tobramycin levels	White Topped Serum Tube	7.5 ml	Separated at 4 ℃ within 48 hours	Dispatched to Biochemistry SVUH
Voriconazole	Voriconazole levels	White Topped Serum Tube	7.5 ml	Separated at -20 ℃ within 24 hours	Dispatched to MMUH

Table 3: Specimen rejection criteria

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
			Urine			
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen	C Urine	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Sarstedt "Urine NFT" primary sample container	< 2 ml (manual microscopy & culture will be performed)	> 4 hours at room temperature > 48 hours at 4 ℃	**Exception:** Nephrostomy and Theatre urines always processed
	C HCG		60 ml sterile container without red sticker on lid	< 2 ml	24 hours at RT > 48 hours at 4 ℃	
	Leg Ur Ag			< 2 ml		
	S pneum Ag			< 2 ml		
	C TB,			< 10 mls		
	C O&P			< 10 mls		
			Faeces			
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen	C diff toxin & Enteric Path	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS	Sarstedt "Urine NFT" primary sample container 10 ml Monovette tube	< 1 ml/g	>48 hours at 4℃	Formed samples & < 2 years old for C.diff
	C diff toxin PCR		Sarstedt "Urine NFT" primary	< 1 ml/g		
	EntericPath			< 1 ml/g		

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
		except during downtime or any test that is lab order	sample container 10 ml Monovette tube		>48 hours at 4℃	
	ROT/ADV			< 1 ml/g		
	C O&P			< 1 ml/g	> 48 hours at 4℃ without addition of 10% formalin-water	Will only be processed for Crypto/Giardia if no travel details have been received or no request from CMT
	H. pylori Ag			< 1 ml/g	> 48 hours unless stored at – 20 ℃	
Respiratory						
ecimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen (If possible clean & process leaking BALs from endoscopy)	C BAL/C Respiratory/C Sputum/C CF Resp	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Sarstedt "Urine NFT" primary sample container	< 15 mls	> 48 hours stored at 4℃ except CF specimens	Salivary samples (except CF) are rejected.
	GALAGB		Sarstedt "Urine NFT" primary sample container	< 1 ml	> 5 days at 4 ℃ >14 days at -20 ℃	
	C TB		Sarstedt "Urine ,FT" primary sample container	< 1 ml (Culture only)	> 24 hours at room temperature	
Specimen unlabeled with MedLIS label Specimen mislabeled with incorrect patient Leaking specimen	COVID 19/FLU	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Swabs other than VTM/UTM viral swab containing one swab or PrimeStore® Lysis MTM swabs	N/A	> 48 hours at room temperture	Copan viral swabs (pink) can be sent to NVRL for processing
	COVID TRANS		Swabs other than VTM/UTM viral swab containing one swab or PrimeStore® Lysis MTM swabs	N/A	> 48 hours at room temperture	

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
Fungal						
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen	C Fungal	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Non sterile container	No visible sample present Culture only performed on insufficient sample	Stored at 4 ℃ > Several months	
	C GALAGS		Any blood sample other that serum	< 7.5 ml	> 5 days at 4 ℃	
Screens						
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details	C MRSA	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Viral swab (pink)ENT swab (orange)Pertussis swab (blue)Liquid Amies eSwab	N/A	> 24 hours at room temperature > 72 hours at 4 ℃	
	C VRE			N/A	> 24 hours at room temperature,> 72 hours at 4 ℃	
	C CPE		Viral swab (pink) ENT swab (orange) Pertussis swab (blue)	N/A	> 24 hours at room temperature > 72 hours at 4 ℃	
	CPE Mol. Scrn			N/A	> 24 hours at room temperature > 72 hours at 4 ℃	If charcoal Transswab received process and enter “See Culture” in GenLab
Swabs						
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details	C Swab/C Wound/C Eye/C Ear/C Throat/C Mouth/C Nasal/C Pus	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during	Viral swab (pink) Pertussis swab (blue)	N/A	> 24 hours at room temperature > 72 hours at 4 ℃	
	C Genital		Liquid Amies eSwab ENT swab (orange) for	N/A	> 24 hours at room temperature	

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
		downtime or any test that is lab order only	any site other than ear, nose, throat		> 72 hours at 4 ℃	
	C GC		Agar plate other than VCAT	N/A	N/A	
	C HVS		Viral swab (pink),ENT swab (orange),Pertussis swab (blue),Liquid Amies eSwab	N/A	> 24 hours at room temperature > 72 hours at 4 ℃	
		Fluids				
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen (If possible clean & process)	C Bile fl C Drainage fl C Pancreatic fl C Peritoneal fl C Pleural fl C Perf/Ves. Perf. fl C Pericardial fl C Joint fl C Fl/Asp	Incorrect MedLIS order on label,Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Non sterile container	< 1 ml in 60 sterile container Visibly no sample inoculated for blood culture bottles	> 24 hours at room temperature > 48 hours at 4 ℃ for 60 ml sterile container ≥ 4 hours for blood culture bottles samples processed with "BC DELAY" comment.	
	C PD fl		60 ml sterile container Non sterile container		≥ 4 hours for blood culture bottles samples processed with "BC DELAY" comment.	
	Fluid Cell Ct		Any blood bottle other than EDTA	< 1 ml	> 24 hours at room temperature	
	C TB		Non sterile container	<1 ml (Culture only performed on insufficient volume)	> 24 hours at room temperature If delay store at 4 ℃	
		Theatre				
Specimen unlabelled with MedLIS label (Send	C Theatre	Incorrect MedLIS	Non sterile container	No visible specimen	> 48 hours at 4 ℃ process with "DELAY" comment	Perfusion fluids from theatre can be processed with

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
back to theatre to label) Specimen mislabelled with incorrect patient (Contact theatre to fill out MF-MIC-Change Patient Details) Leaking specimen'(If possible clean in safety cabinet & process with comment)		order on label (Send back to theatre to re order) Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only (Send back to theatre to order)	(Process with comment.			C Perf/Ves. Perf. Fl orders
	C TB		Non sterile container (Process with comment.	< 1 ml	> 24 hours at room temperature process with "DELAY" comment	
			Pus			
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen,(If possible clean & process)	C Pus	Incorrect MedLIS order on label	Non sterile container	< 1 ml	> 24 hours at room temperature > 48 hours at 4 ℃	If < 1 ml charcoal swab can be processed
			Tips			
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details	C Cath Tip	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Non sterile container	> 4-5 cm length	> 24 hours at room temperature > 48 hours at 4℃	Urinary catheter tips not processed for culture
			CSF			
Specimen unlabelled with MedLIS label	C CSF BH		Non sterile container (Process with	Insufficient volume: Liase with CMT to prioritise tests	> 2 hours (Comment added 'The white cell count	

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
(Contact clinician to order in lab) Specimen mislabelled with incorrect patient (Clinician to come to lab and fill out MF-MIC-Change Patient Details) Leaking specimen (If possible Clean in safety cabinet & process with comment for sample rejection)		Incorrect MedLIS order on label (Clinician to re order in lab) Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order (Clinician to order)	comment. See LI-MIC-Barcodes for sample rejection)		on a CSF rec'd in lab 2hrs or more after collection may not be accurate due to cell lysiswith	
	C TB		Non sterile container (Prcess with comment. See LI-MIC-Barcodes for sample rejection)	< 500 µl	> 24 hours at room temperature process with "DELAY" comment	
Blood Cultures						
Specimen unlabelled with MedLIS label (Contact clinician to order in lab) Specimen mislabelled with incorrect patient (Clinician to fill out MF-MIC-Change Patient Details) Leaking specimen (Clean in safety cabinet & process with comment.	C Blood	Incorrect MedLIS order on label (Clinician to re order) Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only to order)	Incorrect blood culture bottles (Contact clinician to reorder if needed, otherwise not processed)	Visibly no blood inoculated	> 4 hours (Process with "BC DELAY" comment)	
	C TB Blood		Incorrect blood culture bottles (Contact clinician to reorder if needed, otherwise not processed)	Visibly no blood inoculated	> 4 hours (Process with "BC DELAY" comment)	
Quantiferon						

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
Specimen unlabelled with MedLIS label (Send back with clinician to order) Specimen mislabelled with incorrect patient Leaking specimen	Quantiferon TB	Incorrect MedLIS order on label (Clinician to re order) No MF-MIC-55 request form (Clinician to fill out) No Date & Time filled out on MF-MIC-55 request form (Clinician to fill out)	Any blood bottles other than QuantiFERON®-TB Gold blood collection tubes	Insufficient volume are sent to MMUH and rejected by testing hospital	> 16 hours at room temperature	
Cryptococcal antigen						
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen	Crypto Ag	Incorrect MedLIS order on label Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only	Fluid other than CSF	< 100 µl	> 72 hours at 4 ℃	
	Crypto Ag		Blood bottle other than white topped serum tube	< 7.5 ml	> 72 hours at 4 ℃	
Virology (External laboratories)						
	AmikR	Incorrect MedLIS order on label	Blood bottle other than white topped serum tube	Visibly no blood in bottle	Not separated at 4 ℃ within 48 hours	
	ADVADNA VRL ADVDNAL VRL		Blood bottle other than EDTA tube (pink top)			
	CMVDNA VRL					
	EBV DNA VRL					
	HBVL VRL HBGER VRL		Blood bottle other than			

Specimen	Label	Test ordered	Container	Volume	Stability	Comments
Specimen unlabelled with MedLIS label or mislabelled with incorrect patient details Leaking specimen	HCVGE VRL HCVVL VRL	Specimen with request form, not ordered on MedLIS except during downtime or any test that is lab order only (See LI-MIC-Laboratory Only Microbiology Orders)	white topped serum tube			
	HIVGER VRL					
	HIV1VL VRL		Blood bottle other than EDTA tube (pink top)	Visibly no blood in bottle	Not separated at 4 ℃ within 24 hours	
	B-D GLUCAN		Blood bottle other than white topped serum tube	Visibly no blood in bottle	Not separated at 4 ℃ for 15 days,not separated at -20 ℃ for 27 days	
	NORXPERT VRL		Non sterile container	Visibly no faeces	> 48 hours at 4 ℃	
	PARVDNA VRL		Blood bottle other than white topped serum tube	Visibly no blood in bottle	Not separated at 4 ℃ within 24 hours	
	Teicoplanin Level					
	Tobra Trough					
	Voriconazole					

*2.4.4 **Serological Investigations***

HIV- VIRAL LOADS AND HEPATITIS C PCR

- Samples for routine viral investigations are referred to the NVRL and transported to the NVRL three times daily by courier: 10.30am, 12.30pm and 2.30pm. For HIV viral load, blood should be collected in an EDTA blood collection tube.
- For hepatitis C PCR, a serum sample is required
- Hepatitis C PCR and HIV viral load investigations should be sent to the laboratory immediately for processing. **The serum must be frozen within 6 hours of taking the patient's blood.**
- Specimens are transported at -20˚C by courier each Friday to the NVRL.

VIRAL SCREENING

- Samples for routine viral investigations are referred to the NVRL and transported to the NVRL three times daily by courier: 10.30am, 12.30pm and 2.30pm.
- Clotted blood is the specimen of choice for most other external investigations.
- Please include relevant clinical details, complete demographics and inform laboratory if urgent.

GALACTOMANNAN

Serum or BAL samples can be tested for Galactomannan in house as an aid in the diagnosis of Invasive Aspergillosis.

MENINGOCOCCAL/PNEUMOCOCCAL PCR

- Specimens for PCR are referred to the Children's Hospital, Temple St.
- An EDTA blood specimen or CSF or both should be sent. All the relevant patient details must accompany the specimen.
- Please phone ext. 2647 to alert the laboratory to the imminent arrival of the specimens

ANTIBODY DETECTION.

- Samples for antibody investigations are referred to the NVRL and transported to the NVRL three times daily by courier: 10.30am, 12.30pm and 2.30pm
- In order to establish a diagnosis of acute or recent viral infection by serology, viral specific IgM needs to be detected.
- Before laboratory investigations are performed, paired sera must be submitted. The first should be taken as early as possible in the illness, and the second 14-21 days later and a four-fold rise in titre is required to confirm recent infection.
- A single specimen of serum is required to determine immune status or past infection.

Important – These investigations are requested on Powerchart by the dialysis and hepatology units, using agreed algorithms. All others must also order on Powerchart (www.nrvl.ie).

- Please ensure that the specimens and Powerchart requests are completed correctly
- For serological investigations, a serum specimen of more than 1ml is required. One container of clotted blood should be sent to the NVRL.
- For results enquiries, please phone the NVRL 01- 7161354.

- Printed reports are are available on Powerchart.

QUANTIFERON FOR TB

- This test is referred to the Mater Misericordiae University Hospital
- TB Quantiferon is ordered on Powerchart
- Kits must be collected directly from the microbiology Laboratory.
- The person collecting the TB kit must sign the Quantiferon Issue Log when collecting and returning the kit- this will be facilitated by the microbiology laboratory staff.
- Due to the large volume of kits used by Phlebotomy, they are exempt from this rule and can use porters to collect and return kits to the lab without signing the issue log.
- When the Quantiferon kits are being issued, a request form (Quantiferon TB request form) is provided. Multiple use drawing needle and a safety tube holder are also provided if required.
- There are 4 blood tubes in the kit and it is imperative that they are taken in the colour order Grey, Green, Yellow, and Purple. (The Quantiferon TB request form also provides this information). If they are not taken in this order an accurate result cannot be guaranteed. There is a black 'fill line' (1ml) on each tube, and each tube must be filled to this line.
- When the kits are returned ensure that the blood tubes are labelled and the patient detail section on the request form (part1) is completed fully, including the time and date the specimen was taken at.

Quantiferon kits and request forms must be returned to the Microbiology Laboratory within 16 hours of sampling.

2.5 HISTOPATHOLOGY/CYTOPATHOLOGY/NEUROPATHOLOGY

2.5.1 Current Best Practice for Renal Biopsies

Two cores of tissue should be taken to ensure that there are sufficient numbers of glomeruli for examination – not less than 10 for light microscopy and immunofluorescence. This applies to native and allograft kidneys. Both cores can be placed in the same container.

2.5.2 Handling of Tissue after Biopsy has been taken.

Tissue must be fresh in order to allow immunological assessment to be performed. In Beaumont Hospital biopsies are carried out in the X-Ray Dept. by one of the Radiologists. The biopsy cores are placed in a universal container which is at least half full of normal saline. The container is placed in a biohazard bag and the Renal Biopsy Request form which should have been filled in by the Nephrology team on the ward prior to transfer of the patient to X-Ray is placed in the outer pouch of the bag.

2.5.3 Coroners's Post Mortem

In all cases the Information Sheet on Post-Mortem Examination (Lab 360A) should be given to families.

Circumstances where a death should be reported to the Coroner are listed below.

If an autopsy is required, the clinical staff must inform the Anatomical Pathology Technician at extension 2679 or Mortuary Service Co-Ordinator at extension 8180. Information relating to consent is available on front page on intranet.

For "consented" autopsies (so called non-Coroners or "House Cases") it is the responsibility of the individual who requests the autopsy to ensure the completed consent form (LAB 358B).

In the case of deaths outside normal working hours, the individual who obtained consent for autopsy must ensure that the relevant documentation is given to the Anatomical Pathology Technician or Autopsy/Mortuary Manager (Ext 8354) the following morning.

In Coroner's cases it is the responsibility of the clinical team to notify the Coroner and to ensure that the Coroner Autopsy Post Mortem Examination Form (LAB 357BP.65) is completed.

DEATHS WHICH MUST BE REPORTED TO THE CORONER

(a) Deaths occurring at home or other place of residence:

- Where the deceased was not attended by a doctor during the last illness;

- Where the deceased was not seen and treated by a doctor within one month prior to the date of death;
- Where death was sudden or unexpected;
- Where death may have resulted from an accident (regardless of length of time
- between injury and death), suicide or homicide;
- Where the cause of death is unknown or uncertain;
- Where concerns are expressed by any person in relation to a death.
- Where the cause of death is suspected to be CJD.

(b) Deaths occurring in hospital:

- Deaths occurring in the accident and emergency department and individuals dead on arrival at hospital;
- Deaths occurring within 24 hours of admission;
- Where a patient dies before a diagnosis is made and the general practitioner is also unable to certify the cause;
- When death occurred while a patient was undergoing an operation or under anaesthesia or within 24 hours of same;
- Where death occurred during or as a result of any procedure;
- Where any question of negligence or misadventure arises in relation to the treatment of the deceased;
- Where death resulted from an industrial disease;
- Where death was due to neglect or lack of care (including self neglect);
- Where death occurred in a Mental Hospital;
- Where death may have resulted from an accident (regardless of length of time
- between injury and death), suicide or homicide.
- Where a patient has MRSA, C. Diff. or VRE if this is a contributing factor
- Where a patient is resident in a long stay unit or nursing home (e.g. Rockfield Unit)
- Where the cause of death is suspected to be CJD.

(c) A death is reported to the coroner by a member of the Garda Siochana:

- Where death may have resulted from an accident, suicide or homicide;
- Where death occurred in suspicious circumstances;
- Where death is unexpected or unexplained;
- Where a dead body is found;
- Where there is no doctor who can certify the cause of death.

(d) Other Circumstances

- Sudden infant deaths;
- Where a body is to be removed out of Ireland.

A detailed list of reportable deaths is available in the "The Role of the Coroner in Death Investigation". Information is available on front page on intranet.

It is the responsibility of the most senior member of the medical staff attending the patient to ensure that the death is reported to the Coroner.

2.6 MOLECULAR PATHOLOGY

*2.6.1 **Sample selection***

All samples for solid tumour mutation analysis should be submitted as FFPE blocks. Samples for testing must arrive with a completed request form and a report on the patient sample.

All samples for Neuromolecular mutation analysis should be submitted as FFPE blocks with an accompanying H&E-stained slide. The H&E stained slide must be representative of the material in the block so a recent H&E is advised. The slide will be held in the Molecular laboratory in case the result needs to be queried in the future, for this reason a slide cut specifically for molecular testing is advised. Samples for testing must arrive with a completed request form and a report on the patient sample.

For germline BRCA testing, a peripheral blood sample should be submitted with the BRCA request form. Signed Patient consent must be obtained on this request form, the assay cannot be performed without this and will be rejected.

All samples should be sent to the following:

Molecular Pathology Laboratory
c/o Pathology Specimen Reception
Beaumont Hospital
Beaumont Road
P.O. Box 9063
Dublin 9

*2.6.2 **Reporting of results***

Internal Requests for Molecular Assays are ordered through MedLIS (Powerchart and PathNet). Reports are generated and sent to the reporting Consultant Pathologist for verificiation. Once verified these reports are available to view under the patients record on Powerchart. If deemed necessary, Molecular results will be added as a supplementary report on WinPath and a full integrated report will be available on PIPE. External results are reported by email to the secure email provided to the laboratory on the Molecular Pathology Test Request form. Reports can be sent to at least two recipients by email. It is common practice to add the treating clinician or practice nurse to the email list to ensure that the result arrives to the clinic as rapidly as possible. As well as any individual's email a generic laboratory email (that can be checked by different individuals to cover periods of leave) should also be provided. This facilitates integration of the result into the sending hospital's laboratory information system (LIS). All

email addresses must be specified in the recipients section of the test request form.

2.6.3 ***Contacting The Department***

Teresa Loftus	Chief Medical Scientist	018092856	molecular@beaumont.ie teresaloftus@beaumont.ie

The Molecular Pathology laboratory provides a molecular pathology diagnostic and consultative service for hospitals throughout Ireland.

The information provided below is a broad guideline to the use of more commonly provided tests. However the Consultant Pathologists and staff are always happy to discuss the service & individual patients in more detail.

The Molecular Pathology Department is staffed from 08:00 – 17:00, Monday – Friday. The laboratory does not operate on Saturdays, Sundays or Bank Holidays.

Please go to section 3.7 for more details

2.7 NHISSOT

The National Histocompatibility and Immunogenetics Service for Solid Organ Transplantation (NHISSOT) provides a nationwide transplant immunology service for solid organ transplantation, including HLA typing and crossmatching of both donors and recipients, HLA antibody screening for post transplant monitoring and HLA typing for disease association.

NHISSOT or H&I (Histocompatibility & Immunogenetics) is an accredited laboratory awarded by The European Federation for Immunogenetics (EFI). EFI is a European organisation that focuses on immunogenetics, tissue typing and transplantation. The EFI Accreditation Programme provides an internationally recognised accreditation scheme for laboratories providing Histocompatibility & Immunogenetics testing services in support of solid organ transplantation.

The H&I Department is committed to providing and maintaining a service of the highest quality by strictly adhering to policies and procedures that are in place to ensure the EFI standards are being maintained and updated.

We actively participate in well established external and internal quality control programmes to ensure best practice is being followed. We are continuously implementing ways to improve the service by assessing and validating new assays and techniques to provide the best level of service for our patients.

The NHISSOT provides H&I support for:

- The National Kidney Transplant Services at Beaumont Hospital
- The National Liver /Pancreas Transplant Services at St Vincent' s University Hospital
- The National Heart/ Lung Transplant Services at the Mater Misericordiae University Hospital
- Organ Donation Transplant Ireland

This document is intended as a guide to the services and tests available in the H&I Department. It provides details of the tests available, their specimen requirements, as well as appropriate background information.

2.8 NEAR PATIENT TESTING

Please see section 3.9 below

3 LABORATORY SERVICES PROVIDED

3.1 GENERAL INFORMATION

3.1.1 Location of Department

The Clinical Directorate of Laboratory Medicine is located between the lower ground and ground floors of Beaumont Hospital.
The postal address of the Directorate is:

Clinical Directorate of Laboratory Medicine
Beaumont Hospital
PO Box 1297
Beaumont Road
Dublin 9
D09 V2N0

Visitors to any laboratory should go to the Pathology Reception Office on the Lower Ground Floor. Staff at pathology reception will contact the Department and a member of staff will accompany them to the relevant Laboratory.

3.1.2 Contacting the Department/Telephone Numbers

FUNCTION	CONTACT	TELEPHONE/ EMAIL
Beaumont Hospital Reception	Switchboard	01-8093000/8377755
Directorate Management	Clinical Director	01-8092644
	Laboratory Manager	01-7977925
	Business Manager	01-8092508
Quality Management	Quality Manager	01-8092978
BLOOD TRANSFUSION & HAEMOVIGILANCE		
Medical Enquiries	Dr. Philip Murphy	01-8093382
	Dr. John Quinn	01-8092664
	Prof. Patrick Thornton	01-8092664
	Haematology Registrar	Bleep 276
	SP Registrar	Bleep 887
	For Out-Of- Hours Service	Contact Switch Board
Scientific Enquiries	Chief Medical Scientist	01-8094733
	Senior Medical Scientists	01-8094734
	Senior Scientist with Responsibility for Quality	01-8094734
	Routine Laboratory	01-8092705
	On Call	Bleep 252
Haemovigilance Enquiries	Haemovigilance Officers	01-8093334/2034
HAEMATOLOGY DEPARTMENT		

FUNCTION	CONTACT	TELEPHONE/ EMAIL
Appointments/ Enquiries	Haematology Secretary Office	01-8092655
Department email	haematologyadmin@beaumont.ie	
Lab Enquiries	Lab Reception	3914/2674/2669/4075
Results	Pathology Reception	01-8092690
Medical Enquiries	Prof. Philip Murphy	01-8093382
	Prof John Quinn	01-8092664
	Prof Patrick Thornton	01-8092664
	Prof. Siobhan Glavey	01-8092664
	Dr. Karl Ewins	01-8528832
	Dr Jeremy Sargent	01-8092664
	Dr Elizabeth Smyth	01-8092664
Clinical Advice and Laboratory Test Interpretation	Coleman. K. Byrne Unit	01-8092150/2622
	Haematology Registrars	Contactable through switch
	Haematology Senior House Officers	Contactable through switch
	Chief Medical Scientist	01-8092662
Clinic	Coleman. K. Byrne Unit	01-8092150/2622
	Warfarin Clinic	01-8092083/3982
Scientific Enquiries	Chief Medical Scientist	01-8092662
	Haematology Laboratory	01-8092703
	Coagulation Laboratory	01-8092656
	Flow Cytometry Laboratory	01-8092763
	Morphology Special Haematology	01-8093226
	Emergencies only/on-call Scientist	Bleep 852
IMMUNOLOGY DEPARTMENT		
General Enquiries	Departmental Secretary	01-8093026
	Secretary to Prof. Keogan/Dr Khalib/Dr Cox	01-8092652
	Specialist Registrar	Bleep 797
Appointment Information	Secretary to Prof. Keogan/Dr Khalib/Dr Cox	01-8092652
Clinical Advice and Laboratory Test Interpretation	Specialist Registrar	Bleep 797 immunologydepartment@beaumont.ie
Lab Enquiries	Lab Reception	3914/2674/2669/4075
Results	Pathology Reception	01-8092690
Scientific Enquiries	Chief Medical Scientist	01-8093174
	Immunology Laboratory	01-8092635/2421 immunologylab@beaumont.ie

FUNCTION	CONTACT	TELEPHONE/ EMAIL
CHEMICAL PATHOLOGY DEPARTMENT		
General Enquiries	Pathology Reception	01-8092507/4674
Test Results	Pathology Reception	01-8092507/4674
Medical Enquiries	Dr. Shari Srinivasan	01-8092676
	Dr Clodagh Loughrey	01-8092035
	Specialist Registrar	01-8092666
Scientific Enquiries	Chief Medical Scientist	01-8092670
	Chief Medical Scientist	01-7977811
	General Clinical Biochemistry/Endocrinology	01-8092668/2704 or 01/8528727
	Proteins	01-8092305
	Mass Spectrometey	01-8092351or 01-7977333
	Emergency (on-call) service	Bleep 251
MICROBIOLOGY DEPARTMENT		
All Enquiries	Microbiology office	01-8092646
Results	Microbiology office	01-8092646
Medical Enquiries	Prof. B. Dinesh	01-8092646
	Prof. F. Fitzpatrick	01-8092646
	Prof. K. Burns	01-8092646
	Dr. Ciara O' Connor	01-8092646
	Dr. Sinead O' Donnell	01-809 2646
	Dr. Helene McDermott	01-809 2646
	Registrars	01 -8093320/3321/2667
	Out of Hours	Through Switchboard
Medical scientist on-call	Through the switchboard or bleep.	Bleep 869
Scientific Queries	Microbiology laboratory	01-8092971
HISTOPATHOLOGY & CYTOPATHOLOGY DEPARTMENT		
General Enquiries	Department Office	01-8092636/2353
	Department Email	histo@beaumont.ie
Medical Enquiries	Dr. Clíona Ryan	01-80922284
	Dr. Marie Staunton	01-8092997
	Dr. Anthony Dorman	01-8094242/ Bleep 4240
	Prof Brendan Doyle	01-8092636
	Dr. Anne Marie O'Shea	01-8093910
	Dr. Maeve Redmond	01-8092998
	Dr. Helen Barrett	01-8092641
	Dr. Christian Gulmann	01-8092078
	Dr Neil Pilson	01-8093986
	Dr. Clive Kilgallen	01-8092284
	Dr. Odharnaith O'Brien	01-8094218
	Dr. Laura Mc Kenna	01-8093286

FUNCTION	CONTACT	TELEPHONE/ EMAIL
Scientific Enquiries	Chief Medical Scientist	01-8092555
	Main Laboratory	01-8092353
	Specimen Reception	01-8092659
	Cytology Laboratory	01-8092640
	Molecular Histopathology	01-8093726
Reports	Histopathology Office	01-8092636/2632/3919/3150/2154
	MDT Co-Ordinator	01-8092640
RENAL PATHOLOGY		
Medical Enquiries	Dr. Anthony Dorman	01-8092644/ Bleep 322
	ProfBrendan Doyle	01-8092636
Scientific Enquiries	Renal Pathology Laboratory	Dect Phone (01-8528633)
General Enquiries	Renal Pathology Secretary	01-8092765 (Dect phone)
NEUROPATHOLOGY		
Medical Enquiries	Dr Jane Cryan	01-8093973
	Dr. Francesca Brett	01-8093143/ Bleep 324
	Dr. Alan Beausang	01-8092615
	Specialist Registrar	01-8092706
Scientific Enquiries	Senior Medical Scientist	01-8092633
	Senior Medical Scientist (CJD)	01-8092633
	Research Scientist	01-8092706/ 3798
	Brain Bank	01-8092706
	Molecular Neuropathology	01-8098452/8453
Reports	Neuropathology Office	01-8092631/2072
NHISSOT		
General Enquirines	Main Laboratory	01-8092650
	Chief Medical Scientist	01-8092661
Scientific Enquiries	Main Laboratory	01-8092650
	Molecular	01-8093955
	Scientists Office	01-8093238/2960
	Reporting Room	01-8092651/4246
	Antibody Screening	01-8094248
	Out of Hours Medical Scientist on duty	On-call mobile: 087 2615 112 Speed Dial: 70128
Email Addresses	General enquires	crossmatch@beaumont.ie
	Patient enquires	transplantlab@beaumont.ie
	Post transplant enquires	posttransplant@beaumont.ie
Clinical Enquiries	Consultant Immunologist	01-8092652
	Out-of-hours	Through Switchboard
Renal Transplant Co-Ordinators Beaumont Hospital	Office	01-8092759
	E-Mail	transplantcoordina@beaumont.ie
	Urgent Call via Switch	01-809300/8377755

FUNCTION	CONTACT	TELEPHONE/ EMAIL
PHLEBOTOMY		
Appointments	Pathology Reception	809 2669 / 2674/2507
NEAR PATIENT TESTING (NPT)		
General Enquiries	NPT Manager	DECT 01-7977885
	NPT Scientist	01-7974786
	Departmental Email	POCT@beaumont.ie
MOLECULAR		
General Enquiries	Chief Medical Scientist	01-8092856 molecular@beaumont.ie

When contacting the laboratory regarding a specific patient it is essential to have the current patient Case Number (Episode Number) available as it is the only way that laboratory staff can access the patient file. The Patient History number is required for the Blood Transfusion Department

Check the status of all orders on Powerchart prior to contacting the laboratories. Powerchart clearly indicates the status of a sample:

- Awaiting Collection = not received by the laboratory
- Received in Laboratory = Sample is in process.
- Partial Result = Some tests have been completed.
- Order Complete = All test on the sample are complete.

*3.1.3 **Department Opening Hours***

The Clinical Directorate of Laboratory Medicine is open 8am to 8pm, Monday to Friday. There is a routine Saturday, 09.00 – 13.00. A reduced service is offered between Christmas, New Year and Easter.

- Immunology laboratory hours are from 9.00 am to 5.00pm, on Monday to Friday.

- Blood Transfusion laboratory routine hours are: 8am -5pm Monday to Friday and 9am-1pm on Saturday contactable on Ext. 2705. An Emergency On –Call service from 5pm -8am Monday to Friday and 1pm - 8am Saturday to Monday contactable on Bleep. 252

- Chemical Pathology laboratory routine hours 8am to 8pm, Monday to Friday. There is a routine Saturday service from 9am to 1pm. An Emergency On – Call service from 8pm - 8am Monday to Friday and 1pm - Saturday to 8am Monday. Contactable on Bleep. 251. A reduced service is available on public holidays.

- Haematology Laboratory routine hours 8am to 8pm, Monday to Friday. There is a routine Saturday, 09.00 – 13.00. An Emergency On –Call service from 8pm - 8am Monday to Friday and 1pm - 8am Saturday to Monday. Contactable on Bleep. 852. A reduced service is offered between Christmas, New Year & Easter

- Microbiology laboratory hours are from 8:00am to 8.00pm, on Monday to Fridays and 09:00am to 1.00pm on Saturdays. After 8pm on weekdays, and from 1pm Saturday until 8:00am Mondays, Microbiology provides emergency on-call service only. The medical scientist on-call may be bleeped at 869.

- Only a limited Histopathology/Cytopathology/Neuropathology service is provided between 5pm to 8am and scientists on call can be contacted through switch.

- NHISSOT Laboratory hours are from 8am to 6pm Monday to Friday. After 6pm, it is an emergency on call service. The laboratory is closed on Saturday, Sunday and Bank Holidays

- Molecular Pathology Laboratory hours are from 8am to 5pm Monday to Friday. The laboratory does not operate at weekends/bank holidays.

- NPT hours are from 8am to 4pm Monday to Friday.

There is no clerical support outside Monday to Friday 09:00-17:00

Please ensure samples arrive in the laboratory as early as possible in the working day.

*3.1.4 **Use of The Laboratory I.T. System:***

The Powerchart system is used in Beaumont Hospital to access the laboratory service. Powerchart gives a user friendly image of the laboratory system such that what is seen on Powerchart is identical to what is seen in the laboratory system.

Access to the Powerchart (Lab Ordering and Results icon) system is password protected and passwords are only granted when training has been completed. Contact the IT department with regard to training issues, 2550.

3.1.4.1 Ordering

Ordering is electronic at ward level. Patient requests are placed on Powerchart and any specific requirements with regard to timings, fasting, foil covering, labile samples, special requirements regarding ice or days/times that samples cannot be drawn are specified on the computer screen within the order. When all orders have been placed and updated, the patient barcode labels are printed. Routine orders are gathered for the phlebotomy rounds, routine requests must be placed before midnight for phlebotomy draw the next day.

Draw one sample per barcode label. The barcode label gives all the required information with regard to sample type on the lower left hand corner of the label. In some cases this is replaced by a reference to special requirements for sample collection.

All commonly requested tests are available to order on Powerchart, including tests that are referred externally for analysis. As some analytes are labile or require special processing conditions they can only be accepted in the laboratory Monday to Friday 9am to 5pm, see specific details when the order is placed on Powerchart. Samples that required shipping outside Ireland, with limited stability are normally only accepted Monday to Wednesday. Samples shipped on a Thursday are only dispatched if clinically urgent and can be repeated, as if there is any transport delay, referral sites will not accept samples on a Saturday/Sunday or Public Holiday.

Urine orders may print more than one label depending on the combination of orders placed; multiple labels may be attached to a single 24 hour collection provided the sample type indicated on the upper right hand corner is the same on each label.

Contact the laboratory for instructions on how to order rare/esoteric test requests that are not available to order on Powerchart.

3.1.4.2 Order-com Sample Label

The label contains the following information:

1. Surname
2. First name
3. MRN number
4. Accession number
5. Anticoagulant Ward/ department
6. Date of Birth
7. Date/time label printed
8. Routine or Stat request
9. M/F Male or Female
10. Bench routed in MedLIS
11. Mnemonic for test*

3.1.4.3 Haematology Requests

HbA_1c is analysed in the Chemical Pathology Laboratory. Patients requiring a FBC and HbA_1c will require **2** EDTA 2.6mL samples sent with the test requests.

INR only should be requested for patients on Warfarin therapy and not a COAG screen.

New **CD4** Patients that require **G6PD**: These require **2** EDTA 2.6mL samples. If only one sample is received, the G6PD assay will be performed and a repeat sample will be required for the CD4.

3.1.4.4 Microbiology Requests

- Specimens should be collected using aseptic techniques to minimise contamination by normal flora. A sufficient volume of material must be submitted.
- Swabs in transport media are acceptable for throat, eye, ear, vaginal and urethral specimens otherwise pus or tissue is preferable to a swab.
- Swabs with special transport media are available, e.g. viral transport swabs (available from Microbiology Dept.), chlamydia GenProbe swabs (available from NVRL or St. Johns ward).
- If a diagnosis of a viral haemorrhagic fever (Lassa, Ebola, Marburg, Congo-Crimean fever), or CJD is suspected, the consultant microbiologist must be informed before any specimens are collected.
- If a potentially cytotoxic specimen is being sent, the chief or senior medical scientists in microbiology **must** be informed.

3.1.4.5 Molecular / Genetics Requests

Patient consent is required for all Molecular/Genetic tests and consent forms are available to download from The intranet under Quicklinks>> Laboratory User Guide and Request Forms. : Pathology Department: Lab User guide and forms.

There are different consent forms:

- Haemochromatosis,
- Haematology Genetic Consent form
- Huntington's,
- Cystic Fibrosis
- Karyotyping.
- Familial Hypercholesterolaemia
- FSHD requests for Bristol
- All other requests for DCG

All samples must be accompanied by the specific request form above, and where appropriate, the patient consent form.

Demographic information on samples and forms must match completely – otherwise the request will be rejected. No changes are permitted to any demographics.
Haemochromatosis, CF & FHC are Powerchart orderable,

Haemochromatosis testing is performed in Beaumont Hospital. All other test requests are referred to The National Centre for Medical Genetics, they extract the DNA and refer the request to a suitable laboratory if not done in DCMG.

ATTENDING PHLEBOTOMY:

Should a patient require any of these tests to be taken in Phlebotomy, the appropriate request form must be completed in full in the clinic (including patient consent obtained), and given to the patient to bring to phlebotomy. Both the completed form and the bloods must be sent together to the Laboratory.

3.1.4.6 Out Patient Requests

All orders are placed on Powerchart by the requesting clinician or by clerical staff in the Phlebotomy department.

A bleep number must be clearly indicated on the form so that the requesting clinician can be contacted with clinically urgent results.

3.1.4.7 H&I Requests

Consent forms for HLA typing and HLA Antibody screening can be obtained by emailing crossmatch@beaumont.ie

3.1.4.8 NPT Requests

- Blood Gases, Glucose, Ketone, INR, HbA1c analysis:

There is no requirement to order any of the above NPT tests on Powerchart. These NPT requests are classified as unsolicited orders. This means that the order is generated as the patient's details are scanned by the analysers/devices which are located at or near the patient's bedside. The patient's **current number** (available on the patient's wristband and/or addressograph label) is the only acceptable patient ID to be scanned/entered on any NPT device when processing samples.

All blood gas samples are to be correctly labelled with the patient's addressograph label prior to analysis. This is to ensure the samples are correctly identified.

The only test which must be pre ordered on Powerchart are blood gases to be analysed in the Chemical Pathology Laboratory. These samples must be labelled with the barcode label.

Quick Reference Guides are available on the hospitals intranet page (link below) which provide step by step guidance for trained staff on how to perform relevant NPT.

Point of Care Testing - All Documents (beaumont.ie)

- Liat Covid & Influenza A/B analysis:

There is no requirement to pre order NPT Covid and Flu A/B tests for the Liat. Three identical addressograph labels must be printed together. One addressograph label is to be placed on the sample to be tested and the other two are to accompany the sample to the Liat room. All samples requested on patients outside of the approved patient pathway must be pre-approved by site/incident manager or Microbiology Consultant on duty.

3.1.5 Consent

The laboratory shall obtain the informed consent of the patient for all procedures carried out on the patient. For most routine procedures, consent can be inferred when the patient presents himself or herself with a request form and willingly submits to the collecting procedure e.g. venepuncture. Patients in a hospital bed should normally be given the opportunity to refuse.

Special procedures, including more invasive procedures, or those with an increased risk of complications to the procedure, may need a more detailed explanation and, in some cases, recorded consent.

If obtaining consent is not possible in emergency situations, the laboratory may carry out necessary procedures, provided they are in the patient's best interest

The requirement for consent for individual tests performed is outlined in the relevant departmental sections of this laboratory manual.

*3.1.6 **Specimen Collection Guidelines & Order of Draw***

3.1.6.1 Patient Preparation

Patients should adhere strictly to any conditions which are required prior to and during primary sample collection. Caregivers and phlebotomists should ensure that patients are informed of the procedure required for specialist primary sample collection and that they have the required equipment e.g. 24hr urine collection containers. For further information on patient preparation for primary sample collection, please contact the relevant laboratory using the contact details provided in section 3.1.2 above.

Specific sampling conditions and requirements are outlined in the orders in Powerchart where they apply,e.g. fasting sample required, or sample must be on ice etc. These conditions must be adhered to.

3.1.6.2 Specimen Labelling

- Samples must be labelled with an order-com label generated in Powerchart, which is placed over the **existing** bottle label, with the writing in the same direction (to facilitate barcode scanners), see below.

- The barcode label must be stuck to the blood sample bottle straight down the length of the tube without any creases. Never wrap a label around a tube. Only one barcode label per tube.

- The sample bottle must be labelled immediately after the sample is drawn and before moving on to the next patient. **The patient wrist band must be checked against the name on the barcode label.** Refer to section 2.1.5 for Specimen labelling requirements for Blood Transfusion.

In the case of 24 hour urine collections – if multiple barcode labels are generated that indicate the same sample requirement e.g. 24HU – then all labels with a 24HU sample type requirement can be attached to the same collection.

3.1.6.3 Venepuncutre Instructions

The collection of a venous sample means the identification of the best vein to source the sample. The arm veins are normally the first choice for a phlebotomist. The most commonly used veins are the cephalic, medial cubital or basilic veins.

1. The Limb should be supported on a pillow or armrest of a phlebotomy chair.
2. Apply the tourniquet 2 – 3 inches above the selected site.
3. Wear your disposable gloves, cleanse the patients skin with a mediswab.
4. Anchor the vein using manual traction below the site of entry. The vein should feel firm and slightly bouncy.
5. Insert the needle with the bevel facing upwards and the needle at 15° angle.
6. There should be a flashback of blood to denote a vein has been accessed.
7. The needle should be held firmly between your thumb and fingers to allow the change of the different tubes onto the needle.
8. When all blood specimens have been obtained, release the tourniquet, detach the last tube and now remove the needle smoothly and quickly.
9. Apply pressure to the venous site for as long as required. This avoids a haematoma forming.
10. Dispose of the used needle immediately into the sharps bin. Do not recap the needle

The blood bottles must now be labelled correctly and any special requirements adhered to.

3.1.6.4 Blood Sample Order of Draw

Samples must be drawn in the order as tabulated below, to avoid any cross contamination of samples.

Colour Code	Tube type and Order of Draw	Investigations
 **Brown**	**1st** **Serum Gel** **STAND UPRIGHT ONCE DRAWN**	**4.9ml Chemical Pathology** (specific tests only, see label) **4.9ml Immunology**
 **White**	**2nd** **Serum** **STAND UPRIGHT ONCE DRAWN**	**4.9ml Chemical Pathology** (specific tests only, see label) **Virology** (Serological testing) **4.9ml** WHITE on ICE
 **Green**	**3rd** **Sodium Citrate Coag**	**10ml** required for **HLA27 / Tissue Typing** **2.9ml / 1.8ml** for **Coagulation Tests** ***Under-filled or over-filled tubes will be rejected***
 **Orange**	**4th** **Lithium Heparin** 4.9ml	**Troponin** only ***Under-filled tubes will be rejected***
 **Orange**	**5th** **Lithium Heparin** 4.9ml	**4.9ml Chemical Pathology** (specific tests only) **4.9ml** orange on ice Metal-free available from Specimen Reception (using special metal-free needle)
 **Pink**	**6th** **K-EDTA**	**2.6ml** Pink **FBC (Haematology tests),HbA1C** **Molecular Tests** **Virology** (Molecular Investigations eg EBV,CMV,HIV molecular)
 **Blue**	**7th** **K-EDTA** Blue 4.9ml with BTD label	**4.9 ml** EDTA for **Type and Screen** **4.9 ml** EDTA for **ACTH/PTH/Aldosterone/Renin**
 **Yellow**	**8th** **Sodium Fluoride**	**Glucose** **Alcohol**
 **Purple**	**9th** **Sodium Citrate**	**ESR** ***Under-filled tube will be rejected***

Never pour blood from one tube into another. The preservative in the first tube could contaminate the second tube; this can greatly affect results and potentially compromise patient care.
Refer to the each departments test library for information on sample requirements and the number of tubes required. Tubes CANNOT be used / shared across different platforms because of the risks involved in sample re-labelling.
The brown and white cap samples must be stood upright to clot as soon as the bottles are filled to ensure that the clot forms in the base of the tube and not the lid. The yellow, orange, green, purple and pink bottles must be inverted gently to ensure complete mixing.

Place all the labelled samples into the bio-hazard bag attached to the patient request form and seal.
Please note: The order of draw is in line with approved standards.

3.1.6.5 24-Hour Urine Collection: General Information for Patients:

You will receive

- A large plastic container with acid in which to store urine.
- A request form with your details on it.
- A plastic bag in which to return your collection and request form.

1. You may need more than one storage container to contain all of your urine for the 24-hour period.
2. Make sure each storage container is labelled with your full name and hospital number written on it. **If your container is not labelled properly, you may be asked to repeat the 24-hour collection.**
3. Keep your storage container cool throughout the 24-hour collection period until you bring it back
4. For certain collections, a blood sample may need to be taken within the 24 hour collection period; you will be informed if this is the case.

How to collect your sample

1. Start the 24-hour urine test by urinating directly into the toilet. Do not save this urine.
2. After you urinate, write the date and time on your storage container, **this is the start of your test.** Write this time & date on the container.
3. For the next 24 hours, collect all your urine into your storage container.
4. Exactly 24 hours after you started the test, urinate one last time and place the urine in your storage container. **This is the end of your test.** Write the date and time the test ended on your storage container.
5. If you need to use more than one container during the 24-hour period, use one container at a time. When it is full, collect your urine in the next container.
6. Please bring the urine to the hospital as soon as possible. To prevent leaks, make sure the lid is on tightly, and that the container is transported upright inside a plastic bag.
7. If you are an inpatient, your nurse will tell you what time to begin and end the collection and will set up more containers, as needed. If you have questions about the procedure, please ask.

3.1.6.6 24-Hour Urine Collection (Acidified): Information for Patients

HCl can cause burns and irritate the respiratory system. It is designated harmful and corrosive and bears the following hazard warnings.

Harmful

Corrosive

You will receive

- A large plastic container with acid in which to store urine.
- A request form with your details on it.
- A plastic bag in which to return your collection and request form.

1. You may need more than one storage container to contain all of your urine for the 24-hour period.
2. Make sure each storage container is labelled with your full name and hospital number written on it. **If your container is not labelled properly, you may be asked to repeat the 24-hour collection.**
3. Keep your storage container in a cool place throughout the 24-hour collection period and until you return it to the laboratory.
4. For certain collections, a blood sample may need to be taken within the 24 hour collection period; you will be informed if this is the case.

How to handle acid safely

1. Your storage container is supplied with a small volume of acid, do not throw this out.
2. You should open the container in a well ventilated area as fumes may escape from the acid.
3. Do not urinate directly into an acidified container.
4. Pour the urine slowly down the inside wall of the container, trying not to splash the acid.
5. Close the lid and swirl the container gently, to mix the acid and the urine.
6. Repeat steps 2~4 each time you add urine to the container.
7. Should you spill any acid on your skin, wash it off at once with plenty of running water.
8. If you experience soreness or reddening of your skin, as a result of a splash, consult your doctor & take these instructions with you.
9. **Keep the container in a safe place and out of the reach of children at all times.**

How to collect your sample

1. Start the 24-hour urine test by urinating directly into the toilet. Do not save this urine.
2. After this urination, write the date and time on your storage container, **this is the start of your test.**
3. For the next 24 hours, collect all your urine into your storage container.
4. Exactly 24 hours after you started the test, urinate one last time and collect this urine in your storage container. **This is the end of your test.** Write the date and time the test ended on your storage container.
5. If you need to use more than one container during the 24-hour period, use one container at a time. When it is full, collect your urine in the next container.

6. Please bring the urine to the hospital as soon as possible. To prevent leaks, make sure the lid is on tightly, and that the container is transported upright inside a plastic bag.
7. If you are an inpatient, your nurse will tell you what time to begin and end the collection and will set up more containers, as needed. If you have questions about the procedure, please ask.

3.1.6.7 Mid-Stream Urine

Male: Clean the glans penis with soap and water. Commence micturition and when a few ml of urine has been passed, introduce a widemouthed primary container into the stream (New Needle free transfer system (NFT) system

Females: If the patient is able to collect urine without assistance from the nursing staff, instruct them as follows:

1. Separate the labia and with cotton wool or a sponge moistened with water, wipe the vulva from the front to the back. Disinfectants must not be used.
2. With the labia still separated allow some urine to pass into the toilet, and then, without stopping, allow some to pass into a sterile container.
3. Pass the remaining urine into the toilet.

3.1.6.8 Swabs

Collect the specimen by passing the swab twice over the relevant area. Label and send to the laboratory as soon as possible after collection

3.1.6.9 Endocervical Swab for GC Culture

Clean the cervical os with a large sterile swab and discard. Insert a new swab into the endocervix and rotate 360 degrees.17 Swab the external os 360 degrees if os stenosed

3.1.6.10 Sputum

Instruct the patient to remove dentures, rinse mouth and gargle with tap water and not with antiseptic mouthwash. Instruct the patient to expectorate saliva or postnasal discharge and discard, before expectorating a deep lung sputum sample into a specimen container. Specimens must be submitted in a wide-mouthed container and sent to the laboratory without delay.

3.1.6.11 Stool Samples

Stool specimens should be collected in a clean container with a secure lid, labeled, and sent to the laboratory as soon as possible after collection

3.1.6.12 (ABG) Blood Gas analysis

All samples for ABG analysis must be collected in the appropriate heparanised syringes. The needle must be removed from the syringe and disposed of in the sharps bin as soon as the sample has been collected. Once the sample is collected any air in the sample must be removed immediately. The cap provided must then be fitted to the syringe. Once capped, the sample should be mixed by gently rolling it between the palms of the hand for 30secs.

ABG samples to be sent to the Chemical Pathology lab for processing must be hand delivered. Samples must not be sent to the lab via the pneumatic chute. Please ensure samples are correctly labelled with the appropriate barcode request, and placed in a biohazard bag for transport.

If sending samples to the lab out of hours, please bleep the Chemical Pathology scientist on call prior to sending the sample.

3.1.6.13 Disposal of Materials Used

Dispose of all clinical waste must be in accordance with National Guidelines.

- Universal precautions must be adhered to at all times.
- Gloves must be worn at all times.
- Gloves must be changed after each patient.
- Needles must not be recapped after use.
- Dispose of sharps in a suitable sharps container.
- Dispose of all clinical waste into yellow bag.

SAMPLE REQUIREMENTS FOR TOXICOLOGY.

- Blood toxicology and urine drugs of abuse screens are available, but **not for Medico-legal purposes.**
- Additional tests that are available include: ethylene glycol, methanol, paraquat. Please contact the toxicology laboratory for further information if any of these are required.
- **SAMPLE REQUIREMENTS FOR TDM**
- Therapeutic Drug Monitoring (TDM) samples should be taken immediately prior to next dose, i.e. a trough sample.
- **Digoxin:** samples must be taken pre-dose or at least 6 hours post-dose.
- **Lithium:** samples must be collected 12 hours post dose.
- Samples for FK506 must be delivered to the laboratory by 11am Monday – Friday, excluding Bank Holidays, to ensure analysis within the day.

RANDOM URINE SAMPLES

Random spot urine samples are collected into plain MSU containers; these contain no preservative. Ensure the lid is tightly closed.

24 HOUR URINE COLLECTIONS

A 24 hour urine collection is either taken in a plain container or an acidified container, depending on the test required. Pre-acidified containers with 50% acid are available from the laboratory. Plain containers are available on the ward or from supplies. Urine orders may print more than one label depending on the combination of orders placed; multiple labels may be attached to a single 24 hour collection provided the sample type indicated on the upper right hand corner is the same on each label.

If the patient urine volume exceeds the capacity of a 24 hour collection bottle a second bottle must be used – the 2nd bottle must be clearly labelled with the patient demographics and clearly labelled as the 2nd part of a collection with a note on the 1st bottle to indicate a 2nd bottle exists as part of the collection. Both bottles must be delivered to the laboratory at the same time, in the same bag.

CSF SAMPLES

CSF samples are sent directly to the Microbiology Department for analysis.

Once the sterile work has been completed the samples are then sent to Chemical Pathology for analysis of Protein and Glucose, or dispatched for Oligoclonal IgG bands or other referred tests.

SAMPLES FOR CSF XANTHOCHROMIA

Samples for CSF Xanthochromia must be drawn into a brown plastic container or if not available –foil wrapped to protect from light, one mL sample is required and must be delivered by hand to Chemical Pathology immediately. Please note: Do NOT place samples in the chute system. See Beaumont Hospital - Chemical Pathology for further guidance.

OTHER MOLECULAR TESTING

For other molecular tests please contact the Department of Clinical Genetics at Our Lady's Children's Hospital, Crumlin [01-409 6739].

*3.1.7 **Urgent samples***

Specimen Type	Prioritised For
Haematology/ Coagulation/ Flow Cytometry	Oncology, CKB, Day Oncology, High Dependency Unit (HDU), A/E, Resus, EMR AMU/ AMAU, ITU, RDW & RTU & Transplant patients, Stroke Unit
Chemical Pathology	Oncology, CKB, Day Oncology, High Dependency Unit (HDU), A/E, Resus, EMR AMU/ AMAU, ITU, RDW & RTU, Transplant patients and Stroke Unit

Microbiology	A/E, EMR AMU/AMAU, ICN, ICS, RTU & transplant patients, Oncology
Immunology	

Otherwise, it is imperative that if a sample is urgent, the relevant laboratory must be informed by telephoning the laboratory with the urgent sample details or hand delivering the sample directly to the laboratory.

Samples must be ordered as STAT on Powerchart in order for them to be prioritised and identified by the analysers as STAT.

3.1.8 ***Sample Collection & Labelling Guidelines During Computer Downtime***

In the event of computer downtime, electronic ordering is not available. A limited repertoire of critical tests will be available during downtime as specified below and as decided by the Laboratory Clinical Director and Beaumont Hospital Clinical Advisory Group. These tests must be ordered on a paper- request form which can be obtained from the laboratory if required.

Critical Tests available during Downtime

- FBC
- Coag
- D-Dimer
- INR
- BNP
- Troponin
- CRP
- Renal
- Liver
- Pregnancy test
- Blood Cultures
- CSF
- Urine
- COVID
- Group and Screen

The menu of tests offered may need to be adjusted in order to adapt to practicalities and the priorities imposed by the nature of the emergency

Ordering of laboratory requests must be kept to clinically urgent requests highlighted above as the laboratories will have drastically reduced capacity and

manual procedures. The downtime system is only designed to deal with clinically urgent samples only.

*3.1.9 **Specimen Acceptance Criteria***

The name on the request and accompanying specimen(s) must match e.g. do not use Pat on one and Patrick or Patricia on other. Please ensure that writing is legible- BLOCK CAPITALS. The requesting clinician is responsible for the correct labelling of specimens and request cards. Incorrectly or inadequately labelled specimens are not accepted by the laboratory and will be rejected.
Specimens will be rejected in the following situations:

- Unlabelled / Incorrectly labelled specimens i.e. without two unique patient identifiers
- Leaking or improperly sealed containers.
- Overfilled specimens
  ESR samples where blood is collected into the lid of the container.
  Coagulation containers where the blood is filled beyond the marking on the label.
- Underfilled specimens:
  ESR samples must be 85mm full. 2.7 ml
  FBC and Retic samples must have a minimum of 1mL of blood. 1.8 ml samples should have at least 500µL for FBC Coagulation samples must be filled to the marking on the label.
- Obvious inadequacy of specimen for the test(s) required e.g. only one coagulation specimen for a Thrombophilia screen
- Clotted samples with the exception of a serum clotted sample when required.
- Incorrect anti-coagulant: Samples in the wrong container for the requested test.
- Samples transferred from incorrect anti-coagulants to correct anti-coagulant containers e.g. beads in sample
- Samples where the laboratory has been informed the specimen was collected from the incorrect patient
- Haemolysed Coagulation specimens and ESR samples
- Aspirate/ Fluid samples: All aspirate/fluid samples must be sent to Microbiology.
- Any EDTA sample bottles other than the 2.6mL for FBC analysis. Other EDTA sample bottles with different dimensions are not compatible with the laboratory cap piercing analysers.
- 8.2 mL sodium citrate samples for Coag screens, INR's these samples are not compatible with the Coagulation analysers.
- Unsanctioned requests e.g. ALL Non routine coagulation samples must be sanctioned by the Haematology Team.
- Factor V Leiden sample, if the screening test APCR is not also requested. Exceptions allow for family history.
- All inherited thrombophilia/ Lupus requests if the patient is on anticoagulation.
- APCR request if the patient is on DOAC, proceed directly with FVL.

- Haematology Molecular testing cannot be performed unless patient consent has been obtained and HAEMG-LF-084 Request form has been completed in full.
- One specimen submitted for CD4 and G6PD. In the event whereby 1 EDTA sample is received fro CD4 and G6PD analysis, the G6PD will be given priority and the CD4 reequest rejected.

Aged Samples:
Coagulation samples must be <4 hours old, with the exception of INRsample which canbe processed <24hours old.
D-Dimer/: Request for D-Dimer/ add-on, must be <8 hours old post sample collection
ESRs should be < 6 hours old. Samples >6 hours can lead to a false lowering of results.
Reticulocyte samples must be < 24 hours old.
Malaria Samples must be less than 2 hours old for analysis. External patients must attend A/E or the Phlebotomy Outpatients if Malaria is suspected
Flow Cytometry CD4, TBNK , LST 72 hours & Lymphoproliferative Panels must be <24 hours old. T-Cell Panels or Acute Panels must be <24 hours in EDTA or <48 hours in RPMI and Sodium Heparin. EDTA samples for PNH testing may be stored in the fridge for <72 hours. Fine Needle Aspirate samples in RPMI and Sodium Heparin are stable for 24 hours in the fridge.

- FBC: EDTA samples must be <24hours
  Blood film preparation: samples must be <8 hours old

3.1.10 Specimen Tubes & Containers

With the exception of swabs, pre-acidified 24hr urine collection bottles and saliva collection devices, specimen tubes and containers are available from Beaumont Hospital Stores Department. Contact number: 01 809 3030. All orders must be accompanied by a requisition form. These are also available from the Stores Department.
Sarstedt brand tubes are used by Beaumont Hospital. It is important to check expiry dates on all tubes. Tubes Must Be FILLED to ensure the appropriate concentration of any anticoagulant. Only the blood transfusion department accept Paediatric tubes. Paediatric EDTA from Raphaels is acceptable..
Westmed heparanised syringes are required for blood gas analyses. These are also available from stores.

Never pour blood from one tube into another. The preservative in the first tube will contaminate the second tube; this can greatly affect results.

BLOOD SAMPLES

Tube colour	Anticoagulant	Volume (ml)
Orange	Lithium Heparin	4.9
Orange	Lithium Heparin For Troponin Only	2.7
Orange	Lithium Heparin in FOIL	4.9
White	White Serum ,in FOIL	4.9
Pink	EDTA wrapped in FOIL	
Random Urine	Random urine wrapped in FOIL	
Faecal Sample	Faecal Sample, foil wrapped.	
Brown	Plain, With Gel Separator	4.9
White	Plain, 4.9 mL volume	4,9
White	Plain	7.5
White On Ice	Plain White	7.5
Orange On Ice	Lithium Heparin	4.9
Pink	Potassium EDTA	2.6
Pink on ICE	Potassium EDTA on ICE	2.6
Yellow	Sodium Fluoride	2.7
Pink- Large	Potassium edta	7.5
N/A	plain	
**Orange	Special Metal Free Tube & Needle	7.5
N/A	Plain	
N/A	Pre-Acidfied	
N/A	CSF Plain	
CSF – Brown	Plain-Protect From Light	At least 1ml
Arterial syringe	Lithium heparin	
Purple	Tri-sodium citrate 4NC	3.5 mL
Pink	EDTA-KE (Tri-potassium Ethylenediaminetetra-acetic acid)	2.6 mL 1.8 mL-Paediatric
Green	Tri-sodium citrate 9NC	2.9 mL 1.8 mL-Paediatric
Red	0.82mg Magnesium/mL	2.7mL
n/a	Salivette	
Pale Pink Cap	Potassium EDTA with Blood Bank label	4.9

URINE SAMPLES

Both 24 hour urine collections and random spot urine samples are analysed in the laboratory.

- Random spot urine samples are collected into approved yellow screw-capped Sarstedt containers (CE Marked); these contain no preservative. REF #75.9922.745

- A 24 hour urine collection is either taken in a plain 3L container or an acidified 3L container, depending on the test required. Pre-acidified containers with either 50% acid or concentrated acid are available from phlebotomy. If known in advance that the patient has an unusually large output, please request 2 containers for the test. Results are normally expressed per 24 hour period. Where two tests are desired, each requiring a different container, two separate 24 hour collections must be obtained. If in doubt please contact the relevant laboratory prior to commencement of the test.

APTIMA GENPROBE COLLECTION DEVICES

Aptima GenProbe Collection Devices (swabs and urine containers) are only available from the NVRL. Contact number: (01) 7161354

SALIVA SAMPLES

Saliva collection devices are available from Phlebotomy and Sample Reception.

3.1.11 ***Test Results***

If you have any queries in relation to a report, please contact the relevant laboratory area to discuss the result. Feedback from users about difficulty with reports helps us to improve the service. Contact details are available in Section 3.1.2 of this manual.
All reports are available on Powerchart. All Powerchart reports contain the appropriate reference ranges and are available to be viewed through the system as soon as they are authorised in the laboratory.
Reports generated during I.T. downtime are paper reports that are transported to the requesting laboratory.

PLEASE NOTE: It is the responsibility of the laboratory to ensure that tests are performed to the highest possible standard and reported in the time specified within this User Manual. It is the responsibility of the requesting clinician to follow up on the test results.

Despite our best efforts, it is possible that an error can occur. If you have concerns about a report please draw it to our attention without delay, and we will investigate immediately.

3.1.11.1 Genetic Test Requests Referred by Haematology

Haematology Cytogenetic reports are available on Powerchart.

3.1.11.2 Critical Values

Results falling outside defined alert limits and results critical to patient care will be communicated to appropriate personnel as soon as available. The below table outlines the laboratory process for communication of critical results:

<table>
<tr><th colspan="2">Communication of Critical Results – All wards except A/E</th></tr>
<tr><th>Routine Hours</th><th>Outside of Routine Hours</th></tr>
<tr><td>1. Contact the referring / ordering clinician or an appropriate member of his / her team.
2. In the event that the referring/ordering clinician or his/her team cannot be contacted, contact
• nurse in-charge of the relevant area, or
• nurse caring for the patient.
3. In the event that the nurse cannot be contacted, contact the Consultant in charge of the patient through switch</td><td>1. Contact the
• nurse in-charge of the relevant area, or
• nurse caring for the patient.
2. In the event that the nurse cannot be contacted, contact the 2nd medical SHO on call through switch on Dect 7402 or through switch.
3. In the event that 2nd medical SHO cannot be contacted, contact the 1st medical SHO on Dect 7403 or through switch.
4. In the event that 1st medical SHO cannot be contacted, contact the 3rd medical SHO on call through switch.
5. In the event that 3rd medical SHO cannot be contacted, contact the overnight nurse manager through switch</td></tr>
<tr><th colspan="2">Communication of Critical Results – Emergency Department (ED)</th></tr>
<tr><th colspan="2">At all times</th></tr>
<tr><td colspan="2">1. Contact the
• nurse in-charge of ED or</td></tr>
</table>

nurse caring for the patient.

Nurses Station: 2838, 2721 or 2722

Doctors Station: 3349, 2713 or 2717.

2. In the event that the nurse cannot be contacted, contact the Consultant in charge of ED through switch

Communication of Critical Results - OPD

Routine Hours	**Outside of Routine Hours**
1. Contact the referring / ordering clinician or an appropriate member of his / her team. 2. In the event that the clinician cannot be contacted, contact the Consultant in charge of the patient through switch	1. Contact the referring / ordering clinician or an appropriate member of his / her team. 2. In the event that the referring/ordering clinician or his/her team, contact the 2nd medical SHO on call on Dect 7402 or through switch. 3. In the event that 2nd medical SHO cannot be contacted, contact the 1st medical SHO on Dect 7403 or through switch. 4. In the event that 1st medical SHO cannot be contacted, contact the 3rd medical SHO on call through switch. 5. In the event that 3rd medical SHO cannot be contacted, contact the overnight nurse manager through switch

Communication of Critical Results – Haematology/Oncology patients

Routine Hours	**Outside of Routine Hours**
1. Contact the referring / ordering clinician or an appropriate member of his / her team.	1. If identified as under the care of Haematology/Oncology, contact the Haematology/Oncology SHO on call through switch

2. In the event that the referring/ordering clinician or his/her team cannot be contacted, contact • nurse in charge of the relevant area, or • nurse caring for the patient. 3. In the event that the nurse cannot be contacted, contact the Consultant in charge of the patient through switch	2. In the event that the Haematology/Oncology SHO cannot be contacted, contact the Haematology/Oncology Registrar on call through switch 3. In the event that the Haematology/Oncology Registrar cannot be contacted, contact the Haematology/Oncology Consultant on call through switch

Communication of Critical Results – GP patients

At all times

1. Contact the referring GP
2. If the referring GP is uncontactable, contact the 2nd medical SHO on call on Dect 7402 or through switch.
3. In the event that 2nd medical SHO cannot be contacted, contact the 1st medical SHO on call on Dect 7403 or through switch.
4. In the event that 1st medical SHO cannot be contacted, contact the 3rd medical SHO on call through switch.
5. In the event that 3rd medical SHO cannot be contacted, contact the overnight nurse manager through switch

Communication of Critical Results – Referral Labs

At all times

1. Contact the referring laboratory

   If contact details have been provided to the laboratory, they will be available on laboratory Qpulse in documents module under 'Communication of…' otherwise contact the referring laboratory through their switch.

   Consult departmental procedures for further details

Details of all telephoned results will be recorded and include name (forename, Surname and Grade) of the person taking the result ;the patient's name, date of birth, address (for outpatients/GP results) and one other form of identification e.g.

hospital number and also contain the test, examination date and request date/time (where pertinent).

Any difficulties encountered in notifying the patient's clinical team of a critical result will be documented in the same manner as telephoned results departmentally, recorded as a non-conformance on Q-Pulse and notified to laboratory management.

3.1.12 A/E Patient that has been Discharged

If the laboratory needs to contact **an A/E** patient that has been discharged with anadd on result e.g. a Blood morphology report, positive Lupus screen, whereby this result has a clinical impact on patient treatment and care, the Liaison Nurse on 2708 will be contacted.

Chemical Pathology Samples that are received that were not drawn on the day of delivery to the department will have all labile tests reported as 'on cells'.

3.1.13 Specimen Referral

Tests not provided by Beaumont Hospital are referred to an appropriate referral Laboratory. The choice of laboratory is primarily based on quality grounds, with accredited laboratories being chosen preferentially. Other factors such as cost and turnaround times are also considered. A list of referral laboratories in use is available from the Directorate on request.

3.1.14 Specimen Transportation Guidelines

- Transport specimens to the laboratory as quickly as possible.
- Place all specimens in bio-hazard bags and transport to the laboratory in a way as to minimise damage or risk of leakage. Up to 10 specimens may be placed in the bag.
- Porter sample collections are Monday- Friday collections at 10.00, 12.00, and 15.00, Saturday and Sunday collections at 9.00, 11.00, and 13.00.
- Specimens where the external surface is contaminated with blood or other body fluids will not be accepted for analysis – another specimen must be collected.
- If a specimen arrives in a condition which places staff at risk, we regret that it cannot be processed. Where contact details are provided the requesting clinician will be informed, however we can take no responsibility for delays which occur due to the lack of contact details.
- Samples drawn by the Phlebotomy Department are collected by the laboratory portering service from all wards at specified times through the day and on Saturday and Sunday mornings.

- Urgent samples or samples drawn outside the standard phlebotomy service must be sealed into a bio-hazard bag and may be delivered to the laboratory via the chute system unless specifically specified in Powerchart.
- Labile samples must be delivered directly to the laboratory with the time of sampling clearly on the label.
- 24 hour urine samples must be tightly sealed and in a plastic bag.
- MSU samples must be sealed in a bio-hazard bag.
- Urine samples must be delivered to the appropriate laboratory, as specified on the sample label, to ensure appropriate storage prior to analysis.
- Blood gas samples (ABGs) to be processed by the laboratory must be hand delivered within 30mins of sample collection (15mins if ionised calcium is requested). Samples must arrive in a sealed biohazard bag with no needle attached to the syringe.
- Blood, CSFs and other critical specimens must be transported to the laboratory immediately. All specimens should be placed in bio-hazard bags and transported to the laboratory in such a way as to minimise damage or risk of breakage.
- Blood cultures must be incubated at 37˚C within 4 hours of collection. Specimens in plastic bottles should be sent by the pneumatic tube system; otherwise bottles should be transported to the laboratory by the portering service and placed in the automated blood culture monitoring system. This can be arranged by calling extension 2140.
- Samples for auto antibody crossmatches for NHISSOT should reach the laboratory within 24 hours'.

Please note: Glass specimen tubes are not acceptable due to Health and Safety regulations.

3.1.14.1 Exception to the above

Test	Details	Department
Critical specimens	Must be hand delivered/sent by porter	All departments
CSF	Must be hand delivered/sent by porter	Microbiology
CSF Xanthochromia	Must be hand delivered/sent by porter	Chemical Pathology

3.1.14.2 Pneumatic Chute System

Specimens may be sent via the Chute system to the following terminals:

Laboratory Department	Terminal Number
Blood Transfusion	2706
Haematology	2703/2656

Chemical Pathology	2668/2704
Immunology	2635
Microbiology	2645 / 2647
NHISSOT	2650

The following specimens may **NOT** be transported using the Chute System:

- CSF Specimens
- Blood gas samples
- LDH test results may be increased by up to 15% if sample is sent via Chute System

3.1.15 Specimen Storage Conditions

- Store blood samples at room temperature, unless otherwise specified. Note that blood samples stored in a refrigerator may have falsely elevated results e.g. potassium.
- 24 hour urine collections should be refrigerated throughout the collection and brought to the laboratory ASAP.
- Addition of test requests to existing samples is not recommended due to issues of sample integrity. Contact individual laboratory for advice.
- Blood, CSFs and other critical specimens must be transported to the laboratory immediately.
- CSF Samples for Xanthochromia.must be hand delivered to the Chemical Pathology laboratory immediately. Do not put into the Chute.
- Samples that require preservation on ice post collection due to the labile nature of the analyte must be sent to the lab immediately.
- In most cases, if delays are unavoidable, microbiology specimens can be preserved by refrigeration at 2-8˚C in a designated specimen fridge, as this maintains the viability of the pathogens present and prevents the overgrowth of non-pathogenic bacteria. This is of particular importance if quantitative or semi-quantitative culture is required, for example during microbiological analysis of sputum and urine.
  Exceptions to this include:
  1) Blood cultures should be promptly incubated at 37˚C.
  2) CSF should be held at room temperature and arrive in laboratory <2 hours after collection for accurate microscopy results.
  3) Samples specifically for the isolation of *Neisseria gonorrhoea.* (i.e. cervical or urethral specimens) should be stored at room temperature.

3.1.16 Data Protection Policy

The Clinical Directorate of Laboratory Medicine complies with the policy of the HSE regarding the legislation pertaining to the rights of the patient and staff and to act in an ethical and responsible manner in maintaining the security and integrity of all personal information

The Directorate retains the following information in relation to each test request received, for a minimum of 30 years, in order to ensure patient history is maintained and that sufficient information is available to staff responsible for the interpretation and reporting of results from the laboratory:

1. Patient full name
2. Patient Address
3. Patient medical record number/episode number
4. Patient date of birth
5. For each specimen: date/time of collection, date/time of receipt in the laboratory and date/time of report, specimen type, priority.
6. Clinical information provided by clinicians
7. The results and where appropriate, interpretation of each test requested.
8. Requesting clinician and address

3.1.17 ***Placing Patient Information in the Public Domain***

It is laboratory policy that information obtained or created during the performance of laboratory activities is not placed in the public domain unless agreed by the patient. If the laboratory is required by law or authorised by contractual arrangements to do so, the patient's clinician will be informed and they will inform the patient (unless this is prohibited by law). Further details are outlined in the relevant departmental standard operating procedures.

Information about the patient from a source other than the patient (e.g. complainant, regulator) is kept confidential by the laboratory. The identity of the source is kept confidential by the laboratory and is not shared with the patient, unless agreed by the source.

3.1.18 ***Time Limits for Requesting Additional Examinations***

Please note that requests for any additional examinations must be placed electronically in Powerchart and the barcode delivered to the appropriate laboratory, in order for results to be issued.

Requests for add-on testing cannot be accepted by Chemical Pathology during any period of I.T. Downtime.

3.1.19 ***Repeat Examination due to Analytical Failure***

In the event of an analytical failure, if the system returns to normal within the test cut-off time, the samples are processed accordingly. However, if this time exceeds the test cut-off limit, the users are notified and repeat samples are requested, where applicable

*3.1.20 **Uncertainty of Measurement (UM)***

Every measurement, including a laboratory result, is subject to a level of uncertainty. For example blood pressure measured a few times within a single clinical visit may vary. This variation is made up of biological variation together with the uncertainty of measurement (and may be compounded further if any error is made). Systems in the laboratory are designed to minimise error – however if you are concerned that an error has occurred please contact us to let us investigate this. Even when error is eliminated, uncertainty of measurement affects all results.

When interpreting the results of a laboratory test the uncertainty of measurement (UM) of that result needs to be considered. UM is a numerical value & is an expression of the magnitude of uncertainty of a result. It characterizes the dispersion of values reasonably attributed to measurement. If not understood may lead to over interpretation of results.
e.g. If the UM is 10% & the result is 100, then the true result probably lies between 90-110. Therefore is the result obtained due to clinical changes in the patient or imprecision of the test method itself?

Uncertainty is not error. Error tells us the difference between the true value & the measured value. Error can be corrected, uncertainty cannot. UM is the quantitative expression of doubt (uncertainty) & spread of a particular measurement. It is an estimate of the confidence in the result produced by the laboratory.
Uncertainty is a parameter associated with every result & is specific to each result. The uncertainty of any assay performed in the laboratory is available on request.

*3.1.21 **Complaints***

Beaumont Hospital is committed to responding to patient and user feedback both positive and negative. The hospital endeavors to respond to concerns and identify and manage any deviation from high quality care.

Complaints and feedback may be given directly to any member of staff in the laboratory or through the Patient Advisory Liaison Service (PALS) In any case, there may be a resolution at point of contact or the case may be of a serious nature that requires further action. All complaints (verbal or written) are recorded directly onto Q-Pulse, and are classified as per Non-conformity procedure. The medical significance of each complaint is decided upon by the departmental Consultant Pathologist. The Head of Department or Laboratory Manager may deal with the complaint depending on its severity. Records of complaints are maintained for periods as defined in schedule for record retention.

If a complaint cannot be resolved at local level it will be forwarded to the hospital's Patient Liaison officer.

The laboratory actively seeks feedback from its patients, users and personnel which is used to analyse and improve the laboratory management system, activities and services provided to users as demonstrated below.This is achieved through regular user satisfaction surveys, complaints and compliments that are received and through it's annual management review. All of these contribute to the laboratory continual improvement process.

*3.1.22 **Open Disclosure***

Beaumont Hospital follows the HSE National Policy for Open Disclosure. Open Disclosure is a requirement of the HIQA National Standards for Safer Better Healthcare. Open Disclosure "an open, consistent approach to communicating with patients when things go wrong in healthcare. This includes expressing regret for what has happened, keeping the patient informed, providing feedback on investigations and the steps taken to prevent a recurrence of the adverse event."Open Disclosure should happen when a service user has experienced an "adverse event" but also when a service user experiences a "no harm event" or is exposed to a "near miss event".

*3.1.23 **Accreditation/Quality Standards***

Beaumont Hospital Clinical Directorate of Laboratory Medicine's current scope of Accreditation to ISO15189 is available from the INAB website, https://www.inab.ie/fileupload/medical-testing/beaumont-hospital-225mt.pdf

The H&I Department is accredited by EFI (European Federation for Immunogenetics).

3.2 HAEMATOLOGY

*3.2.1 **Repertoire of Haematology Tests***

<table>
<tr><th>Test</th><th>Specimen Container</th><th>Minimum / Container Volume</th><th>Adult Reference Range
(Refer to Report for Paediatric Ranges)</th><th>TAT</th><th>Comment</th><th>Test Method</th><th>Mnemonic/ display name</th></tr>
<tr>
<td>Full Blood count</td>
<td>EDTA (pink capped)</td>
<td>2.6ml standard</td>
<td>
<table>
<tr><th>Parameter Tested</th><th>Male</th><th>Female</th></tr>
<tr><td>Hb</td><td>13-17.5 g/dL</td><td>11.5-16.5 g/l
11.7-16.0*</td></tr>
<tr><td>PCV</td><td>0.37-0.54 L/L</td><td>0.335-0.54 L/L
0.355-0.52*</td></tr>
<tr><td>RCC</td><td>4-6.5 x10^{12}/L</td><td>3.8-5.8 x10^{12}/L
3.8-5.6*</td></tr>
<tr><td>RDW</td><td colspan="2">11-15 %</td></tr>
<tr><td>MCV</td><td colspan="2">79 -96 fL</td></tr>
<tr><td>MCH</td><td colspan="2">27 -32 pg</td></tr>
<tr><td>PLTS</td><td colspan="2">140 -400 x10^{9}/L</td></tr>
<tr><td>WBC</td><td colspan="2">4.0 -11 x10^{9}/L</td></tr>
<tr><td>Neut</td><td colspan="2">2.0 -7.5 x10^{9}/L</td></tr>
<tr><td>Lymph</td><td colspan="2">1.0 -4.0 x10^{9}/L</td></tr>
<tr><td>Mono</td><td colspan="2">0.2- 1.0 x10^{9}/L</td></tr>
<tr><td>Eosin</td><td colspan="2">0.04- 0.4 x10^{9}/L</td></tr>
<tr><td>Baso</td><td colspan="2">0.01- 0.1 x10^{9}/L</td></tr>
</table>
</td>
<td>In-house: 4 Hours
Urgent: 1 hour</td>
<td>7.5ml and 10ml EDTA samples are incompatable with the analysers and will be rejected.

*women > 50 years</td>
<td>Sysmex XN
• Sodium Lauryl Sulphate (SLS) Haemoglobin Method
• Calculated Parameters
• Impedance Technology
• Fluorescence Flow Cytometry</td>
<td>FBC</td>
</tr>
<tr>
<td>Platelet Clumping Check*</td>
<td>0.82mgMg^{2+}/mL
(Red)</td>
<td>2.6mL</td>
<td>140 -400 x10^{9}/L</td>
<td>In-house: 4 Hours
Urgent: 1.5 hour</td>
<td>Arrange in advance with laboratory to obtain sample tube.</td>
<td>Sysmex XN
• Impedance Technology
• Fluorescence Flow Cytometry</td>
<td>Plt Exact</td>
</tr>
</table>

Test	Specimen Container	Minimum / Container Volume	Adult Reference Range (Refer to Report for Paediatric Ranges)	TAT	Comment	Test Method	Mnemonic/ display name
ESR	Trisodium citrate 4NC /3.5 (purple)	3.5 ml **must** be filled to the line	*Male*: 1- 12 mm/hr; *Female*: 1-20 mm/hr	1 Working Day Urgent for Temporal Arthritis: 90 minutes	Theclinical Haematology team have listed the following conditions as the only times an ESR is indicated *1.Giant cell arteritis, Temporal arteritis* *2. Polymyalgia rheumatica.* *3.'Suspected myeloma'* *4. Hodgkins Lymphoma* *5.Prosthetic joint infection* *6. Osteomyelitis* *7. Rheumatoid Arthritis* Stat samples - Must contact the Laboratory to request sample to be prioritised.	Sarstedt Desaga S2000 Sedimentation of RBC's	**ESR**

Test	Specimen Container	Minimum / Container Volume	Adult Reference Range (Refer to Report for Paediatric Ranges)	TAT	Comment	Test Method	Mnemonic/ display name
Reticulocyte Count	EDTA (pink capped)	2.6mL standard	Retic: 0.4-1.9 %Male 0.4-1.8% Female Retic (Abs) 14-100 $x10^9$/L	In-house: 4 Hours Urgent: 1 hour	7.5ml and 10ml EDTA samples not acceptable	Sysmex XN FFluorescence Flow Cytometry	**Retics**
Infectious mononucleosis Screen	EDTA (pink capped)	2.6mL standard	Negative	1 Working Day Urgent: 1 hour		Manual Immunoassay	**IM**
Blood film examination	EDTA(pink capped)	2.6mL standard	N/A	Routine: 5 working days Urgent: 24 hours	Sample must be <8 hrs old. Clinical details and reason for blood film must be on the form.	Sysmex sp50,Staining/Microscopy	**Must be requested by phoning the Laboratory directly**
Referral Blood Film	EDTA(pink capped)	2.6mL standard	N/A	Routine: 9 working days Urgent: 24 hours	Blood film sent to Haematology Team for review. Report will follow within 7 days.	Sysmex sp50, Staining/Microscopy	**HBFC**Only ordered by Haematology staff

Test	Specimen Container	Minimum / Container Volume	Adult Reference Range (Refer to Report for Paediatric Ranges)	TAT	Comment	Test Method	Mnemonic/ display name
Malaria: Rapid Diagnostic Tests (RDT's) and Blood Film	EDTA(pink capped)	2.6mL standard	Negative	3 hrs for RDT. 4-72 hours depending on RDT results for Blood films. RDT neg – film processed next working day	Samples must be < 2 hours old.	Manual/ Immuno-chromatographic test Manual Staining/microscopy	Mal Scr Mal film

Test	Specimen Container	Minimum / Container Volume	Adult Reference Range (Refer to Report for Paediatric Ranges)	TAT	Comment	Test Method	Mnemonic/ display name
Sickle Solubility Screen	EDTA (pink capped)	2.6mL standard	Negative	Urgent: 2 hours. If non-urgent, sample is Referred to SJH for full HB-EL screen: A verbal report is available 7 days after dispatch. Phone No.'s:01-4162394 (SJH) A printed report is available 5 weeks after dispatch.	This test is performed for urgent pre-op anaesthetic screening only. If urgent, please contact the laboratory. In all other instances, order Haemoglobin Electrophoresis Complete the SJH request form available as a link on Powerchart The Sickle solubility test is a screening method and as such is subject to false positives and negatives. All sickle solubility tests must be confirmed by HPLC/Electrophoresis. This test is performed in St James Hospital.	Manual Solubility Test for HbS	Sickle Hb'opathy Scr (SO)

Test	Specimen Container	Minimum / Container Volume	Adult Reference Range (Refer to Report for Paediatric Ranges)	TAT	Comment	Test Method	Mnemonic/ display name
Bone marrow aspirate	Bone marrow aspirate on glass slides. Needles and slides available in CKB (2150)	A minimum of 5 slides.	N/A	Processed during Routine working hours Stained for next Working Day. Await Consultant reporting: Reporting TAT: Written report is available on Powerchart within 3 weeks	Slides must be labelled in pencil with the patients' Surname and second unique identifier either D.O.B or unique hospital number. Order the Bone Marrow Aspirate (Haem)	Staining/ Microscopy	**BMA**

*3.2.2 **Repertoire of Flow Cytometry Tests***

Test	Specimen Container	Minimum/ Container Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
CD4	EDTA (pink capped)	2.6mL standard	502-1749 Cells/ul	3 Working days	Samples must be <48 hours old. Only processed Monday to Friday. Must be Received in Laboratory before 3pm on a Friday	Flow Cytometry	**CD4**
TBNK	EDTA (pink capped)	2.6mL standard	CD3#797-2996Cells/ul CD3/4#502-1749Cells/ul CD3/8#263-1137Cells/ul CD19#99-618Cells/ul CD56#72-577Cells/ul	3 Working days	Samples must be <48 hours old. Only processed Monday to Friday. Must be Received in Laboratory before 3pm on a Friday	Flow Cytometry	**TBNK**
Lymphoid Screening Tube	EDTA (pink capped Sodium Heparin (orange capped - BMA)(white capped, RPMI, – cytogenetics bottle Lymph Node Aspirate)	2.6mL standard	N/A	Written report: 10 working days Verbal report: 24 hours	All samples must be <48 hours old. Must be Received in Laboratory before 3pm on a Friday	Flow Cytometry	**LST**

Test	Specimen Container	Minimum/ Container Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
Lymphoproliferative Panel	EDTA (pink capped) Sodium Heparin (orange capped - BMA) with 1ml RPMI	2.6mL standard	N/A	Written report: 10 working days Verbal report: 24 hours	All samples must be <48 hours old.	Flow Cytometry	B NHL Panel
Acute Leukaemia Screen Acute Leukaemia Panel Blast count	EDTA (pink capped) Sodium Heparin (orange capped- BMA) with 1ml RPMI.	2.6mL standard	N/A	Written report: 10 working days Verbal report: 24 hours	Must be arranged in advance with prior consultation with the lab. Containers are only obtained from the lab.	Flow Cytometry	**BLAST** Acute Panel Acute Scr
					EDTA Samples must be <24 hours old.		
					Sodium Heparin (orange capped - BMA) with 1ml RPMI must be < 48 hours old		
Paroxysmal Nocturnal Haemoglobinuria	Fresh EDTA (pink capped)	2.6mL standard	N/A	Written report: 10 working days Verbal report: 24 hours	Arrange in advance with Laboratory personnel. Sample may be stored in fridge for <72 hours if not for immediate testing	Flow Cytometry	**PNH**
T-Cell Panel		2.6mL standard	N/A	Written report: 10 working days	EDTA Samples must be <24 hours old.	Flow Cytometry	

Test	Specimen Container	Minimum/ Container Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
	EDTA (pink capped) Sodium Heparin (orange capped) with 1ml RPMI			Verbal report: 24 hours	Sodium Heparin (orange capped - BMA) with 1ml RPMI must be < 48 hours old		T NHL Panel

*3.2.3 **Repertoire of Coagulation Tests***

Test	**Specimen Container**	**Number of Samples**	**Minimum Volume**	**Reference Range**	**TAT**	**Comment**	**Test Method**	**Mnemonic/ Display name**
Coag Screen includes PT, INR, APTT and APTT Ratio (APTTR) Coag GP – is the same as above without the APTTR	Trisodium citrate 9 NC/2.9/1.8 mL (green capped)	1	**Must** be filled to the line	PT: 10-13.2 seconds INR- The INR should only be used for monitoring Warfarin therapy. Refer to local treatment algorithmAPTT: 24 – 36 seconds APTTR 1.5 -2.5 ratio APTTR: The APTT ratio should only be used for monitoring the anticoagulant effect of an Unfractionated Heparin Infusion.	In-house: 4 Hours Urgent: 1.5 hour	Sample must be <4 hours old	Coagulometric(turbidimetric) Calculated Parameters	Coag Scr Coag GP
INR	Trisodium citrate 9 NC/2.9/1.8 mL (green capped)	1	**Must** be filled to the line	The INR should only be used for monitoring Warfarin therapy. Refer to local treatment algorithm.	In-house: 4 Hours Urgent: 1.5 hour	INRs only are stable for 24 hrs Warfarin Office contact no. 01-8092083	Calculated Parameter	**INR**
D-Dimer	Trisodium citrate 9 NC/2.9/1.8 mL (green capped)	1	**Must** be filled to the line	Under 50 yrs<0.5 µg/ml Then increases in 5 year increments by 0.5. i.e 55-60 (<0.6) and 85-90 (<0.9)	In-house: 4 Hours Urgent: 1.5 hour	Sample must be <8 hours old	Immuno-turbidimetric	Dimer

Test	Specimen Container	Number of Samples	Minimum Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
Fibrinogen	Trisodium citrate 9 NC/2.9 /1.8 mL (green capped)	1	**Must** be filled to the line	1.9 – 3.5 g/L	In-house: 4Hours Urgent: 1.5 hour	Sample must be <4 hours old For patients on Argatroban a Clauss Fibrinogen test is not appropriate & will be reported as follows: "Fibrinogen result is unavailable as the patient is on Argatroban which may cause a false low fibrinogen result in the Clauss fibrinogen assay. Please discuss with the Haematology team".	Clotting (Clauss)	**Fib-c**
Mixing study	Trisodium citrate 9 NC/2.9 mL (green capped)	2	**Must** be filled to the line	Corrected to within the PT and APTT normal ranges	1 week	Lab criteria for mixing study are prolonged PT or APTT when patient is not on anticoagulant and the liver function is normal. Mixing study requests must be approved by the Haematology team. For urgent requests, contact the laboratory in the morning, may be able to facilitate testing that day.	Coagulometric(turbidimetric) Calculated Parameter	Mix Stdy

Test	Specimen Container	Number of Samples	Minimum Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
ntrinsic actor assay creen	Trisodium citrate 9 NC/2.9 mL (green capped)	2	**Must** be filled to the line	See individual assays below	Case dependent, maximum 14 days	Requests must be approved by the Haematology team c/o Coagulation consultant.Tests done in batches.	Coagulometric(turbidimetric)	**IFS**
xtrinsic actor assay creen	Trisodium citrate 9 NC/2.9 mL (green capped)	2	**Must** be filled to the line	See individual assays below		Requests must be approved by the Haematology team c/o Coagulation consultant.Tests done in batches.	Coagulometric(turbidimetric)	**EFS**
actor Assays ndividual equests	Trisodium citrate 9 NC/2.9 mL (green capped)	2	**Must** be filled to the line	FII 0.72-1.31 IU/mL FV 0.63-1.33 IU/mL FVII 0.51-1.54 IU/mL FVIII 0.60-1.36 IU/mL FIX 0.80-1.47 IU/mL FX 0.64-1.50 IU/mL FXI 0.72-1.52 IU/mL FXII 0.52-1.64 IU/mL	Case dependent, maximum 14 days	Tests done in batches. For urgent requests, contact the laboratory in the morning, may be able to facilitate testing that day. Requests must be approved by the Haematology team c/o Coagulation consultant.	Coagulometric(turbidimetric)	**FII, FV, FVII, FVIII:C,FIX, FX, FXI, FXII**

Test	Specimen Container	Number of Samples	Minimum Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
Thrombophilia screen	Trisodium citrate 9 NC/2.9 mL (green capped)	4	**Must** be filled to the line	See individual requests APCR, Prot C, Prot S Act,, Antithrombin	4 weeks.	Batch tested. Inherited Thrombophilia screen includes the following tests: PT,APTT, Fib-c, AT,Prot C, Prot S Act, APCR 5LEIDEN*. A Lupus screen is not on this profile. Hence, these tests do **not** need to be ordered on an individual basis**, Order the thrombophilia careset The coagulation consultant will review and saction all Thrombohpilia orders**	APCR Coagulometric(turbidimetric) PC Antithrombin Chromogenic Prot s Immuno-turbidimetric	Thrombophilia care set conatins the Thrombophilia questionnaire and the screen request (Thrphilia)
Protein C	Trisodium citrate 9 NC/2.9 mL (green capped)	1	**Must** be filled to the line	0.74 - 1.32 IU/mL	4 weeks.	Batch tested. Patient must be off warfarin for a minimum of 2wks to perform this assay.	Chromogenic	Prot C
Free Protein S	Trisodium citrate 9 NC/2.9 mL (green capped)	1	**Must** be filled to the line	Males: 0.76-1.46 IU/mL Females:0.65-1.33 IU/mL	4 weeks.	Batch tested. Patient must be off warfarin for a minimum of 2wks to perform this assay	Immuno-turbidimetric	Prot S Act

Test	Specimen Container	Number of Samples	Minimum Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
Anti Xa (LMWH and UFH)	Trisodium citrate 9 NC/2.9 mL (green capped)	1	**Must** be filled to the line	For clinical interpretation please contact the haematology team.	1 week	Clinical indication & timing of blood samples must be discussed with & sanctioned by the Haematology team. Please contact the laboratory prior to sending samples. Sample must be <2 hours old.	Chromogenic	XA .
Antithrhrombi	Trisodium citrate 9 NC/2.9 mL (green capped)	1	**Must** be filled to the line	0.82 - 1.18 IU/mL	4 weeks.	Batch tested. Patient must not be on Direct Thrombin inhibitor anticoagulant.	Chromogenic	Antithrombin
Activated Protein C Resistance (APCR)	Trisodium citrate 9 NC/2.9 mL (green capped)	1	**Must** be filled to the line	Negative	4 weeks.	Batch tested Patient must not be on A Direct oral anticoagulant.	Coagulometric(turbidimetric)	**APCR**
Von Willebrand Factor	Trisodium citrate 9 NC/2.9 mL (green capped)	2	**Must** be filled to the line	0.49 - 1.73 IU/mL	Case dependent, maximum 14 days	"The presence of Rheumatoid Factor may produce an overestimation of the result"	Immuno-turbidimetric	VWF Ag

Test	Specimen Container	Number of Samples	Minimum Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
Lupus Anticoagulant	Trisodium citrate 9 NC/2.9 mL (green capped)	1	**Must** be filled to the line	DRVVS ratio: <1.17 DRVVT-TR ratio: < 1.23 SCT-TR ratio <1.14	4 weeks	Batch tested Patients must not be on any anticoagulation as they interfere with the interpretation of the assayThe coagulation consultant will review and sanction all Lupus orders.	Coagulometric(turbidimetric)	**Order the** Lupus Anticoagulant care set. This contains the Lupus questionnaire and the Lupus screen request (LA Scr).
Rivaroxaban	Trisodium citrate 9 NC/2.9 mL (green capped)	1	**Must** be filled to the line	No therapeutic reference range as monitoring not needed	1 weeks	Clinical indication & timing of blood samples must be discussed with & sanctioned by the Haematology team. Please contact the laboratory prior to sending samples.	Chromogenic	Rivaroxaban

3.2.4 ***Repertoire of Haematology Molecular Tests***

Test	**Specimen Container**	**Number of Samples**	**Minimum Volume**	**Reference Range**	**TAT**	**Comment**	**Test Method**	**Mnemonic/ Display name**
Factor V Leiden mutation	EDTA sample (pink)	1	2.6ml Standard	Negative	6 weeks	Only tested if APCR (Activated Protein C) is positive or family history is indicated on the request form. See previous page for APCR requirements) The laboratory will no longer take receipt or store the form containing patient genetic consent. It is the responsibility of the ordering clinician to obtain and file a copy of genetic consent in the patient's record.	**Real time PCR**	**Lab order only FVL**
Prothrombin G20210A mutation	EDTA sample (pink)	1	2.6ml Standard	Not Detected	6weeks	. The laboratory will no longer take receipt or store the form containing patient genetic consent. It is the responsibility of the ordering clinician to obtain and file a copy of genetic consent in the patient's record	**Real time PCR**	PTGA

Test	Specimen Container	Number of Samples	Minimum Volume	Reference Range	TAT	Comment	Test Method	Mnemonic/ Display name
HFE Haemochromatosis	EDTA sample (pnk)	1	2.6ml Standard		4weeks	Must be accompanied by completed Haemochromatosis Genetic Screening Request (HAEMC-LF-077) This form can be obtained from the Beaumont Hospital website, under Haematology Dept. If genetic consent is not obtained the molecular test will be rejected. The laboratory will no longer take receipt or store the form containing patient genetic consent. It is the responsibility of the ordering clinician to obtain and file a copy of genetic consent in the patient's record.	**Real time PCR**	**HFE**

*3.2.5 **Clinical Advice & Laboratory Test Interpretation***

Interpretation of Laboratory Tests / procedures may be obtained by phoning any of the telephone numbers in section 3.1.2 and asking for the Chief Medical Scientist or by requesting a senior member of staff 09:00- 17:00 Mon-Fri excluding Bank Holidays

*3.2.6 **Specimens Referred to External Hospitals***

If there is an issue with the sample or the required/ correct referral form does not accompany the sample, the sample will be sent back to the requesting area to be ordered correctly. HAEMG-LF-124 Form with reasons for return of BMA/Fluid/CSF to ward, for correction –

Test reports from external referral laboratories are scanned into the patient record when received & are available on Powerchart.

ADAMTS 13 Assay	2 fresh coag samples <4hrs ADAMTS13 request form must have requesting clinician's name, mobile number and email address. For urgent requests telephone Haemostasis laboratory in Belfast City Hospital. Urgent samples must be in Belfast lab by noon for testing that day.	Belfast City Hospital Tel: 028 950 40910	ADAMT Q pulse form EX-HAEM-1062- Avavailable in lab and CKB
Amyloid	1 GLASS tube (available in CKB)	National Amyloidosis Centre, London	Amyloid (SO)
Apixaban	2 fresh Coag samples, relevant clinical details, anticoagulant therapy, must be supplied with each request. Must be cleared by requesting Dr with Coagulation in SJH	National Coagulation Laboratory, St. James' Hospital Tel: 01 4162956	Apix (SO)
Breast Implant Fluid Flow Cytometry	5ml RPMI Heparin	Clinical Cytometry & Haemoglobinopathy, St James's Hospital	**Breast Implant Fluid FCM (SO)** **Form required** Hand written request on St James Hospital Flow Cytometry request form **EX-HAEM-1074**
CSF for Flow Cytometry	Get a Transfix tube. CSF sample is stable in Transfix for 3 days at 2-8°C.	MLL Münchner München	CSF FCM (SO)
Cancer Molecular Diagnostics (CMD)	2 EDTA samples	Cancer Molecular Diagnosis St. James' Hospital	CMD
Cytogenetics	Place sample in RPMI medium with sodium heparin. (Universal Container obtained from fridge in Haem Lab).	Department of Clinical Genetics, Our Lady's Hospital, Crumlin	Cytogen/FISH CHI

Cytogenetics (FISH)	Lithium Heparin sample	MLL Münchner München	Cytogen/FISH MLL
Cytogenetics, ERIC Panel, (TP53-IGHV Mutation), T-cell gene rearrangement studies (TCR)	2 EDTA samples or BM in RPMI sample if Haematology team requests it. Transported at RT°C	Molecular Haematology, Belfast City Hospital	IgHV Rearrangement, P53 Deletion, TCR (SO)
Dabigatran Level	2 fresh Coag samples, relevant clinical details, anticoagulant therapy, must be supplied with each request. Must be cleared by requesting Dr with Coagulation in SJH	National Coagulation Laboratory, St. James' Hospital	Dabigatran (SO)
EMA binding assay Test for Hereditary Spherocytosis	1 x 2.6mL EDTA sample & Blood film required. EDTA sample must be < 24hrs old on testing. Complete clinical details and any family history of HS. (also known as Eosin-5-Maleimide, replaces Osmotic Fragility)	Clinical Cytometry & Haemoglobinopathy, St James's Hospital	HS Scr (SO)
Factor VIII and FIXinhibitors	2 fresh Coag samples, relevant clinical details, anticoagulant therapy, must be supplied with each request. Must be cleared by requesting Dr with Coagulation in SJH	National Coagulation Laboratory, St. James' Hospital	_FVIII INH (SO) FIX INH (SO)
FXIII antigen	2 fresh Coag samples, relevant clinical details, anticoagulant therapy, must be supplied with each request. Must be cleared by requesting Dr with Coagulation in SJH	National Coagulation Laboratory, St. James' Hospital	FXIII Ag (SO)
Fanconi Anaemia Screen	2 x 4 ml Lithium Heparin (peripheral blood)	MLL München	FS (SO)
Fluid Flow Cytometry • **Ascitic fluid** • **Pleural fluid**	5ml RPMI Heparin	Clinical Cytometry & Haemoglobinopathy, St James's Hospital.	Fluid FCM (SO)**Form required** Hand written request on St James Hospital Flow Cytometry request form **EX-HAEM-1074**
G6PD G6PD_Q (The latter Will be referred by SJH to Guys if deficient)	1 EDTA sample and marked as urgent Note: SJH require that all sections of the form are completed, in particular the clinical details and Haematology indices sections	Clinical Cytometry & Haemoglobinopathy, St James's Hospital	G6PD Scr G6PD Assay (SO)

Haemoglobin Electrophoresis & Sickle Cell confirmation	1 EDTA sample < 7 days old. 1 serum sample for Ferritin measurement to be done in-house if not already done. All sections of the form must be completed, in particular the clinical details and Haematology indices sections	Clinical Cytometry & Haemoglobinopathy, St James's Hospital	Hb'opathy Scr (SO)
Haptoglobin	1 serum sample-	MMUH , Eccles St,	Hapto (SO)
High Molecular weight Kininogen/ Prekallikrein	2 fresh Coag samples,	Eurofins	HMWK careset
HIT Screen	2 serum samples. Samples received in lab after 14.00 will be sent to SJH the following day.	National Coagulation Laboratory, St. James' Hospital	HIT (SO)
Minimal Residual Disease (MRD)	Performed by PCR 4 EDTA samples Complete a CMD request form	Cancer Molecular Diagnostics, St James Hospital	B ALL MRD (SO) CLL MRD (SO) T ALL MRD (SO)
Myeloid Gene panel	2 EDTA samples	King's College Hospital, London	Myeloid Gene Panel
MPN panel	Assay includes JAK2 V617F, JAK2 exon 12, CALR & MPL mutations. Peripheral blood or Bone marrow, 9ml in RPMI	Cancer Molecular Diagnostics, St James Hospital,	MPN panel
MRD NPM1	EDTA PB or BMA Samples should reach the laboratory within 24 hours of collection. Storage and transport: Room temperature.	Guys	NPM1 Quant
Plasma cell screen (SO)		MLL	MM Panel (SO)

Plasma Viscosity	1 or 2 EDTA samples less than 48 hours old. All sections of the form must be completed, in particular the clinical details and Haematology indices sections	Clinical Cytometry & Haemoglobinopathy St James's Hospital	PV (SO)
Plasminogen Activator Inhibitor	1 Coag sample required This test is extremely sensitive to pre analytical conditions. A freshly drawn coag sample must be mixed immediately by gentle inversion at least six times following collection.	Eurofins/Biomnis,	PAI-1
Pyruvate Kinase	EDTA sample x 2. NB: keep sample at RT do not put in the fridge Order a RETFBC & a PK, Avoid sending on Thursdays and Fridays.	Chris Lambert, Red Cell Protein Laboratory, King's College Hospital, London	PK (SO)
Red Cell Gene Panel/ Neutropenia panel	5 mls EDTA blood adults (2 samples) For red cell panel - please provide FBC, HPLC screening results, iron levels and markers of haemolysis plus a blood film, if available.Stored in the fridge where possible.	Viapath Analytics Molecular Pathology Laboratory, King's College Hospital,	RC/Neutropenia Panel
Ristocetin Co-Factor (RICOF)	2 fresh Coag samples, relevant clinical details, anticoagulant therapy, must be supplied with each request. Must be cleared by requesting Dr with Coagulation in SJH	National Coagulation Laboratory, St. James' Hospital	VWF RCo (SO)
Vaccine Induced Thrombotic Thrombocytopenia (VITT)	2 x serum samples. Confirm that the case has been discussed with Haematology. If not, contact Dr Karl Ewins Coagulation consultant or bleep registrar (#870) or the Haematology registrar / consultant on call if out of hours. Positive tests will have PF4 induced Plt activation assay (PIPA) referred to external laboratory.	National Coagulation Laboratory, CPLM building, St. James' Hospital	VITT
Von Willebrand Study send out	2 fresh Coag samples, relevant clinical details, anticoagulant therapy, must be supplied with each request. Must be cleared by requesting Dr with Coagulation in SJH	National Coagulation Laboratory, CPLM building, St. James' Hospital	VWFS (SO)

Warfarin (drug) Level	Separated serum is optimal sample type. Complete a Coagulation request form. Store and transport at room temp.	Viapath, St Thomas Hospital, Lambeth Palace Road, London	Warfarin Level

Note: if a CKB patient is being referred to SJH for a stem-cell transplant and if Bone marrow aspirate slides are referred, the following form must be completed and sent with the BMA slides. Clink on the link: GP & External Request Forms | St James's Hospital and then download the 'Bone Marrow Aspirate Request Form'

3.2.7 Requests for Additional Analysis

Provided a suitable sample is available verbal requests will be accepted for tests. Refer to table below for test cut-off times when requested to add a test to a sample already received in the Laboratory. Ensure that the correct sample requirements are met when taking an add-on request i.e. the sample has been received/ correct anti-coagulant/ the sample is not too old for analysis.

3.2.7.1 Test Cut-Off Times

Test	Test Cut-off Times
FBC	<24 hours
Blood Film preparation	<8 hours
Platelet Exact for platelet clumping	<24 hours
Reticulocyte	< 24 hours
ESR	< 6 hours
Haptoglobin	< 8 days once stored @ 2-8°C
Malaria	< 2 hours
IM	<24 hours.
Sickle Screen	< 45 days if stored @ 2-8°C
PNH	< 72 hours if stored at @ 2-8°C
LST, TBNK & CD4	<48 hours
Flow Cytometry: Lymphoproliferative Panel	<48 hours (All samples)
Flow Cytometry: Acute Leukaemia Panel	<48 hours (Bone marrow)
	< 24 hours (EDTA samples)

Test	Test Cut-off Times
Flow Cytometry: T Cell Panel	<24 hours (All samples)
Coagulation Samples(PT, APTT, Fibn)	< 4 hours
D-dimer	< 8 hours
INR	<24 hours
Factor V Leiden, , Prothrombin G20210A mutation and HFE	<28 days once stored at 2-8°C

3.2.7.2 **Process for additional analysis is by placing the order through powerchart and selecting the priority as add on. Then the requestor must call the lab to inform them of this add on request and to see whether there is a suitable sample or not.**

As a blood film request is not available on powerchart (only for the Haematology consultants) this must be ordered directly by calling the lab , given the clinicians name , bleep number , whether it is a bld film or for consultant review and the reason for the request.

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3.2.8 Critical Values

- Results falling outside defined alert limits are telephoned to the appropriate ward/ personnel as document in Section 3.1.11.

*H/M = Hypochromic/ microcytic and N/N = Normochromic/ normocyticThe Following Table is a list of these results that will be phoned:

Test	Result to be Telephoned
Hb	Leave N/N* as <7 category A , but 5-7 H/M* category B >20 new limit (now 19) and category A
PLT	<20 x 10^9/L & >1000 x 10^9/L (1^{st} time)
WCC	>30 as category B with a morphology follow up
Neutrophils	<0.5 x 10^9/l & >50 x 10^9/L (1^{st} time)
FBC	Results indicating possible leukaemia i.e. numerous flags (especially blast), increase WCC, DIFF vote-out or very abnormal, plt<100 and low Hb. Phone ward/clinical team responsible for the patient and to bring these results to their attention.
INR	>5.0 communicated to relevant clinical staff as per Hospital Policy: PPCC-HAEM-11
Fibrinogen	<1.5 g/l
Flow Cytometry	New Acute Leukaemia/PNH patients
Morphology	New Acute Leukaemia TTP/MAHA
Malaria Screen & Film	Positive
Sickle Screen	Positive

3.3 CHEMICAL PATHOLOGY

3.3.1 Services Offered

The Chemical Pathology Department provides a comprehensive suite of routine and specialised tests including;

- General biochemistry, including test profiles for renal, liver, bone, cardiac, muscle, lipid disorders and glucose homeostasis.
- Immunoassay tests of thyroid, gonadal, adrenal and pituitary function, haematinics, therapeutic drug monitoring.
- Biochemical tests for phaeochromocytoma, neuroblastoma and carcinoid tumours including Plasma Free Metanephrines, urinary fractionated catecholamines, metanephrines and 5HIAA.
- Protein Electrophoresis, Immunofixation and Serum Free Light Chain analysis.
- CSF Xanthochromia

3.3.2 Out of Hours / Weekend Service

Out of Hours / Weekend service provided includes the tests shown in the table below.

All tests marked with * must be discussed with the laboratory staff on duty.

In the event of the laboratory having an incident that curtails service provision, the tests listed in Column A will be given priority over those in Columns B & C

Column A: Priority Tests

Column B: Assays will be available when possible

Column C: Assays will be deferred until full service provision returns.

Assays not listed below may have samples drawn if clinically urgent, i.e. they must be taken at baseline prior to a clinical intervention; contact the laboratory for further information. The samples will be stored for analysis the next working day.

A	B	C
Na/K	Urea	Chloride
Creatinine	CRP	Cholesterol
Calcium	Bilirubin	Triglyceride
Magnesium	ALT	HDL
Albumin	AST	Urate
CSF Protein	Alkaline phosphatase	Protein
CSF Glucose	Phosphate	Transferrin Saturation
Amylase	ETOH	Urine Amylase
BDS	γGT	Urine Na
Iron	LDH	
Paracetamol *	ABG	
Salicylate *	CK	
Lithium *	TCO2	
Osmolality *	Digoxin *	
Troponin	Phenytoin *	
Gentamycin	Phenobarb *	
Vancomycin	Carbamazepine *	
	Valproate *	

*3.3.3 **Contact Details for Medical / Clinical Advice***

For medical advice contact;
Consultant Chemical Pathologist; Dr. Shari Srinivasan on (01) 8092676
Consultant Chemical Pathologist: Dr. Clodagh Loughrey on (01) 8092035

During working hours medical advice can also be obtained by contacting;
Chemical Pathology Specialist Registrar; (01) 8092666 or 8093000 Bleep #331

During working hours scientific advice can be obtained by contacting;
Chief Medical Scientist; Alison Griffin (01) 8092670
Chief Medical Scientist; Miriam Shinners (01) 7977811

For information on test requirements please see below.

*3.3.4 **Requests for Additional Tests***

Samples are retained in the Department for 72 hours and are validated for testing only up to this time. The laboratory will advise on the suitability of the sample for additional testing. Please note that verbal requests for additional testing are not acceptable and all requests for further testing should be implemented by ordering the test on Powerchart using the same episode number as the existing sample.

Added-on requests cannot be processed STAT. If the request is clinically urgent a fresh sample is advised.

In the event that the automated sample filing equipment is out of order – the laboratory will be unable to accept any add-on orders.

3.3.5 Routine Test Profiles and their Components

Description	Mnemonic	Tests
Renal Profile	Renal	Urea, Na, K, Cl, Creatinine, eGFR
Liver Profile	Liver	Bilirubin, ALT, ALK, γGT, AST, ALB, TP, Globulin
Lipid Profile - Fasting Lipid Profile - Non-fasting	FHDL HDL	Cholesterol, Triglyceride, HDL, Calculated LDL, non-HDL Cholesterol
Bone Profile	Bone	Ca, ALB, Phosphate, Ca Adjusted, ALK
Thyroid Function Test	TFT	FreeT4 and TSH

3.3.6 Fluid Orders

All orders for testing of 'fluids' – that is **not** blood, urine or CSF, must be ordered on Powerchart.

The type of 'fluid' must be entered into each request from the drop down window – e.g. Pleural, Ascites etc.

Samples must be drawn into the tube type specified on the barcode label.

CAPD fluid ordering is managed via Renal wards through a dedicated menu.

3.3.8 Testing for Familial Hypercholesterolaemia

Order on Powerchart, FHC. The samples are referred to St James's for analysis. The requested must be accompanied by a completed request form. The form can be printed from the Beaumont Hospital Intranet: Pathology: Laboratory User Guides and Forms

3.3.9 Urine Catecholamines and Metabolites

3.3.9.1 Adult reference ranges:

Analyte	Reference Interval
Noradrenaline	< 0.900 umol/24hrs
Adrenaline	< 0.230 umol/24hrs
Dopamine	< 3.300 umol/24hrs
Metanephrine	< 1.80 umol/24 hrs
Normetanephrine	< 2.80 umol/24 hrs

3.3.9.2 Paediatric Reference Ranges:

Age Group (yrs)	Noradrenaline	Adrenaline	Dopamine
< 1	< 0.43	< 0.08	< 1.95
1 – 3	< 0.20	< 0.08	< 1.45
3 – 5	< 0.19	< 0.08	< 0.95
5 – 8	<0.18	< 0.08	< 0.85
8 – 11	<0.17	< 0.08	< 0.75
> 11	<0.13	< 0.08	< 0.65

Units are mmol/mol Urinary Creatinine

3.3.10 Plasma Metanephrines

3.3.10.1 Adult Reference Ranges

Analyte	Reference Interval	Comments
Plasma Normetanephrine	0 – 1180 pmol/L	Seated
Plasma Metanephrine	0 – 510 pmol/L	Seated
Plasma 3 Methoxytyramine	0 – 180 pmol/L	Seated
Plasma Normetanephrine	< 730 pmol/L	Supine (30 mins)
Plasma Metanephrine	< 450 pmol/L	Supine (30 mins)
Plasma 3 Methoxytyramine	< 180 pmol/L	Supine (30 mins)

3.3.10.2 Drugs that may cause elevated Plasma Metanephrines

Drug causes of elevated values should be excluded prior to further investigation. See below for list of drugs that can cause elevated plasma metanehrines.

Drug Class	Examples
Tryclic Antidepressants	Amitriptyline, Clomipramine, Dosulepin
Selective Serotonin Reuptake Inhibitors	Citalopram, Fluoxetine, Sertraline
Serotonin/Noradrenaline Reuptake Inhibitors	Venlafaxine, Duloxetine
Alpha Adrenergic Receptor Blockers	Phenoxybenzamine, Doxazosin, Indoramin
Beta Adrenergic Receptor Blockers	Atenolol, Labetolol, Propanolol
Calcium Channel Blockers	Amlopidine, Diltiazem, Nifedipine
Monoamine Oxidase Inhibitors	Isocarboxazid, Phenelzine, Moclobamide
DOPA Related	L-Dopa, Methyldopa
Stimulant/Sympathomimetic Drugs	Ephedrine, Amphetamine, Cocaine, Nicotine, Caffeine

3.3.11 Critical Phoning Limits

- Results falling outside defined alert limits are telephoned to the appropriate ward or requesting clinician.
- Note: This may not be possible due to an inability to contact the relevant clinical personnel out of hours. In such cases, the critical alert value will be telephoned to the medical SHO on-call.
- It is the responsibility of the healthcare professional who requests a laboratory test to ensure that the result is reviewed and appropriate action taken.
- Results apply to the **current patient episode**.
- **Urgency A**- rapid communication of the result within 2 hours.
- **Urgency B**- results require communication within 24 hours, and preferably on the same working day. This would also apply to outpatients. For outpatients if there is no facility to phone on a Saturday then discuss with the on-call senior to determine the urgency.
- **Urgency C**- communication of these results on the next working day is deemed satisfactory.

RESULTS FOR URGENT COMMUNICATION						
	Units	**Action Limits**		**Urgency**	**Ref.**	**Comments**
Analyte		**Lower**	**Upper**			
Sodium	mmol/L	120	155	A	1	
		130 if< 16 yrs		A	2	**Note different phoning limits for in-patients and GP/OPD**
		125 GP/OPD		A	3	
Potassium	mmol/L	2.5	6.5	A	2	Check for haemolysis, age of sample & EDTA contamination.
			6 GP/OPD	A	1	
		2.7 GP/OPD		A	3	**Note different limits for in-patients and GP/OPD**
Urea	mmol/L	-	30	A	1	
			10 if< 16 yrs	A	2	
			35 CKD patients	A	3	
Creatinine	µmol/L	-	354	A	1,2	
			200 if < 16 yrs	A	2	
			800 CKD patients	A	3	
Glucose	mmol/L	2.5	25	A	1,2,3	
			30 GP/OPD/known diabetics	A	2	
			15 if < 16 yrs	A	2	
Calcium Adjusted (Total Calcium if no calculation available)	mmol/L	1.8*	3.5	A	1,2	*report with Albumin
			3 GP/out-patients	B	1	Request and perform U&E.
			3.2 CKD patients	A	3	All calcium results above upper action limit to be phoned regardless of previous critical result.
Phosphate	mmol/L	0.3	-	A	2	
		0.45 GP/OPD		B	1	
Magnesium	mmol/L	0.4		A	1,2	
Creatine Kinase	U/L	-	5000	A	1,2	
			400 if <16 yrs	A	3	
Amylase	U/L	-	500	A	1,2	
CRP	mg/L	-	300	A	1,2	
AST	IU/L	-	500 female	A	1,2	
			600 male	A	1,2	
ALT	IU/L	-	500 female	A	1,2	
			600 male	A	1,2	

Cortisol	nmol/l	50	-	A	1	Unless part of dexamethasone suppression test **Do not assume a dexamethasone test has been undertaken.**
Cortisol (SST)	nmol/L	250		A	2	As part of short synacthen test
Bicarbonate	mmol/L	10	-	A	2	Excluding ICU patients
Ethanol	mg% (mg/dL)		400 All levels in <16 yrs	A A	2 3	
CSF results	All Xanthochromia results to be phoned			A	3	
Paracetamol	mg/L	All results		A	2	
Digoxin	ug/L	-	2.5	A inpatients B GP/OPD	2 1,2	Check timing > 6 hrs from last dose. Give U&E results also. More urgent if K^+< 3 mmol/L. Phone **immediately** to GP/OPD requestor if overdose suspected or K^+ low
Carbamazepine	mg/L		15	A inpatients B GP/OPD	3 3	
Phenobarbitone	mg/L	-	70	A inpatients B GP/OPD	3	
Phenytoin	mg/L	-	25	A inpatients B GP/OPD	2,3 1,2,3	
Valproate (Valproic acid)	mg/L	-	120	A inpatients B GP/OPD	3	
Theophylline	mg/L		25	A inpatients B GP/OPD	2 2	
Lithium	mmol/L	-	1.5	A inpatients B GP/OPD	2 1,2	
Salicylate	mg/L	-	300	A	2	
Triglycerides	mmol/L	-	20	B	1	If specimen lipaemic, measure and report direct ISE Sodium and Potassium.
Haem 4+ samples	Phone all URGENT haem 4+ (this will include all ED)			A	3	
PSA	ng/mL	-	40	C	3	If no previous critical result
Ferritin	ng/mL	-	5000	C	3	
TSH	mU/L		30	C	3	
fT4	pmol/L	-	50	C	1,3	
Prolactin	mU/L	-	2000	C	3	
Testosterone female	nmol/L	-	5	C	3	
Gamma-globulins	g/L	IgG<3		C	1	With low IgA and IgM
Serum FLC Ratio		-	>100	C	3	First time detection
Paraprotein	g/L	Any IgE/IgD	IgG>15 IgA>10 IgM>10	C	1	First time detection

		Monoclonal free light chain- any size, whether or not with intact paraprotein	C	3	First time detection

3.3.12 Interference in Laboratory Tests

Many laboratory tests are subject to interference by endogenous or exogenous factors which may alter the true concentration of a substance within the body, or cause an analytical interference giving a potentially erroneous or misleading result.
All samples are routinely checked for Haemolysis, Lipaemia and Icterus which can interfere with laboratory tests to varying extents. Significant levels of any of these may affect the quality of some test results which will be highlighted and/or removed from the individual report.
Test results should be interpreted in conjunction with clinical findings and if interference is suspected please contact the laboratory Drug interferences are also commonly encountered, a summary list is available at http://www.beaumont.ie/media/Interference_in_Laboratory_Tests1.pdf.

3.3.13 Externally Referred Tests

Test reports from external referral laboratories are scanned into the patient record in Powerchart when the result is available.

3.3.14 Reference Intervals

All reference intervals and/or clinical decision values apply only to non-pregnant adults unless specifically stated otherwise.

3.3.15 *Blood, CSF & Fluid Tests*

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
ACTH	EDTA Plasma	Potasium EDTA (Blue Top)	4.9ml	7.2 – 63.3 pg/ml	10days STAT: Contact laboratory
Alanine Transaminase ALT	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M < 41 I.U/L F < 33 I.U/L	Routine: 4hrs STAT: 2hrs
Albumin	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	35 - 52 g/L	Routine: 4hrs STAT: 2hrs
Alcohol (ETOH) Plasma	Plasma	Fluoride Oxalate (Yellow Top)	2.7ml	Units: mg%	Routine: 4hrs STAT: 2hrs
Aldosterone	EDTA plasma (patient must be seated for 10mins prior to sample draw)	Potasium EDTA (Blue Top)	4.9ml	Female: 0 – 1179pmol/L Male: 0 - 670pmol/L	20 days
Alkaline Phosphatase	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M 40 - 129I.U/L F 35 – 104 I.U/L	Routine: 4hrs STAT: 2hrs
Alpha Fetoprotein (blood)	Serum	Brown top (Serum)	4.9ml	0 – 5.8 (kU/L)	3days
Alpha-1-Antitrypsin	Plasma	Lithium Heparin (Orange Top)	4.9ml	0.9-2.0 g/L	72 hours

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Adrenal Vein Sampling (Aldosterone and Cortisol)	See labels	See labels	See labels	See individual tests	See individual tests
Amylase	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	28 - 100 I.U/L	Routine: 4hrs STAT: 2hrs
Amylase (fluid)	Fluid	Plain (White Top)	5ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs STAT: 2hrs
Aspartate Transaminase	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M < 40 I.U/L F < 32 I.U/L	Routine: 4hrs STAT: 2hrs
B2 Microglobulin Serum	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	<60yrs: 0.8 – 2.4mg/L >60yrs: ≤ 3.0mg/L	72 hours
Beta Human Chorionic Gonadotrophin	Serum	Serum (Brown Top)	4.9ml	IU/L Non-pregnant, pre-menopausal women: <1 Postmenopausal women: <7 Men: <2	Routine: 3days STAT:2hrs
Beta Natriuretic Peptide (NT proBNP II)	Lithium Heparin or Serum	Plain (White Top) or Lithium Heparin (Orange Top)	4.9ml	35y-45y M 0-115pg/mL 35y-45y F 0-237 pg/mL 45y-55y M 0-173 pg/mL 45y-55y F 0-284 pg/mL 55y-65y M 0-386 pg/mL 55y-65y F 0-352 pg/mL 65y-75y M 0-879 pg/mL 65y-75y F 0-623 pg/mL	24hours

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Beta 2 Transferrin	Fluid collection (otorrhoea / rhinorrhea) plus Paired serum sample	Fluid - Plain Serum (white top)	As much as possible 4.9ml	See Interpretive Comment	196 hrs
Bilirubin	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	< 21 µmol/L	Routine: 4hrs STAT: 2hrs
Bilirubin (fluid)	Fluid	Plain (White Top)	5ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs STAT: 2hrs
Bilirubin Direct	Lithium Heparin Protected from light.	Lithium Heparin (Orange Top)	4.9ml	< 5.0µmol/L	72 hours
C-Peptide	Serum	Plain (White Top)	4.9ml	1.1 – 4.4µmol/L	10days
C Reactive Protein	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	0 – 5 mg/L	Routine: 4hrs STAT: 2hrs
CA 12-5	Serum	Brown top (Serum)	4.9ml	<35 kU/L	3days
CA 15-3	Serum	Brown top (Serum)	4.9ml	<25–kU/L	3days
CA 19-9	Serum	Brown top (Serum)	4.9ml	<27 kU/L	3days
Caeruloplasmin	Lithium Heparin	Lithium Heparin (Orange top)	4.9ml	M 0.15 – 0.30 g/L F 0.16 – 0.45g/L	72 hours

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Calcium	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	18-60yrs: 2.15 – 2.50mmol/L 60-90yrs: 2.20 – 2.55mmol/L >90yrs: 2.05 – 2.40mmol/L	Routine: 4hrs STAT: 2hrs
Calcium Adjusted	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	2.21 – 2.52 mmol/L (Locally derived equation)	Routine: 4hrs STAT: 2hrs
Carbamazepine	Serum	Plain (White Top)	4.9ml	4.0 - 12.0 mg/L	Routine: 4hrs STAT: 2hrs
Carcinoembryonic Antigen	Serum	Brown top (Serum)	4.9ml	<5.2 ng/ml	3days
Chloride Plasma	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	95 - 108 mmol/L	Routine: 4hrs STAT: 2hrs
Cholesterol	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	< 5.0mmol/L	Routine: 4hrs
Cholesterol – Fluid	Fluid	Plain (White Top)	4.9ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs
Cortisol A.M.	Serum	Brown Top (Serum)	4.9ml	166 - 507 nmol/L	24hrs
Cortisol Day Curve (Hydrocortisone)10 timed samples for Cortisol	See Labels	See Labels	7.5ml	N/A Dynamic Function Test	24hrs
Cortisol Day Curve (Cushings) 6 timed samples for Cortisol	Serum	Brown Top (Serum)	4.9ml	N/A Dynamic Function Test	24hrs
Cortisol M/N	Serum	Brown Top (Serum)	4.9ml	See Interpretive Comment	24hrs
Cortisol Random	Serum	Brown Top (Serum)	4.9ml	See Interpretive Comment	Routine: 24hrs STAT: 2hrs

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Creatine Kinase Total	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M 39 – 308 I.U/L F 26 - 192 I.U/L	Routine: 4hrs STAT: 2hrs
Creatinine (fluid)	Fluid	Plain (White Top)	4.9ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs
Creatinine (plasma)	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M 59 – 104 µmol/L F 45 - 84 µmol/L	Routine: 4hrs STAT: 2hrs
Creatinine Clearance 2 labels print – 24 hr Urine and Blood	Lithium Heparin/24HU	Lithium Heparin (Orange Top)/24HU	4.9ml & 24HU	80 - 125 ml/min	Routine: 48hrs
CRF Timed samples for Cortisol and ACTH	See Labels	See Labels	4.9ml	N/A Dynamic Function Test	STAT: Contact laboratory
Cryoglobulins (CRYOS, SPE, IGG) Sample must be clotted @ 37°C	Serum & EDTA plasma 8 hour Fasting Samples Required	Serum Plain (White Top) Plasma Pink EDTA	7.5ml filled 2.6ml filled	Qualitative See individual tests	840 hours
CSF Protein / Glucose	CSF	Plain	300ul	See individual tests	Routine: 4hrs STAT: 2hrs
CSF Xanthochromia	CSF Brown	Brown plastic	1ml	N/A See Interpretive Comment	24hours
Cyclosporin A	Whole Blood	Potassium EDTA (Pink Top)	2.6ml	N/A See Interpretive Comment	10 days
Cystatin C	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	0.61mg/L – 0.95mg/L	10 days

<table>
<tr><th>Test</th><th>Sample Required</th><th>Specimen Container</th><th>Minimum Volume</th><th>Reference Range</th><th>TAT</th></tr>
<tr><td>Dehydroepiandrostenesulphate (DHEAS)</td><td>Serum</td><td>Plain (White Top)</td><td>4.9ml</td><td>(µmol/L)<table><tr><th>Years</th><th>Females</th><th>Males</th></tr><tr><td>15-20y</td><td>1.8-10.0</td><td>1.9-13.4</td></tr><tr><td>20-25y</td><td>4.0-11.0</td><td>5.7-13.4</td></tr><tr><td>25-35y</td><td>2.7-9.2</td><td>4.3-12.2</td></tr><tr><td>35-45y</td><td>1.7-9.2</td><td>2.4-11.6</td></tr><tr><td>45-55y</td><td>1.0-7.0</td><td>1.2-9.0</td></tr><tr><td>55-65y</td><td>0.5-5.6</td><td>1.4-8.0</td></tr><tr><td>65-75y</td><td>0.3-6.7</td><td>0.9-6.8</td></tr><tr><td>≥ 75y</td><td>0.3-4.2</td><td>0.4-3.3</td></tr></table></td><td>3days</td></tr>
<tr><td>Dexamethasone Supression.
High Dose Long
3 Timed Cortisol Samples</td><td>Serum</td><td>Brown Top (Serum)</td><td>4.9ml</td><td>N/A
Dynamic Function Test</td><td>24hrs</td></tr>
<tr><td>Dexamethasone Supression.
Low Dose Long
3 Timed Cortisol Samples</td><td>Serum</td><td>Brown Top (Serum)</td><td>4.9ml</td><td>N/A
Dynamic Function Test</td><td>24hrs</td></tr>
<tr><td>Dexamethazone Overnight Supression.
Single Timed Cortisol Sample</td><td>Serum</td><td>Brown Top (Serum)</td><td>4.9ml</td><td>N/A
Dynamic Function Test</td><td>Routine: 24hrs
STAT: 2hrs</td></tr>
<tr><td>Dexamethazone Suppression Test 8mg</td><td>Serum</td><td>Brown Top (Serum)</td><td>4.9ml</td><td>N/A
Dynamic Function Test</td><td>24hrs</td></tr>
<tr><td>Digoxin</td><td>Serum</td><td>Plain (White Top)</td><td>4.9ml</td><td>0.6 – 1.2 µg/L</td><td>Routine: 4hrs
STAT: 2hrs</td></tr>
<tr><td>Estimated Glomerular Filtration Rate (eGFR)</td><td>Lithium Heparin</td><td>Lithium Heparin (Orange Top)</td><td>4.9ml</td><td>>90ml/min/1.72m^2</td><td>Routine: 4hrs
STAT: 2hrs</td></tr>
<tr><td>Ethanol</td><td>Plasma</td><td>Fluoride oxalate (YELLOW cap)</td><td>2.7ml</td><td>Unit: mg %</td><td>2 hours for STAT samples</td></tr>
</table>

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Ferritin	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	Female 17-60yr: 13 – 150 ng/mL Male 20-60yr: 30 – 400 ng/mL No reference range for >60yr old.	3days
Folate/Folic Acid	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	3.9-26.8 µg/L	3days
Follicle Stimulating Hormone	Serum	Brown Top (Serum)	4.9ml	Male :1.5 – 12.4 U/L Female: Follicular: 3.5-12.5 U/L Mid Cycle: 4.7 – 21.5 U/L Luteal 1.7-7.7 U/L Post Menopausal : 25.8-134.8 U/L	3days
Free T3	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	3.1 – 6.8	3days
Free Thyroxine (FT4)	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	11.9 -21.6 pmol/L	3days
G-Glutamyl Transferase	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M < 59 I.U/L F< 39 I.U/L	Routine: 4hrs STAT: 2hrs
Globulin (calculated value includes Protein & Albumin)	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	See individual tests	Routine: 2.5hrs STAT: 2hrs
Glucagon Test	See Labels	See Labels	4.9ml	N/A Dynamic Function Test	See individual tests
Glucose (fluid)	Fluid	Fluoride Oxalate (Yellow Top)	2.7ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Glucose 120 minutes (2 HR PP)	Plasma	Fluoride Oxalate (Yellow Top)	2.7ml	Units: mmol/L	Routine: 4hrs STAT: 2hrs
Glucose Random Sample	Plasma	Fluoride Oxalate (Yellow Top)	2.7ml	Units: mmol/L	Routine: 4hrs STAT: 2hrs
Glucose Tolerance Test	See Labels	Fluoride Oxalate (Yellow Top)	2.7ml	Units: mmol/L	Routine: 4hrs STAT: 2hrs
Glucose Tolerance Test (Short)	See Labels	See Labels	See Labels	See individual tests	See individual tests
Glucose Tolerance Test for HGH	See Labels	See Labels	See Labels	N/A Dynamic Function Test	20 days
Glucose Tolerance with Rels. Factors	See Labels	See Labels	See Labels	See individual tests	See individual tests
Glucose Zero Time (Fasting)	Plasma	Fluoride Oxalate (Yellow Top)	2.7ml	3.6 – 6.0mmol/L	Routine: 4hrs STAT: 2hrs
Gonadotrophins (FSH & LH)	Serum	Brown Top (Serum)	See Labels	See individual tests	3days
GTT Prolonged	See Labels	See Labels	See Labels	N/A Dynamic Function Test	See individual tests
GTT with Insulin	See Labels	See Labels	4.9ml	N/A Dynamic Function Test	10 days
Haemoglobin A1C	Whole Blood	Potassium EDTA (Pink Top)	2.6ml	20 – 42 mmol/mol In normal subjects	96hours

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
HGH day Curve 5 Timed GH samples	See Labels	See Labels	See Labels	N/A Dynamic Function Test	20days
Hirsute Synacthen Stimulation	See Labels	See Labels	See Labels	N/A Dynamic Function Test	See individual tests
Human Growth Hormone	Serum	Brown Top (Serum)	4.9ml	(ng/ml) See Interpretive Comment	20days
Hypoglycaemia Screen glucose, insulin, c-peptide, proinsulin, beta-hydroxybutyrate serum Sulphonylureas	See Labels	See Labels	See Labels	See Individual Tests	See individual tests
Interleukin 6	Serum	Brown Top (Serum)	4.9ml	< 7.0pg/mL	10 days
Immunoglobulins G,A,M	Serum	Brown Top (Serum)	4.9ml	IgG: 7.0 – 16.0g/L IgA: 0.7-4.0 g/L IgM: 0.4-2.3 g/L	72 hours
Insulin & C-Peptide	See Labels	See Labels	See labels	See individual tests	10days
Insulin Stress Test Timed samples for Insulin, Growth Hormone & Glucose	See Labels	See Labels	See Labels	N/A Dynamic Function Test	10days
Insulin Stress Test+ Release Factors	See Labels	See Labels	See Labels	N/A Dynamic Function Test	10days
Insulin Fasting	Serum	Plain (White Top)	See Labels	Fasting: 2.6-24.9 mU/L (provided fasting glucose is within normal/ reference range)	10days

<table>
<tr><th>Test</th><th>Sample Required</th><th>Specimen Container</th><th>Minimum Volume</th><th>Reference Range</th><th>TAT</th></tr>
<tr><td>Insulin-Like Growth Factors-1</td><td>Serum</td><td>Plain
(White Top)</td><td>4.9ml</td><td>(ng/ml)
<table>
<tr><th>Years</th><th>Female</th><th>Male</th></tr>
<tr><td>0-1y</td><td>17.9-125.6</td><td>27.0-157.0</td></tr>
<tr><td>1-2y</td><td>19.5-132.3</td><td>29.7-166.8</td></tr>
<tr><td>2-3y</td><td>22.2-145.4</td><td>33.9-183.9</td></tr>
<tr><td>3-4y</td><td>25.9-164.2</td><td>39.0-204.5</td></tr>
<tr><td>4-5y</td><td>30.7-187.8</td><td>44.3-225.0</td></tr>
<tr><td>5-6y</td><td>26.2-214.4</td><td>50.0-245.5</td></tr>
<tr><td>6-7y</td><td>42.0-240.4</td><td>56.2-267.1</td></tr>
<tr><td>7-8y</td><td>48.6-269.6</td><td>63.4-291.9</td></tr>
<tr><td>8-9y</td><td>56.9-305.3</td><td>72.4-323.1</td></tr>
<tr><td>9-10y</td><td>67.2-349.4</td><td>83.6-361.6</td></tr>
<tr><td>10-11y</td><td>79.5-400.3</td><td>96.9-406.6</td></tr>
<tr><td>11-12y</td><td>92.6-452.6</td><td>111.6-454.4</td></tr>
<tr><td>12-13y</td><td>105.3-499.1</td><td>126.1-498.7</td></tr>
<tr><td>13-14y</td><td>115.9-533.4</td><td>138.6-532.5</td></tr>
<tr><td>14-15y</td><td>123.4-552.0</td><td>147.5-551.2</td></tr>
<tr><td>15-16y</td><td>127.4-554.2</td><td>152.2-553.5</td></tr>
<tr><td>16-17y</td><td>127.9-541.5</td><td>152.9-541.8</td></tr>
<tr><td>17-18y</td><td>125.3-517.3</td><td>150.6-520.6</td></tr>
<tr><td>18-19y</td><td>120.5-485.8</td><td>146.2-493.6</td></tr>
<tr><td>19-20y</td><td>114.4-450.8</td><td>140.2-462.7</td></tr>
<tr><td>20-21y</td><td>107.8-416.0</td><td>133.1-430.0</td></tr>
<tr><td>26-31y</td><td>78.4-270.0</td><td>97.9-281.6</td></tr>
<tr><td>31-36y</td><td>73.1-243.0</td><td>88.3-246.0</td></tr>
<tr><td>36-41y</td><td>69.0-227.0</td><td>83.4-232.7</td></tr>
<tr><td>41-46y</td><td>61.5-204.4</td><td>74.9-216.4</td></tr>
<tr><td>46-51y</td><td>56.8-194.5</td><td>66.9-205.1</td></tr>
<tr><td>51-56y</td><td>53.0-189.6</td><td>60.6-200.3</td></tr>
<tr><td>56-61y</td><td>45.6-172.4</td><td>54.3-194.2</td></tr>
<tr><td>61-66y</td><td>42.2-169.0</td><td>48.8-187.7</td></tr>
<tr><td>66-71y</td><td>38.3-162.5</td><td>46.5-191.9</td></tr>
<tr><td>71-76y</td><td>36.6-164.7</td><td>40.9-179.2</td></tr>
<tr><td>76-81y</td><td>34.7-164.8</td><td>37.1-172.0</td></tr>
<tr><td>81-86y</td><td>34.4-172.4</td><td>33.8-165.4</td></tr>
<tr><td>86-91y</td><td>33.6-177.8</td><td>32.2-166.1</td></tr>
</table></td><td>20days</td></tr>
</table>

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Intravenous Petrosal Sampling 16 site specific labels for ACTH	EDTA Plasma	BLUE	4.9ml	N/A Dynamic Function Test	10days
Iron (FE) & Transferrin Saturation	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	5.8 – 34.5µmol/L A Fasting Transferrin Saturation > 55% in Males or > 50% in Females indicates Iron accumulation.	Routine: 4hrs
Lactate	CSF	Plain	300ul	1.01 – 2.09 mmol/L	Routine: 4hrs STAT: 2hrs
Lactate Dehydrogenase	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M 135 – 225 I.U/L F 135 – 214 I.U/L Please note: LDH test results may be increased by up to 14% by sending the sample to the laboratory using the pneumatic chute transport system. Interpret results with caution.	Routine: 4hrs
LDH (fluid)	Fluid	Plain (White Top)	5ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs
Lithium Serum	Serum	Plain (White Top)	4.9ml	0.6 – 1.2 mmol/L	Routine: 4hrs STAT: 2hrs
Lipid Profile (Fasting)	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	Cholesterol ≤ 5.0mmol/L LDL (calculated) ≤ 3.0mmol/L HDL Cholesterol ≥ 1.0mmol/L Triglycrides ≤ 1.7mmol/L Non HDL cholesterol ≤ 3.8mmol/L	Routine: 4hrs

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Lipid Profile (Non Fasting)	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	Cholesterol ≤ 5.0mmol/L LDL (calculated) ≤ 3.0mmol/L HDL Cholesterol ≥ 1.0mmol/L Triglycrides ≤ 2.0mmol/L Non HDL cholesterol ≤ 3.8mmol/L	Routine: 4hrs
Liver Function	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	See individual tests	Routine: 4hrs STAT: 2hrs
Lutenising Hormone	Serum	Brown Top (Serum)	4.9ml	Follicular: 2.4 - 12.6 U/L Ovulation: 14.0 - 95.6 U/L Luteal: 1.0 - 11.4 U/L Post Menopausal: 7.7 - 58.5 U/L Male : 1.7 - 8.6 U/L	3days
Lutenising Hormone Releasing F.	See Labels	See Labels	4.9ml	See individual tests	See individual tests
Magnesium	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	0.66 – 1.07mmol/L	Routine: 4hrs STAT: 2hrs
Oestradiol	Serum	Brown Top (Serum)	4.9ml	Male: 41.4 – 159 pmol/L Female: Follicular: –114-332 pmol/L Ovulation: 222-1959 pmol/L Luteal: 222-854 pmol/L Post Menopausal: 18.4 - 505 pmol/L	3days
Osmolality Plasma	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	275 – 295 mOsm/Kg	Routine: 4hrs STAT: 4hrs
Paracetamol - Serum	Serum	Plain (White Top)	4.9ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs STAT: 2hrs

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Parathyroid Hormone	Plasma	Potasium EDTA (Blue Top)	4.9ml	17 - 74pg/mL	3days
Phenobarb	Serum	Plain (White Top)	4.9ml	10.0 - 40.0 mg/L	Routine: 4hrs STAT: 2hrs
Phenytoin	Serum	Plain (White Top)	4.9ml	5.0-20.0 mg/L	Routine: 4hrs STAT: 2hrs
Phosphate	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	0.81 - 1.45 mmol/L	Routine: 4hrs STAT: 2hrs
Pituitary Screen	See Labels	See Labels	See labels	See Individual Tests	20days
Plasma Metanephrines	EDTA Plasma on Ice (Sample must arrive in the Lab within 1 hour of collection)	REDL	7.5ml	Reference ranges are based on a fasting adult patient in a seated position: Normetanephrine <1180 pmol/L Metanephrine <510 pmol/L 3-Methoxytyramine <180 pmol/L For samples taken in a supine Posture (post 30 mins rest), supine reference ranges are recommended: Normetanephrine <730 pmol/L Metanephrine <450 pmol/L 3-Methoxytyramine <180 pmol/L	12 days
Post Transplant GTT(Timed GLUC and INS)	See Labels	See Labels	See Labels		See individual tests
Potassium	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	3.5 – 5.3 mmol/L	Routine: 4hrs STAT: 2hrs

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Potassium (fluid)	Fluid	Plain (White Top)	5ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs
Procalcitonin	Serum	Brown Top (Serum)	4.9ml	See Interpretive Comment	1 batch run daily
Progesterone	Serum	Brown Top (Serum)	4.9ml	Male: 0.159 - 0.474 nmol/L Female: Follicular: 0.159 – 0.616 nmol/L Ovulation: 0.175 – 13.2 nmol/L Luteal: 13.1 – 46.3 nmol/L Post Menopasal: 0.159-0.401 nmol/L	3days
Prolactin	Serum	Brown Top (Serum)	4.9ml	Total Prolactin Female: 102-496 mIU/L Male: 86-324 mIU/L Bioactive Prolactin: Female: 75-381mIU/L Male: 63-245 mIU/L Bioactive prolactin is the biologically active form of prolactin.	Routine: 3days STAT: Discuss with laboratory
Prostate Specific Antigen	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	Age related PSA Levels (non-suspicious DRE) <50 = <2ug/L 50 – 59 = <3ug/L 60 – 69 = <4ug/L 70+ = <5ug/L	Routine: 3days

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Protein & Albumin	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	See individual tests	Routine: 4hrs STAT: 2hrs
Protein & Albumin (fluid)	Fluid	Plain MSU	5ml	See individual tests	Routine: 4hrs
Protein Total	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	60 - 80 g/L	Routine: 4hrs STAT: 2hrs
Renal Profile (UREA/NA/K/CL/CREAT)	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	See individual tests	Routine: 4hrs STAT: 2hrs
Renin	EDTA plasma	Potasium EDTA (Blue Top)	4.9ml	Female: 6.1 – 62.7mIU/L Male: 9.0 – 103.5mIU/L	20days
Salicylate - serum	Serum	Plain (White Top)	4.9ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs STAT: 2hrs
Saline Suppression Test	See Labels	See Labels	4.9ml	N/A Dynamic Function Test	See individual tests
Serum Free Light Chains	Serum	White Top (Serum)	4.9ml	Free Kappa 3.30 – 19.40 mg/L Free Lamda 5.71 – 26.30 mg/L Kappa / Lambda ratio 0.26 – 1.65 Modified Kappa / Lambda ratio of 0.82 – 3.6 where eGFR ≤55Ml/min//1.73m^2	14 days

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Serum Protein Electrophoresis (Protein Total, SPE, IGGs)	Serum	Brown Top (Serum)	4.9ml	Protein Total 60 - 80 g/L IgG: 7.0 – 16.0g/L IgA: 0.7-4.0 g/L IgM: 0.4-2.3 g/L And Interpretative Comment	840 hours
Sex Hormone Binding Globulin	Serum	Plain (White Top)	4.9ml	M: 20-49yr: 18.3-54.1 nmol/L M: ≥ 50yr: 20.6-76.7 nmol/L F: 20-49yr: 32.4-128 nmol/L F: ≥ 50yr: 27.1-128 nmol/L No SHBG reference intervals for <20yr old.	3days
Sodium	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	133 - 146 mmol/L	Routine: 4hrs STAT: 2hrs
Sodium (fluid)	Fluid	Plain (White Top)	5ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs
Synacthen Stimulation Test	See Labels	See Labels	4.9ml	N/A Dynamic Function Test	Routine: 24hrs STAT: 2hrs
Tacrolimus (FK506)	Whole Blood	Potassium EDTA (Pink Top)	2.6ml	N/A See Interpretive Comment	72hrs. Cut off for receipt of samples for same day analysis is 11am

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Testosterone	Serum	Plain (White Top)	4.9ml	Male: (19 - 50y): 8.6 - 29.0 nmol/L (≥50y): 6.7 - 25.7 nmol/L Female: (19 - 50y): 0.3 - 1.7 nmol/L (≥50y): 0.1 –1.4 nmol/L	3days
Theophylline	Serum	Plain (White Top)	4.9ml	10.0 - 20.0 mg/L	Routine: 4hrs STAT: 2hrs
Thyroid Function Tests	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	See TSH & FT4 reference ranges.	Routine: 3days
Thyroid Stimulating Hormone	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	0.27-4.20 mU/L	Routine: 3days
Thyrotropin Releasing Factor	See Labels	See Labels	7.5ml	N/A Dynamic Function Test	See individual tests
Total CO2 / Bicarbonate	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	22 - 29 mmol/L	Routine: 4hrs STAT: 2hrs
Total Thyroxine (TT4)	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	66 – 181nmol/L	3days
Triglyceride	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	Fasting 0.5 – 1.7mmol/L Non Fasting 0.5 – 2.0mmol/L	Routine: 4hrs
Triglyceride (fluid)	Fluid	Plain (White Top)	5ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Troponin T Must have a dedicated sample	Lithium Heparin	Lithium Heparin (Orange Top)	2.7ml	< 14 ng/L	1.5 hours
Urate/Uric Acid	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	M 202 - 416µmol/L F 143 - 340µmol/L	Routine: 4hrs STAT: 2hrs
Urea	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	2.8 – 8.1mmol/L	Routine: 4hrs STAT: 2hrs
Urea (fluid)	Fluid	Plain (White Top)	5ml	N/A Interpret in conjunction with clinical findings.	Routine: 4hrs STAT: 2hrs
UREA/NA/K/CL/CREAT/TCO2	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	See individual tests	Routine: 4hrs STAT: 2hrs
Valproic Acid	Serum	Plain (White Top)	4.9ml	50 – 100 mg/L	Routine: 4hrs STAT: 2hrs
Vit.B12 / Folic Acid	Lithium Heparin	Lithium Heparin (Orange Cap)	4.9ml	See individual tests	3days
Vitamin B12	Lithium Heparin	Lithium Heparin (Orange Top)	4.9ml	197-771ng/L	3days
Vitamin D	Serum	Serum Gel	4.9ml	Deficient: < or = 50nmol/L	10 days
Water Deprivation Test 10 Timed Samples plasma & urine osmolality	See Labels	See Labels	4.9ml plasma 5ml urine	N/A Dynamic Function Test	24 hours

3.3.16 *Urine Tests*

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
5-HIAA Urine	24 Hour Urine	Pre-Acidified Container	N/A	<50 umol/24hours	288 hours
Albumin Creatinine Ratio(Urine)	MSU	Plain MSU	5ml	M 0.0 – 2.5mg/mmol F 0.0 – 3.5mg/mmol	Routine: 96hrs
Alcohol (ETOH) urine	MSU	Plain MSU	5ml	Qualitative	Temporarily outsourced. 5 days
Amylase - Spot Urine Sample	MSU	Plain MSU	5ml	M: 16 – 491 I.U/L F: 21 – 447 I.U/L	Routine: 4hrs STAT: 2hrs
Calcium - 24 Hour Urine	24 Hour Urine	24hr. No Preservative	N/A	2.5 - 7.5 mmol/24Hr	Routine: 48hrs STAT: 2.5hrs
Chloride - Spot Urine Sample	MSU	Plain MSU	5ml	Units: mmol/L	Routine: 4hrs
Creatinine - Spot Urine Sample	MSU	Plain MSU	5ml	Units µmol/L	Routine: 4hrs
Creatinine – 24 Hour Urine	24 Hour Urine	24hr. No Preservative	N/A	M 9000 – 19000 µmol/24Hrs F 6000 - 13000 µmol/24Hrs	Routine: 4hrs
Magnesium - 24 Hour Urine	24 Hour Urine	24hr Collection. No Preservative	N/A	3.0 – 5.0 mmol/24Hr	Routine: 24hrs
Osmolality Urine	MSU	Plain MSU	5ml	400-1000 mOsm/Kg	Routine: 24hrs STAT: 4hrs
Phosphate - 24 Hour Urine	24 Hour Urine	24hr Collection. No Preservative	N/A	13.00 – 42.00 mmol/24Hrs	Routine: 24hrs
Potassium – Spot Urine Sample	MSU	Plain MSU	5ml	Units: mmol/L	Routine: 4hrs
Potassium - 24 Hour Urine	24 Hour Urine	24hr Collection. No Preservative	N/A	30.0 – 100.0mmo/24Hrs	Routine: 24hrs STAT: 2.5hrs

Test	Sample Required	Specimen Container	Minimum Volume	Reference Range	TAT
Protein-Creatinine Ratio	MSU	Plain MSU	5ml	3 - 14 mg/mmol	Routine: 96hrs
Sodium - 24 Hour Urine	24 Hour Urine	Plain Container	N/A	40.0 – 220.0mmol/24Hrs	Routine: 24hrs STAT: 2.5hrs
Sodium - Spot Urine Sample	MSU	Plain MSU	5ml	Units: mmol/L	Routine: 4hrs
Total Urinary Proteins	24 Hour Urine	Plain Container	N/A	0.05 - 0.14 g/24HR	Routine: 24hrs STAT: 2.5hrs
Urate - 24 Hour Urine	24 Hour Urine	Plain Container	N/A	1.20 – 5.90mmol/24Hr	Routine: 24hrs
Urea - 24 Hour Urine	24 Hour Urine	Plain Container	N/A	428.0 – 714.0mmol/24Hr	Routine: 24hrs
Urea - Spot Urine Sample	MSU	Plain MSU	5ml	Units: mmol/L	Routine: 4hrs
Urinary Catecholamines	24 Hour Urine	Pre-Acidified Container	N/A	Reference Ranges quoted in Section above this table	Routine: 576hrs
Urinary Total Fractionated Metanephrines (Total Metanephrine & Total Normetanephrine)	24 Hour Urine	Pre-Acidified Container	N/A	Reference Ranges quoted in Section above this table	Routine: 576hrs
Urine Protein Electrophoresis: (BJP) or Myeloma Screen Known Myeloma Patient	EMU (early morning urine) 24 Hour Urine	Plain Container	N/A	Qualitative	35 days
Urine Stone Screen.	See Labels	See Labels	See Labels	See individual tests	See individual tests

3.3.16.1 Calculated / Derived Tests

Calculated Parameter	Formula	Reference Range	Units	Important Notes
Calcium Adjusted	[Ca] + (46.18 – [Alb]) * 0.01516	2.21 – 2.52	mmol/L	Equation only validated for Albumin 30g/L and < 52g/L. Equation derived in house.
Estimated Glomerular Filtration Rate (Female Creatinine < 62µmol/L)	$144 \times (Creat/62)^{-0.329} \times (0.993)^{Age}$	>90	$ml/min/1.72m^2$	The calculation is not valid in patients with acute kidney injury, pateints receiving dialysis, patients under the age of 18yrs, pregnant patients, for drug dosing and/or in people at extremes of body type e.g patients with limb amputations, severely malnourished or very muscalr.
Estimated Glomerular Filtration Rate (Female Creatinine > 62µmol/L)	$144 \times (Creat/62)^{-1.209} \times (0.993)^{Age}$	>90	$ml/min/1.72m^2$	
Estimated Glomerular Filtration Rate (Male Creatinine < 80µmol/L)	$141 \times (Creat/80)^{-0.4.11} \times (0.993)^{Age}$	>90	$ml/min/1.72m^2$	
Estimated Glomerular Filtration Rate (Male Creatinine > 80µmol/L)	$141 \times (Creat)/80)^{-1.209} \times (0.993)^{Age}$	>90	$ml/min/1.72m^2$	
Globulin	Total protein - albumin	N/A	g/L	
LDL (Low Density Lipoprotein) Cholesterol	Cholesterol – HDL – (triglyceride / 2.2)	See Above	mmol/L	The calculation is unsuitable if the triglyceride level is > 4.5mmol/l
Non-HDL Cholesterol	Total Choleaterol – HDL Cholesterol.	See Above	mmol/L	

Calculated Parameter	Formula	Reference Range	Units	Important Notes
Transferrin saturation (TfS)	(Iron / Transferrin) * 398	See Interpretive Comment	%	If transferrin saturation > 50% please repeat on a morning fasting sample. Refer to: BSCH guidelines. A fasting transferrin saturation > 55% in males or >50% in females indicates iron accumulation.
Unconjugated Bilirubin	Total Bilirubin – Conjugated Bilirubin	0.0 – 5.0	µmol/L	Lithium Heparin, protected from light.

3.4 IMMUNOLOGY

The Immunology Department provides both Clinical and Laboratory Services. Additionally we are keen to assist with the development of guidelines for investigations of potential immunological disorders, clinical audit and other educational activities.

3.4.1 Clinical Service

There is a general immunology clinic held in Clinic A on Monday mornings and an allergy clinic held in Clinic F on Thursday afternoons. Additionally, ANP led allergy clinics are held in the department on Monday, Tuesday, Wednesday and Thursday mornings. The Department also has an established home therapy programme for patients on immunoglobulin replacement therapy and an ANP-led review clinics for these patients are held in the department on Thursday afternoons.

Referrals are accepted from hospital teams and GPs. Self-referrals from patients cannot be accepted. Appropriate referrals include known or suspected immunodeficiency, recurrent infections, serious allergy (anaphylaxis) or angioedema, as well as difficult autoimmune disease. A detailed referral letter including current medications, previous treatments and laboratory investigations with results should be sent to Prof. Keogan/Dr Khalib/Dr Cox. Please ensure that the patients' correct address and phone number is included.

For perioperative anaphylaxis assessment referrals, a referral Proforma must be completed. This Proforma is available for download from the departmental intranet and internet homepage.

Appointments are allocated on the basis of clinical urgency. Due to the long waiting time, we do not routinely offer second appointments to patients who fail to attend without cancelling their appointment.

3.4.2 Laboratory Service

The Laboratory provides a large range of immunological investigations focussing on investigations for autoimmune and allergic disorders. Details of disease specific test profiles and test repertoire and disease specific test profiles are provided below. Some immunology tests are carried out in the Protein chemistry and Haematology laboratories.

When we are unable to provide a clinically important assay, we will attempt to source a referral laboratory, to which specimens may be sent. We welcome input from interested clinicians in this process. The choice of laboratory is primarily based on quality grounds, with only accredited laboratories being chosen. If a clinically important test is only available on a research basis only, the

immunology team is available for further discussion. Other factors such as cost and turnaround times are also considered. A list of commonly requested referred investigations is included below in section 3.5.6.

*3.4.3 **Out-of-Hours Service***

There are no arrangements in place as yet to provide an out-of-hours service. On the rare occasions when there is genuine clinical urgency in performing an assay, every effort is made to perform the relevant test, however such a service cannot be guaranteed.

The Consultant Immunologist on-call, Prof. Keogan/Dr Khalib/Dr Cox can be contacted through the switch board for clinical advice out-of-hours. If immunological investigations would affect a patient's management on an out-of hours or urgent basis, such requests should be discussed with Prof. Keogan/Dr Khalib/Dr Cox by a senior member of the clinical team who is familiar with the patient's history.

*3.4.4 **Educational Activities***

If you feel that Immunology input would be helpful in some of your training or audit activities, please contact Prof. Keogan/Dr Khalib/Dr Cox.

*3.4.5 **Urgent Requests***

An urgent service is available for some assays. We will only consider performing urgent assays when the result obtained is likely to affect the patient's management. It is helpful if requests for urgent samples can be made by telephone as early as possible in the day.

Urgent requests must be discussed with a senior member of the scientific staff in the first instance, and may also require discussion with the consultant immunologist. Additionally when requesting an urgent test, please use the 'STAT' flag on the computer system. Please remember however, that a 'STAT' flag alone does not ensure that the specimen will be processed immediately. Urgent samples must be hand delivered to the Immunology laboratory.

*3.4.6 **Tests Referred to External Laboratories***

Please note dispatch of samples to our referral labs is done weekly however urgent referral is available pending discussion. Note: Due to a lack of courier service to UK/Europe the turnaround times for referral tests during the Christmas/New Year period is increased by on average 7-10 days.

Test reports from external referral laboratories are scanned into the patient record when received & are available on Powerchart.

Test	Mnemonic	Sample Requirements	Notes	Referral Lab	Ref Range	Turn-Around Time
Adalimumab (both levels & IgG antibodies)	ADALIM & ADALIMIG G	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield		2-4 Weeks
Anti-Acetylcholine Receptor Antibodies	ACRA	Serum Gel Tube 4.9mls		Glasgow Neuroimmunology Laboratory	<0.5 nmol/L	1 Month
Anti-Aquaporin 4 Antibodies (NMO)	AQUA4	Serum Gel Tube 4.9mls		Neurosciences Group, Oxford	Negative	4 Weeks
Anti-Aquaporin 4 Antibodies (NMO) CSF	AQUA4CSF	CSF		Neurosciences Group, Oxford	Negative	4 Weeks
Anti-C1Q Antibodies	ANTIC1Q	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	0-15 u/mL	2-4 Weeks
Anti-Cardiac and Striated Muscle Abs	MUSCLEABSO	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	Negative	24 days

Test	Mnemonic	Sample Requirements	Notes	Referral Lab	Ref Range	Turn-Around Time
Anti- Diphtheria antibodies	DIPH	Serum Gel Tube 4.9mls		Manchester Medical Microbiology Partnership	0.1IU/mL protective level	Up to 3 Months
Anti-Gangleoside Antibodies	GANG AB	Serum Gel Tube 4.9mls		Glasgow Neuroimmunology Laboratory	Negative	18 days
Anti-Ganglioside Antibodies (CSF)	GANG ABCSF	CSF		Neurosciences Group, Oxford	Negative	18 days
Anti-Glutamic Acid Decarboxylase Antibody	GAD	Serum Gel Tube 4.9mls		Immunology Dept, Mater Hospital	<9 IU/mL	5 Weeks
Anti-Haemophilus influenzae B Antibodies (HIB)	HIB	Serum Gel Tube 4.9mls		Immunology Black Country Pathology Services New Cross Hospital	0.15 mg/L Minimum protective level	Up to 2 Months
Anti-Insulin Antibody	INAB	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	<5 mg/L	19 days
Anti-Islet Antigen Type 2 Antibodies	IA2	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	<10 IU/mL	4 Weeks
Anti-Islet Cell Antibodies	ICA	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	Negative	24 days

Test	Mnemonic	Sample Requirements	Notes	Referral Lab	Ref Range	Turn-Around Time
Anti-Musk Antibodies	MUSK	Serum Gel Tube 4.9mls		Neurosciences Group, Oxford	Negative	4-6 Weeks
Anti-MAG antibodies	MAGA	Serum Gel Tube 4.9mls		Neurosciences Group, Oxford	0-1000 BTU	3-4 Weeks
Anti-MOG Antibodies	MOG	Serum Gel Tube 4.9mls		Neurosciences Group, Oxford	Negative	5 Weeks
Anti-Myelin Oligodendrocyte Antibodies (CSF)	MOGCSF	CSF		Neurosciences Group, Oxford	Negative	5 Weeks
Anti-Ovarian Antibodies	OVA	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	Negative	1 Month
Anti-PLA2R Antibodies	PLA2R	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	0-13 RU/mL	4 weeks
Anti-Tetanus Antibodies	TET	Serum Gel Tube 4.9mls		Immunology Black Country Pathology Services New Cross Hospital	0.01-0.09 IU/mL Basic protection	Up to 2 Months
Anti-Thyroid Receptor Antibodies	TRAB	Serum Gel Tube 4.9mls		Dept. of Endocrinology, St. James Hospital	<1.8 IU/L	24 days
Anti-Voltage Gated Ca Channel Antibodies	VGCC	Serum Gel Tube 4.9mls		Neurosciences Group, Oxford	0-45 PM/L	4-6 Weeks
Anti-Voltage Gated Ca Channel Abs CSF	VGCCCSF	CSF		Neurosciences Group, Oxford		4-6 Weeks

Test	Mnemonic	Sample Requirements	Notes	Referral Lab	Ref Range	Turn-Around Time
Anti-Voltage Gated K+ Channel Antibodies	VGKC	Serum Gel Tube 4.9mls		Neurosciences Group, Oxford	70-130 PM/L Equivocal >130 PM/L Positive	4-6 Weeks
Anti-Zinc Transporter Antibodies	ZNT8	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	<10 U/mL	24 Days
Biologics (except Infliximab, Adalimumab & Rituximab) serum levels & IgG antibodies)	BIOLOGIC & BIOLOGICIGG	Serum Gel Tube 4.9mls	Requesting Clinician to complete Biologics Request Form (LF-IMM-GEN0055) Please contact lab for details.	Sanquin Diagnostic Services, Amsterdam		2-4 Weeks
C3 Nephritic Factor	C3NF	Fresh frozen Serum Gel Tube 4.9mls	Only done on C3 reduced samples	Dept of Immunology, Sheffield	Negative	By Arrangement
Complement C1q Level	C1QLEVEL	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	50-250 mg/L	4-6 Weeks
Complement C2	C2	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	10-30 mg/L	4-6 Weeks

Test	Mnemonic	Sample Requirements	Notes	Referral Lab	Ref Range	Turn-Around Time
Complement Function	COMPFSO	Serum Gel Tube 4.9mls	Serum must be separated & frozen maximum of 3 hours after venepuncture	Dept. of Immunology, St James Hospital	Normal	3 months
Functional C1 Inhibitor	C1INHFXN	Serum Gel Tube 4.9mls		Dept. of Immunology, St James Hospital		35 days
IgG Subclass 4	IGG4	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield	Age Related. Adult 0-1.3 g/L	19 days
Infliximab (both levels & IgG antibodies)	INFLIXIGG & INFLIX	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield		2-4 Weeks
Mannose Binding Lectin	MBL	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield		24 days
Meningococcal Serology (Serotype Specific Antibodies)	MENINGO	Serum Gel Tube 4.9mls		Manchester Medical Microbiology Partnership	Serogroups A,C,Y,W >=8 rSBA Titre protective	Up to 3 Months
Neutrophil Oxidative Burst	OXBURSTSO	Fresh EDTA 4mls plus travel control		Dept. of Immunology, St James Hospital	Normal	By Arrangement/12 days

Test	Mnemonic	Sample Requirements	Notes	Referral Lab	Ref Range	Turn-Around Time
Rituximab (both levels & IgG antibodies)	RITUX & RITUXIGG	Serum Gel Tube 4.9mls	Requesting Clinician to complete Biologics Request Form (LF-IMM-GEN0055) Please contact lab for details.	Sanquin Diagnostic Services, Amsterdam		2-4 Weeks
Specific IgE Referral	SIGEREFERRAL	Serum Gel Tube 4.9mls		Dept of Immunology, Sheffield		24 days
Serotype Specific Anti-Pneumococcal Antibodies	SSPNEUM	Serum Gel Tube 4.9mls		Immunology Addenbrooks Hospital, Cambridge	0.35µg/mL Protective	4-6 Weeks
Urinary Soluble CD163	UCD163	Urine		Dept. of Immunology, St James Hospital		28 days

3.4.6.1 Contact Details of External Laboratories

1. Neurosciences Group, Headington, Oxford Tel:00 44 186 522 5995
2. Glasgow Neuroimmunology Laboratory. Tel:00 44 141 354 9010
3. Dept of Immunology, Northern General Hospital, Sheffield. Tel:00 44 114 271 5552
4. Dept. of Immunology, St James Hospital, Dublin 8. Tel:01 416 2924/2925
5. Immunology Black Country Pathology Services New Cross Hospital. Tel: 00 44 01902 695279
6. Immunology Department, Mater Misericordiae University Hospital, Dublin 7. Tel: 01 803 2398/2119

7. Manchester Medical Microbiology Partnership Tel: 0044 161 276 8854
8. Immunology Addenbrooks Hospital, Cambridge University Hospitals NHS Foundation Trust. Tel: 0044 122 321 6729
9. IMD Berlin, Nicolaistraße 22, Berlin, 12247, Germany Tel: +49 30 77001-220
10. Sanquin Diagnostic Services, Dept UDC, Plesmanlaan 125, 1066 CX Amsterdam, The Netherlands Tel: 0031 20 512 3449

*3.4.7 **Repertoire of Tests & Test Profiles***

All tests are performed on serum samples. Up to 5 tests can be performed on a 10 mL sample. However separate samples are required for some tests to facilitate optimum handling.

Test	**Specimen**	**Minimum Volume**	**Method**	**Reference Range**	**TAT**	**Urgent Service**	**Comment**	**Mnemonic**	**Frequency of Retesting**
Anti-Adrenal Antibodies	Serum Gel Tube	4.9mls	Indirect immunofluorescence	Negative	4 weeks			ADRA	6 months
Anti-Beta2Glycoprotein 1 (IgG and IgM)	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	<10 U/ml	8 days			APS	12 weeks
Anti-Cardiolipin Antibodies (IgG and IgM)	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	IgG: 0-10 GPLU/mL IgM: 0-10 MPLU/mL	8 days			APS	12 weeks
Anti-CCP	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	< 7 U/ml	8 days			CCP	3 Months
Anti-dsDNA Antibodies	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP) & IIF by DNA crithidia	EliA:<10 IU/mL IIF: Negative	EliA:<3-5 days IIF: 8 days	On Request		DNA	>3 weeks (unless plasma-apheresis/ discussion)
Anti-ENA (Extractable Nuclear Antigen) Antibodies – includes anti-Ro, La, RNP, Sm, Jo-1 & Scl-70)	Serum Gel Tube	4.9mls	EliA with confirmation by EliA/Immunoblot	Negative for all 6 components	2-3 weeks		ENA Typing is carried out on all Equivocal and Positive ENA Screens by EliA & conformed with Immunoblot	ENA	>1 year unless patient is pregnant
Anti-Endomysial (IgA) Antibodies	Serum Gel Tube	4.9mls	Indirect Immunofluorescence	Negative	8 days			EMA	>3 months

Test	Specimen	Minimum Volume	Method	Reference Range	TAT	Urgent Service	Comment	Mnemonic	Frequency of Retesting
Anti-Endomysial (IgG) Antibodies	Serum Gel Tube	4.9mls	Indirect Immunofluorescence	Negative	8 days		Only performed when IgA deficiency	EMAG	
Anti-Gastric-Parietal Cell antibodies (Anti-GPC)	Serum Gel Tube	4.9mls	Indirect Immunofluorescence	Negative	3-5 days			GPC	>3 months
Anti-Glomerular Basement Membrane antibodies (Anti-GBM)	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	Negative: <7U/ml Equivocal: 7- 10U/ml Positive: >10 Uml	1-3 days	On Request		GBM	As requested & discussed
Anti-Histone Antibodies	Serum Gel Tube	4.9mls	Immunoblot	Negative	4-6 weeks			HIST	Once Off
Anti-Intrinsic Factor Antibodies	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	Negative: <7 U/ml Equivocal: 7-10 U/mL Positive: > 10 U/ml	8 days			IF	>6 months
Anti-Liver-Kidney Microsomal (LKM and or LC1) Antibodies	Serum Gel Tube	4.9mls	Indirect Immunofluorescence + Immunoblot if IIF positive	Negative	3-5 days			LKM	>1 month
Anti-Mitochondrial Antibody (including M2 subtyping)	Serum Gel Tube	4.9mls	Indirect Immunofluorescence + ELISA if positive	Negative M2 ELISA <10 IU/ml	3-5 days (1 month if IIF positive)			AMA	>3 months M2 performed only once
Anti-Myeloperoxidase antibodies (Anti-MPO)	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	<3.5IU/mL	3-5 days, or as required	On request	Follow-up of patients with know MPO-ANCA positive disease	MPO	3 Weeks, unless discussed

Test	Specimen	Minimum Volume	Method	Reference Range	TAT	Urgent Service	Comment	Mnemonic	Frequency of Retesting
Anti-Myeloperoxidase antibodies (Anti-MPO) & Anti-Proteinase 3 antibodies (Anti-PR3)	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	<3.5IU/mL MPO <2IU/mL PR3	3-5 days, or as required	On request		MPR3	3 Weeks, unless discussed
Anti-Neuronal Antibodies incorporating Anti-Hu, Anti-Yo, Anti-Ri, Anti-PNMA2, Anti-Amphiphysin, Anti-Cv2/CRMP5, Anti-Recoverin, Anti-SOX1, Anti-Zic4, Anti-Titin, Anti-GAD65, Anti-Tr	Serum Gel Tube & CSF	4.9mls	Indirect Immunofluorescence & Immunoblot	Negative	15 days		Paired Serum/CSF samples will be accepted. Results of both must be interpreted in the clinical context.	Serum: NEURONAL/ NEUROBLOT CSF: NEURONALCSF / NEUROBLOTCSF	>6 months
Anti-Neutrophil Cytoplasm Antibodies (ANCA) (IIF)	Serum Gel Tube	4.9mls	Indirect Immunofluorescence	Negative	8 days			ANCA	3 Weeks, unless discussed
Anti-NMDA Antibodies Serum	Serum Gel Tube	4.9mls	Indirect Immunoflourescence	Negative	8 days	Upon request		NMDA	Discuss with Clinical Team
Anti-NMDA Antibodies CSF	CSF		Indirect Immunflourescence	Negative	8 days	Upon request		NMDACSF	Discuss with Clinical Team
Anti-Nuclear Antibodies	Serum Gel Tube	4.9mls	Indirect Immunofluorescence	Negative. Weak positive (1:80) are commonly seen particularly in healthy older women.	3-5 days		Investigating Autoimmune Liver Disease, otherwise order CTDSCRN	ANA	No more than 3 monthly

Test	Specimen	Minimum Volume	Method	Reference Range	TAT	Urgent Service	Comment	Mnemonic	Frequency of Retesting
Anti-Nucleosome Antibodies	Serum Gel Tube	4.9mls	Immunoblot	Negative	4-6 weeks		Strong clinical suspicion of lupus with negative routine serology. Must discuss with Consultant Immunologist.	NUCSOME	Once Off
Anti-Proteinase 3 antibodies (Anti-PR3)	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	<2IU/mL	3-5 days, or as required	On request	Follow-up of patients with known PR3-ANCA positive disease.	PR3	3 Weeks, unless discussed
Anti-Ribosomal-P Antibodies	Serum Gel Tube	4.9mls	Immunoblot	Negative	4-6 weeks		Strong clinical suspicion of lupus with negative routine serology. Must discuss with Consultant Immunologist.	RIBOP	Once Off
Anti- SARS-CoV-2 Antibodies	Serum Gel Tube	4.9mls	Immunoassay	Nucleocapsid: Not Detected Anti-Spike: <0.8 U/ml Not Detected	16 days		Nucleocapsid and Spike Antibody	ANTICV19	
Anti-Scleroderma Antibodies/ Systemic Sclerosis Panel	Serum Gel Tube	4.9mls	Immunoblot	Negative	4-6 weeks			SCLRDERM	

Test	**Specimen**	**Minimum Volume**	**Method**	**Reference Range**	**TAT**	**Urgent Service**	**Comment**	**Mnemonic**	**Frequency of Retesting**
Anti-Skin Antibodies	Serum Gel Tube	4.9mls	Indirect immunofluorescence	Negative	8 days			SKIN	6 months but Positive ICS as requested
Anti-Smooth Muscle Antibodies	Serum Gel Tube	4.9mls	Indirect Immunofluorescence	Negative	3-5 days			SMA	>3 months
Anti-Streptolysin-O Titre (ASOT)	Serum Gel Tube	4.9mls	Immunoturbidimetry	<200IU/ml	3-5 days			ASOT	3 weeks
Anti-Thyroid Peroxidase Antibodies (anti-TPO)	Serum Gel Tube	4.9mls	Immunoassay	Negative: <=34 IU/mL Positive: > 34 IU/mL	8 days			TPO	>6 months; if equivocal >3 months
Anti-Tissue Transglutaminase Antibodies (anti-tTG)	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	Negative: < 4 U/ml Equivocal: 4-10 U/ml Positive: 10 U/ml	8 days			tTG	>3 months
Autoimmune Encephalitis Panel (AIEPANEL) incorporating anti-NMDA, anti-AMPA 1/2 , anti-$GABA_b$, anti-DPPX, anti-LGI1, anti-CASPR2 Antibodies	Serum Gel Tube CSF	4.9mls	Indirect Immunoflourescence	Negative	8 days	Upon request	Paired Serum/ CSF samples required particularly during initial work up.	AIE & AAIECSF	Discuss with Clinical Team

Test	Specimen	Minimum Volume	Method	Reference Range	TAT	Urgent Service	Comment	Mnemonic	Frequency of Retesting
Autoimmune Encephalitis Screen Serum (AIESERUM) incorporating anti-NMDA, anti-AMPA 1/2 , anti-$GABA_b$, anti-DPPX, anti-LGI1, anti-CASPR2 Antibodies	Serum Gel Tube	4.9mls	Indirect Immunoflourescence	Negative	8 days	Upon request	Paired Serum/CSF samples preferred, particularly during initial workup. Plasma can be accepted following discussion with Lab/Clinical staff	AIE	Discuss with Clinical Team
Autoimmune Encephalitis Screen CSF (AIECSF) incorporating anti-NMDA, anti-AMPA 1/2 , anti-$GABA_b$, anti-DPPX, anti-LGI1, anti-CASPR2 Antibodies	CSF		Indirect Immunoflourescence	Negative	8 days	Upon request	Paired Serum/CSF samples preferred, particularly during initial workup.	AIECSF	Discuss with Clinical Team
C1 Esterase Inhibitor (C1INH)	Serum Gel Tube	4.9mls	Turbidimetry	0.21-0.38 g/L	4-6 weeks			C1INH	Once off if normal. As required if low
C3	Serum Gel Tube	4.9mls	Immunoturbidimetry	0.9-1.8 g/L	1-5 days	On request		C3	As Requested
C4	Serum Gel Tube	4.9mls	Immunoturbidimetry	0.1-0.4 g/L	1-5 days	On request		C4	As Requested
CTD Screen	Serum Gel Tube	4.9mls	EliA (IMMUNOCAP)	Negative	2-5 days			CTDSCRN	No more than 3 monthly

Test	Specimen	Minimum Volume	Method	Reference Range	TAT	Urgent Service	Comment	Mnemonic	Frequency of Retesting
Direct Immunofluorescence (DIF) on Skin Biopsies	Fresh skin biopsy, transported on damp gauze to the laboratory		Direct Immunofluorescence		4 weeks		Unless special arrangements have been agreed specimen MUST reach the immunology laboratory by 4pm		
IgG Subclasses	Serum Gel Tube	4.9mls	Turbidimetry	IgG 7 - 16 g/L IgG1 3.824 - 9.286 g/L IgG2 2.418 - 7.003 g/L IgG3 0.218 - 1.761 g/L Note: These are adult specific reference ranges	8 weeks			IGGSub	Annually
Tryptase	Serum Gel Tube	4.9mls	FEIA (IMMUNOCAP)	2-14 µg/L (Anti-mortem specimens only)	1 month			TRYPTASE	As requested/discussed
Myositis Screen /Panel	Serum Gel Tube	4.9mls	Immunoblot, correlated with ANA apperance	Negative	4-6 weeks			MYOSITIS	Once off
Immunology Consult	Serum Gel Tube	4.9mls	Consultant, SPR or Chief Medical Scientist will select appropriate tests	As appropriate	As per assay		Full clinical details and contact bleep number required	IMMCON	
Rheumatoid Factor	Serum Gel Tube	4.9mls	Immunoturbidimetry	<14 IU/mL	3-6 days			RF	>3 Months

Test	Specimen	Minimum Volume	Method	Reference Range	TAT	Urgent Service	Comment	Mnemonic	Frequency of Retesting
Specific IgE	Serum Gel Tube	4.9mls	FEIA (IMMUNOCAP)	<0.35 Units Class 0 Negative 0.35-0.7 Class 1 Weakly Positive 0.7-3.5 Class 2 Positive 3.5-17.5 Class 3 Positive 17.5-52.5 Class 4 Strongly positive 52.5-100 Class 5 Strongly positive >100 Class 6 Strongly positive	15 days 21 days for sIgE to Drugs			See section 3.4.7.1 on page 225	1 year for same allergens
Specific IgGs sIgG Aspergillus sIgG M. Faeni sIgG Budgie sIgG Pigeon	Serum Gel Tube	4.9mls	FEIA (IMMUNOCAP)	<40 mgA/l <22 mgA/l <30 mgA/l <38 mgA/l	30 days				>6 months
Total IgE	Serum Gel Tube	4.9mls	FEIA (IMMUNOCAP)	Range is age related. Adult reference range 0-100 kU/L	15 days			TIGE	1 year

Any of these guidelines may be overruled in a particular clinical situation, if the case is discussed with staff in the immunology laboratory and/or the Consultant Immunologist. If you are uncertain of how best to investigate the patient, you are welcome to contact the Chief Medical Scientist, the Specialist Registrar or Prof. Keogan/Dr Khalib/Dr Cox, Consultant Immunologists to discuss the individual case.

3.4.7.1 Current available Specific IgE (sIgE) Allergens

Allergen	Code	Allergen	Code
Asthma Panel	ASTHMA	Grape	f259
CF-ABPA Panel	Careset	Grass Pollen Mix	gx1
Acarus siro (Flour mite)	d70	Hake	f307
Almond	f20	Hazel nut	f17
Alternaria alternata	m6	Hazel nut components	CORA9A14
Amoxicilloyl	c6	Honey bee	i1
Ampicilloyl	c5	Horse dander	e3
Animal Panel	ANIMAL	House dust mite (d1)	d1
Apple	f49	House dust mite (D. Farinae)	d2
Aspergillus fumigatus	m3	Kiwi	f84
Banana	f92	Latex	k82
Barley	f6	Lentil	f235
Blue mussel	f37	Lobster	f80
Brazil nut	f18	Macadamia nut	f345
Cagebird Feather Mix	ex72	Mackerel	f206
Candida albicans	m5	Maize, Corn	f8
Cashew nut	f202	Milk	f2
Cat dander	e1	Morphine	c260
Cefaclor	c7	Mushroom	f212
Chick pea	f309	nCor a 9, Hazel nut	f440
Chicken	f83	Nut Mix	fx1
Chilipepper	f279	Oat	f7
Chlorhexidine	c8	Orange	f33
Citrus Fruit Mix	fx29	Oyster	f290
Cladosporium herbarum	m2	Pea	f12
Coconut	f36	Peach	f95
Cod	f3	Peanut	f13
Common silver birch	t3	Peanut Panel	PEANUT
Common wasp (Yellow jacket)	i3	Pecan nut	f201
Crab	f23	Penicillin Panel	PENICILLIN
Dog dander	e5	P. chrysogenum (notatum)	m1
Egg	f245	Penicilloyl G	c1
Egg white	f1	Penicilloyl V	c2
Fish Mix	fx2	Pine nut, pignoles	f253
Fruit Mix	fx21	Pistachio	f203
Pollen Panel	POLLEN	Salmon	f41
Pork	f26	Sesame seed	f10
Potato	f35	Shellfish Panel	SHELLFISH
rAra h 2 Peanut	f423	Shrimp	f24
rAra h 8 PR-10, Peanut	f352	Soybean	f14
rAra h 9 LTP, Peanut	f427	Spice Mix	fx71
rAsp f 2 Aspergillus	m219	Strawberry	f44

Allergen	Code	Allergen	Code
rBet v 1 PR-10, Birch	t215	Suxamethonium	c202
rCor a 1 PR-10, Hazel nut	f428	Timothy grass	g6
rCor a 14, Hazel nut	f439	Tomato	f25
rCor a 8 LTP, Hazel nut	f425	Tree Pollen Mix	tx8
Rhinitis Panel	RHINITIS	Tuna	f40
Rice	f9	Walnut	f256
rMal d 1 PR-10, Apple	f434	Wheat	f4
rMal d 3 LTP, Apple	f435	Yeast	f45
Rocuronium	U254	Total IgE	IgE
rPru p 3 LTP, Peach	f420	Tryptase (Random)	TRYPTRAND
rPru p 4 Profilin, Peach	f421	Tryptase <1 HR	TRYPT1HR
rTri a 19 Omega-5 Gliadin, Wheat	f416	Tryptase 24 HR	TRYPT24HR
Rye	f5	Tryptase 3 HR	TRYPT3HR

***Details of Panel & Mix contents are given below**

ALLERGENS	Panel & Mix Details
ANIMAL PANEL	Cat, Dog
ASTHMA PANEL	HDM, Aspergillus fumigatus, Cat
CAGEBIRD FEATHER MIX	Budgerigar, Canary bird, Parakeet, Parrot & Finch feathers
CITRUS FRUIT MIX	Orange, Lemon, Grapefruit, Mandarin
FISH MIX**	Fish, Shrimp, Blue mussel, Tuna, Salmon
FRUIT MIX	Kiwi, Melon, Banana, Peach, Pineapple
GRASS POLLEN MIX	Cock's-foot or orchard grass, Meadow fescue, Ryegrass, Timothy-grass, Common Meadow-grass (Dactylis glomerata, Festuca elatior, Lolium perenne, Phleum pratense, Poa pratensis)
Hazel Nut Components	nCor a 9 & rCor a 14, Hazel nut
NUT MIX**	Peanut, Hazel nut, Brazil nut, Almond, Coconut
PEANUT PANEL	Peanut & Arah2
PENICILLIN PANEL	Penicillin G, Penicillin V, Amoxicillin, Ampicillin, Cefaclor
POLLEN PANEL	Trees, Grass
RHINITIS PANEL	HDM, Cat, Trees, Grass
SHELLFISH PANEL	Lobster, Crab, Shrimp, Mussel
SPICE MIX	Caraway, Mace, Cardamom, Clove;
TREE MIX	Box-elder, Common silver birch, Hazel, Oak & Maple leaf sycamore (Acer negundo, Betula verrucosa, Corylus avellana, Quercus alba, Platanus acerifolia)

**For nut mix & fish mix, if we get a positive result, we would automatically do the individual allergens included in the relevant mix.

Please request **SIGEREFERRAL,** and state name of allergen, for anything not on the above list. If the history indicates an unusual allergen, the appropriate test will be sent to the UK.

3.4.7.2 Test Profiles

To make test ordering more efficient we have set up a range of disease specific test profiles, for investigations of common potentially immunological disorders. Where screening tests are included in test batteries, positive screening tests lead to reflex ordering of appropriate follow-up tests, as detailed in Section 8.

Profile	*Tests Included*	*Indication*	*Comment*
Acute Renal Failure Screen	CTD Anti-MPO and PR3 Antibodies GBM C3/C4 ASOT	Acute or acute –on-chronic renal failure.	Please discuss all pulmonary-renal syndrome or ? rapidly progressive GN, as urgent service available.
Inflammatory Arthritis Antibodies	RF CCP CTD	Isolated inflammatory arthritis, in the absence of systemic features.	ANCA should be added if urinalysis is abnormal. NB: 2 separate samples are required for INFL ABS.
Liver Disease Associated Autoantibodies	ANA Anti-Smooth Muscle Anti-Mitochondrial Anti-LKM	Suspected chronic liver disease.	If MITO pos, M2 subtyping will be performed, on the first occasion only.
Vasculitis Screen	CTD Anti-MPO and PR3 Antibodies RF C3/C4	Suspected vasculitis or connective tissue disease.	This battery is intended for diagnosis only. More selective tests should be used for monitoring once diagnosis established.
Asthma sIgE	sIgE - House dust mite sIgE – Aspergillus sIgE – Cat	Allergic asthma.	
Rhinitis sIgE	sIgE – House dust mite sIgE – Cat sIgE – Trees sIgE - Grass	Perennial Rhinitis, thought to be allergic.	

Profile	*Tests Included*	*Indication*	*Comment*
Shellfish sIgE	sIgE – Lobster sIgE - Crab sIgE - Shrimp sIgE - Mussel	Suspected allergy to shellfish.	Negative result does not rule out shellfish allergy. If this is suspected clinically referral to a Clinical Immunologist is advised.
Pollen sIgE	sIgE – Mixed gras sIgE–Mixed trees		
Coeliac Screen	Anti-tTG Anti-EmA (if tTG is Equivocal or Positive)	Suspected Coeliac Disease. Malabsorption. Anaemia. Gastrointestinal symptoms.	
Autoimmune Encephalitis Panel AIEPANEL	Anti-NMDA, Anti-AMPA 1/2, Anti-DPPX, Anti-$GABA_b$, Anti-LGI1, Anti-CASPR2 Antibodies	Suspected Autoimmune Encephalitis, Myotonia, seizures, Neuropsychiatric symptoms.	Paired Serum/CSF samples preferred, (particularly in the initial diagnostic phase), due to the known incidence of false negatives on serum documented in the literature.

3.4.7.3 Immunological Tests performed in other Laboratories in Beaumont Hospital

Test	**Mnemonic**	**Specimen**	**Contact**
Immunoglobulins	IGGS	Serum Gel	Proteins (809) 2305
C Reactive Protein	CRP	Heparin	Clin Chem (809) 2668
Protein electrophoresis	SPE	Serum Gel	Proteins (809) 2305
Urine electrophoresis (Bence Jones Protein)	UPE	24 hour urine collection	Proteins (809) 2305
β2 Microglobulin	B2M	Serum Gel	Proteins (809) 2305
Cryoglobulins	CRYOS	Special instructions on computer 8 hour Fasting Samples Required	Proteins (809) 2305
Lymphocyte subsets	LY-SUB	EDTA	Haematology (809)2763

3.5 MICROBIOLOGY

3.5.1 Out-Of-Hours Services

- The medical scientist on-call must be contacted through the switch or through bleep 869. The following specimen requests are routinely processed:
- CSFs from all wards and from the Emergency Department.
- Urines for culture and sensitivity until 12 midnight from the Emergency Department.
- Pregnancy tests from the Emergency Department and day theatre.
- Peritoneal dialysis fluids from nephrology wards.
- Broncho-alveolar lavage fluids from ITU/RTU until 9pm.
- Loading of all blood cultures and processing of any blood cultures that flag positive.
- Flu swabs for Influenza A/B/RSV and COVID-19 PCR testing from emergency department and ICS, ICN/RTU at agreed times.
- Transplant COVID-19 from recipient and donor

The consultant microbiologist on-call must sanction all other requests.

- **Other tests which may be available on request include:**
    1. Microscopy and culture of specimens from sterile sites e.g. surgically or radiologically collected 'critical or theatre specimens'.
    2. TB PCR.
    3. Cryptococcal antigen.
    4. Urines from wards other than the Emergency Department.
    - Specimens should be sent by means of the pneumatic tube system (2647) **with the exception of Mycobacterium glass blood culture bottles, CSF** and **critical specimens.**

3.5.2 Medical Out of Hours Services

A consultant microbiologist is available at **all** times for diagnostic, therapeutic and infection prevention and control advice.
The consultant microbiologist may be contacted through the switch.
If an interim report, clinical advice or result interpretation is required please contact the Clinical Microbiology Team.

3.5.3 Requests for Additional Tests

Please note that if it is necessary to request further tests on samples which have already been received in the laboratory, this should be done within 48 hours. After this time, specimens may be unsuitable for further testing.

All additional requests must be ordered by the requesting doctor on Powerchart and the label sent to the laboratory via the pneumatic chute system. Verbal requests cannot be taken over the phone.

Additional tests for referral:

These can be requested by the patient's clinical team or the clinical Microbiology team
When an aliquot is required for sending out, the following is adhered to:

-Sufficient sample available

-Appropriate container for aliquot

-Labelling criteria (same information as original sample) See section 2.1.6

-Stability and storage conditions correct

-Samples that are aliquoted for referral include: Respiratory samples, Theatre/tissue/pus/fluids samples, CSFs, Faeces, Serology tests. See table below. For serology see table 'All Serology referred tests' below.

3.5.3.1 Samples that are aliquoted by the laboratory

Specimen	Test	Location
CSF	Protein/Glucose	Biochemistry Beaumont
	Viral panel	NVRL
	H.influenzae PCR *N.meningitidis* PCR *S.pneumoniae* PCR	IMSRL
Theatre/Pus/Fluid	16S	GOSH
	18S	GOSH
Faeces	*C.difficile* typing	PHL Cherry Orchard
	Norovirus	NVRL
Respiratory specimens	Galactomannan	In-house
	PJP	NVRL
	Viral screen	NVRL
Serology	Amikacin levels	Biochemistry MMUH
	CMV PCR	NVRL
	EBV Serology	NVRL
	Hep B Viral Load/PCR/DNA	NVRL
	Hep C PCR/Genotype/DNA/Viral Load	NVRL
	HIV Viral Load/PCR	NVRL
	Beta-D-glucan	Dispatched to Southmead, Bristol
	Parvovirus PCR	NVRL
	Teicoplanin levels	Eurofins Biomnis
	Tobramycin levels	Biochemistry SVUH
	Voriconazole levels	MMUH

*3.5.4 **Test Request Forms***

Table 4 is a list of Microbiology test requests that can only be ordered in the Laboratory and therfore need to be requested via form which is available on Q-pulse as LF-MIC-CRIT or on the intranet at http://my.beaumont.ie/Documents/Request%20Form%20for%20Critical%20Specimens.pdf.

*3.5.5 **Reporting***

All specimens with test requests are received in laboratory. Specimen status is visible once received in laboratory from collected to verified. All results are viewable on Powerchart in Results Review. All report results are printable from Powerchart.

If an interim report, clinical advice or result interpretation is required please contact the Clinical Microbiology Team.

*3.5.6 **Specimen Storage Criteria***

Samples must be delivered to laboratory as soon as possible after the sample is taken. Where a delay in transport is envisaged, store specimens as follows:

Specimen	**Storage**
Blood cultures	Room temperature
CSF	2-8˚C
Neisseria gonorrhoea	Room temperature
Urines	2-8˚C
All other microbiology specimens	2-8˚C

Repertoire of Test Services *See Table 4.* The table is a brief guide to the test name changes on Powerchart, MedLIS

3.5.7 ***Repertoire of Testing***

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
			URINE				
Microscopy	N/A	The Sarstedt NFT (Needle Free Transfer) system. 100ml NFT primary container Reference 75.562.900) and a 10mL Monovette tube reference 10.252)	15 mls 2mls	WBC, RBC <1 to >100 per µL	Within 24 hours from receipt	Culture is only performed on urines which meet the appropriated laboratory and clinical criteria. 'WBC ≥50/uL **OR** sediMAX bacterial count of >+. The following urines are always cultured: Urology/ Transplant,Nephrology, Haematology, Oncology and RAD/ONC, pregnant women, children <16 years old, Nephrostomy & intra-operative urine (I.O.U) urines	URINE
Routine culture and susceptibility	N/A	The Sarstedt NFT (Needle Free Transfer) system	15 mls 2mls	N/A	2-6 Days		URINE

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
Pregnancy test	N/A	The Sarstedt NFT (Needle Free Transfer) system	15 mls	HCG Preg Positive 25mIU/mL HCG Preg Negative HCG Weak Positive	1 Day	Samples received from Emergency Department for HCG are processed within 30 mins of receipt if requested as urgent. Samples received from Day Theatre for HCG are processed within 30 mins of receipt if requested as urgent. Repeat specimen requested within 48 hrs for weak pos results	PREG
Legionella antigen	Legionella	The Sarstedt NFT (Needle Free Transfer) system	15 mls	Leg U Ag Detected Leg U Ag not detected	2 Days		Leg UR Ag
Streptococcus pneumoniae antigen	*Streptococcus pneumoniae*	The Sarstedt NFT (Needle Free Transfer) system	15 mls	S Pneum U Ag Detected S pneum U Ag not detected	2 Days	Not suitable for testing of urines from children or for testing of urines that have been concentrated or boiled prior to testing	S pneum Ag
TB culture	*Mycobacterium* spp.	Sterile 60ml container*	15 mls	N/A	70 Days	3 consecutive EMUs needed	TB
FAECES							

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
Enteric pathogens	Enteric pathogens including *Cryptosporidium,parvum hominis and Giardia lamblia*	Sterile 60ml container*	1-2g	N/A	3-6 Days	A negative disclaimer is added to 'Not Detected' results	FAECES
C difficile toxin	*C difficile* toxin	Sterile 60ml container*	1-2mls	C diff tox Detected/ not detected	2 Days	Performed on semi-formed and liquid samples onlys	C diff toxin PCR
Rota/adeno virus	Rota/adeno virus	Sterile 60ml container*	1-2g	Adeno/Rota virus Positive Adeno/Rota virus Neg	3 Days	Performed on infants <2 years old	ROT/ADV
Ova/parasites	Ova/parasites	Sterile 60ml container*	1-2g	N/A	4-8 days	Travel details essential	Ova and Parasites
Helicobacter pylori antigen	Helicobacter *pylori*	Sterile 60ml container*	1-2g	H.pylori Ag Not detected/detected	4 days	A negative disclaimer is added to 'Not Detected' results	H pylori Ag
RESPIRATORY SPECIMENS							
Broncheolar Lavage(BAL)/ EBUS Sputum/Tracheal Aspirate Routine Culture CF culture	Respiratory pathogens	Sterile 60ml container*	15mls	N/A	2-14 Days 18 Days	Salivary samples are unsuitable (except in the following: ITU/RTU, Haematology,Oncology, Radiology, CF patients,specimens for TB or Legionella	Resp CF Resp

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
Broncheolar Lavage (BAL)/ Sputum/Tracheal Aspirate TB Microscopy	Acid Fast Bacilli (AFB)	Sterile 60ml container*	15mls	N/A	5 Days		TB
Broncheolar Lavage (BAL)/ Sputum/Tracheal Aspirate TB Culture	*Mycobacterium* spp.	Sterile 60ml container*	15mls	N/A	70 Days	3 consecutive morning samples	TB
Broncheolar Lavage (BAL)/ Sputum/Tracheal	Legionella Culture	Sterile 60ml container	15 mLs	N/A	12 Days		LEG
TB PCR	MTB/Rif Resistance	Specimen	At least 1 mL	Detected/ Not Detected	1 Day		In lab order
Galactomannan	*Aspergillus*	Sterile Container	1ml	(BAL) Galacto Ag (BAL) positive/Negative	7 Days	An index value of ≥1.0 is considered pos result for BALs. Negative disclaimer on 'Not Detected' Can also be performed on serum	Galacto mannan BAL
SKIN SCRAPINGS/NAIL CLIPPINGS/HAIR							
Microscopy	Fungal Elements Dermatophytes, moulds & Yeasts	Dermapak /Sterile 60ml container*	As much as possible	N/A	7 Days	Swabs are not an appropriate specimen for fungal culture. Hair must contain root	Fungal
Culture	Fungal Elements Dermatophytes, moulds & Yeasts	Dermapak /Sterile 60ml container*	As much as Possible	N/A	40 Days	Swabs are not an appropriate specimen for fungal culture. Hair must contain root	Fungal

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
SWABS							
MRSA Screen	MRSA	Charcoal Transswab	N/A	N/A	3-10 Days	Nasal, Groin & Wound site	SCREEN
VRE Screen	VRE	Charcoal Transswab	N/A	N/A	3-10 Days	Only from rectal swabs	SCREEN
CRE Screen	CPE	Charcoal Transswab	N/A	N/A	4 Days	Only from rectal swabs	SCREEN
CRE Molecular screen	CPE	Copan Eswab	N/A	DNA Detected/ Not Detected	4 Days	Only from rectal swabs	SCREEN Molecular screen
Non uro-genital (e.g. wound, eye, ear, nasal, throat)	Pathogens appropriate to site	Charcoal Transswab	N/A	N/A	3-6 Days	Relevant clinical details essential e.g. surgery, post-partum	Swab
Penile/vulval	Non -STI pathogens	Charcoal Transswab	N/A	N/A	3-6 Days		Swab
HVS – culture	Candida & non-STI pathogens	Charcoal Transswab	N/A	N/A	3-4 Days		HVS
FLUIDS – ASCITES/CAPD/PLEURAL/SYNOVIAL/PERITONEAL/PERICARDIAL							
Microscopy	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	12-24 hours	EDTA tube needed if cell count required	FLUID
Routine Culture	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	3-6 Days		FLUID
TB Microscopy	Acid Fast Bacilli (AFB)	Sterile/ Universal Container	As much as possible	N/A	5 Days		TB
TB Culture	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	70 days		TB
Perfusion	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	3-5 Days		FLUID
THEATRE SPECIMENS							

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
Microscopy	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	12-24 hours	Do not place specimens in formalin and do not use histology containers. Specimens must be hand-delivered to laboratory. Request form must contain type and site of specimen	THEATRE
Gram Stain	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	1 Day	Do not place specimens in formalin and do not use histology containers. Specimens must be hand-delivered to laboratory. Request form must contain type and site of specimen	THEATRE
Culture	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	3-8 Days	Do not place specimens in formalin and do not use histology containers. Specimens must be hand-delivered to laboratory.	THEATRE
TB Microscopy	Acid Fast Bacilli (AFB)	Sterile/ Universal Container	As much as possible	N/A	5 Days		TB
TB Culture	All significant isolates	Sterile/ Universal Container	As much as possible	N/A	70 Days	Do not place specimens in formalin and do not use histology containers. Specimens must be hand-delivered to laboratory. Request form must contain type and site of specimen	TB
ON-SITE COVID-19/ INFLUENZA TESTING							

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
COVID-19/ Flu A/B	COVID-19 & Influenza A/ Influenza B	VTM/UTM viral swab containing one swab or PrimeStore® Lysis MTM swabs	N/A	Flu A/B/ SARS-CoV-2 Detected FluA/B/ SARS-CoV-2 RNA Not Detected	2 Days *	*Flu A/B only available during FLU PCR Influenza season as decided by the outbreak influenza committee A negative disclaimer is added to a negative result	COVID
COVID-19 ONLY	COVID-19	VTM/UTM viral swab containing one swab or PrimeStore® Lysis MTM swabs	N/A	SARS-CoV-2 Detected SARS-CoV-2 RNA Not Detected	2 Days	A negative disclaimer is added to a negative result	COVID
COVID-19 for Transplant patients	COVID-19	VTM/UTM viral swab containing one swab or PrimeStore® Lysis MTM swabs BAL	N/A 1ml	SARS-CoV-2 Detected SARS-CoV-2 RNA Not Detected	4 hours 6 hours	Sample should be transported to the laboratory as soon as possible after taking	COVID
TIPS							
Tips	All significant isolates	Sterile/ Universal Container for culture	N/A	N/A	4 days		CATHETER

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
CSF							
Microscopy	All significant isolates	Clear Sterile/ Universal Container	As much as possible	N/A	4 Hours	Do not send CSF samples in chute system – must be hand delivered to laboratory within 2 hours of being taken. Contact Bleep 158 if sending between 8pm and 8am. Label all CSFs numerically (sequentially)	CSF
Routine Culture	All significant isolates	Clear Sterile/ Universal Container	As much as possible	N/A	4 Days	Do not send CSF samples in chute system – must be hand delivered to laboratory within 2 hours of being taken Contact Bleep 158 if sending between 8pm and 8am. Label all CSFs numerically (sequentially)	CSF
TB Microscopy	Acid Fast Bacilli (AFB)	Sterile/ Universal Container	As much as possible	N/A	5 Days		TB

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
TB Culture	All significant isolates	Clear Sterile/ Universal Container	As much as possible	N/A	70 Days	Do not send CSF samples in chute system – must be hand delivered to laboratory as soon as possible after taking. Contact Bleep 158 if sending between 8pm and 8am.	TB
BLOOD CULTURES							
Routine Blood Cultures Direct Gram stain of positive blood culture bottle	All isolates	Blood Culture Bottles	See IPCT "Taking a blood culture" guidelines	N/A	5 hours		Blood Culture
Routine Blood Cultures	All significant isolates	Blood Culture Bottles	See IPCT "Taking a blood culture" guidelines	N/A	6 days for routine negative result	All blood cultures should be transported to the laboratory as soon as possible after taking.	Blood Culture
Routine Blood Cultures	All significant isolates	Identification/ Susceptibility testing	N/A	N/A	24-48 hours		Blood Culture
Mycobacterium Blood Cultures	All significant isolates	Blood Culture Bottles	See IPCT "Taking a blood culture" guidelines	N/A	7 weeks	Myobacterium blood culture bottles can NOT be sent in the chute system, must be hand-delivered to laboratory.	TB
SEROLOGY –REFERRED TESTS (IF THE TEST REQUESTED IS NOT AVAILABLE TO ORDER ON POWERCHART, PLEASE SEND PAPER REQUEST FORM LF-MIC-VIR OR HTTP://MY.BEAUMONT.IE/DOCUMENTS/REQUEST%20FORM%20FOR%20VIROLOGY%20SEROLOGY.PDF							

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
Acanthamoeba PCR	N/A	Eye scrapings	As much as possible	N/A	2/3 days	Tested in the NVRL	
Adenovirus PCR	N/A	Potassium EDTA	2.6mls	N/A	2/3 days	Tested in the NVRL	
Adenovirus Serology / Culture	N/A	Stool, Throat or Eye Swab, Nasal Aspirate	As much as possible	N/A	2/3 days	Tested in the NVRL	
Alcoban Levels	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead Bristol	
Amikacin Levels	N/A	White Topped Serum Tube	7.5ml	N/A	Same day	Tested in Biochem Dept. Mater Hospital	
Anti HB's (Hep B)	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Antiretrovirus (see HIV) Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Arbovirus	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Aspergillus Abs	N/A	White Topped Serum Tube	7.5ml	N/A	~ 3 weeks	Tested in Immunology Beaumont	
Aspergillus Antigenemia	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Eurofins Biomnis	
Atypical Pneumonia Serology <20 years old	N/A	White Topped Serum Tube	7.5ml	N/A		**Requires convalescent sample** Tested in the NVRL	
Atypical Pneumonia Serology >20 years old	N/A	White Topped Serum Tube	7.5ml	N/A		**Requires convalescent sample** Tested in PHL Bristol	
Avian Antibodies	N/A	White Topped Serum Tube	7.5ml	N/A	~ 3 weeks	Tested in Immunology Beaumont	
Bartonella serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 weeks	Tested in Eurofins Biomnis	
Beta-D-glucan or Beta-1-3-glucan	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead Bristol	

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
BK- Polyoma Virus	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Blastomycosis Ab	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead Bristol	
Bordetella	N/A	N/A	N/A	N/A	N/A	See Pertussis IgG	
Borrelia Burgdorferi (Lyme's)	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Botulism	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in RVPBRU-Colindale	
Brucella (Melitensis Sero)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Liverpool UK	
C.J.D.	N/A	White Topped Serum Tube	7.5ml	N/A		**On request directly to Clinical Micro Team** Tested in Neuropathology, Beaumont	
Campylobacter serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 weeks	Tested in Southmead, Bristol	
Candida I.D. (Pan Fungal)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead Bristol	
Cellcept/ mycophenolic Acid	N/A	CSF		N/A		Tested in Royal Brompton Hospital	
Chagas disease	N/A			N/A		(See Trypanosomiasis)	
Chicken Pox (VorcellaZoster)	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in NVRL	
Chickungunya Virus	N/A	CSF		N/A	2/3 days	Tested in NVRL	
Chlamydia (GC) Trachomatis	N/A	Eye/ Urethral/ Cervical Swab, Urine (Genprobe)	N/A	N/A	2/3 days	Tested in NVRL	
Chlamydia Serology	N/A	White Topped Serum Tube	7.5ml			Tested in Southmead Bristol	
Chloramphenicol levels	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in Southmead, Bristol	

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
Ciprofloxacin Levels	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Antimicrobial Reference Lab. Southmead, Bristol	
CMV (Cytomegalovirus) Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in NVRL	
CMV PCR/ Quantitative/ Viral Load	N/A	Potassium EDTA	2.6mls	N/A	2/3 days	Tested in NVRL	
Coccidiodes Levels	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Infectious & Tropical Diseases, Southmead, Bristol	
Colistin Levels/ Colomycin	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Antimicrobial Reference Lab Southmead, Bristol	
Co-Trimoxazole Level	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Coxiella (Barbrella Borrelia)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Eurofins Biomnis	
Coxsackie Antibodies (Serology)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Eurofins Biomnis	
Coxsackie Virus + Enterovirus	N/A	Faeces	1-2g	N/A	2/3 days	Tested in NVRL	
Cryptococcal PCR	N/A	Potassium EDTA	2.6mls	N/A		Tested in Southmead, Bristol	
Cryptococcus Antibodies	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
CSF VIROLOGY PANEL	N/A	CSF	As much as possible (Min 0.5ml)	N/A	2/3 days	**Ordered in Microbiology** Tested in the NVRL	
Cycloserine Level	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
Cyclosporin Levels	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Bio Dept, Beaumont	
Dengue Fever Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Diptheria Specific IgG	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in RVPBRU-Colindale	
E. coli 0157 Enteric Pathogen	N/A	Faeces		N/A		Tested in Cherry Orchard, PHL, Dublin	
Echovirus	N/A	Faeces		N/A	2/3 days	Tested in the NVRL	
Ecoli 0157 serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 Weeks	Tested in Cherry Orchard	
Ehrlichia	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Wiltshire UK	
Endemic fungal testing.	N/A	Serum, BAL, Urine, CSF and Plasma	As much as possible	N/A		Tested in MiraVista Veterinary Diagnostics 4705 Decatur Blvd. Indianapolis, IN 46241	
Enterovirus antibodies	N/A	White Topped Serum Tube	7.5ml	N/A		Surrey UK	
Enterovirus Culture PCR	N/A	Faeces		N/A	2/3 days	Tested in the NVRL	
Enterovirus Molecular Qualitative (PCR)	N/A	CSF		N/A	2/3 days	Tested in the NVRL	
Epstein Barr Virus (EBV) Serology	N/A	Potassium EDTA CSF	2.6mls As much as possible	N/A	2/3 days	Tested in the NVRL	
Flavivirus	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Flucytosene Levels	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Galactomannan	*Aspergillus*	Serum/BAL	1 ml	≥0.5 GMI	1 week	Tested In-house	
Hep A,B,C,E, E-HepB S Ag- S Ab- Core	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Hep B Viral Load/ PCR/ DNA	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	

Test	**Target Pathogens**	**Specimen**	**Minimum Volume**	**Biological reference range**	**TAT**	**Comment**	**MedLIS order on Powerchart**
Hep C PCR/ Genotype/ DNA/ Viral Load	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Herpes Simplex Virus	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
HHV 6	N/A	CSF	As much as possible	N/A	2/3 days	Tested in the NVRL	
HHV 6&7	N/A	Potassium EDTA CSF	2.6mls As much as possible	N/A	2/3 days	**On request directly to Clinical Micro Team** Tested in the NVRL	
HHV 8	N/A	Potassium EDTA	2.6mls	N/A		Tested in Virus Ref Lab Colindale	
Histoplasma Abs Double diffusion	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Histoplasma Abs & Antigen	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Histoplasma Abs CFtYeast Phase	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Histoplasma Abs Urinary Antigen	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Histoplasmosis Abs Double Defusion	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
HIV Abs and Antigen 1&2	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
HIV V-Load/ PCR/ Resistance	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
HSV PCR	N/A	Potassium EDTA CSF Dry viral swab	2.6mls As much as possible	N/A	2/3 days	Tested in the NVRL	
HSV specific	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Virus Ref Lab Colindale	

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
HTLV Human T-Lymphotrophic Virus	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Influenza Virus A&B H1N1 PCR	N/A	BAL		N/A	2/3 days	Tested in the NVRL	
Influenza Virus Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Isavuconazole Level	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Itraconazole Level	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
JC (Polyoma or BK) Virus	N/A	White Topped Serum Tube CSF/Urine	7.5ml As much as possible	N/A	2/3 days	Tested in the NVRL	
Legionella Antibodies	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Eurofins Biomnis	
Leptospirosis Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Linezolid Level (Pre or Post)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Listeria Serology	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Eurofins Biomnis	
Lyme Abs	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Lyme PCR	N/A	CSF	As much as possible	N/A		Tested in Eurofins Biomnis	
Measles Antibodies	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Melitensis Serology	N/A	N/A	N/A	N/A	N/A	(See Brucella)	
Meningococcal/ Pneumococcal Serology (Post vaccine response)	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the Immunology Dept, Beaumont	

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
Molluscum contagiosum	N/A	Fluids/Tissue biopsy specimens	As much as possible	N/A		Tested in the NVRL	
Moxifloxacin levels		White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Monkeypox (M pox)	N/A	White Topped Serum Tube	7.5ml	N/A	1/3 days	Tested in the NVRL	
Mumps antibodies	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Mycoplasma IgM <20 Yrs old	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
NEEDLE STICK INJURY	HIV- HBSAG-HCV	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Norovirus	N/A	Faeces	1-2g	N/A	2/3 days	Tested in the NVRL	
Paracoccidiodes Serology	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Paramyxovirus (Mumps)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in the NVRL	

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
Parasites : Amoebiasis Serology Angio Strongyloides Serology Cysticerosis Antibodies Echinococcus Serology Entamoeba Serology Filiarisis Serology, Hydatid Serology Leishmania Serology & K39 Abs –Direct Ag Test Malaria Serology, Neurocysticercosis (Taenia solium) Schistosomiasis Serology Strongyloides Abs Taenia Serology Toxocara Abs Trichinella Abs Trypanosomiasis	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 Weeks	Tested in HTD London	
Parinfluenza Virus	N/A	Nasal Aspirate	As much as possible	N/A	2/3 days	Tested in the NVRL	
Parvovirus B19	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Parvovirus PCR	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Pertussis C+S	N/A	Perinasal swab (charcoal)	N/A	N/A		Tested in Temple street	

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
Pertussis IgG and PCR	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Crumlin Hospital	
Phlebotemina Screen	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in RIPL, London	
Pneumocystis Pneumonia (PCP) PCR	N/A	Respiraotry samples/Nose & throat swabs	N/A	N/A		Tested in Belfast (routine) /NVRL (urgent)	
Polyoma PCR	N/A	White Topped Serum Tube CSF	7.5ml As much as possible	N/A	2/3 days	Tested in the NVRL	
Pseudo-cholinesterase	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Psittacosis	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Q-Fever (Coxiella burnetti) serology	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Eurofins Biomnis	
QuantiFERON®–TB Gold assay	N/A	QuantiFERON®–TB Gold blood collection tubes	1 ml x4 tubes (To the black fill line)	N/A	1 week	Must be returned to Microbiology within 16 hours of sampling	
Respiratory Syncitial Virus (RSV)	N/A	Nasal aspirate/Sputum	As much as possible	N/A	2/3 days	Tested in the NVRL	
Rhinovirus	N/A	Viral throat swab	N/A	N/A	2/3 days	Tested in the NVRL	
Rickettsia Abs (Spotted Fever)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Wiltshire UK	
Rifampicin Levels	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Rubella Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Septrin Levels	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Shigella	N/A	Faeces	1-2g	N/A		Tested in IMSSRL, UHG, Galway	

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
Shigella Serology	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in GBRU, Colindale	
Sirolimus	N/A	Potassium EDTA	2.6ml	N/A		Tested in Royal Brompton Hospital, UK	
Spotted Fever	N/A	N/A	N/A	N/A	N/A	(See Rickettsia)	
Streptomycin Level	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Southmead, Bristol	
Syphilis Serology/ (Treponema pallidum) / VDRL/TPHA/RPR	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Teicoplanin levels (TEIC T)	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Eurofins Biomnis	
Tobramycin Levels	N/A	White Topped Serum Tube	7.5ml	N/A	Same day	Tested in Biochemistry, St. Vincents, Dublin	
TORCH	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Toxoplasmosis PCR Abs Dye Test	N/A	White Topped Serum Tube Potassium EDTA Tissue/Pus/CSF	7.5ml 2.6ml As much as possible	N/A		Tested in Swansea UK	
Toxoplasmosis Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in NVRL	
Tularemia	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Porton Down, Salisbury	
Typhus Serology	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Porton Down, Salisbury	
Urinary Histoplasmosis antigen	N/A	White Topped Serum Tube Urine	7.5ml As much as possible	N/A		Tested in MiraVista Veterinary Diagnostics4705 Decatur Blvd. Indianapolis, IN 46241	

Test	Target Pathogens	Specimen	Minimum Volume	Biological reference range	TAT	Comment	MedLIS order on Powerchart
Varicella Zoster (VZV)	N/A	White Topped Serum Tube Potassium EDTA Slides	7.5ml 2.6ml	N/A	2/3 days	Tested in the NVRL	
Viral Pneumonia Screen	N/A	Sputum	As much as possible	N/A	2/3 days	By request Tested in the NVRL	
Voriconazole levels	N/A	White Topped Serum Tube	7.5ml	N/A	Same day	Tested in the Mater Hospital	
Weils disease	N/A	N/A	N/A	N/A	N/A	(See Leptospirosis)	
West Nile Virus Serology	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	
Whipples PCR	N/A	Potassium EDTA CSF	2.6ml As much as possible	N/A		Tested in St. James's Leeds	
Yellow Fever	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in Wiltshire, UK	
Yersinia Abs	N/A	White Topped Serum Tube	7.5ml	N/A		Tested in GBRU Colindale	
Zika Virus	N/A	White Topped Serum Tube	7.5ml	N/A	2/3 days	Tested in the NVRL	

1. Specimens received in Aptima Collection Devices will be sent to the NVRL for processing. The GenProbe (Aptima) collection devices (urine containers and swabs) are supplied by the NVRL.
2. In cases where *Neisseria gonorrhoeae* (GC) is suspected, clinical details of ?STI or 'DISCHARGE' must be provided on the request form. If not, samples will not be cultured for GC.
3. When an aliquot is required for sending out, the following is adhered to:

   -Sufficient sample available

   -Appropriate container for aliquot

   -Labelling criteria (same information as original sample) See section 2.1.6

   -Stability and storage conditions correct

Table 4.

Ordering mnemonics for ordering of tests on Powerchart.

While the actual tests remain the same the test names may be different.

The following table is a brief guide to the test name changes.

	MedLIS Order	**Previous Order (PIP**
FLUID	Abdominal Fluid Culture	FLDCULT
	Ascitic Fluid Culture	
	Bile Fluid Culture	
	Drainage Fluid Culture	
	Fluid/Aspirate Culture	
	Joint Fluid Culture	
	Pancreatic Fluid Culture	
	Perfusion Fluid Culture	
	Pericardial Fluid Culture	

	Peritoneal Dialysis Fluid Culture	
	Peritoneal Fluid Culture	
	Pleural Fluid Culture	
	Fluid Microscopy (Cell Count)	
SWAB	Swab Culture	SWABCULT
	Wound Swab Culture	
	Eye Culture	
	Ear Culture	
	Mouth Culture	
	Nasal Culture	
	Pus Culture	
SCREEN	MRSA Screen	MRSA
	VRE Screen	VRE
	CPE Molecular Screen	CRE
HVS	High Vaginal Swab Culture	HVS

CSF	CSF Culture Microscopy	CSFCULT
URINE	Urine Culture with Microscopy	URCULT
FAECES	(Enteric Pathogens/Faeces Culture, C difficile Toxin PCR)	FAECULT / CDTOX
BLOOD CULTUR	Blood Culture	BLDCULT
TB	TB Culture	TBCULT

3.5.8 General Notes

Contact details must be clearly supplied in order to enable our CMT to contact you for further queries surrounding any samples that may need to be referred to another centre for testing.

3.5.9 Key Factors Affecting Turn Around Times:

The main reason for extended turn-around-times in Microbiology is in the follow up of positive specimens. Microbial isolation and identification can be extensive in some instances, occasionally requiring referral of an isolate to a Reference Laboratory for typing or confirmation. The quoted turnaround times take this into account, but in many cases negative reports are available sooner.

3.5.10 Samples Sent to NVRL for Analysis

Please refer to the NVRL user manual for information on range of tests available in the NVRL, the type of specimen required and turn around time information on these tests. Information available on www.nvrl.ie

3.5.10.1 Notes on Samples Sent to the NVRL

- For tests where clotted blood is required, one 10ml vial is the specimen of choice.
- Results from the NVRL can be viewed on Powerchart. For results or enquiries, the NVRL can be contacted on 01 716 1354. Address: UCD National Virus Reference Laboratory, University College Dublin, Belfield, Dublin 4.
- Request forms can be printed on-line via the NVRL web site (www.nvrl.ie) – at 'How do you send samples?' prompt

3.5.11 Abbreviations Used on Microbiology Reports

CPE: Carbapenem resistant Enterobacterales

ESBL: Extended spectrum Beta-lactamase producers

MRSA: Methicillin resistant Staphylococcus aureus

VRE: Vancomycin resistant enterococci

MSSA: Methicillin sensitive Staphylococci

CPO: Carbapenem Produccing Organism

3.6 HISTOPATHOLOGY/CYTOPATHOLOGY/NEUROPATHOLOGY

The Histopathology Department provides an extensive Histopathology service, including supporting the symptomatic breast service, urology and gastrointestinal units. The department provides a diagnostic Renal Pathology service in addition to supporting the renal transplant service, including an Out of Hours service. Electron Microscopy, Cytopathology and an Autopsy service are also provided by the Histopathology laboratory. The Non-Gynae Cytopathology service includes provision of assistance and support for the Fine Needle Aspirate and endoscopic ultra sound services.

The Neuropathology section provides a diagnostic service for Neurosurgery and Neurology (including paediatric neurology and paediatric neurosurgery). A rapid intra-operative service is provided for the diagnosis of intracranial and spinal lesions including brain tumour. A range of investigations are available for the interpretation of muscle and nerve biopsies. In addition Neuropathology is the national centre for the CJD Surveillance Unit. A Neuropathology autopsy service is also available and provides pathologic diagnosis in a variety of conditions including dementia and other neurodegenerative disorders. A CSF cytology service is also provided.

Other diagnostic services are provided on a consultative basis and include CSF analysis for 14.3.3 protein.

*3.6.1 **Frozen Sections***

A ***frozen section*** service is offered between 09.00 – 17.00. Twenty Four hours notice should be given to the laboratory, prior to a frozen section. Frozen sections outside usual working hours may be provided by prior arrangement with the Consultant Pathologist.

Specimens from patients with TB, HIV or Hepatitis B or C infection should not be sent for frozen section. If such a suspicion is present, the medical staff concerned must inform laboratory personnel in order to safeguard the laboratory staff from risk of infection.

In addition, if the laboratory inadvertently processes such specimens, a decontamination procedure of the equipment required for frozen sections must be carried out. Decontamination of this equipment takes 12 hours. During this time no further frozen sections can be performed.

Frozen section reports are delivered to theatre, usually via the intercom. A written report is available following subsequent routine processing of the specimen.

*3.6.2 **Other Urgent Specimens***

Other urgent specimens are dealt with on an individual basis. The laboratory should be contacted directly with these requests in order to ensure that they are handled appropriately. Overuse of the urgent service will adversely affect the turna***r***ound times for all urgent requests.

The authorized Reports are available through PIPE or by phoning the Histopathology Office at 2632/2636/2687/2154 or the Neuropathology Office at 2631 or the Renal Pathology Office at 2008. Reports are not available in the laboratory. Unauthorized reports and any issues of clinical concern can be discussed with the consultant involved in the case for any clinical advice.

*3.6.3 **Specimen Requirements For Histopathology***

The following is a guideline on the requirements of the various specimen types and the appropriate manner in which they should be delivered to the laboratory. This ensures the integrity of the specimen for laboratory investigations.

Tissue Type	**Fixative Required**	**Comment**
Specimen for Frozen Section.	Send fresh to the laboratory - immediately.	24 hours notice of Frozen sections should be given where possible. Contact the Histopathology Lab Ext 2353. Details supplied with the specimen must include a bleep number or theatre intercom to deliver report to.
Renal biopsies	Send in saline (Dublin Hospitals) Send in Formalin/Zeus (Regional Centres) (full details in section 3.6.7)	Please inform Renal Office Ext. 2765 of specimen. The Main Histology Lab can be contacted @ 2353. The EM lab on 8633.
Lymph nodes (for lymphoma diagnostics)	Send fresh to the laboratory - immediately.	Please supply all relevant clinical details.
Solid Tumours (Colon, Breast, Lung etc.)	Send fresh to the laboratory - immediately.	Please supply all relevant clinical details.
Liver biopsies*	Where possible, send two specimens – one in 10% Neutral Buffered Formalin and one wrapped in saline moistened gauze.	Please supply relevant clinical details.
Oncotyping*	Paraffin Block	Referred to Genomic HealthCare (US) for Onctotpyping

Tissue Type	Fixative Required	Comment
Mitochondrial Studies*	Send fresh to the laboratory - Immediately	Referred to Mitochondrial Research Group in Newcastle University for analysis/St James Hospital (CMD)
CSF for RT-QuIC Analysis	CSF frozen at -70°C within 30 minutes of aspiration and transported to the Neuropathology Dept, Beaumont Hospital on dry ice.	Volume CSF: 1 - 2ml. Sample must be clear and colourless (not blood stained) with a white cell count of <10x10^6/L and have a total protein concentration of <1 g/L1. Red blood cells (>1250 x 10^6/L) inhibit the RT-QuIC response resulting in false negatives. High CSF total protein concentrations of >1.0 g/L and raised white blood cell counts can result in false positives.
Primary Ciliary Dyskinesia*	Nasal Scraping	Referred to Southhampton General Hospital for analysis
Flow Cytometry*	CSF Or Lymph Node	Referred to Haematology in St. James's Hospital Dublin for Analysis
Amyloidosis*	Paraffin Block	National Amyloidosis Centre, London, University College London
PDL1* non-breast (NCCP recommendation)	Paraffin Block	Referred to Poundbury Cancer Institute, Dorchester, London & HSL-Advanced Diagnostics HEALTH SERVICES LABORATORIES (A Sonic Healthcare UK laboratory) for metastatic oesophageal SCC.
Molecular Studies – MY88	Paraffin Block	Referred to Royal Victora Hospital Belfast
All other tissue	Send in 10% Neutral Buffered Formalin.	An adequate volume of formalin in a specimen container of suitable size is essential for proper fixation. The volume of formalin used should be at least twice the volume of the tissue to be fixed. Small specimens

Tissue Type	Fixative Required	Comment
		should be placed in biohazard bags.
Histology Blocks*		outsourcing of blocks for cutting & staining to HTS

*Specimens referred out from Beaumont Hospital - the results of these tests are not covered by the scope of Beaumont Hospital Histopathology Department ISO15189 accreditation.

Specimens referred out from Beaumont Hospital - the results of these tests are not covered by the scope of Beaumont Hospital Histopathology Department ISO15189 accreditation. The responsibility for sending specimens lies with the external centre (Sender).

Please Note: Sample acceptance criteria ensure adequate identification for Histopathology samples and request forms in order for them to be accepted by the laboratory. The requesting clinician is responsible for the correct completion of the request form and the correct labelling of the sample.

Failure to comply with the correct guidance may result in the sample not being accepted in the laboratory. Inadequately or inaccurately labelled samples or forms will not be accepted unless they are considered to be unrepeatable or reproducible. An assessment of acceptance will be made by the laboratory personnel/consultant on an individual bass. The risk to the patient of rejection/acceptance of the sample will be weighed against the risk of acceptance of a wrongly labelled sample and is specific to the examinations requested.Cellular Pathology will accept no responsibility for samples processed which initially failed to meet the acceptance criteria, any deviation from the established collection procedures clearly recorded and an appropriate comment will be included in the pathology report.The laboratory will make every effort to ensure patient requests are processed in a safe and timely manner, but it is essential that request forms and samples are labelled appropriately and legibly. Inadequate or inaccurate labelling results in delays and impacts patient care. If you have any doubts regarding this policy, please contact the lab.

Multiple samples taken from a patient MUST be labelled on the sample container with the number and stae the site of tissue on each. The request form should be labelled accordingly to allow clear specimen location to be identified,**REQUIREMENT FOR EXTERNAL CENTRES**

The responsibility for sending slides/blocks/material lies with the external centre (Sender). External centres may send slides/blocks/material to Pathology for review/conferences etc. Ensure that slides/blocks/material is accompanied with the appropriate request form and relevant report. When multiple slides/blocks/materials are received, all must be labelled with clear identification

of case number, according to acceptance criteria. This allows for unequivabal traceability to the patient. Any discrepancies will be addressed with the relevant referring hospital.

Ensure that packaging and transportation comply with the European Agreement for the Carriage of Dangerous Goods by Road, ADR Regulations.
Address the package to:

Histopathology/Neuropathology (as appropriate to analysis required)
Beaumont Hospital,
Dublin 9
Include the Consignee address and telephone number.

*3.6.4 **Factors Affecting Fresh/Unfixed Tissue Specimens***

The techniques that are performed on fresh tissue are affected by the length of time that the tissue is removed from the patient before it is received for analysis. Therefore it is imperative that all tissue samples required to be sent fresh should be done so immediately. Fresh samples should be sent during normal working hours and the department must be informed in advance if a fresh sample is to arrive out of hours.

NOTE: Specimens from patients with TB, HIV or Hepatitis B or C infection should not be sent "fresh". If such a suspicion is present, the medical staff concerned must inform laboratory personnel in order to safeguard the laboratory staff from risk of infection

The following may be obtained from the Histopathology laboratory.
- Specimen containers – various sizes.
- 10% Neutral Buffered Formalin (in polycubes with taps/5lt containers).
- Pre-filled 60ml 10% Neutral Buffered Formalin containers.
- Histopathology/ Cytopathology/ Neuropathology / Renal Request Cards
- Slides and slide containers with fixative for Fine Needle Aspirates (FNAs).
- EM fixative.
- Liquid nitrogen for the Dermatology clinics.

SAFETY: Formalin is a potent eye and nasal irritant and can cause respiratory distress and allergic dermatitis. Gloves, goggles and aprons should be used when dealing with formalin. Contact the Histopathology Laboratory for any additional information that may be required and if a formalin spillage should occur.

Liquid nitrogen can cause cold burns and is dangerous to use in confined spaces as it is an asphyxiant. It can also shatter receptacles that are unsuitable for its storage. Subsequently it will only be given to Beaumont Hospital personnel and transferred into a suitable receptacle. Information on safety on any of the above may be obtained from Histopathology on request @ ext. 2353

Please note: The laboratory periodically reviews any collection sample and handling issues through feedback via MDT meetings/User feedback Survey's and any issues discussed at departmental meetings. Where compromised samples are accepted (e.g. specimen received with no specimen) the final report will indicate the nature of the problem and if applicable that caution is required when interpreting the results.

3.6.5 Turn Around Time for Results

The turn around time of specimens for Histopathology will vary depending on the nature of the specimen and the complexity of the investigations required. The following is an outline of estimated turn around time for different specimen types from time of receipt in the laboratory:

Biopsies – 5-10 working days (on average)
Resections – 10 working days (on average)
Renal Biopsies – 7-9 weeks for Electron Microscopy
– 4-6 weeks for Light Microscopy
– 14 days for Immunofluorescence
CSF for RT-QuIC –10-15 working days

This is only a guideline and the complexity of a case and the requirement for further investigations may lengthen the turn around time. Results can be obtained from the Histopathology office, ext. 2636/2632/3150/3919. The Consultant/NCHDs can be contacted to discuss individual patients. TAT's are routinely monitored as part of the laboratories quality improvement programme

3.6.6 Cytopathology Specimen Requirements

Specimen	**Specimen requirements**
Bronchial brushings	- Place material in a sterile container labelled with patient and specimen details, including the time of specimen collection.
	-
Fluids (Pleural, Ascitic etc.)	- Place material in a sterile container labelled with patient and specimen details, including the time of specimen collection. - At least 20 mls of fluid is required for diagnosis.
Urine	- Total voided specimen is required for cytology. - The first morning specimen is not suitable. - Place in a container labelled with patient and specimen details.
Fine Needle Aspiration Cytology/EUS/EBUS	Sample from EUS/EBUS is sent to the cytology lab in cytolyt (available in the lab – Ext 2640)
Cerebrospinal Fluid for Cytology.	- Specimen must be collected in a sterile container labelled with patient and specimen details and delivered to the Neuropathology laboratory.

Specimen	Specimen requirements
Flow Cytometry*	- ***Cytometry placed directly into RPMI are viable for up to 18Hrs**. (Contact Cytology on Ext. 2640)*

* Specimens referred out from Beaumont Hospital - the results of these tests are not covered by the scope of Beaumont Hospital Histopathology Department ISO15189 accreditation

ITEMS THAT CAN BE OBTAINED FROM THE CYTOLOGY LABORATORY

- Slides
- Slide holders
- Spray fixative
- Coplin jars of alcohol (Fixing FNA smears)
- Cervical cytology request forms
- ThinPrep kits for cervical smears (Hospital Clinics only)
- Biohazard bags
- Cytolyt containers

NOTE: Each sample should be accompanied by a Histopathology/Cytopathology request form (found on all wards) – please put as in as much information as possible.

TURN AROUND TIMES FOR CYTOLOGY SAMPLES

Non-Gynae Cytology Samples – 3-4 Days

3.6.7 Specimen Requirements for Renal Pathology

The Laboratory should be notified in advance when a renal biopsy is to be taken.

Contact the Renal Pathology Secretary or if she is not available the Medical Scientists in the Renal Pathology/EM/Histopatholgy Laboratories:

DETAILS REQUIRED FOR RENAL BIOPSIES

The following **minimum** information must be supplied LEGIBLY:

On the body of the specimen container:

A Renal Biopsy Request Form must be filled in **(use a ballpoint pen please to make details legible on all copies of the form)** and sent with each biopsy :

- Name of patient
- Date of birth
- Medical record number
- Address of patient
- Name of Consultant
- Source (Ward Name/OPD/Hospital)
- Date sample taken

- Relevant clinical details
- Time sample taken (when applicable) as this can have an impact on the integrity of the results
- Please give ***as much clinical information on the form*** as possible, as this will be required by the Renal Pathologist when considering differential diagnoses.
- If using addressograph labels please attach one to both flimsies and to the backing card – these copies are sent with each portion of the biopsy to the three laboratories involved in the investigation.
- ***Do not*** attach labels, use date stamps or write in the portion marked for "**Laboratory use"** as this area is used by Beaumont Scientific staff for recording the gross description of the biopsy. If your despatch procedures require that stamps or bar codes be attached please use the reverse (blank side) of the form's card copy.

3.6.8 Renal Pathology Requirements for External Centres

- The Renal Pathology Department should be notified before sending biopsy via email to: electronmicroscopy2@beaumont.ie
- The responsibility for sending specimens rests with the external centre.
- The **minimum details** required are as set out above, including the use of the Renal Biopsy request form. Supplies of the Request Form can be obtained by contacting the Renal laboratory on 01-8528633 (Dect phone)
- Packaging and transportation should comply with current UN legislation and the Transport of Dangerous Goods Act.
- The specimen should be dispatched so as to arrive at Beaumont Hospital no later than 16.00.

Packages should be addressed to:

Consultant Renal Pathologist
Renal Pathology/Electron Micrscopy/Histopathology,
Histopathology Department,
Beaumont Hospital,
Dublin 9

NB Beaumont Hospital does not supply containers or fixative solutions for renal biopsies to external centres.

FOR REFERRING HOSPITALS IN THE DUBLIN AREA, if the sample can be transported to Beaumont Hospital within a couple of hours of excision, then place all of the tissue in normal saline in a 60 ml specimen jar or a universal container at least half full of liquid.

FOR REFERRALS FROM REGIONAL CENTRES, tissue can be examined and divided in the Histopathology Laboratory of the hospital prior to dispatch. Fresh tissue for immunofluorescence (0.3-0.4 cm of cortical tissue) should be placed in a transport medium suitable for preserving antigenic activity such as the Tissue Fixative available from Zeus Scientific Ltd. For best results, tissue should not spend any longer than 5 days in Zeus Tissue Fixative.

The remaining cores can be placed in Formalin. It is not necessary for external laboratories to make and keep a stock of glutaraldehyde. A piece of the core can be taken for EM from the Formalin fixed tissue on arrival at Beaumont Hospital Histopathology Department.

3.6.9 Urgent Renal Biopsies for Rapid Processing

If a renal biopsy result is required urgently, i.e. the day of biopsy, then rapid processing can be requested:

- You must contact the renal pathologist on duty to discuss the request, and when the request has been agreed, the Histopathology Laboratory should also be informed.
- The tissue must arrive in the Histopathology Laboratory by 12.30 pm at the latest. The tissue processor is then run for this single biopsy, and cannot be used until the process is completed. The surgical and biopsy specimens from that day's cut-up must be processed daily to maintain continuity of service to all other clinical specialities, so the processor must be available for use again at 5pm.

Please note: Renal biopsy cover: from time to time there may be an arrangement with Belfast. In terms of logistics, generally biopsies can be transferred up on the same day if we receive them by 11.15, after that they will go the following day.

Please liaise with the lab or indicate clearly on the form if a biopsy needs to be sent out or if it can wait for me to come back. It is vital that the lab is contacted regarding urgent biopsies to organise the most appropriate means of transferring the sampl. Renal laboratory personnel can be reached on 01 8528633 and Prof Declan O'Rourke can be contacted on 00447746648787.

3.6.10 Electron Microscopy

The Electron Microscopy (EM) Laboratory was initially set up to serve diagnostic Renal Pathology which comprises the bulk of the caseload but a small number of Neuropathology cases are also handled.

The Laboratory is equipped with a JEOL 1400 Plus Transmission Electron Microscope and an AMT XR50 4 megapixel Digital Camera system. Samples are batched and processed automatically once a week.

The EM Laboratory is not equipped or staffed to deal with Virological EM requests, and due to low frequency of request does not accept nasal brushings for analysis of Primary Ciliary Dyskinesia (PCD)*. This is a highly specialised investigation and requires expertise which cannot be gained in this hospital due the low volume of requests. Please contact the EM laboratory for instructions, request form and fixative. When the procedure has been carried out, the sample should be sent to the EM Laboratory from where it will be referred to the UK National Centre for PCD Analysis in Southampton.

*Specimens referred out from Beaumont Hospital - the results of these tests are not covered by the scope of Beaumont Hospital Histopathology Department ISO15189 accreditation.

3.6.11 Specimen Requirements for Neuropathology

Tissue Type	**Means of Delivery to Neuropathology**	**Comment**
Specimen for urgent frozen section	Send fresh. Hand deliver immediately.	The Neuropathology consultation form must include a bleep number or intercom number to deliver the report
Muscle Biopsy*	Send on gauze that is barely dampened in saline. Do not fix in formalin. Hand deliver immediately. See Section 3.6.8 for requirements from external centres.	Must be received during normal working hours unless previously arranged.
Nerve Biopsy	Send on gauze that is barely dampened in saline. Do not fix in formalin. Hand deliver immediately. See Section 3.6.8 for requirements from external centres.	Must be received during normal working hours unless previously arranged.
Hippocampus & Amygdala	Send fresh. Hand deliver immediately to the laboratory.	
Temporal Lobe (Epilepsy)	Send fresh. Hand deliver immediately to the laboratory.	
Temporal Artery	Send in 10% Neutral Buffered Formalin.	Send Immediately/ASAP
Laminectomy/Disc	Send in 10% Neutral Buffered Formalin.	
Tumour fluid for cytology	Hand delivery immediately.	Must be received during normal working hours.
CSF for cytology	Hand delivery immediately.	Must be received during normal working hours.
CSF for RT-QuIC Analysis	CSF frozen at -70°C within 30 minutes of aspiration and transported to the Neuropathology Dept, Beaumont Hospital on dry ice.	Must be received during normal working hours unless previously arranged. CJD Questionnaire must accompany specimen.

Tissue Type	Means of Delivery to Neuropathology	Comment
Autopsy & Biopsy tissue (e.g/ Brain / Tonsil) for Prion Protein Analysis	Hand delivery immediately.	Must be received during normal working hours. Contact Rachel Howley 017977766
All other tissue	Sent in 10% neutral buffered formalin indicating volume.	Must be received during normal working hours.

***** Specimens referred out from Beaumont Hospital - the results of these tests are not covered by the scope of Beaumont Hospital Histopathology Department ISO15189 accreditation.

REQUIREMENTS FOR EXTERNAL CENTRES

The responsibility for sending specimens lies with the external centre (Sender). Specimens must be pre-booked with the Neuropathology department (Tel. 8092633) in advance to enable the department to make arrangements should the sample arrive after hours. Ensure that packaging and transportation comply with current UN legislation.
Address the package to:

Neuropathology,
Beaumont Hospital,
Dublin 9
Include the Consignee address and telephone number. Record that the sample is an '**Urgent sample for Neuropathology'**.
Confirm by contacting the Neuropathology department when the sample has been collected.

RESULTS

Muscle Biopsies: Laboratory tests on muscle biopsies are performed on a weekly basis due to the complexity of the techniques involved. Results are generally available from the Neuropathology office 10 days (on average)

CSF Samples for RT-QuIC Analysis: There is an approximate turn around of 10-15 days from receipt of the sample to results.

Nerve Biopsies: Results are available 10 days from specimen receipt.

REQUIREMENTS / FACTORS AFFECTING MUSCLE BIOPSIES

Requirements

All investigations are performed on unfixed frozen tissue. Samples must be delivered to the lab on gauze that is barely dampened with saline as excess causes swelling and separation of fibres. This makes interpretation difficult. A muscle

having grade 3/5 on MRC strength scale is best. A fatty muscle ('end-stage' biopsy) may have insufficient fibres for diagnosis.

The department must be informed in advance if a sample is being delivered after hours. Ensure a requisition form is properly completed to include clinical details

Specimen Size

An open biopsy is preferable to a needle biopsy especially if mitochondrial DNA (mtDNA) and protein analysis be required. A biopsy of at least 1.5 x 1x 1cm is ideal. This allows extra samples to be banked in case it is necessary to forward any to an external centre for further studies. Biopsies less than 0.5cu cm are insufficient for this purpose.

CSF SAMPLES FOR RT-QUIC ANALYSIS

Requirements

The sample should be sent to the Neuropathology lab immediately after aspiration for freezing as sub optimal sample storage may give unpredictable results. Alternatively the CSF sample must be frozen at -70°C within 30 minutes of aspiration and transported to the Neuropathology Dept, Beaumont Hospital on dry ice. All samples must be logged in with the Neuropathology Lab prior to sending. All samples must accompany a completed questionnaire (LF-NCJD-CSF Questions), copies of which are available from the Neuropathology Laboratory (Ext. 2633) or are available for download from www.cjd.ie.

The sample volume should be between 1-2mls and be clear and colourless (not blood stained) with a white cell count of <10x10^6/L and have a total protein concentration of <1 g/L1. Red blood cells (>1250 x 10^6/L) inhibit the RT-QuIC response resulting in false negatives. High CSF total protein concentrations of >1.0 g/L and raised white blood cell counts can result in false positives.

Safety Precautions

CSF is considered to be a low risk sample for all types of Prion Disease. Take appropriate precautions when sampling.*[see www.cjd.ie]*

In the event of accidental leakage of the sample please contact the Neuropathology laboratory. There is no immediate hazard to health unless the sample is ingested or injected into the body. Disposable gloves must be worn before attempting to handle the material.

years will not be screened for MELAS / mtDNA rearrangements.

3.6.11.1 Test Request Forms

Test request forms are available to download via the Beaumont Hospital Histopathology department website at http://www.beaumont.ie/index.jsp?p=105&n=349 or by contacting the laboratory.

3.6.11.2 Delivery of Specimens for Analysis

Courier Services: Specimens can be delivered via courier directly to the Department of Histopathology.

3.6.11.3 Oral Requests/Additional Requests

Requests for additional tests are made by the Consultant Histopathologists. Molecular testing (PDL1 and DDISH) is currently being performed by Poundbury Cancer Institute (PCI).. Oral/Additional requests to the lab for these tests must be requested by email to the laboratory. The request form is available on the poundbury institute. The request form must be completed by the requesting clinician, scanned and emailed to the histology office on histo@beaumont.ie where send out of material to PCI will be arranged. In-House Molecular testing is available on-site throught he molecular laboratory (see sections 3.7 below). Specimens submitted for Histology are retained in the department for 6 weeks and Cytology for 4 weeks. In addition, blocks and slides are retained indefinitely on all specimens processed. Contact the laboratory/Histology office for advice regarding additional examinations required.

3.6.11.4 Test Results

Despite our best efforts, it is possible that an error can occur. If you have concerns about a report please draw it to our attention without delay, and we will investigate immediately.

3.6.11.5 Specimen Referral

When we are unable to provide a request or required follow-on analysis, we will attempt to source a referral laboratory, to which specimens may be sent. We welcome input from interested clinicians in this process. The choice of laboratory is primarily based on quality grounds, with accredited laboratories being chosen preferentially. Other factors such as cost and turnaround times are also considered.

3.6.11.6 Details Required for All Specimens

Regardless of the specimen type, the minimum essential information and minimum criteria that must be supplied **legibly** include:

On the specimen block/slide:
Histopathology block number

On the request form
- Name of patient
- Date of Birth
- Requesting Clinician/Pathologist
- Referring Hospital
- Relevant clinical details
- Specimen type

Note: Please send the pathology report relating to the sample to be tested and give ***as much clinical information on the form / letter*** as possible, as this will be required by the Pathologist when considering interpretations and advice. Specimens will not be accepted without a minimum of three forms of identification on the request form and will be returned to the source of origin to be completed / labelled correctly.
All hazard labels where appropriate must be used for the health and safety of the staff that will be handling the specimen.

3.6.11.7 Turnaround Times for Results (TATs)

The turnaround time of specimens will vary depending on the nature of the specimen and the complexity of the investigations required. The following is an outline of estimated turn around times for different specimen types from time of receipt in the laboratory:

Histopathology IHC or ISH	5-10 days
HER2 IHC testing	10-15 days
Histopathology (referred to external institute)	20 days

Notes
- TATs refer to working days from receipt of specimen until report has been authorised. Time refers to 95% of referrals.
- Any request forms requesting a phoned report will be phoned to the Clinician or his/her Secretary.
- There is no time limit for requesting additional examinations but requests should be made by contacting the laboratory or the Pathologist dealing with the case.
- Urgent specimens will be “fast tracked”. From receipt of specimen to interim report status can be performed in two days.

3.6.11.8 Reports

Reports are not available through the laboratory.
- Reports are sent to the Clinical Consultant and/or source

- Authorised Reports are sent to the clinician and additional requests for reports are sent via the Fortimail email encryption System. Please contact the Histology admin office if you wish to receive reports by an alternative means or by email: hist@beaumont.ie
- Reports are available by phoning the Histology Office at (01) 8092632/2636/2678/2154/
- Neuropathology reports are available by phoning the Neuropathology results office at (01) 8092636/8092672
- Renal pathology reports are available by phoning the Rena pathology results office at (01) 8092008
- Only authorised reports are available through the office/PIPE

- Release of Information – As a participant of the NHQI programme Data Sharing Agreements are in line with the policy outlined in the NSQI Information Governance Policy (.https://www.healthatlasireland.ie).Only aggregate data will be shared by the NSQI Programmes. Aggregate data are anonymous and provide an overall summary of the findings from individual sites in relation to the different KQIs and targets.

If an interim report, clinical advice or result interpretation is required please contact the Consultant HistopathologistAutopsy Services (Post Mortems)

The Histopathology and Neuropathology Department provide an autopsy service. Autopsies may be performed at the request of the clinical staff responsible for the care of the patient or under the direction of the Coroner.

Written consent from the next of kin on the appropriate post-mortem examination consent form is required for non-Coroner cases (ie "Hospital" or "House" consent cases) before an autopsy is performed. (LAB 358B6)

· In Coroner's cases, including query CJD cases, the Coroner Autopsy Post Mortem Examination Form (LAB 357B) detailing the nature of the procedure and giving the name and number of a family member must be completed.

Written consent from the next of kin on the appropriate post-mortem examination consent form is required for non-Coroner cases (i.e."Hospital" or "House" consent cases) before an autopsy is performed. This consent is the responsibility of the treating physician (LAB 358B6).

In Coroner's cases, including query CJD cases, the Coroner Autopsy Post Mortem Examination Form (LAB 357B) detailing the nature of the procedure and giving the name and number of a family member must be completed by the treating physician. Consent from the next of kin is not an option as the Coroner may, under the law, order a post mortem in certain situations to establish or clarify the cause of death".

3.7 MOLECULAR PATHOLOGY

3.7.6 ***Histomolecular Mutational Analysis***

The laboratory provides a solid tumour mutation testing service using next generation sequencing (NGS).

The AmpliSeq for Illumina Focus NGS Panel is a targeted resequencing assay for biomarker analysis of 52 genes with known relevance to solid tumours (Table 1). The Focus Panel can simultaneously analyse both DNA and RNA extracted from the same specimen. The Focus Panel is part of a workflow that includes AmpliSeq for Illumina PCR-based library preparation, Illumina sequencing by synthesis (SBS) next-generation sequencing technology and automated analysis.

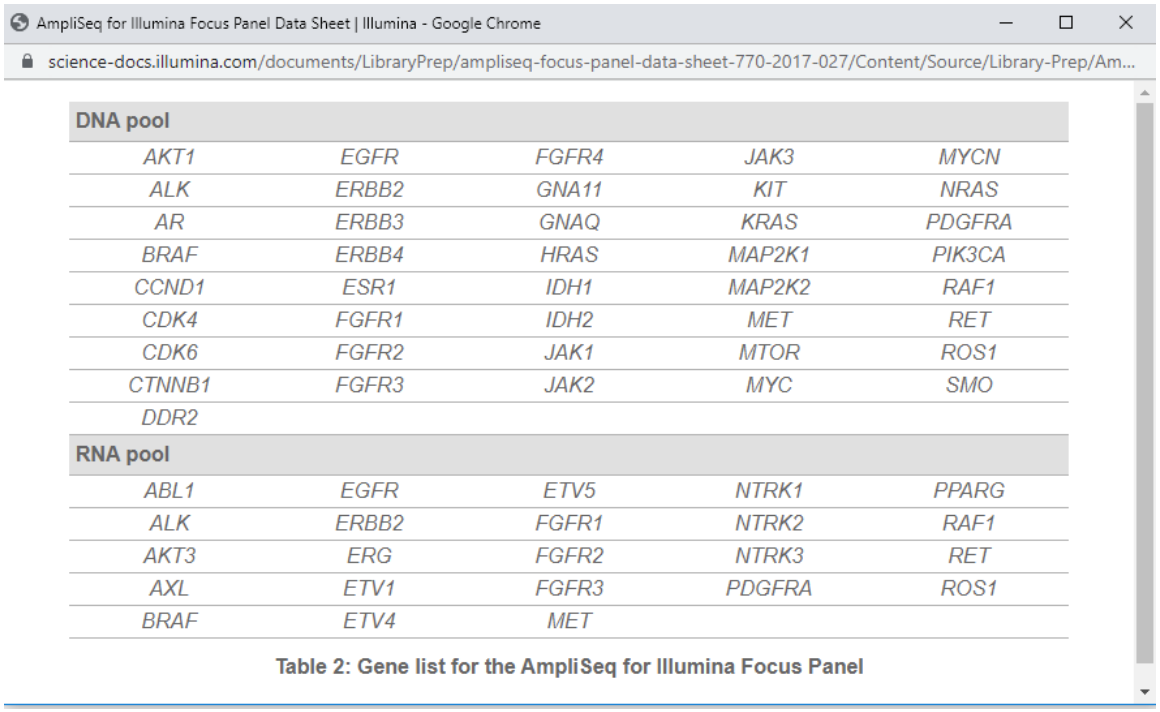
Starting with 10 ng of DNA and RNA, the panel enables the analysis of genes associated with multiple cancer types, including lung, colon, breast, and melanoma. The low-input requirement allows use with various sample types, including formalin-fixed, paraffin-embedded (FFPE) tissues. As part of the AmpliSeq for Illumina targeted resequencing solution, the Focus Panel enables quick and accurate assessment of genomic variation. The reference genome against which NGS is assessed is Ch37. A similar approach is used for BRCA1&2 germline and somatic analysis. Currently germline only analysis is performed for HER2 negative locally advanced or metastatic breast cancer patients.

In conjunction with germline analysis, FFPE material is required for somatic analysis for prostate cancer patients. Homologous Recombination deficiency (HRD) testing is now performed on patients who have ovarian, fallopian tube or primary peritoneal cancer. FFPE tissue is required for the test while it is advised that a blood sample is also sent for MLPA testing. Sequencing of germline and somatic testing for these tumour types is performed in accordance with National testing guidelines.

3.7.6.1 Relevant gene content

The AmpliSeq for Illumina Focus Panel targets hundreds of mutations across 52 key genes associated with solid tumours (Table 2). Gene content for this panel was selected based on published literature, current guidelines (National Comprehensive Cancer Network [NCCN], Association for Molecular Pathology [AMP], College of American Pathologists [CAP], European Society for Medical Oncology [ESMO], etc.), and relevant clinical trials. A positive control sample is included on each run and the expected variant allele frequency (VAF) is compared to what is detected per run. For each sample the limit of detection is the following: VAF is set to detect a 2% variant allelic frequency (VAF) with at least 1000 reads.

Like most similar panels, this is a hotspot panel and does not cover all exons for all genes. Please contact the laboratory if you have a specific variant to analyse.



DNA pool				
AKT1	*EGFR*	*FGFR4*	*JAK3*	*MYCN*
ALK	*ERBB2*	*GNA11*	*KIT*	*NRAS*
AR	*ERBB3*	*GNAQ*	*KRAS*	*PDGFRA*
BRAF	*ERBB4*	*HRAS*	*MAP2K1*	*PIK3CA*
CCND1	*ESR1*	*IDH1*	*MAP2K2*	*RAF1*
CDK4	*FGFR1*	*IDH2*	*MET*	*RET*
CDK6	*FGFR2*	*JAK1*	*MTOR*	*ROS1*
CTNNB1	*FGFR3*	*JAK2*	*MYC*	*SMO*
DDR2				
RNA pool				
ABL1	*EGFR*	*ETV5*	*NTRK1*	*PPARG*
ALK	*ERBB2*	*FGFR1*	*NTRK2*	*RAF1*
AKT3	*ERG*	*FGFR2*	*NTRK3*	*RET*
AXL	*ETV1*	*FGFR3*	*PDGFRA*	*ROS1*
BRAF	*ETV4*	*MET*		

Table 2: Gene list for the AmpliSeq for Illumina Focus Panel

3.7.6.2 Colorectal Cancer (CRC) Mutation Panel:

KRAS & NRAS

KRAS & *NRAS* mutation status are critical when evaluating patients with a view to placing them on *EGFR*-targeted monoclonal antibody therapy. The presence of an activating *KRAS* or *NRAS* mutation is generally associated with a lack of response to anti-*EGFR* therapy.

BRAF

Mutations in position p.V600 in *BRAF* have been associated with poor prognosis, especially in patients with metastatic disease. Currently there is insufficient evidence to recommend *BRAF* V600 mutational status as a predictive molecular biomarker for response to anti-*EGFR* therapy but this is a rapidly evolving field.

MICROSATELLITE INSTABILITY (MSI)/MISMATCH REPAIR DEFICIENCY (DMMR)

MSI/dMMR CRC have been shown to have increased sensitivity to immune-oncological (IO) agents such as PD-L1 inhibitors. In addition, while the majority of these tumours are sporadic, MSI/dMMR tumours are more likely to be associated with Lynch syndrome than MSS/MMR intact tumours. MSI and/or

immunohistochemistry (IHC) testing is performed on tumour tissue samples to predict likely response to IO agents. In addition, the results of this testing allow for risk stratification in relation to Lynch syndrome (in certain circumstances this will be the primary indication for this testing).

MSI testing is performed initially and, if required, samples will be reflexed for MMR IHC. IHC uses a panel of 4 mismatch protein IHC markers (MLH1, PMS2, MSH2 & MSH6). MSI testing is performed using a multiplex PCR approach for thirteen different microsatellite loci followed by DNA fragment analysis using the SeqStudio™ Genetic Analyser. PCR is carried out using the Applied Biosystems TrueMark™ MSI Assay which can identify microsatellite instability in FFPE samples from multiple tumour tissue types.

3.7.6.3 Lung Cancer Mutation Panel:

EGFR

EGFR mutation status is critical when evaluating patients with a view to placing them on anti-*EGFR* Tyrosine Kinase Inhibitors (TKIs). The presence of a sensitising mutation is associated with a favourable response to treatment with *EGFR* TKIs. The presence of resistance mutations need to be interpreted in the context of any previous treatment regimes.

ERBB2 (HER2) and KRAS G12C

Clinical trials are currently enrolling patients with EBRB2 exon 20 insertions and KRAS variants. The results of these trials will determine whether these treatments become part of standard care for patients with these mutations.

BRAF

BRAF mutation status is critical when evaluating patients with a view to placing them on *BRAF* targeted therapies. The presence of a mutation in codon 600 of *BRAF* is required for treatment with *BRAF* targeted therapies.

ALK

ALK translocation has been associated with response to anti-ALK targeted therapies such as crizotinib. ALK translocations can be assessed by a number of different methodologies. Any of immunohistochemistry, in-situ hybridisation or next-generation sequencing is acceptable methodologies for assessing the presence of translocations.

ROS1

ROS1 translocation has been associated with response to targeted therapies, including crizotinib. ROS1 translocations can be assessed by a number of different methodologies. Any of in-situ hybridisation or next-generation

sequencing is acceptable methodologies for assessing the presence of translocations. While antibodies exist for ROS1 immunohistochemistry it is not currently an accepted method for assessing ROS1 translocations.

Note: *ALK* and ROS1 FISH testing is routinely performed on all lung cases

3.7.6.4 Melanoma Mutation Panel:

BRAF

BRAF mutation status is critical when evaluating patients with a view to placing them on *BRAF* targeted therapies. The presence of a mutation in codon 600 of *BRAF* is required for treatment with *BRAF* targeted therapies.

KIT

KIT gene analysis enables the selection of those melanoma patients with KIT variants that will benefit from TKIs.

3.7.6.5 Breast Cancer Mutation Panel:

PIK3CA

PIK3CA mutation status provides information to guide treatment with PIK3CA inhibitors. It may also have a role in predicting response to chemotherapy.

3.7.6.6 BRCA 1 & 2 analysis and Multi Ligation-dependant Probe Amplification (MLPA)

This assay detects variants in BRCA1 or BRCA2, helping to identify patients that may benefit from treatment with PARP inhibitor. MLPA analysis also looks for largescale alterations in the BRCA 1 and 2 genes.

There is also an important role in BRCA testing for identifying germline variants that may be responsible for Hereditary Breast and Ovarian Cancer (HBOC). The results of these tests can then be used by clinicians to guide family testing as required. MLPA is performed on patients samples referred for germline testing.

Currently, we offer germline only analysis to HER2 negative locally advanced or metastatic breast cancer patients.

We offer somatic analysis and MLPA for patients with prostate cancer. Germline testing is performed reflexively if a significant variant is detected. Ideally, both a germline (EDTA blood) and a tumour sample (FFPE) will be provided on the same patient.

A separate request from for BRCA analysis is available on the Beaumont internet and intranet.

Service	Specimen type	Specimen Requirements
IHC & ISH	FFPE Blocks/slides	Ensure that sections are mounted on adhesive slides.
Mutational Analysis	FFPE Blocks	A representative block of tumour (resection, biopsy or cytology preparation) should be provided. The analysis can only be performed on specimens where there is adequate tumour material.
MSI	FFPE Blocks	Send representative blocks of tumour and normal tissue and if these are not available then contact us to discuss alternatives. The normal tissue sample need not be from the same specimen. If no normal tissue is available the analysis will be performed using a generic normal control. However, this can affect the interpretation of results.
Germline BRCA1 & 2 (including MLPA)	EDTA blood	Germline only analysis is currently performed for HER2 negative locally advanced or metastatic breast cancer patients. FFPE material will be required is somatic analysis is required for prostate, ovarian, fallopian tube or primary peritoneal cancer.

3.7.6.7 Homologous Recombination Deficiency

This assay gives a Genomic Instability Score (GIS) A score of ≥ 48 is positive. BRCA1 or BRCA2 are also assessed in the same assay and a positive GIS and/or positive for a pathogenic/likely pathogenic BRCA1/2 variant will identify patients that may benefit from treatment with PARP inhibitor. MLPA analysis also looks for largescale alterations in the BRCA 1 and 2 genes This is performed on the blood sample requested to accompany the FFPE block for HRD testing. The request form is available on the internet and intranet. Detailed on the request form is the sampel type required, the FFPE block and an EDTA Blood sample.

3.7.7 Neuromolecular Pathology Tests and Requirements:

Molecular Test performed	**Requirement:**
1p19q Array CGH	10x5micron sections of requested block on unbaked glass slides.
MGMT methylation analysis	10x5micron sections of requested block on unbaked glass slides.
BRAF Fusion qPCR	5x5micron sections of requested block on unbaked glass slides.
IDH 1&2 sequencing analysis	10x5micron sections of requested block on unbaked glass slides.
DNA Methylation profiling	10x5micron sections of requested block on unbaked glass slides.
FusionPlex NGS	10x5micron sections of requested block on unbaked glass slides.
DNA/RNA NGS CNS Tumours (External Referral to SIHMDS-AG)	10x5micron sections of requested block in two separate labelled sterile 1.5mL tubes.

From an external referral centre the samples must arrive with adequate documentation and request form, outlining patient details as detailed in 10 below.

3.7.7.1 Array CGH

Microarray - Comparative Genomic Hybridization (array-CGH) is a molecular cytogenetic method for analysing Copy Number Variations (CNVs) relative to ploidy level in the DNA of a test sample (eg. tumour) compared to a reference control sample. Test (eg. tumour DNA) is labelled in one fluorescent dye (eg. Cy3) while reference (sample with a normal complement of chromosomes) is labelled in another fluorescent dye (eg. Cy5). Fluorescent intensities from both dyes are then scanned and compared to each other for every locus that is

represented on the microarray. The final output is a genome-wide graph of copy number gains (gain or amplification) or deletions.

3.7.7.2 MGMT methylation analysis

MGMT in gliomas is a useful predictor of the responsiveness of tumours to alkylating agents. The protein O6-methylguanine-DNA methyltransferase (MGMT) functions to repair alkylated guanine in DNA by transferring the alkyl group at the O-6 position to a cysteine residue in the enzyme. This activity confers a certain chemoresistance to tumour cells and the silencing of *MGMT* through promoter methylation results in a better response to alkylating chemotherapy. In 2005 Hegi *et al*., reported that patients with methylated *MGMT* demonstrated a significant survival advantage with temozolomide treatment in a prospective phase III trial. The assessment of the methylation status of the *MGMT* promoter has therefore become an important genetic marker which is associated with response to alkylating chemotherapy and subsequent increased overall and progression free survival in GBM patients.

Assay Principle

The MGMT assay is based on the pyrosequencing of 8 CpG sites within the MGMT gene modified from Dunn J et al. 2009. The average methylation across the 8 CpG sites is calculated automatically by the PyroMark software. Methylated samples are defined as having an average methylation of $\geq$ 9% methylation in accordance with the clinically significant thresholds reported by Dunn *et al*.

3.7.7.3 BRAF Fusion

Molecular detection of the *BRAF-KIAA1549* fusion gene on chromosome 7q32 has been identified in up to 70% of PAs and is therefore of diagnostic value in these tumours (JONES, D. T. et al, Cancer Research, 2008). A qPCR based method is employed which based on the amplification of the 3 most common fusion partners in pilocytic astrocytoma. Primers specific for each of the exons above are used to amplify the fusion product. Fluorescent probes specific for the fusion junctions are used to detect the amplified product. A positive control (*GAPDH)* is included in each analysis to ensure the quality of tumour RNA. The assay is based on the publication by Tian *et al*. Journal of Molecular Diagnostics, 2011.

3.7.7.4 IDH 1&2 Sequencing

IDH1 mutations have been reported in 60-80% of WHO grade II and III gliomas, and secondary glioblastomas, whilst 2-5% of these tumours have *IDH2* mutations. Approximately 5% of primary GBM harbour *IDH* mutations. *IDH1* mutations have been associated with better clinical outcome; they are suitable predictive markers for adult glioma patients. In terms of diagnosis the presence of an *IDH* mutation can help to distinguish oligodendrogliomas from other

tumours such as clear cell ependymomas and dysembryonic neuroepithelial tumours, as well as helping to differentiate between ganglioliomas and diffuse gliomas[2-5]. Mutations affecting *IDH1* and *IDH2* have been shown to be limited to the binding site of the proteins –cDNA positions 394 and 395 in *IDH1* and 514, 515 and 516 in *IDH2*, with mutations thought to be mutually exclusive.

3.7.7.5 DNA Methylation profiling

DNA methylation plays an important and dynamic role in regulating gene expression. It allows cells to become specialized and stably maintain those unique characteristics throughout the life of the organism, suppresses the deleterious expression of viral genes and other non-host DNA elements, and provides a mechanism for response to environmental stimuli. Aberrant DNA methylation (hyper or hypomethylation) and its impact on gene expression have been implicated in many disease processes, including cancer. By providing quantitative methylation measurement at the single-CpG–site level for normal and formalin-fixed paraffin-embedded (FFPE) samples, this assay offers powerful resolution for understanding epigenetic changes.

Following bisulfite conversion of DNA samples, DNA restoration is carried out using the Infinium HD FFPE Restoration Kit to optimise the processing of DNA previously extracted from FFPE tissue. The Illumina EPIC array Kit is then used to amplify, fragment and hybridise DNA to a beadchip which can be analysed on the Illumina iScan instrument to determine the methylation profile of the sample DNA.

3.7.7.6 FusionPlex NGS

Archer FusionPlex NGS is an RNA-based next generation sequencing panel for the identification of fusions and variants from FFPE tissue including NTRK fusions. The panel consists of 57 genes (shown below) which are assessed under the direction of the reporting neuropathologist. Any of these genes can be assessed upon request by contacting the reporting neuropathologist.

AKT1	*DDR2*	*FGFR2*	*IDH1*	*MAP3K8*	*NTRK3*	*PRKCA*	*TRIM11*
ALK	*DNAJB1*	*FGFR3*	*IDH2*	*MET*	*NUTM1*	*PRKCB*	
AXL	*EGFR*	*GNA11*	*KEAP1*	*MYB*	*PAX8*	*RAF1*	
BRAF	*ERBB2*	*GNAQ*	*KIT*	*MYBL1*	*PDGFRA*	*RET*	
BRD3	*ERBB4*	*GNAS*	*KRAS*	*NRAS*	*PIK3CA*	*ROS1*	
BRD4	*ERG*	*H3F3A*	*LTK*	*NRG1*	*POLD1*	*STK11*	
CTNNB1	*ESR1*	*HIST1H3B*	*MAP2K1*	*NTRK1*	*POLE*	*TMPRSS2*	

CYSLTR2	*FGFR1*	*HRAS*	*MAP3K3*	*NTRK2*	*PPARG*	*TP53*	

3.7.7.7 DNA/RNA NGS for CNS Tumours

CNS tumours are referred to the external laboratory listed below for the purpose of DNA and RNA next generation sequencing. The purpose of this testing is to identify variants and fusions clinically relevant to CNS tumours as either diagnostic markers or indications for treatment.

SIHMDS Acquired Genomics Laboratory,
North Thames Genomic Laboratory Hub,
Level 4 Barclay House,
37 Queen Square,
London
WC1N 3BH

Samples are referred as cut sections in sterile tubes which undergo nucleic acid extraction at the referral site. This material is then sent to the Clinical Genomics laboratory at the Royal Marsden Hospital (also part of the North Thames genomic hub), where it undergoes DNA and RNA NGS using their custom gene/fusion panels. The data output is then returned to SIHMDS-AG for analysis, interpretation and reporting. For more information regarding the NGS panels and genes included, please contact the Molecular Pathology Laboratory, Beaumont Hospital.

3.7.8 Test Request Forms

Test request forms are available to download via the Beaumont Hospital Molecular department website at:

https://www.beaumont.ie/pages/health-A-Z/laboratorypathology or by contacting the laboratory.

3.7.9 Delivery of Specimens for Analysis

Courier Services Specimens can be delivered via courier directly to the Molecular Pathology Department care of Pathology Specimen reception in the Laboratory Directorate addressed to the following.

Molecular Pathology Laboratory
c/o Pathology Specimen Reception
Beaumont Hospital
Beaumont Road
P.O. Box 9063

Dublin 9

3.7.10 Test Result Queries

Despite our best efforts, it is possible that an error can occur. If you have concerns about a report please draw it to our attention without delay, and we will investigate immediately.

3.7.11 Specimen Referral

When we are unable to provide a request or required follow-on analysis, we will attempt to source a referral laboratory, to which specimens may be sent. We welcome input from interested clinicians in this process. The choice of laboratory is primarily based on quality grounds, with accredited laboratories being chosen preferentially. Other factors such as cost and turnaround times are also considered.

3.7.12 Details Required for All Specimens

Regardless of the specimen type, the minimum essential information and minimum criteria that must be supplied **legibly** include:

On the specimen block/slide:

Histopathology block number

On the blood sample:

On the request form:

- Name of patient
- Date of Birth
- Requesting Clinician/Pathologist
- Referring Hospital
- Relevant clinical details
- Specimen type

Note: Please send the pathology report relating to the sample to be tested and give ***as much clinical information on the form / letter*** as possible, as this will be required by the Pathologist when considering interpretations and advice. Specimens will not be accepted without a minimum of three forms of identification on the request form and will be returned to the source of origin to be completed / labelled correctly. All hazard labels where appropriate must be used for the health and safety of the staff that will be handling the specimen.

3.7.13 Turnaround Times for Results (TATs)

The turnaround time of specimens will vary depending on the nature of the specimen and the complexity of the investigations required. The following is an outline of estimated turn-around times for different specimen types from time of receipt in the laboratory:

Solid tumour mutation analysis	15 days
ALK & *ROS1* FISH testing	15 days
Microsatellite Instability analysis (MSI)	20 days
MLH1 Hypermethylation analysis	20 days
Neuromolecular testing (aCGH, MGMT, BRAF fusion, IDHSeq,DMET, NGS)	42 days
HRD testing	48 days
BRCA 1&2 testing (including MLPA)	48 days

Notes

- TATs refer to working days from receipt of specimen until report has been authorised. Time refers to 90% of referrals.
- All reports are emailed by the laboratory staff to the requesting clinical and referral site. No results are issued over the phone.
- There is no time limit for requesting additional examinations but requests should be made by emailing the laboratory at molecular@beaumont.ie including an updated request form and stating the patient's name, DOB and original sample number of available.
- Urgent specimens will be "fast tracked" as appropriate.

3.7.14 Reports

Reports are available through the laboratory.

- External Reports are sent to those listed on the MolecularPathology request form or Consent form
- If a report has not been received, and the test request has exceeded the stated TAT, an enquiry can be made by emailing molecular@beaumont.ie Please do not email unless the TAT has been exceeded.
- Only authorised reports are available from the laboratory.
- If an interim report, clinical advice or result interpretation is required please contact the Consultant Histopathologist/Neuropathologist.

3.8 NHISSOT

3.8.6 How to Order Tests

As per the EFI standard for sample acceptance, all samples received and accepted into the laboratory **must** have the patient's name, date of birth and sample date. Samples that do not comply with this EFI standard will be rejected and repeat samples will be required.

- HLA Typing: The Histocompatibility Testing Request and Consent Form [H&I-Form-509] **must** be completed and must include the patient name, date of birth, requesting clinician/consultant, centre and sample date. This form should accompany the blood samples
- It is the responsibility of the requestor to ensure that the patient has read and understood the permission statement on the consent form. This must be signed by the consenting individual.
- HLA antibody screening: A HLA antibody screening request form must be completed [H&I-Form-236]. This form may be E-mailed to crossmatch@beaumont.ie or posted with the samples to the H&I Department.
- Forms for HLA typing and HLA antibody screening are available from the H&I department. Please phone or email crossmatch@beaumont.ie if a request form is required.

3.8.7 Repertoire of Tests

Test		**Blood Container**	**Minimum Volume**
HLA Typing of patients for solid organ transplant		Sodium Citrate	2.9ml
HLA Antibody Screening for solid organ transplant Pre transplant / Post transplant / Antibody Mediated Rejection query		Clotted	Paeds: 3ml Adult: 5ml
ABO blood grouping of patients for solid organ transplant		EDTA	5ml
HLA Disease Association Testing [B*27 / B*57:01/ HLA-DQ]		Sodium Citrate	2.9ml
Potential deceased donor work-up		Sodium Citrate Clotted EDTA	60ml 5ml 5ml
Living donor work-up: Potential Donors	1st Workup	Sodium Citrate EDTA	2.9ml 5ml
	2A Workup	Sodium Citrate EDTA	2.9ml 5ml
	2B Workup	Sodium Citrate EDTA	50ml 5ml
	3rd and Final Workup	Sodium Citrate	40ml

Test		**Blood Container**	**Minimum Volume**
		Clotted	5ml
Living donor work-up: Potential Recipients	2B Workup	Sodium Citrate Clotted	40ml 5ml
	3rd and FinalWorkup Clotted blood should be within 7 days of the proposed transplant date	Sodium Citrate Clotted	40ml 5ml
Autocrossmatch		Sodium Citrate Clotted	40ml 5ml
HLA typing for partners		Sodium Citrate	2.9ml

3.8.8 HLA Typing of Patients for Solid Organ Transplantation

Human Leucocyte Antigen (HLA) type is defined by the presence of different HLA antigens on the cell surface. These antigens enable the immune system to recognise foreign organisms and destroy them.

In solid organ transplantation the major HLA antigens involved are HLA-A, HLA-B, HLA-C, HLA-DR, HLA-DQαβ and HLA-DPαβ.

Mismatches between donor and recipient HLA type are a major stimulus of the development of donor specific HLA antibodies leading to rejection of the transplanted organ.

Potential recipients are HLA typed by low to medium resolution molecular techniques. These techniques use commercial probes and primer sets selected according to the EFI standards for HLA typing.

- Specimens received for HLA typing have DNA isolated and stored, serum stored and a sample sent for blood grouping.
- Prior to issuing a clinic appointment, the Transplant Co-Ordinator, HLA Typing and antibody screening will be carried out. A NHISSOT patient report will be issued prior to the patient's appointment at the renal and pancreas transplant clinics.
- **Samples and tests required prior to a transplant clinic appointment**

  1x 2.9ml Sodium Citrate sample for HLA typing
  1x 5ml Clotted sample for Antibody Screening
  1x 5ml EDTA sample for Blood Grouping
  Histocompatibility Testing Request and Consent Form

MOLECULAR (DNA) TYPING

Patient's DNA is isolated from citrated blood and typed by molecular techniques:

1. PCR-SSP (sequence specific primers) – these SSP primers consist of allele and group specific primers that are designed to anneal to specific sequences characteristic of a given allele or group of alleles. Amplified products of DNA are visualised by gel electrophoresis.
2. PCR-SSO (sequence specific oligonucleotides) – After PCR amplification the amplicons are denatured to form single stranded DNA which are added to a microsphere or chip containing specific SSO probes. The amplicons then hybridise to those probes that contain a complementary target sequence. Assignment of a HLA type is based on the reaction patterns associated with published HLA gene sequences.

Note: Luminex® technology for SSO typing allows for multiplex, high throughput testing. This method is therefore particularly suited for the routine HLA typing of multiple DNA samples. SSO typing is not suitable for donor typing due to time constraints.

Note: DNA samples may be sent to the National Histocompatibility and Immunogenetics Reference Laboratory (NHIRL) for high resolution or sequencing for confirmation of rare HLA types

Note: Patients are HLA typed on two separate samples taken on two different occasions.

3.8.9 Antibody Screening

Antibodies to HLA antigens can develop through pregnancy, transfusion, previous solid organ transplant or cardiac mechanical assist device placement. These antibodies can potentially react with a transplant organ causing graft rejection. All patients for solid organ transplantation are tested for HLA antibodies and these are recorded in the H&I database.

3.8.9.1 Screening Tests

Luminex Single Antigen

Microbeads coated with purified HLA antigens are used to detect HLA antibodies. . The Luminex flow analyser detects the fluorescent emission from the beads and the amount of fluorescence can help to estimate the amount of antibody present.

3.8.9.2 Antibody Analysis and Identification

The HLA antibody screening results are analysed and any HLA antibody identified is recorded in the patient's antibody profile as an unacceptable antigen.Therefore, if a donor is identified and a recipient list is generated, any potential recipient with an antibody to the potential donors's HLA antigens, are excuded. This significantly reduces the liklihood of a positive crossmatch.

3.8.9.3 Pgen

PGEN - GENERATED OR CALCULATED PRA

Using the H&I database of donor HLA types, we can calculate how many donors are unsuitable due to the presence of HLA antibody. This is referred to as generated PRA - Pgen. The Pgen value can be used as an indicator of how difficult it is to find a compatible graft.

Pgen example

HLA-A2 is present in approx 25% of Irish donor population. If a recipient has an antibody to HLA-A2, the Pgen is calculated at 25%. This tells us that 25% of donors in the Irish population are unsuitable for this recipient. The more antibodies the patient has, the higher the Pgen.

3.8.9.4 Specimen Requirements for Antibody Screening

Renal/pancreatic patients who are active on the transplant waiting list:

- HLA antibody screening sample (clotted sample) every 90 days.
- CAPD and pre-emptive patients can have the samples taken by their local GP and posted to the department - see section 3 for transport requirements.
- Following a transfusion (blood products or platelets) a clotted sample is required 14 days post transfusion or as soon as possible thereafter. It is **vital** we receive these samples to monitor a patient for donor specific HLA antibodies.

Note: Routine 3 monthly samples are essential for screening and crossmatching patients on the waiting list. If we do not have a sample less than 90 days old, the patient will not be listed for transplant.

Renal/pancreatic patients who are *not yet* on the transplant waiting list:

- All patients transfused (blood products or platelets) require a clotted sample 14 days post transfusion or as soon as possible thereafter. It is **vital** we receive these samples.

Cardiothoracic patients

- Patients identified as positive for HLA antibody – **Sample every month.**
- Patients with no identified HLA antibody **– Sample every 3 months.**
- Patients with cardiac mechanical assist device placement – Samples required every month unless otherwise notified.

Due to time constraints in cardiothoracic transplants the following schedule applies to ensure that a sample within an acceptable time frame is available for crossmatch: Following a blood transfusion (blood products or platelets), we require a sample at week 2, 3 and 4.

3.8.10 Solid Organ Transplant Pools Work-Up

3.8.10.1 Renal/Pancreatic Patients

If a patient is approved for the transplant waiting list at the transplant clinic by the Consultant Transplant Surgeon, the Transplant Co-ordinator will contact the laboratory by email to confirm patient's approval for activation. The patient will appear on the monthly transplant waiting list as 'NHISSOT workup'.

A Patient is 'activated' on the transplant list when all the documentation and immunological work is completed.

A letter is then issued from the H&I Department to the patient, their Consultant Nephrologist and Transplant Co-ordinator to confirm activation on the transplant list.

3.8.10.2 Cardiothoracic Patients

On receipt of a request by email from the Cardiothoracic Transplant Co-ordinator, the patient is HLA typed and tested for HLA antibodies. The report issued will indicate if the patient will need a prospective crossmatch when listed for transplant.
Additional samples are required on patients listed for lung transplant for auto crossmatch. These bloods will be requested by the Cardiothoracic Transplant Co-ordinators when the patient has been approved for the active lung transplant waiting list.

3.8.10.3 Liver Patients

On receipt of a request by email from the Liver Transplant Co-ordinator, a patient is HLA-B typed and ABO blood grouped. A Confirmatory HLA-B type is performed following transplantation

3.8.11 Deceased Donor Work-up and Potential Recipient List Generation

The ODTI Transplant Co-ordinator (Organ Donation and Transplant Ireland) contacts the H&I Department when a potential donor is identified. Donor bloods are sent to the laboratory.

On receipt

- Potential donor is HLA typed.
- ABO blood group requested.
- Match programme to identify suitable recipients is generated.
- Potential recipient list is complied according to agreed criteria andcontains information on the following :
  - Priority Patients/Paediatric Patients/Acceptable Mismatched Patients.
  - Significantly Sensitised Patients (Highly Sensitised) PGen ≥ 50.
  - Favourable Match / Reasonable Match Patients.
  - Longest Waiting Patients.
  - HLA incompatiable patients (HLAi).
  - Simultaneaous Pancreas and Kidney (SPK) Patients.

The list of immunological suitable recipients is sent to the Consultant Transplant Surgeon and the Renal Transplant Co-ordinator.

3.8.12 Matchability Scores

A database of HLA types of previous deceased donors from the Irish population is used to calculate the chance of a patient getting a good match from our donor population. This data is expressed as a percentage of the population and is made available to the referring clinicians on the monthly transplant waiting lists.The

ODT (Organisation for donation and transplantation in the UK)) define a favourable match as:

- 000, 100, 200, 010, 110, 210 (HLA -A, -B, -DR) – Figures represent donor mismatched antigens
- These grafts show a definite survival advantage in most large studies. Additionally, for patients likely to require a further transplant the degree of sensitisation following a well matched graft is usually less than that following a poorly matched graft.

DEFINING MATCHABILITY

For patients of blood groups A and O:

Score	Reported
5% or under	Low
5.1-7.9%	Medium
8% and over	High

3.8.13 Living Donor Work-Up

3.8.13.1 What is living donation?

Living donation is where a living person donates an organ (or part of an organ) for transplantation to another person. Living Donation is only considered after thorough evaluation when the donor is healthy, where the loss of the organ or part of an organ is not deemed to place their longterm health at undue risk, and where the donor understands the process and freely consents to donation.

The following forms must accompany potential donor samples for work-up:

HLA Request form for 1st Living Donor Workup
Activation Request form for Living Donor Workup

Samples should be forwarded to the H&I Department, either directly from the transplant co-ordinator, or by post if from abroad. Only 2 potential donors per recipient will be processed by the laboratory at any one time. If either is deemed unsuitable, two further potential donors can be evaluated once a signed activation form has been received.

3.8.13.2 What makes a donor suitable?

- **Compatible blood group**
  The living donor and recipient blood groups should be compatible

- **Compatible HLA type**

  HLA antigens are inherited therefore blood relatives are more likely to have similar HLA type. A brother and sister have a one in four chance of having an identical type.

  Those genetically unrelated can also be assessed for living donation. Any potential living donor is HLA typed to ensure that their HLA type is compatible with the potential recipient

  HLA antigens assessed for matching are HLA-A, -B, -C, -DR, -DQ, -DP.

- **Compatible Antibody Profile**
  A potential living donor can be eliminated at the first stage of living donor work-up, if the potential recipient has an antibody to the donor's HLA antigens. This antibody can pose a risk to the graft.

3.8.13.3 Summary of stages for Living Donor work-up

Note: Families who wish to donate **must** initially contact the Transplant Co-ordinators. Any samples received into the laboratory **will not be processed** without prior contact with the Transplant Co-ordinators.

Note: Samples required are listed in the repertoire of tests.

First living donor work-up – virtual crossmatch

- Potential donor HLA type and blood group
- Risk assessment issued

Second living donor work-up

2a Workup – virtual crossmatch

- Confirmatory HLA type and blood group
- Risk assessment issued

2b Workup – 'wet' crossmatch

- Confirmatory HLA type and blood group
- Crossmatch using the potential donor cells and recipient sera
- Autocrossmatch of the potential recipient
- Risk assessment issued

Final living donor work-up

- This final stage of the work-up takes place no more than one week pre-transplant
- 'Wet' crossmatch
- Risk assessment issued

3.8.13.4 Risk Assesment

Using antibody screening data, sensitisation history and crossmatch results the immunological risk for a donor/recipient pair is assigned by the Consultant Immunologist

3.8.13.5 REPORTING

Reports for the first and second work-up are issued to the Transplant Co-ordinator. The final work-up report is sent to the Consultant Surgeon and Transplant Co-ordinator.

Note: Results cannot be transmitted directly to the potential recipient's Nephrologist or dialysis centre.

3.8.14 Crossmatching for Solid Organ Transplantation

Transplanting an organ into a patient who has circulating HLA antibodies to donor HLA antigens could result in a hyperacute rejection and immediate organ loss.

The crossmatch prior to transplantation will detect any donor specific antibodies and thus prevent hyperacute rejection, greatly reduce acute rejection and the risk of graft loss.

A positive crossmatch is not necessarily a bar to transplant. A patient's sensitisation history and antibody screening profile is also taken into account for the risk assessment.

The crossmatch uses a selection of both current and historic sera:

- Detection of historic antibody can be an indication of prior sensitisation (exposure) of the patient to donor antigen and the presence of memory T and B cells. This can lead to a rapid immunological response if challenged with the same antigen.
- Detection of current antibody, if directed against HLA antigens present on the graft, can cause hyperacute rejection of the organ or an acute rejection.
- A day of transplant (DoTx) sample is required for crossmatch where a patient has had a recent sensitising event, graft in situ, failed graft within

12 months or borderline donor specific reactivity against donor HLA antigen.

Please note:

It must be stressed that all crossmatch interpretation should be done in consultation with the H&I staff and the Consultant Immunologist or designated Senior Medical Scientist

3.8.14.1 Crossmatch tests

The crossmatch techniques used in the laboratory are flow cytometry and complement dependent cytotoxicity (CDC). They can detect both HLA class I and class II donor specific antibodies.

3.8.14.2 Virtual crossmatching

In limited circumstances a patient may be suitable for transplant without a prospective crossmatch due to theatre time constraints. Renal and Cardiothoracic patients who fulfil **certain** criteria are suitable for consideration for virtual crossmatch in discussion with the transplant team. **Note:** If the patient has had transfusion/pregnancies or has a failing transplant they may not be suitable for a virtual crossmatch.

All patients transplanted using virtual crossmatching require a flow crossmatch retrospectively in accordance with EFI standards.

3.8.14.3 Autocrossmatch

This assay involves a crossmatch of the recipient's lymphocytes with autologous (own) serum. This can identify auto-reactive antibodies.

Knowledge of the presence and type of autoantibody can be helpful in interpreting positive crossmatches.

- Samples for autocrossmatches should reach the laboratory within 24 hours
- Please contact the H&I deparment to book in the samples for autocrossmatch

3.8.15 Post-Transplant Monitoring

Antibody testing post transplant can detect the presence of donor specific antibodies (DSA) that may develop clinical and sub-clinical. Screening for DSA post transplant and early intervention could prevent graft rejection and improve graft outcomes.

3.8.15.1 Graft Rejection

Rejection of solid organ grafts is conventionally classified as hyperacute, acute and chronic.

- Hyperacute rejection causes rapid activation of complement, platelet aggregation, thrombosis and ischaemic necrosis. It is mediated by pre-formed antibodies that react with many different antigens expressed on the transplanted organ. The result of hyperacute rejection is rapid destruction of the transplanted organ which must be removed immediately to prevent a severe inflammatory response.
- Acute rejection usually occurs early following transplantation (typically within 4 weeks). It is a classical cell-mediated immune response involving presentation of foreign antigens to T cells by antigen presenting cells, proliferation and activation of T cell clones and destruction of the graft by cytoxic T cells.
- Chronic rejection occurs later (typically months or years after transplantation). It leads to a gradual deterioration of renal function with biopsy appearances of fibrous intimal thickening, interstitial fibrosis and tubular atrophy. The most consistent predisposing factor is that of previous episodes of acute rejection

3.8.15.2 Post Transplant: Renal/Pancreatic Patients

Specimen Requirements

- Clotted sample weekly for the first month.
- Clotted sample monthly for the next two months.
- Clotted sample should then be sent at 6, 9 and 12 months.
- Clotted sample should then be sent on each subsequent anniversary of the transplant
- Clotted sample should be sent when clinically indicated - at biopsy, when there are concerns regarding graft function or a change to immunosuppressive regimen.

Note: Samples are tested according to their post transplant testing schedule and a post transplant report sent to the requesting Clinican

Note: Please email posttransplant@beaumont.ie or phone the H&I department when screening is clinically indicated. Please include any clinical indicators such as creatinine levels and a contact number for urgent results. If antibody mediated rejection is suspected, this should be discussed with a Senior Medical Scientist who will contact the Consultant Immunologist with patient clinical details.

3.8.15.3 Post Transplant: Cardiothoracic Patients

- Clotted sample weekly for the first month

- Clotted sample monthly for the next two months
- Clotted sample -should then be sent at 6, 9 and 12 months post transplant
- Clotted sample should then be sent on each subsequent anniversary of the transplant
- Clotted sample should be sent when clinically indicated - at biopsy, when there are concerns regarding graft function or a change to the immunosuppressive regimen

Note: Samples are tested according to their post transplant testing schedule and a post transplant report sent to the requesting Clinican

3.8.15.4 Post Transplant: Liver Patients

Graft versus Host Disease (GvHD) can pose significant risks to liver transplant patients. If GVHD is suspected, please contact the department with clinical details by phone or email posttransplantlab@beaumont.ie.

3.8.16 Patients for Disease Association

There are many thousands of different HLA types as a result of the differences in our HLA genes.

Some of these tissue types are associated with disease including ankylosing spondylitis, Behcet's disease, coeliac disease, narcolepsy, rheumatoid arthritis and selective IgA deficiency

Only Beaumont Hospital patients and GP patients in the catchment area are HLA typed for disease association. All disease association typing from other hospitals are carried out in the NHIRL, National Blood Centre, James's Street, Dublin 8.

3.8.17 Patients for HLA-B57 Typing

Patients who express a specific allele of HLA-B57 (HLA-B*57:01) are at risk of a life-threatening reaction if exposed to abacavir, anantiretroviral drug. Patients who require treatment are HLA typed for HLA-B57. Patients found to be HLA-B57 positive by low resolution are typed by high resolution to define the B*57allele.

3.8.18 HLA Typing for Partners of Recipients

During pregnancy or birth the baby's cells can cross the placenta and expose the mother to paternal's HLA antigens.

Occasionally this can induce an immune response and the mother can subsequently develop HLA antibodies. These only become clinically relevant if the mother requires a transplant.

Paternal HLA typing is helpful to identify the antigens the mother may have been exposed to.This can aid antibody identification and help to build up an antibody profile on a patient.

3.8.19 ABO blood group typing

Beaumont Hospital Blood Transfusion Department carries out all donor and recipient blood groups on request.

3.8.20 Out of Hours services (On-Call)

The H&I department provides an out-of-hours service for solid organ transplantation.

The services available are:

- HLA typing and crossmatching all potential donors for solid organ transplantation.
- Urgent antibody screening for cardiothoracic patients.
- Urgent antibody screening for post transplant rejection episodes.

Note:

- All requests for urgent antibody screening **out of hours must be** done in consultation with the Medical Scientist on-call
- For clinical advice **out-of-hours**, the Consultant Immunologist on-call can be contacted through the switch board. During normal working hours urgent requests must be discussed with a Senior Medical Scientist or e-mailed to the following e-mail address detailing the reason for the urgent request:

posttransplant@beaumont.ie
transplantlab@beaumont.ie

3.8.21 Data Protection Act and Freedom of Information

The H&I computer database is used to maintain patient data. A back-up paper copy is also retained. All data is stored in compliance with General Data Protection Regulation. Data can include the following:

- Name.
- Hospital chart numbers.
- Date of birth.
- Address.
- Phone number(s).
- Email address.
- Dates of dialysis.
- Type of dialysis.
- Dates of transfusions/transplants.
- Dates of sera samples received.
- Antibody screening information and results.
- HLA type.
- Molecular DNA typing information.
- Blood group
- Number of pregnancies.
- Related donor information, where patients have been transplanted.
- Related family information, where a family study has been performed.
- Partner's HLA type where applicable.

3.8.22 Reports issued/Expected Turn Around Times (TAT)

3.8.22.1 Turn Around Times

The following table lists the turn-around-times for H&I reports:

TESTS	**TURN AROUND TIMES**
HLA typing for Solid Organ Transplant	3 weeks – *Urgent service available*
HLA Antibody Screening	2-4 weeks – *Urgent service available*
HLA Antibody Screening HLA typing requests for emergency transplantation	Same day service if requested
NHISSOT Patient report for the transplant clinic	4 weeks from request to issuing a report
Transplant pool work-up	2-6 weeks
Deceased donor work-up	6 hours
Potential donor recipient list	8 hours
Crossmatching for renal transplants	6 hours

TESTS	TURN AROUND TIMES
Crossmatching for pancreatic/cardiothoracic transplants. Time taken from receipt of bloods in H&I laboratory and potential names for crossmatch given to the on-call scientist	6.5 hours for processing a single donor with a standard workup of a maximum 4 names. This time may change due to additional names or for technical issues. Users will be informed
Living donor work-up	1st work-up 4 weeks 2nd work-up 3 weeks Final work-up 48 hours
Autocrossmatch	2-3 days
Post Transplant Monitoring Non Urgent. *If contacted by the referring clinician for a more timely report the sample can be set on the next screen.* Further testing/ typing	2 weeks. 3 weeks
Post Transplant monitoring - Urgent antibody screening request for possible graft rejection *Requires discussion with Antibody Screening Senior. The level of urgency must be stated by the referring clinician.*	Same day service available if required, otherwise the sample is set on the next screen.
HLA typing for disease association	4 weeks
HLA typing for BMT/HSCT	2 weeks (unless awaiting further potential donors from overseas)
HLA typing for B57	4 weeks
HLA typing for partners	3 weeks
ABO Blood Grouping	2-3 hours

3.8.22.2 Abbreviations on H&I Reports and Printouts

Dialysis Centres

AM Antrim Area Hospital
BE Beacon Clinic Sandyford, Dublin
BD Beacon Clinic Drogheda, Dublin
BT Beacon Clinic Tallaght, Dublin
BF Belfast City Hospital
BH Beaumont Hospital, Dublin
CA Cavan General Hospital
CB Mayo General Hospital, Castlebar
CO Cork University Hospital
CR Our Lady's Hospital for Sick Children, Crumlin, Dublin
EU Patients dialysing in hospitals overseas within the EU
FR Fresensius Limerick
GA Galway University Hospital, Galway

GW Wellstone Clinic, Galway
JA St. James's Hospital, Dublin
KK Wellstone Clinic, Kilkenny
LE Letterkenny General Hospital
LI Limerick University Hospital
MA Mater Misericordiae University Hospital, Dublin
MK Merlin Park Hospital, Galway
MW Midlands Wellstone Clinic
NC Northern Cross Clinic, Dublin
NE Daisy Hill Hospital, Newry
OM Omagh General Hospital
OS Patients dialysing overseas – outside the EU zone
SL Sligo General Hospital
SV St. Vincent's University Hospital, Dublin
TA Tallaght Hospital (AMANCH), Dublin
TE Children's University Hospital, Temple Street, Dublin
TR UniversityHospital Kerry
TU Tullamore General Hospital
WA University Hospital WaterfordWW Wexford Wellstone

3.8.22.3 Renal/Pancreatic Transplant Pool Printout Abbreviations

Age	Age in years
Blood G	Blood Group
BMI	Body Mass Index
Compno	H&I computer number
Cyto Due Date	Date a sample for antibody screening isrequired
Days until sample	Number of days sample is due. Minus number indicates the number of days the sample is outstanding
Dial Cen	Dialysis centre
Dial	Dialysis type:P = CAPD/CCPD H =Haemodialysis
KG	Weight in kilos
Match %	Matchability score
PGen	Generated PRA PGen4: calculated on 4 HLA loci PGen10: calculated on 10 HLA loci
Prev Tx	Previous transplant(s): Number is printed
Ref Hosp	Referring Hospital
Urgent	Highest urgency - ABO compatible kidney
Wait	Length of time on transplant pool in months

3.8.22.4 Crossmatch Codes - Potential donor offer list

DoTx	Day of transplant sample required
Std	Standard – sample(s) available in the laboratory and suitable for crossmatch

VXM Suitable for virtualcrossmatch

3.9 NEAR PATIENT TESTING

3.6.1 NPT Services Offered

Below is a list of services and associated equipment currently under the governance of NPT.

NPT Service	Equipment
Blood gas	Gem 5000
Glucometry	AccuChek Inform II meters
Ketones	V-Trust meters
*INR	Coaguchek Pro II meters
**HbA1c	Cobas b101
***SARS-CoV-2 & Influenza A/B	Cobas Liat

* Service currently available in Warfarin Clinic only
** Service currently available in Omni clinic only
*** Service currently available in ED only

For any queries regarding these services please contact POCT@beaumont.ie or phone ext 4786.

3.9.6 Out of Hours/Weekend Service

Routine hours for the NPT Office is Mon-Fri 08.00-16.00. There is no supporting NPT weekend service. During out of hours and at weekends, Chemical Pathology can provide limited support for blood gas only. Please bleep 251.

All NPT services can be used by trained staff 24/7/365.

3.9.7 Contact Details for Medical / Clinical Advice

During working hours medical advice can be obtained by contacting;
For biochemistry queries - Consultant Chemical Pathologist: Dr. Clodagh Loughrey on ext 2035 or email clodaghloughrey@beaumont.ie

For microbiology queries - Consultant Microbiologist: Dr. Helene McDermott by email helenemcdermott@beaumont.ie

For haematology queries - Consultant Haematologist: Dr. Karl Ewins on ext 8832 or email karlewins@beaumont.ie

During working hours scientific or operational advice can be obtained by contacting;
Chief Medical Scientist; Gemma O'Brien (01) 7977885

3.9.8 NPT supplies

Please see table below regarding where to obtain/order relevant NPT supplies:

Consumable/Product	Supplied by:
Blood Gas cartridges	NPT office (Chem Path out of hours/weekends)
Blood Gas paper	NPT office (Chem Path out of hours/weekends)
Glucose Strips	Supplies Dept
Glucose Controls	Supplies Dept
Ketone Strips	NPT
Ketone Controls	NPT
INR strips	NPT
INR Controls	NPT
HbA1c Test kits	NPT
HbA1c Control	NPT
SARS-CoV-2 & Influenza A/B	Microbiology Lab*

*The Liat staff in ED can collect SARS-CoV-2 & Influenza A/B test kits from the Microbiology walk-in fridge 24/7/365.

3.9.9 NPT Training

All NPT users must participate in the NPT Training and Competency Assessment Programme. Only fully trained and competent staff are permitted to use any NPT device. Competency assessment is required every 2 years to maintain access to any NPT device. Sharing of personal log ons to access devices is strictly prohibited.

Training and Competency Assessment will be provided by either the NPT Department, designated local cascade trainers or a training representative from the associated company. Training is also facititated at intern, nursing and student/ nursing inductions. Please contact NPT (Ext 4786 or email poct@beaumont.ie.) for any training queries.

3.9.10 How to Request NPT tests

3.9.10.1 Blood Gas, Liat, Glucometry, Ketones, INR and HbA1c Orders

There is no requirement to order above NPT on MedLIS. These NPT orders are classified as unsolicited orders. This means that the order is generated as the patient's details are scanned by the analysers/devices which are located at or near the patient's bedside. The patient's current episode number (available on the patient's wristband and addressograph label) is the only acceptable patient ID to be scanned/entered on any NPT device when processing samples.

All blood gas samples are to be correctly labelled with the patient's addressograph label prior to analysis. This is to ensure the samples are correctly identified.

Quick Reference Guides are available on the hospitals intranet page (link below) which provide step by step guidance for trained staff on how to perform relevant NPT.

Point of Care Testing - All Documents (beaumont.ie)

3.9.10.2 Liat Orders

All samples for SARS-CoV-2 & Flu A/B must be dropped in to the designated Liat room located in ED. The samples must be correctly labelled with the patient's addressograph label with barcoded episode number and they should be accompanied with two additional identical addressograph labels.

Liat testing is performed by specially trained nurses who are available for testing 24/7/365. They can be contacted on DECT 7776.

3.9.11 Interferences

Many laboratory tests are subject to interference by endogenous or exogenous factors which may alter the true concentration of a substance within the body, or cause an analytical interference giving a potentially erroneous or misleading result. Interferences may be:

biological- where the offending substance alters the true concentration within the body or

analytical,- where the method is not specific.

Lists of substances that interfere with each method are available in the Near Patient Testing Department.

Test results should be interpreted in conjunction with clinical findings and if interference is suspected please contact the NPT department or Consultant Chemical Pathologist to discuss.

3.9.11.1 Sodium descrepancies between ABG and laboratory methods

ABG sodium results measured on GEM 5000 ABG analysers are on average 3.1 mmol/L lower than laboratory sodium results taken on the same patient at the same time. Using the sodium results from different methods interchangeably could present a clinical risk in patient management.

Both methods' precision is excellent. This means that tracking individual patient's course with either method is not affected, but the same method is to be used throughout individual patient's clinical course.

3.9.12 Reference Ranges

Test	Sample required	Speimen container	Min sample volume	Reference ranges	TAT	Comments	Mnemonic
Arterial Blood Gas NPT	Arterial sample	Lithium Heparin Arterial Syringe	1mL	pH: 7.35-7.45 pCO2: 4.3-6.4 kPa pO2: 11.0-14.4 kPa sO2: 94.0-98.0% $HCO_3^-(P,)_c$: 21-28 mmol/L $HCO_3^-(P,st)_c$: 22-26 mmol/L SBE_c: -2.0 to 3.0 mmol/L tHb: 11.7-17.4 g/dL FO_2Hb: 90.0-95.0% Na^+: 136-145mmol/L K^+ : 3.5-5.1 mmol/L Cl^- : 98-107 mmol/L Ca^{2+} :1.15-1.33 mmol/L Glu: 3.6-5.3 mmol/L Lac: 0.4-0.8 mmol/L Hct_c: N/A	2mins	Test profile for ABG samples processed at the **point of care**. Reference ranges quoted are specific for arterial blood sample types and are not gender specific. Never transfuse a patient based on a blood gas tHb result.	ABGPOCT
Arterial Blood Gas Lab	Arterial sample	Lithium Heparin Arterial Syringe	1mL	pH: 7.35-7.45 pCO2: 4.3-6.4 kPa pO2: 11.0-14.4 kPa sO2: 94.0-98.0% $HCO_3^-(P,)_c$: 21.0-28.0 mmol/L $HCO_3^-(P,st)_c$: 22-26 mmol/L SBE_c: -2.0 to 3.0 mmol/L	0.5Hrs	Test profile for ABG samples processed in the **Chem Path Lab**. Reference ranges quoted are specific for arterial blood sample types and are not gender specific. Never transfuse a patient based on a blood gas tHb result.	ABG

Test	Sample required	Speimen container	Min sample volume	Reference ranges	TAT	Comments	Mnemonic
Lactate, Arterial Sample	Arterial sample	Lithium Heparin Arterial Syringe	1mL	0.4-0.8 mmol/L	0.5Hrs	Processed in Lab only	ALACT
Lactate, Venous Sample	Arterial Syringe or Lithium Heparin	Lithium Heparin (Orange Top)	1mL (syringe) 2.7ml (Li-Hep tube)	0.6-1.4 mmol/L	0.5Hrs	Processed in Lab only	VLACT
pH (fluid)	Arterial syringe	Lithium Heparin	1mL	N/A	0.5Hrs	Processed in Lab only	FLPH
Carboxyhaemoglobin	Arterial sample	Lithium Heparin Arterial Syringe	1mL	FCOHb: 0.5- 3.0%	2mins	No specific ranges reported on analyser for smoker/non/smoker	COHB
Methaemoglobin	Arterial Syringe	Lithium Heparin	1 mL	0.0 – 1.5 %	0.5 hours		
Methanol	Serum	Plain (White Top)	4.9ml	Units: mg%	24 hours	Processed in Lab only	METHB
SARS-CoV-2 & Influenza A/B	Nasopharyngeal Swab	VTM/UTM viral swab containing one swab	N/A	N/A	30mins	TAT from time sample loaded on to Liat device	CV19POCT
Glucose NPT	Capillary	Fingerprick		4-7mmol/L	10s	Confirm any abnormal result with a venous sample sent to lab	N/A
Ketone NPT	Capillary	Fingerprick	1.0 µL	0.1-0.6 mmol/L	10s		N/A
INR NPT	Capillary	Fingerprick	8µL	INR target ranges depend on the presenting condition that requires the patient to be on anticoagulant therapy. Results >4.5 must be followed up with an urgent sample to the lab	10s	Confirm result >4.5 with a venous sample sent to lab	N/A

Test	Sample required	Speimen container	Min sample volume	Reference ranges	TAT	Comments	Mnemonic
HbA1c NPT	Capillary	Fingerprick		<48mmol/mol (6.5%) in normal subjects	5mins	For new patients always send first sample for HbA1c analysis to the Chem path lab to check for any existing variants prior to ever using NPT devices.	N/A

3.10 REQUESTS REFERRED EXTERNALLY

3.10.6 General Information on Referred Tests

The table below (3.10.2) lists items that are available to order on Powerchart for analysis in external referral laboratories. It indicates the sample type required and the contact information for the referral laboratory. These details are available when placing the order in Powerchart and on the sample label. Samples are sent to the UK and Europe Monday to Thursday only, excluding Bank holidays. Samples referred locally are sent out daily. Relevant clinical information, when indicated must be included as an order comment with all requests. Requests that are not listed in the below table must be discussed with a Chief or Senior in the laboratory prior to drawing bloods to ensure that the information regarding a suitable service provider, sample type required and any special conditions can be obtained. Test reports from external referral laboratories are scanned into the patient record in Powerchart when the result is available.

3.10.7List of Referred Tests

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
11-Deoxycortisol	Send samples from endocrine teams, otherwise must be checked / approved by endocrinology prior to dispatch.	WHIT	Vincents
17-Hydroxy Progesterone	Send sample s from endocrine teams,othewise must be checked / approved by endocrinology prior to dispatch.	WHIT	Eurofins
Acid maltase	See Alpha Glucosidase		
Angiotensin Converting Enzyme (ACE)		WHIT	Eurofins

Test Description	**Conditions/ Comments/ Restrictions**	**Sample type on label**	**Provider**
Acylcarnitine	Guthrie Card, order urorgac also, fill out special card. Kit 2	Card available from 2668	Temple St **
Adrenal Vein Sampling	Multiple site specific samples for cortisol and aldosterone. Single sample – analysed by MS	2.7mL EDTA	Wythenshawe
ALA	Order Porphyrins, Uporphyr For A Known / Diagnosed Patient Being Monitored		
Alkaline Phosphatase (Placental)	Not For CSF See CSFPLAP	WHIT	Eurofins
Alkaline Phosphatase Isoenzymes	Bone / intestinal / liver / placental as comment. Include alk phos result with order. Only send if alk phos is elevated.	WHIT	Charing Cross
Alpha glucosidase (pompe disease)	Can Only Be Drawn Mon, Tue And Wed To 2pm, Or Willdbs Can Be Done Any Day	REDL	Willink
Alpha α Galactosidase (Fabrys Disease)	Can Only Be Drawn Mon, Tue And Wed To 2pm, Or Willdbs Can Be Done Any Day	REDL	Willink
Alpha-1-Acid Glycoprotein		WHIT	Eurofins
Aluminium	Trace element free tube & needle required. Tube no. 3	METL	Public Analysts
Amino acid screen, plasma	Send to laboratory for immediate processing. Relevant clinical information must be suppplied at time of order as per pipe.	OICE	Temple Street **

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Amino acid screen, urine	Fresh sample, send to laboratory for immediate freezihg. Relevant clinical information must be supplied at time of order as per pipe.	MSU	Temple Street **
Amino laevulinic acid (ALA)	Order porphyrins, uporphyr for a known / diagnosed patient being monitored.		
Amiodarone Cordarone		WHIT	Eurofins
Ammonia (Plasma)	Send to lab within 15 mins for immediate processing, relevant clinical information must be supplied at time of order as per PIPE	OICE	Temple Street **
Amylase Isoenzymes	Include Amylase Result With Request	ORAN	Eurofins
Arginine Vasopressin	Send to laboratory on ice for immediate processing. Minimum vol. of 2 ml plasma required. Send osmo result with request	OICE	SASN
Arsenic	Urine Arsenic Must Be Checked First, If Positive Plasma Will Not Be Tested	ORAN	Eurofins
Arylsulphatase A	Can Only Be Drawn Mon, Tue And Wed To 2pm	REDL	Willink
Asialotransferrin	Fluid? CSF, in a plain container (b2transferrin, transferrin isoforms, also known as tau-transferrin – not to be confused with tau-protein)	FLUID	Inst. Neur
Beta β Galactosidase	Can Only Be Drawn Mon, Tue And Wed To 2pm	REDL	Willink

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
B-Hydroxybutyrate	Part of a hyposcrn order. Send glucose result with request & clearly specify the time of draw as per label – there may be more than one request for this test – it is important to label each sample very clearly.	ORAN	Surrey
Cadmium, Urine	Acid Washed Container Required	URIN	Public Analysts
Caffeine	Trough Sample	WHIT	Eurofins
Calcitonin	Send Both Aliquots	ICEW	Mater Public
Carnitine (Total & Free).	Can Only Be Drawn Mon, Tue And Wed To 2pm	ORAN	Willink
Cholestanol	Only To Be Drawn Mon, Tue And Wed To 2pm	REDL	Sheffield
Cholinesterase Serum (Pseudo)		WHIT	St. James's
Cholinesterase, red cell. Not PIPE orderable	Inhibition studies, phenotype and genotype. Not pipe orderable. Take an orange and a large edta.		Bristol
Chromium &Cobalt	For metal-on-metal hips. Use metal free tube and needle.	METL	Eurofins
Chromogranin A	16 Hr Fast Required, Separate And Freeze Immediately	ICEW	St. James's
Clozapine	Form 7 Must Accompany Sample	PINK	Kings
Copper serum		WHIT	Public Analysts

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Copper – urine	Acid washed container required. Note total urinary volume as a comment.	24HU	Public Analysts
Coproporphyrin	Component of Faeces porphyrin and Urine porphyrin. Order Porphyrins		
Cortisol by MS	For patients on Metyrapone. For Endocrine team.	Serum	Whythenshawe
Cortisol Binding Globulin	This Is Not TBG	ICEW	Charing Cross
CSF ACE		CSF	Neuormetab
CSF Alpha Fetoprotein		CSF	Charing Cross
CSF bHCG		CSF	Charing Cross
CSF For Total TAU-Protein & Ab1-42 Protein	Unhaemolysed CSF taken into a polypropylene tube. Store in -80ºc, freeze within 2 hours of collection, in haematology pcr room, (L1H9) prior to dispatch. Suitable tubes are:Sarstedt 60.613.010 (Samples for 14-3-3 are processed by neuropathology.)	SPEC	Inst. Neur
CSF Oligoclonal IgG	A white Serum sample must accompany CSF, order Oligoser	CSF	Inst. Neur
CSF PLAP		CSF	Charing Cross
CSF Pterins,	Samples must be frozen at the bedside. Sampling MUST be pre-arranged with Biochemistry Laboratory.	CSF	Neurometab

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
CYCLIC AMP (URINE)		24HU	Sheffield
Cystine, White Cell, Leucocyte	Can only be drawn mon, tue or wed before 2pm, sample must arrive in uk within 24 hours. Do not store in fridge. Sample must be sent out the day of draw at ambient. Do not put in fridge. Label packet- 'do not put in fridge or freezer'	ORAN	Evelina
Equilibrium Dialysis of FT4	Lab Only Order	WHIT	Addenbrooks
Erythrocyte Protoporphyrin, EPP	Component of bporphyr result. See porphyrins.		
Erythropoietin		WHIT	Eurofins
Fabrys	See Alpha-Galactosidase Or Willdbs Or Shires Assay Managed By Dave Farrell, Extn 4775, Done On Females		
Faecal Elastase		FAECES	Eurofins
Free Erythrocyte Porphyrin	Includes Free Protoporphyrin	REDL	St. James's
Fructosamine		EDTA	Coombe
Galactocerebrosidase Krabbe	can only be drawn mon, tue and wed to 2pm	REDL	Willink
Gastrin	16 Hr Fast , Send To Laboratory On Ice For Immediate Processing	ICEW	St. James's

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Gel Filtration Of Prolactin	Lab Only Order, Based On Prolactin Result Refer To Endo	WHIT	South
Glucagon	16 Hr Fast , Send To Laboratory On Ice For Immediate Processing	REDL	RVH
Glucagon Timed Samples	Send To Laboratory On Ice For Immediate Processing	REDL	RVH
Glycosaminoglycans	Fresh sample, freeze immediately. Clinical information essential	MSU	Temple Street **
Growth Hormone Releasing Hormone	Tube from biomnis, EDTA/aprotonin. Tube no 1	Special tube on ice	Eurofins
HBAIC Variants	For referral of samples for identification of Hb variants, lab only order.	FBC	Eurofins
Hexosaminidase A /Tay Sachs	Can Only Be Drawn Mon, Tue And Wed To 2pm	REDL	Willink
Homocysteine Blood	Heparin sample on ice. Not for GP patients. Sample must come on ice and be promptly spun and separated, then stored in fridge	OICE	Eurofins
Homocystine (Urine)	Ordering doctor consult temple street fasting, early morning sample, freeze in < 1 hour. Clinical information essential	MSU	Temple Street **
Hydroxyproline	See order item notes for conditions. Note total urinary volume as a comment.	24HU	Eurofins
Inhibin A and B	Only For Oncology, Do Not Send If Haemolysed. Single Sample Sufficient For A & B	ICEW	Eurofins

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Insulin-Like Growth Factor Binding Protein-3 IGFBP3	Separate and freeze within 4hrs Attach clinical data.	ICEW	AMNCH
Ketones	Done On A Meter In The Ward		
Lamotrigine	Lamictal, Larig, Lamoro	ICEW	Eurofins
Lead		ORAN	Public Analysts
Levetiracetam	Keppra	WHIT	Eurofins
Lipase		WHIT	Eurofins
Lipoprotein (A)		WHIT	Eurofins
Macroprolactin GFC	See GFCPRL Order		
Manganese	Only For Long Term Tube Feeding, Use Metal Free Needle	EDTA	Public Analysts
Mercury		REDL	Public Analysts
Metabolic Screen	Urine organic acids & plasma amino acids see order above.		Temple Street **
Methionine	See plasma amino acid screen above		
Methotrexate	Samples are referred directly to St. James's hospital by the requesting ward, by prior arrangement with SJH. The laboratory does not deal with methotrexate levels.		

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Methyl Malonic Acid	Fresh sample, freeze immediately. Specify methyl malonic on the request form. Clinical information essential	MSU	Temple Street **
Mitotane		ORAN	Mitotane
Mucopolysaccharide Confirmation	Order Urorganic Acids As 1st Line Screening Test	MSU	Willink
Mucopolysaccharides	Order METABSCR, HEP & MSU Required (URORGAC, AMACP) temple streetreet do an initial mucoploysaccharide screen – if positive a sample needs to be sent to Willink for URMPS. Clinical information essential	SEE	Temple Street **
Mycophenolate	Trough Sample	EDTA	Eurofins
5- oxoproline	Fresh sample, freeze immediately. Specify Oxoproline on the request form as an order comment, OC.. Clinical information essential	MSU	Temple Street **
P3NP	See Procollagen 3		
Oxalate, Urine	Plain 24 hr collection	24 Hr Urine	Eurofins
Panceatic Polypeptide Zero Time	16 hr fast required on ice, separate & freeze immediately	REDL	RVH
Pancreatic Polypeptide	16 hr fast required, on ice, separate & freeze immediately	REDL	RVH
Pancreatic Polypeptide -10 Mins	16 hr fast required on ice, separate & freeze immediately	REDL	RVH

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Phenytoin free	Discuss with G Collier	Serum - White	Liverpool
Phytanic Acid	Also includes pristanic acid.	REDL	Willink
PIIINP	See Procollagen 3		
Pompe	See Alpha Glucosidase Or WILLDBS		
Porphobilinogen, PBG	Component of uporphyr profile, see porphyrins.		
Porphyrins	4 samples, heparin, edta, urine, faeces, all must be foil wrapped. Refer to the individual items: BPORPHYR – Whole Blood- EDTA PPORPHYR – Plasma – Li Hep UPORPHYR - Urine FPORPHYR – Faecal Sample Send the PCV result from a recent FBC on the request form. If no FBC ask Haematology to run a PCV on the EDTA sample prior to freezing	See individual components	St. James's
Plasma Porphyrin	Part of a full porphyrin screen, foil wrap. Do not send haemolysed samples	ORAN/FOIL	St. James's

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Blood Porphyrin	Part of a full porphyrin screen, foil wrap. Send the PCV result from a recent FBC on the request form. If no FBC ask Haematology to run a PCV on the EDTA sample prior to freezing	REDL/FOIL	St. James's
Urine Porphyrin	Part of a full porphyrin screen, foil wrap, freeze if delay- particularly at weekend. Note total urinary volume as a comment. MSU will be sufficient for screening	24HU/FOIL	St. James's
Faecal Porphyrin	Part Of A Full Porphyrin Screen, Foil Wrap	Faeces foil wrapped	St. James's
Prealbumin		WHIT/Brown	Eurofins
Pristanate	Part Of Phytanic Acid Order		
Procollagen 111	Sent In Batches Monthly	ICEW	Manchester
Proinsulin	Send To Laboratory On Ice For Immediate Processing	ICEW	Surrey
PTH-RP: PTH Related Peptide.	EDTA/aprotonin. Tube no 1. Lab only order	Special Tube On Ice	Eurofins
Pyruvate	Lactate must be done first. Only done if lactate is abnormal.		
Renal Calculus / Stone Analysis		MICR	Eurofins
Retinol	See Vitamin A	WHIT in foil	St. James's

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Retinol Binding Protein		WHIT	Eurofins
Salivary Cortisol	Contact Endolab, 8675, for special tube (no. 5).	SALI	Wythenshawe
Selenium Level		WHIT	Public Analysts
Sirolimus	Dispatched Daily	FBC	Mater
Sulphonylurea	Note total urinary volume as a comment.	24HU	Eurofins
TEP, Total Erythrocyte Porphyrins	Component Of Blood Porphyr Result – See Porphyrins Request		
Thiopurine Methyltransferase	Only Stable For 10 Days. Haemoglobulin result must be included with this request	EDTA	Thomas's
6 Thioguanine Nucleotide	Only Stable For 10 Days. Haemoglobulin result must be included with this request	EDTA	Thomas's
Thyroglobulin	Send One Aliquot And Keep Second Sample	WHIT	Newcastle
Thyroid Binding Globulin	Send To Laboratory For Immediate Processing	WHIT	Eurofins
Cortisol Binding Globulin	This Is Not TBG	ICEW	Charing Cross
Total T4	On Endocrinology menu	WHIT	St. James's
TSH Alpha Subunit		WHIT	UHB

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Urine Drugs of Abuse Amphetamine Barbiturate Benzodiazepine Cannabinoids Cocaine Ethanol Methadone Opioids	Qualitative analysis only	MSU	Eurofins Biomnis
Urinary Free Cortisol	Must be refrigerated. Note the total urinary volume as a comment.	24HU	Mater
Urine Citrate	Note the total urinary volume as a comment. Sample must be stored in the fridge.	24HU	Eurofins
Urine Copper	Acid washed container required from the laboratory. Note the total urinary volume as a comment.	24HU	Public Analysts
Urine Cortisol Metabolites		24HU	
Urine Cystine	Freeze if delay. Write ' ? Renal calculus' on form as details. Clinical information essential	MSU	Temple Street **

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Urine Lead	Note the total urinary volume as a comment.	24HU	Public Analysts
Urine Mucopolysaccharide	Fresh Urine – Freeze Immediately	MSU	Willink
Urine Organic Acids	Fresh sample, freeze immediately. Clinical information essential	MSU	Temple Street **
Urine Oxalate	Acidify the plain collection as per Eurofins protocol. CN14015, June 2014 Acidify the 24-hour collection with 12N hydrochloric acid until the pH is between 2 and 3. Refrigerate	24AU	Eurofins
Urine steroid profile/ profile	Sample can thaw in transit. Note the total urinary volume as a comment.	24HU	Steroid Met
Very Long Chain Fatty Acids	Do Not Sent Haemolysed Samples	REDL	Willink
Vitamin A (Serum Retinol)	Sample Must Be Foil Wrapped. Order CRP also	WHIT in foil	St. James's
Vitamin B1 (Thiamine)	Sample Must Be Foil Wrapped – Freeze Within 4 Hours	EDTA in fiol on ice	Eurofins
Vitamin B6 (Pyridoxine)	Sample Must Be Foil Wrapped – Freeze Within 4 Hours	EDTA in foil and on ice.	Biomnis
Vitamin E (Alphatocopherol)	Sample Must Be Foil Wrapped	WHIT in foil	St. James's
White Cell Enzymes	Sample must reach the UK laboratory within 72hrs of draw.	REDL	Willink

Test Description	Conditions/ Comments/ Restrictions	Sample type on label	Provider
Willink Dried Blood Spots	For fabry or pompe disease, special pack, in laboratory, kit no. 1	N/A	Willink
Zinc - Red Cell		ORAN	Biomnis
Zinc Protoporphyrin		ORAN	Biomnis
Zinc, Serum		WHIT	Public Analysts

3.10.8Referral Laboratory Information

Laboratory	**Laboratory Address**	**Contact Name & Number**
ADDENB	Department of Clinical Biochemistry, Box 232, Addenbrooks Hospital, Cambridge, CB2 2QR, England	Dr. Peter Barker Tel: + 44-1223217 157
BIOUCLH	Dept Clinical Biochemistry, University College London Hospitals 60, Whitfield Street, London, W1T 4EU	Gill Rumsby TEL: +44-20-34472955 FAX: +44-20-34479584
BRISTOL	Department of Clinical Biochemistry Cholinesterase Investigation Unit Pathology Sciences Building Southmead Hospital Westbury-on-Trym Bristol BS10 5NB	Ms. Roberta Goodall TEL: 00-44-117 3236083 FAX: 00-44-117 959 1792

Laboratory	**Laboratory Address**	**Contact Name & Number**
CHARINGC	Medical Oncology Laboratory, Ground Floor East Wing, Charing Cross Hospital, Fulham Palace Rd. London W6 8RS.	Julia Jones –For CBG Tel: +44-20 88461234 Richard Harvey – For CSF 0044-2088461415 or 0044-2088461417
Eurofins	EurofinsLaboratories, Sandyford ind. Estate, Sandyford, Dublin 18	Dr. Michael Louw Tel 1800-252966
COOMBE	Biochemistry Laboratory, Coombe Hospital, Coombe, Dublin 8	Ruth O'Kelly 01-4085327
ERVH	Endocrine Laboratory Department of Biochemistry Kelvin Building, Royal Victoria Hospital, Belfast. BT 12 04	048-90634007, endo lab 048-90633798 for Biochemistry

Laboratory	**Laboratory Address**	**Contact Name & Number**
EXETER	Molecular Genetics / Medicine School of Post Graduate Medicine & Health Sciences, Barack Road, Exeter, EX2 5AX, England	Dr. Sian Ellard Tel: 0044 1392 402910
FREEMAN	Clinical Biochemistry Dept. Freeman Hospital, Freeman Road, Newcastle Upon Tyne, NE 77 DN, England	DR. Bob Peaston P 0044-191-2231577 F 0044-191-2331292
GOSH	Camelia Botnar Laboratory, Great Ormond St Hospital, Great Ormond Street, London WC1 N3JH	Ms Helen Aitkenhead Tel: 0044-207-8138-8318

Laboratory	**Laboratory Address**	**Contact Name & Number**
GUYS	Cytogenetics Laboratory, 5th Floor, Tower Wing, Guys Hospital, Great Maze Pond, London SE1 9RT	Dr Z Docherty +44-2071881709
HAREFIELD	The IMS laboratory &UK National Monitoring Service. Harefield Hospital, Hill End Road, Harefield, Middlesex UB9 6JH	00-44-1895828570
NEUROMETAB	Neurometabolic Laboratory National Hospital for Neurology & Neurosurgery Queen Square London WC1N 3BG, England	Dr Simon Heales Neurometabolic Unit Tel: 0044-20-34483844 Or Dr Ian Hargreaves +44-2034483844

Laboratory	**Laboratory Address**	**Contact Name & Number**
INST NEUR	NeuroImmunology & CSF Laboratory (NICL) (Box 76) 9th Floor UCL Queen Square Institute of Neurology London WC1N 3BG England	Dr V Worthington CSF Oligoclonal IgG Tel 0044-20-76762154
KINGS	Kings College Hospital, Toxicology Unit, 3rd Floor Bessemer Wing, Denmark Hill, London SE5 9RS	Bob Flanagan T: 00-44-20-32995881 F; 00-44-20-32995888

Laboratory	**Laboratory Address**	**Contact Name & Number**
MANCHESTER	Liver Research Unit Clinical Research Department Manchester Royal Infirmary Oxford Road Manchester M13 9WL, England	Dr Sandy Smith Tel: 0044-161-2764179
MATER	Pathology Department, Mater Misercordiae Hosp., Eccles Street, Dublin 7	Dr. Graham Lee 01-8032423 Duty Biochemist bleep 2164 through the switch, 01-803200
MITOTANE	Hopital Cochin 27 Rue du Faubourg Saint Jacques Laboratoire Biologie Du Medicament et Toxico 75014 Paris France	+33-1-58413316

Laboratory	**Laboratory Address**	**Contact Name & Number**
MULLINGAR	Biochemistry Department, Midlands Regional Hospital Mullingar Co.Westmeath	Ms Helen Corrigan (044) 934 0221
DCMG	National Centre for Medical Genetics, Our Lady's Children's Hospital, Crumlin, Dublin 12	01-4096733 www.genetics.ie
NEWCASTLE	Blood Sciences Reception Level 3, Leazes Wing Royal Victoria Infirmary Queen Victoria Rd Newcastle upon Tyne NE1 4LP	Tel: 0044 191 282 4559

Laboratory	**Laboratory Address**	**Contact Name & Number**
NGQS	Neurogenetics Laboratory, 6th Floor, The National Hospital for Neurology & Neurosurgery (NHNN), Queen Square, London WC1N 3BG, England	
NOTTINGHAM	Mr Anthony Walker, Haematology Dept., Red Cell Laboratory, Queen's Medical Centre, Derby Road, Nottingham, NG7 2UH	Mr Anthony Walker

Laboratory	**Laboratory Address**	**Contact Name & Number**
PRSHEFFIELD	Dept Immunology, Northern General Hosp., Herries Road, Sheffield, S5 7AU, England.	Kevin Green Tel. 0044-114 271 5707 Fax 0044-114 261 9721
PUBLIC ANAL	Public Analyst's Laboratory Sir Patrick Dun's Lower Grand Canal Street Dublin 2	Dr. Ian Nesbitt Tel: 01-6612022
RVH	Regulatory Peptide Laboratory, 2nd floor, Kelvin Building, Royal Victoria Hospital, Belfast, BT 12 6BA	Dr J Ardill Tel: 048-90263019

Laboratory	**Laboratory Address**	**Contact Name & Number**
SASL	SAS Laboratory, Dept of Clinical Biochemistry 60 Whitfield Street, London WIT 4EU, England	Tel: 0044 845 155 5000, Ext 2956 Fax: 0044 207 380 9584
SASN	SAS Laboratory Department of Clinical Biochemistry Royal Victoria Infirmary Newcastle upon Tyne NE1 4LP	00-44-191 2336161 ext 48889 (Freeman site)/29719 (RVI site)
SHEFFIELD	Department of Clinical Chemistry & Newborn Screening Sheffield Children's NHS Trust Western Bank Sheffield S10 2TH	Dr. J. R. Bonham Tel: 0044-114-2717404

Laboratory	**Laboratory Address**	**Contact Name & Number**
SOUTH	Sarah Mapplebeck Southend University Hospital, Prittle Well Chase, Westcliff on Sea, Essex, FS0 0RY	Sarah Mapplebeck Tel. 0044 1702435555, ext 6454
STEROID MET	Professor of Medicine, Centre for Endocrinology, Diabetes and Metabolism (CEDAM) School of Clinical & Experimental Medicine University of Birmingham Institute of Biomedical Research, Rm 225 Birmingham B15 2TT	Dr. Arlt Wiebke w.arlt@bham.ac.uk or Beverley Hughes
SURREY	Royal Surrey County & St Lukes Hospital, Egerton Road, Guilford, Surrey. GU2 7XX	Dr Gwen Wark Tel: 0044-1483-406715

Laboratory	**Laboratory Address**	**Contact Name & Number**
TEMPLE ST	Pathology Department, Children's University Hospital, Temple Street, Dublin 1	Ms Deirdre Deverell, Ms Anne O'Shea Tel: 01-8784273
THOMAS'S	The Purine Research Laboratory, 4th Floor North Wing, St. Thomas Hospital, London SE1 7EH	Advice: Tel: 0044-20-71881266 Results: Tel: 0044-20-71888008
UHB	Department of Clinical Biochemistry Regional Endocrine Lab, University Hospital Birmingham, NHS Foundation Trust, Birmingham, B29 6JD	Tel: 0044 1216271627 ext 52284 Fax: 0044 1214140078

Laboratory	**Laboratory Address**	**Contact Name & Number**
VINCENTS	Pathology Department, St. Vincent's University Hospital Elm Park Dublin 4	Dr Mark Kilbane Tel: 01-2214513
WILLINK	Willink Unit Genetic Medicine 6th Floor St. Mary's Hospital Oxford Road Manchester M13 9WL	Heather Church Karen Tylee Tel: 0044-161-7012307 Long Chain Fatty Acids Jackie Till TEL: 0044-161 -7012140
WYTHENSHAWE	Department of Clinical Biochemistry Southmoor Road Wythenshawe Manchester M23 9LT	Laura Owen Tel. No. 00-44-161 291 2136