

Title: BSL Haematology and Haemostasis User Handbook

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Author Vassan Thavarajah

Authorised by Volha Klimovich

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Department BSL Haematology and Haemostasis

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| 2 | Referral tests indicated as appropriate (section3) | 30/09/2022 |
| 2 | New Reference ranges included | 30/09/2022 |
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1. Introduction

1.1 General Information

King's College Hospital was originally opened in 1840 and moved to the Denmark Hill site in 1909. It became part of the NHS in 1948 as a teaching hospital. Following the dissolution of South London Healthcare Trust, King's took over the Princess Royal University Hospital (PRUH) in October 2013.

King's College Hospital NHS Foundation Trust is a large provider of acute and specialist services that serves a population of over 1,000,000 in the economically diverse Greater London boroughs of Southwark, Lambeth, Bromley and Bexley. The trust operates from 5 sites; Denmark Hill (main) site, Princess Royal University Hospital (PRUH) Bromley, Beckenham Hospital, Queen Mary's Hospital Sidcup and Orpington Hospital. The PRUH is in Farnborough, near Orpington, Kent. Beckenham Hospital is about 6 miles to the north of the PRUH and provides outpatient services. Orpington Hospital is 3 miles south of PRUH, provides outpatient services, and has 40 intermediate care beds.

The Trust has over 1300 beds including 1050 acute, 125 maternity and 144 critical care beds. The Denmark Hill site has approximately 836 beds including a major critical care service (122 beds) and maternity services (103 beds). Princess Royal University Hospital has 455 acute beds, 22 critical care and 22 maternity beds (and a midwifery led birthing centre) whilst Orpington provides 29 acute beds. Emergency Department services are provided at both King's College Hospital Denmark Hill and Princess Royal University Hospital.

All core services are provided from King's College Hospital Denmark Hill and Princess Royal University Hospital while outpatient and surgical services are provided from Orpington Hospital.

The Haematology laboratories are accredited to ISO 15189:2012 Standard by the United Kingdom Accreditation Service (UKAS).

Each department undergoes regular assessments by UKAS to demonstrate that the quality system in place provides a service that meets recognised quality standards (ISO 15189:2012 Standard).

The Blood Sciences Laboratory (BSL) at King's Denmark Hill (DH) undertake routine Haematology & Haemostasis, aswell as some Specialist Haemostasis investigations, which include full blood counts, clotting, malaria diagnosis, factors assays, thrombophilia tests.

A list of BSL Haematology accredited tests can be found on our schedule of accreditation available on the UKAS website. Copy and paste the link below into your search engine for DH:

https://www.ukas.com/wp-content/uploads/schedule_uploads/00007/9092%20Medical%20Single.pdf

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The list can also be found by entering the department's accreditation number (9092 - DH) in the search bar of the UKAS website <https://www.ukas.com/search-accredited-organisations>

This Handbook includes information on:

- Contact details for key staff
- Service levels and hours of operation
- Location of services
- Types of investigation offered
- Types of specimens required and collection conditions.
- Instructions for collecting specimens with a particular emphasis on safety and maintenance of sample validity

Should any service user have any queries in connection with any aspect of the BSL Haematology service, contact should be made with the relevant departmental senior staff, the Operations Manager, Service Delivery Manager or the Departments Quality Manager.

This Haematology User Handbook should be user-friendly and intuitive. Suggestions for improving the content for the next edition are welcome.

1.2 Pathology Laboratory

The Blood Sciences Laboratory department includes the following specialties: -

Blood Sciences:

- Biochemistry
- Haematology / Haemostasis
- Blood Transfusion

Access to all areas of the Blood Sciences department is restricted to authorised staff only. All entrances into the department are secured by digi-lock or proximity pass access.

The department operates in compliance with the standards laid out by ISO 15189:2012.

The laboratories are registered for training with the Institute of Biomedical Sciences (IBMS).

- The qualified health professionals (Biomedical Scientists) employed in the department are registered with the Health Professions Council (HCPC) meeting the standards for their respective training, professional skills, behaviour and health.
- **Clinical advice** and interpretation of results is available during the laboratory routine opening hours.
- **Clinical advice (out of hours)** - contact details and access to clinical advice out-of-hours is listed.

1.3 Key personnel and contact details

For Denmark Hill switchboard dial 020 3299 9000.

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For OOH Clinical Advice Haematology Registrar is contactable via the main switch board number above or Lab Specialist Registrar ext 32435, bleep no. 737*KH3080.

| Clinical Lead | | |
|--|--|---|
| Professor R Arya | | |
| Haematology BSL Laboratory – Denmark Hill site | | |
| Name | Designation | Contact details |
| Ian Roney | Service Delivery Manager | 31687 ian.roney@nhs.net |
| Vassan Thavarajah | BSL Haematology & Haemostasis Operations Manager | 31659 vassan.thavarajah@nhs.net |
| Volha Klimovich | Quality Manager | 3 v.klimovich@nhs.net |

Postal addresses:

BSL Haematology & Haemostasis Department
King's College Hospital NHS Foundation Trust
Ground Floor, Bessemer Wing
Denmark Hill
London
SE5 9RS

2. Laboratory Service

The department provides a wide range of analytical services for diagnosis, monitoring, screening and follow-up of patients. Clinically qualified members of the laboratory are available on-site during normal working hours (and by air-call at other times). Successful laboratory diagnosis depends greatly upon the selection, timing and method of collection of specimens.

Medical staff are urged to discuss with Senior Blood Science staff members any problem regarding the choice of investigation, the nature and method of specimen collection and interpretation of results.

2.1 Normal laboratory opening times

Monday - Friday: 09:00 – 17:30

The Central Specimen reception is open 24h and 7 days a week for specimen drop off.

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2.2 Out of hours service (Including Bank Holidays)

The out of hours service runs outside of the routine lab hours listed above. At least one Biomedical Scientist (BMS) is on at all times and should be contacted on

0203 299 6216

Tests offered include those in section 3 below.

Clinical advice out of hours can be obtained from the Lab Specialist Registrar who can be contacted through the Hospital switchboard.

Specialist investigations may be available following discussions between the requesting clinician and a senior member of the laboratory team.

3. Use of the Laboratory

3.1 Patient Identification and Specimen Labelling

Either an EPR-based or a paper-based request must accompany all specimens sent to the laboratory. It should clearly state the following information. Those in bold are a minimum requirement and without them the sample could be discarded or delayed:

- **Patient name**
- **Hospital number/NHS number**
- **Date of birth (age if DOB not known)**
- **Sex**
- **Ward or Address for report**
- **Requesting Medical Officer/GP name and number**
- **Date and time specimen taken**
- **Tests required**

Other useful data:

- Contact number for requesting clinician
- Patient address
- All relevant clinical details.

It is the responsibility of the person collecting the sample to ensure it is correctly labelled.

Under no circumstances is it possible to change the details once the sample has been sent to the laboratory.

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The following will be rejected:

- Unlabelled specimens
- Inadequate patient information
- Mismatched samples and forms
- Grossly leaking specimens

Specimens are accepted only when they are correctly labelled and collected as per instructions provided within this Guide and other related policies to ensure validity of the results.

The Haematology department will strictly enforce this policy. The requested analyses will **NOT** be performed on any samples where there is any discrepancy with patient identification.

3.2 Urgent tests

All urgent requests for routine blood tests that are performed in-house will be reported within 1 hour of receipt of the specimen into the laboratory. Other specialist assays be prioritised if there is a valid clinical indication, please contact the Operations Manager for Haematology & Haemostasis to discuss individual cases.

3.3 Transportation of Specimens

Samples must be delivered to the department in a way to protect the integrity of the sample. Samples must not be exposed to extreme temperature or prolonged transport. If samples are in danger of being exposed to conditions where sample integrity can be compromised, please contact the laboratory to discuss the most appropriate method of transport.

When receiving samples from an external institution or laboratory, it is the responsibility of the sender to ensure that the samples are packed in accordance with the current postal regulations, contain appropriate paper work and are labelled correctly. Courier / taxi / suitable transport should be arranged by the sending institution or laboratory.

All pathological samples must have:

3.3.1 Primary receptacle

Primary receptacle - a primary watertight leak-proof receptacle containing the specimen. The receptacle must be packaged with enough absorbent material to absorb all fluid in case of breakage.

3.3.2 Secondary packaging

- Secondary packaging - a second durable, watertight, leak-proof packaging to enclose and protect the primary receptacle(s) i.e. the specimen bag
- All samples must be placed in individual plastic 'kangaroo' type sample bags to avoid cross contamination. Any documentation e.g. request forms are to be placed in the separate pocket on the outside of the bag.
- Bags must not be sealed using staples, pins or paperclips.

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- Several cushioned primary receptacles may be placed in one secondary packaging, but sufficient additional absorbent material shall be used to absorb all fluid in case of breakage.

3.3.3 Outer packaging

The secondary packaging is placed in outer shipping packaging with suitable cushioning material. Outer packaging protects contents from outside influences, such as physical damage, while in transit.

- For postal specimens this will be a UN3373 box
- For cross-site or GP transport this will be a Daniels box

Any specimens that are received leaking or in a dangerous condition will not be processed but will be discarded. In this event the clinician will be informed via a report generated electronically on the pathology computer system.

3.4 Transport of specimens by road

The transport of most specimens from the General Practitioner's surgeries or outreach clinics to the hospital laboratory is provided by designated Courier service providers who will be familiar with their responsibilities.

If for any reason, pathological samples have to be transported via a contracted transport supplier, the following guidelines must be adhered to,

- The box must not be transported in the same compartment as passengers – but must be placed in the boot of any vehicle or the rear compartment of any van used and firmly secured.
- Mail must not be transported in the same carrier box as specimens.
- The container must be secured using appropriate means whilst being transported in the vehicle.
- Specimens must be transported in a secure transport box with a fastened leak proof lid. (Compliant with IATA Packaging Instruction 650 or 621 and UN3373 or UN3291)

It is the responsibility of those sending specimens from locations within the Trust but outside the laboratory site that the correct procedures are observed and that they obtain and utilise the approved and correctly labelled transport boxes.

Each box must display a biohazard warning sign and must also state that the box must not be tampered with or opened and a telephone contact number included for emergency purposes.

Carriage of pathological specimens between hospitals and/ or GP clinics and the hospital by road comes under the remit of 'The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, as amended (CDG Regs)' – ADR regulations.

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3.5 List of examinations performed in KCH BSL Haematology & Haemostasis.

3.5.1 Any tests referred to other laboratories or external sites indicated within additional test information column and listed under section 5.2.

| Test | Additional Test Information | Sample type | Minimum Sample | Turnaround Time | | Time limit for Add on tests |
|---|--|--|---------------------------------|----------------------|---------------------|--|
| | | | | Urgent | Routine | |
| ADAMTS-13 Activity | NOTE: This is a Referral test. Inform the laboratory BMS in advance on Ext.32434 During out of hours ensure to telephone Ext. 32616 Adequately filled sample sent to lab within an hour of clean venepuncture. | SST Serum/ Tri-sodium citrate/blue top tube | 1 x 3mL STT | 24 HOURS | 7 DAYS | Discuss with laboratory on Ext. 32434 |
| ADAMTS-13 Inhibitor | | | Or 1 x 3mL citrate | | | |
| Anti-Xa (Unfractionated Heparin) | Adequately filled samples to be hand delivered directly to the Bessemer Wing Blood Sciences Central Specimen Reception Immediately after clean venepuncture. | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | N/A | Within 1 hour of sample collection. |
| Anti-Xa (Enoxaparin) | Adequately filled sample sent to lab within an hour of clean venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | 4-6 HOURS | Within 4 hours of sample collection |
| Anti-Xa (Tinzaparin) | | | | | | |
| Anti-Xa (Dalteparin) | | | | | | |
| Anti-Xa (Rivaroxaban) | Adequately filled sample sent to lab within an hour of clean venepuncture. | | 1 x 3mL | 60 MINUTES | 4-6 HOURS | Within |

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| Test | Additional Test Information | Sample type | Minimum Sample | Turnaround Time | | Time limit for Add on tests |
|------------------------------|--|----------------------------------|----------------|----------------------|-------------------------|---|
| | | | | Urgent | Routine | |
| Anti-Xa (Apixaban) | Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | Tri-sodium citrate/blue top tube | | | | 4 hours of sample collection |
| Anti-Xa (Edoxaban) | | | | | | |
| Anti-IIa (Dabigatran) | Adequately filled sample sent to lab within an hour of clean venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | 4-6 HOURS | Within 4 hours of sample collection |
| Antithrombin Activity | Adequately filled sample sent to lab within an hour of clean venepuncture. | Tri-sodium citrate/blue top tube | 1 x 3mL | 90 MINUTES | 7 Days | Within 4 hours of sample collection |
| Antithrombin Antigen | Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | | 1 x 3mL | N/A | 14 DAYS | |
| Blood Film | Full Blood Count required for interpretation. Any patient suspected to have cold agglutinins must have their sample kept at 37°C and brought to the laboratory immediately (Blood Sciences Laboratory- Haematology) | EDTA (K2 Type Only) | 1 x 4mL | 2 HOURS | 24 – 48 HOURS | Within 24 hours of sample collection |

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| Test | Additional Test Information | Sample type | Minimum Sample | Turnaround Time | | Time limit for Add on tests |
|--|---|----------------------------------|----------------|----------------------|---|---|
| | | | | Urgent | Routine | |
| Clauss Fibrinogen | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 4 hours of sample collection |
| COAGULATION SCREEN PT/INR aPTT/aPTT ratio | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 4 hours of sample collection |
| Correction Studies PT and aPTT 50:50 Mixing studies | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. | Tri-sodium citrate/blue top tube | 1 x 3mL | 90 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 4 hours of sample collection |
| D-Dimer | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 4 hours of sample collection |

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| Test | Additional Test Information | Sample type | Minimum Sample | Turnaround Time | | Time limit for Add on tests |
|-------------------------|---|----------------------------------|----------------------|-----------------------|---|--|
| | | | | Urgent | Routine | |
| ESR | | EDTA (K2 Type Only) | 1 x 4mL | 120 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 24 hours of sample collection |
| Full Blood Count | Any patient suspected to have cold agglutinins must have their sample kept at 37°C and brought directly to the laboratory (Blood Sciences Laboratory at Bessemer Wing) immediately. | EDTA (K2 Type Only) | 1 x 4mL | 60 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 24 hours of sample collection |
| FII | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | Tri-sodium citrate/blue top tube | 1 x 3mL | 2 HOURS | 3 DAYS | Within 4 hours of sample collection |
| FV | | | | | | |
| FVII | | | | | | |
| FX | | | | | | |
| FVIII | | | 3 x 3mL | | | |
| FIX | | | For multiple factors | | | |
| FXI | | | | | | |
| FXII | | | | | | |

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| Test | Additional Test Information | Sample type | Minimum Sample | Turnaround Time | | Time limit for Add on tests |
|----------------------------------|--|----------------------------------|---|-------------------|-------------------|--|
| | | | | Urgent | Routine | |
| FXIII | <p>NOTE: This is a Referral test. Adequately filled sample with no clots to be sent to lab within an hour of venepuncture.</p> <p>Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected.</p> | Tri-sodium citrate/blue top tube | 1 x 3mL | N/A | 14 DAYS | Within 4 hours of sample collection |
| FVIII (Chromogenic Assay) | <p>NOTE: This is a Referral test. Adequately filled sample with no clots to be sent to lab within an hour of venepuncture.</p> <p>Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected.</p> | Tri-sodium citrate/blue top tube | 1 x 3mL 3 x 3mL For Full vWF Screen | 2 HOURS | 3 DAYS | Within 4 hours of sample collection |

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| Test | Additional Test Information | Sample type | Minimum Sample | Turnaround Time | | Time limit for Add on tests |
|-----------------------------|---|--|---|-------------------|---|--------------------------------------|
| | | | | Urgent | Routine | |
| Glandular Fever (GF) | Negative result cannot completely rule out the possibility of Infectious Mononucleosis, as antibodies may be absent or present at too low a level to be detected. Other conditions can cause a positive result. Test should only be used for symptomatic individuals suspected of having IM and should be used for diagnosis only in conjunction with other clinical findings. Blood Film also performed with every request. | EDTA (K2 Type Only) | 1 x 4mL | 2 HOURS | 48 HOURS | Within 24 hours of sample collection |
| HIT Screen | NOTE: This is a Referral test. Inform the laboratory in advance on Ext.32434 During out of hours ensure to telephone Ext. 32616 | SST Serum. Or Tri-sodium citrate/blue top tube | 1x 3mL SST Or 1 x 3mL Citrate | 24 HOURS | N/A | Within 4 hours of sample collection |
| INR (Warfarin) | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | 4 HOURS 6 HOURS Outpatients/GPs | Within 4 hours of sample collection |

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| Test | Additional Test Information | Sample type | Minimum Sample | Turnaround Time | | Time limit for Add on tests |
|---|---|----------------------------------|----------------|-----------------|------------------------------------|---|
| | | | | Urgent | Routine | |
| Lupus Anticoagulant Test (DRVVT & dAPTT) | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. | Tri-sodium citrate/blue top tube | 3 x 3mL | 24 HOURS | 7 DAYS | Within 4 hours of sample collection |
| Lupus Anticoagulant Test (TSVT) | NOTE: This is a Referral test. | | | | | |
| Malaria Screen | Sample preferably taken at height of fever. Must state travel history, symptoms & any therapy when requesting this test. Analysed in Blood Sciences Laboratory- Haematology. NOTE: ALL first time positive malaria results also referred to Malaria Reference Laboratory in London for confirmation. | | 1 x 4mL | 2 HOURS | N/A | Contact laboratory on Ext. 32418 |
| Platelet Function Test | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture | Tri-sodium citrate/blue top tube | 1 x 3mL | 120 MINUTES | 4 HOURS 6 HOURS Outpatients/GPs | Contact laboratory on Ext. 32434 |
| Protein C Activity | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture | Tri-sodium citrate/blue top tube | 1 x 3mL | 90 MINUTES | 7 DAYS | Contact laboratory on Ext. 32434 |

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|-----------------------------------|---|----------------------------------|----------------|----------------------|---|--|
| | | | | Urgent | Routine | |
| Protein C Antigen | NOTE: This is a Referral test. | Tri-sodium citrate/blue top tube | 1 x 3mL | N/A | 14 DAYS | Contact laboratory on Ext. 32434 |
| Free Protein S Antigen | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture | Tri-sodium citrate/blue top tube | 1 x 3mL | 90 MINUTES | 7 DAYS | Contact laboratory on Ext. 32434 |
| Protein S Functional Assay | NOTE: This is a Referral test. | Tri-sodium citrate/blue top tube | 1 x 3mL | 90 MINUTES | 7 DAYS | Contact laboratory on Ext. 32434 |
| Reticulocytes | Any patient suspected to have cold agglutinins must have their sample kept at 37°C and brought directly to the Haematology laboratory within Blood Sciences Laboratory at Bessemer Wing) immediately. | EDTA (K2 Type Only) | 1 x 4mL | 60 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 24 hours of sample collection |
| Thrombin Time | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture | Tri-sodium citrate/blue top tube | 1 x 3mL | 60 MINUTES | 4 HOURS 6 HOURS Outpatients/ GPs | Within 4 hours of sample collection |

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|----------------------------|--|----------------------------------|---|-------------------|------------------|-------------------------------------|
| | | | | Urgent | Routine | |
| VWF: GPIbR Activity | NOTE: This is a Referral test. Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. Clots of any size, haemolysis, underfilling or overfilling will affect result. Such samples will be rejected. | Tri-sodium citrate/blue top tube | 1 x 3mL 3 x 3mL For Full vWF Screen | 2 HOURS | 3 DAYS | Within 4 hours of sample collection |
| VWF: Antigen | Adequately filled sample with no clots to be sent to lab within an hour of venepuncture. | | | | | |

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3.6 Turnaround times

| | |
|---------------------------------------|-----------------------------------|
| Urgent | Within 1 hours of receipt. |
| Inpatient | Within 4 hours of receipt. |
| GP, outpatient and external locations | Within 6 hours of receipt. |

All turnaround times stated are for tests performed on-site.

3.7 Add on tests.

Add-on for tests accepted within specified timeframes according to sample stability. Add on are handled by the laboratory BMS, who can advise when this is not appropriate.

Haematology 0203 299 9000 ext 32418 M-F 09:00 – 17:30

Haemostasis 0203 299 9000 ext 32434 M-F 09:00 – 17:30

For OOH phone the oncall number 0203 299 6216 for both sections

If an add-on is required urgently, a separate sample may be required.

4. Referral Laboratories used by this Laboratory

- Malaria Reference Laboratory at The London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT (UKAS accredited) - Malaria confirmation
- Haemostasis Laboratory, GSTS Pathology, 5th floor, North Wing, St. Thomas Hospital, Westminster Bridge Road, SE1 7EH (UKAS accredited)

5. Referral tests

- 5.1.1 ADAMTS-13 Activity
- 5.1.2 ADAMTS-13 Inhibitor
- 5.1.3 Antithrombin Antigen
- 5.1.4 FVIII (Chromogenic Assay)
- 5.1.5 HIT Screen
- 5.1.6 Lupus Anticoagulant Test (TSVT)
- 5.1.7 Malaria Confirmation (Thick Film/PCR)
- 5.1.8 Protein C Antigen
- 5.1.9 Protein S Functional Assay
- 5.1.10 VWF: GPIbR Activity

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6. Reference Ranges for Haematology Tests performed at Kings College Hospitals.

Adults Ranges (>12 years of age) for Routine Haematology Tests determined locally in March 2020 and reviewed with KCH Haematology clinical lead (Prof R Arya).

Ranges provided for age range (0-12 years full term) taken from publication by [Barbara J. Bain - Dacie and Lewis Practical Haematology- 12th ed. 2017](#) pages 12- 13.

| Test | Age Range | Reference Range | | Units |
|------------------------|---------------|-----------------|-------------|--------------------|
| | | Lower Limit | Upper Limit | |
| White blood cell count | D0-D3 | 10.00 | 26.00 | $\times 10^9/L$ |
| | D4-1M | 8.00 | 23.00 | |
| | 1M-2M | 5.00 | 19.00 | |
| | 2M-3M | 5.00 | 15.00 | |
| | 3M-1Y | 6.00 | 18.00 | |
| | 1Y-2Y | 6.00 | 16.00 | |
| | 2Y-6Y | 5.00 | 15.00 | |
| | 6Y-12Y | 5.00 | 13.00 | |
| | >12Y | 4.00 | 11.00 | |
| Red Blood Cell Count | D0 to D3 | 5.00 | 7.00 | $\times 10^{12}/L$ |
| | D4-1M | 4.00 | 6.60 | |
| | 1M-2M | 3.00 | 5.40 | |
| | 2M-3M | 3.10 | 4.30 | |
| | 3M-1Y | 4.10 | 5.30 | |
| | 1Y-2Y | 3.90 | 5.10 | |
| | 2Y-6Y | 4.00 | 5.20 | |
| | 6Y-12Y | 4.00 | 5.20 | |
| | >12Y (Male) | 4.50 | 5.80 | |
| | >12Y (Female) | 3.80 | 5.80 | |
| Haemoglobin | D0-D3 | 140 | 220 | g/L |
| | D4-1M | 150 | 210 | |
| | 1M-2M | 115 | 165 | |
| | 2M-3M | 100 | 130 | |
| | 3M-1Y | 111 | 141 | |
| | 1Y-2Y | 111 | 141 | |
| | 2Y-6Y | 110 | 140 | |
| | 6Y-12Y | 115 | 155 | |
| | >12Y (Male) | 130 | 165 | |
| | >12Y (Female) | 115 | 155 | |

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| Test | Age Range | Reference Range | | Reporting Units |
|-------------------------|---------------|-----------------|-------------|-----------------|
| | | Lower Limit | Upper Limit | |
| Haematocrit | D0-D3 | 0.585 | 0.615 | L/L |
| | D4-1M | 0.595 | 0.617 | |
| | 1M-2M | 0.420 | 0.440 | |
| | 2M-3M | 0.280 | 0.420 | |
| | 3M-1Y | 0.345 | 0.400 | |
| | 1Y-2Y | 0.300 | 0.380 | |
| | 2Y-6Y | 0.340 | 0.400 | |
| | 6Y-12Y | 0.350 | 0.450 | |
| | >12Y (Male) | 0.400 | 0.540 | |
| | >12Y (Female) | 0.370 | 0.470 | |
| Mean Cell Volume | D0-D3 | 100 | 120 | fL |
| | D4-1M | 92 | 118 | |
| | 1M-2M | 92 | 116 | |
| | 2M-3M | 87 | 103 | |
| | 3M-1Y | 68 | 84 | |
| | 1Y-2Y | 72 | 84 | |
| | 2Y-6Y | 75 | 87 | |
| | 6Y-12Y | 77 | 95 | |
| | >12Y | 77.0 | 100.0 | |
| Mean cell Concentration | D0-D3 | 31.0 | 37.0 | pg |
| | D4-1M | 31.0 | 37.0 | |
| | 1M-2M | 30.0 | 36.0 | |
| | 2M-3M | 27.0 | 33.0 | |
| | 3M-1Y | 24.0 | 30.0 | |
| | 1Y-2Y | 25.0 | 29.0 | |
| | 2Y-6Y | 25.0 | 30.0 | |
| | 6Y-12Y | 25.0 | 33.0 | |
| | >12Y | 25.0 | 34.0 | |

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| Test | Age Range | Reference Range | | Reporting Units |
|--|-----------------------|-----------------|-------------|--------------------|
| | | Lower Limit | Upper Limit | |
| Red Cell Distribution Width | >12Y (Male/Female) | 11.0 | 15.0 | % |
| Mean Cell Haemoglobin Concentration | D0-D3 | 300 | 360 | g/L |
| | D4-1M | 290 | 360 | |
| | 1M-2M | 290 | 360 | |
| | 2M-3M | 285 | 355 | |
| | 3M-1Y | 300 | 360 | |
| | 1Y-2Y | 320 | 360 | |
| | 2Y-6Y | 310 | 370 | |
| | 6Y-12Y | 310 | 370 | |
| | >12Y | 304 | 360 | |
| Platelet Count | D0-D3 | 150 | 450 | 10 ⁹ /L |
| | D4-1M | 210 | 500 | |
| | 1M-2M | 200 | 500 | |
| | 2M-3M | 210 | 650 | |
| | 3M-1Y | 200 | 550 | |
| | 1Y-2Y | 200 | 550 | |
| | 2Y-6Y | 200 | 450 | |
| | 6Y-12Y | 180 | 400 | |
| | >12Y | 150 | 450 | |

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|-----------------------------|-----------------------|-----|------|----|
| Mean Platelet Volume | >12Y (Male/Female) | 9.1 | 12.8 | fL |
|-----------------------------|-----------------------|-----|------|----|

| Test | Age Range | Reference Range | | Reporting Units |
|-------------------------|-----------|-----------------|-------------|---------------------|
| | | Lower Limit | Upper Limit | |
| Neutrophil Count | D0-D3 | 4.0 | 14.0 | x10 ⁹ /L |
| | D4-1M | 3.0 | 5.0 | |
| | 1M-2M | 3.0 | 9.0 | |
| | 2M-3M | 1.0 | 5.0 | |
| | 3M-1Y | 1.0 | 6.0 | |
| | 1Y-2Y | 1.0 | 7.0 | |
| | 2Y-6Y | 1.5 | 8.0 | |
| | 6Y-12Y | 2.0 | 8.0 | |
| | >12Y | 1.5 | 6.3 | |
| Lymphocyte Count | D0-D3 | 3.0 | 8.0 | x10 ⁹ /L |
| | D4-1M | 2.0 | 8.0 | |
| | 1M-2M | 3.0 | 16.0 | |
| | 2M-3M | 4.0 | 10.0 | |
| | 3M-1Y | 4.0 | 12.0 | |
| | 1Y-2Y | 3.5 | 11.0 | |
| | 2Y-6Y | 2.0 | 9.0 | |
| | 6Y-12Y | 1.0 | 5.0 | |
| | >12Y | 1.0 | 4.0 | |
| Monocyte Count | D0-D3 | 0.5 | 2.0 | 10 ⁹ /L |
| | D4-1M | 0.5 | 1.0 | |
| | 1M-2M | 0.3 | 1.0 | |
| | 2M-3M | 0.4 | 1.2 | |
| | 3M-1Y | 0.2 | 1.2 | |
| | 1Y-2Y | 0.2 | 1.0 | |
| | 2Y-6Y | 0.2 | 1.0 | |

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|--|--------|-----|-----|--|
| | 6Y-12Y | 0.2 | 1.0 | |
| | >12Y | 0.2 | 1.0 | |

| Test | Age Range | Reference Range | | Reporting Units |
|------------------------------------|-----------------------|-----------------|-------------|---------------------|
| | | Lower Limit | Upper Limit | |
| Eosinophil Count | D0-D3 | 0.1 | 1.0 | x10 ⁹ /L |
| | D4-1M | 0.1 | 2.0 | |
| | 1M-2M | 0.2 | 1.0 | |
| | 2M-3M | 0.1 | 1.0 | |
| | 3M-1Y | 0.1 | 1.0 | |
| | 1Y-2Y | 0.1 | 1.0 | |
| | 2Y-6Y | 0.1 | 1.0 | |
| | 6Y-12Y | 0.1 | 1.0 | |
| | >12Y | 0.0 | 0.4 | |
| Basophil Count | >12Y (Male/Female) | 0.00 | 0.10 | x10 ⁹ /L |
| Immature Granulocytes Count | >12Y (Male/Female) | 0.00 | 0.00 | x10 ⁹ /L |
| Metamyelocytes Count | >12Y (Male/Female) | 0.00 | 0.00 | x10 ⁹ /L |
| Myelocytes Count | >12Y (Male/Female) | 0.00 | 0.00 | x10 ⁹ /L |
| Promyelocytes Count | >12Y (Male/Female) | 0.00 | 0.00 | x10 ⁹ /L |

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|------------------------|-----------------------|------|------|-----------------|
| Blasts Count | >12Y (Male/Female) | 0.00 | 0.00 | $\times 10^9/L$ |
| Nucleated RBC's | >12Y (Male/Female) | 0.00 | 0.01 | $\times 10^9/L$ |

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| Test | Age Range | Reference Range | | Reporting Units |
|----------------------------|---------------|-----------------|-------------|---------------------|
| | | Lower Limit | Upper Limit | |
| Reticulocytes Count | D0-D3 | 120.00 | 400.00 | x10 ⁹ /L |
| | D4-1M | 50.00 | 350.00 | |
| | 1M-2M | 20.00 | 60.00 | |
| | 2M-3M | 30.00 | 50.00 | |
| | 3M-1Y | 40.00 | 100.00 | |
| | 1Y-2Y | 30.00 | 100.00 | |
| | 2Y-6Y | 30.00 | 100.00 | |
| | 6Y-12Y | 30.00 | 100.00 | |
| | >12Y | 50 | 150 | |
| ESR | >12Y (Male) | 1 | 10 | mm/hr |
| | >12Y (Female) | 1 | 15 | |

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7. Reference Ranges for Routine and Special Haemostasis tests performed at Kings College Hospitals.

Adults Ranges (>12 years of age) for Routine Haemostasis Tests determined locally in March 2020 and reviewed with KCH Haematology clinical lead (Prof R Arya).

Normal limits provided for all other age range taken from published limits by [Andrew M, Paes B, Milner R et al. Development of the coagulation system in the healthy premature infant. *Blood* 1988; 72: 1651–1657](#) and [Maureen Andrew, B. Paes, and M Johnston. Development of the Haemostatic System in the neonate and young infant. *The American journal of Paediatric Haematology / Oncology* 12 \(1\): 95 – 104, 1990.](#)

| Test | Age Range (Male/Female) | Reference Range | | Reporting Units |
|------------------|-------------------------|-----------------|-------------|-----------------|
| | | Lower Limit | Upper Limit | |
| Prothrombin Time | D1 – D91 | 8.2 | 14.1 | Seconds |
| | D91 – 12Y | 9.6 | 11.8 | |
| | >12Y | 10.0 | 12.0 | |
| INR Ratio | >12Y | 0.90 | 1.15 | Ratio |
| APTT (seconds) | D1 – D4 | 29.0 | 51.5 | Seconds |
| | D5 – D21 | 28.0 | 55.0 | |
| | D22 – D84 | 28.0 | 50.0 | |
| | D85 – D175 | 28.0 | 45.0 | |
| | D176 – Y01 | 28.0 | 40.0 | |
| | 01Y – 12Y | 26.0 | 38.0 | |
| | >12Y | 20.0 | 29.0 | |
| APTT Ratio | >12Y | 0.80 | 1.14 | Ratio |
| Thrombin Time | D1 – 12Y | 9.2 | 15.0 | Seconds |
| | >12Y | 14.0 | 18.0 | |
| Fibrinogen | D0 – 12Y | 1.7 | 4.0 | g/L |
| | >12Y | 1.8 | 4.9 | |
| D-Dimer | D1 – D12Y | ≤312 | | ng/mL FEU |

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|--|------|------|--|
| | >12Y | ≤550 | |
|--|------|------|--|

Therapeutic Ranges for Anticoagulant Therapy Monitoring.

| Test | Therapeutic Range | | Units |
|---|-------------------|-------------|-------|
| | Lower Limit | Upper Limit | |
| INR Ratio (Vitamin K Anticoagulants) | 2.0 | 4.0 | Ratio |
| APTT Ratio (Unfractionated Heparin) | 2.0 | 2.5 | Ratio |
| Anti-X Level (LMWH) | 0.1 | 1.0 | IU/mL |
| Anti-Xa Level (UFH) | 0.3 | 0.7 | IU/mL |

HIT Screen and ADAMTS-13 (Ranges from St' Thomas' Haemostasis)

| Test | Reference Range | | Units |
|----------------------------|-----------------|-------------|-------|
| | Lower Limit | Upper Limit | |
| HIT Screen | 0.00 | 1.00 | U/mL |
| ADAMTS-13 Activity | 78.0 | 107.0 | % |
| ADAMTS-13 Inhibitor | 0.0 | 15.0 | U/mL |

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| | Negative <10.0 u/mL Borderline 10.0 – 15.0 u/mL Positive >15.0 u/mL | |
|--|--|--|

Expected Peak and Trough level for Rivaroxaban, Apixaban, Edoxaban and **Dabigatran.**

| Rivaroxaban | | |
|------------------------------|---------------------------|-------------------|
| Indication | Stroke prevention in NVAf | Treatment PE/VTE |
| Dose | 20 mg once a day | 20 mg once a day |
| Peak concentration (ng/mL) | 249b (184–343) | 270b (189–419) |
| Trough concentration (ng/mL) | 44b (12–137) | 26b (6–87) |

| Apixaban | | |
|------------------------------|---------------------------|---------------------|
| Indication | Stroke prevention in NVAf | Treatment PE/VTE |
| Dose | 5 mg twice a day | 5 mg twice a day |
| Peak concentration (ng/mL) | 171c (91–321) | 132c (59–302) |
| Trough concentration (ng/mL) | 103c (41–230) | 63c (22–177) |

| Edoxaban | | |
|------------|---------------------------|------------------|
| Indication | Stroke prevention in NVAf | Treatment PE/VTE |
| Dose | 60 mg once a day | 60 mg once a day |

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| | | |
|---------------------------------|-------------------|-------------------|
| Peak concentration (ng/mL) | 170d (125–245) | 234e (149–317) |
| Trough concentration (ng/mL) | 36e (19–62) | 19e (10–39) |

| Dabigatran | | |
|---------------------------------|---------------------------|--------------------|
| Indication | Stroke prevention in NVAf | Treatment PE/VTE |
| Dose | 150 mg twice a day | 150 mg twice a day |
| Peak concentration (ng/mL) | 175a (117–275) | 175a (117–275) |
| Trough concentration (ng/mL) | 91a (61–143) | 60a (39–95) |

Thrombophilia Screen, Factors and vWF Screen Assays.

| Test | Age Range (Male/Female) | Reference Range | | Units |
|--------------------------------|----------------------------|-----------------|-------------|-------|
| | | Lower Limit | Upper Limit | |
| Factor II | >12Y (Male/Female) | 50 | 150 | IU/dL |
| Factor V | | 50 | 150 | IU/dL |
| Factor VII | | 50 | 150 | IU/dL |
| Factor X | | 50 | 150 | IU/dL |
| Factor VIII | | 50 | 150 | IU/dL |
| Chromogenic Factor VIII | | 50 | 150 | IU/dL |
| Factor IX | | 50 | 150 | IU/dL |

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| Factor XI | | 60 | 150 | IU/dL |
| Factor XII | | 40 | 150 | IU/dL |
| APCR | | 0.95 | 1.23 | Ratio |
| Free Protein S Antigen | | 60 | 150 | % |
| Protein C Activity | | 70 | 140 | U/dL |
| Antithrombin Activity | | 80 | 130 | % |
| Antithrombin Antigen | | 71.70 | 118.5 | U/dL |
| vWF Antigen | | 50 | 150 | IU/dL |
| vWF: GPIbR Activity | | 34.1 | 118.6 | IU/dL |
| vWF Collagen binding | | 35.4 | 136.9 | U/dL |
| Plasminogen Activity | | 75.00 | 150.00 | IU/dL |

Lupus Anticoagulant Screen.

| Test | Age Range (Male/Female) | Reference Range | | Units |
|----------------------------------|----------------------------|-----------------|-------------|-------|
| | | Lower Limit | Upper Limit | |
| DRVVT Screen Ratio | >12Y (Male/Female) | 0.82 | 1.11 | Ratio |
| DRVVT Screen 50:50 Ratio | | 0.90 | 1.06 | Ratio |
| DRVVT Confirm Ratio | | 0.89 | 1.08 | Ratio |
| DRVVT Confirm 50:50 Ratio | | 0.93 | 1.06 | Ratio |

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|--|--|------|------|-------|
| DRVVT Screen/Confirm Ratio | | 0.88 | 1.08 | Ratio |
| DRVVT % correction of Ratio | | ≤10 | | % |
| DRVVT % Correction of 50:50 ratio | | ≤10 | | % |
| TSVT Ratio | | 0.91 | 1.09 | Ratio |
| Ecarin Time Ratio | | 0.87 | 1.14 | Ratio |

Nutristasis Tests (Ranges from St Thomas' Haemostasis).

| Test | Reference Range | | Units |
|-------------------|-----------------|-------------|--------|
| | Lower Limit | Upper Limit | |
| Vitamin K1 | 0.15 | 1.55 | Ug/L |
| PIVKA-II | 17.36 | 50.90 | mAU/mL |

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