BLOOD TEST GLOSSARY		
Units		
IU/L	Short for International Units per litre	
mmol/L	Short for millimoles per litre	
µmol per litre	Short for micromoles per litre	
Reference range	The reference range contains the results of 95% of normal people. So 5% of normal people will have results below or above the reference range.	
Systems		
Name	**Description**	**Why it matters**
Lymphatic system	Runs similarly to the blood circulatory system, but carries a clear fluid called lymph. It collects bacteria that get into the body and fluid or cells that leak into the tissues and takes them to the lymph nodes where T lymphocytes become immune to the bacteria and kill them. Everything then goes back into the bloodstream where the liver and kidneys filter out the rubbish.	If there is an infection in the tissues, the lymph nodes expand to fight it e.g. in tonsillitis where the glands in your neck swell up. If your feet swell up during the day, it's the fluid that has leaked from the blood into the tissues. While you sleep, when your legs are no longer dangling down, the lymphatic system drains the fluid back into the blood. If someone has cancer, the lymphatic system may pick up the cells and take them to the nearest lymph node which stops them going any further. The node may then swell up.
Plasma	The fluid that the blood cells float in	
Cells and the immune pathway		
Blood cells	There are three main types: **Red cells** carry oxygen and carbon dioxide. **White cells** deal with infection, inflammation and allergy. **Platelets** clump together if you cut yourself and block the hole made by the cut	

Name	Description	Why it matters	Reference Range
Red Blood Cells (RBC, erythrocyte)	"Erythro" means red, "cyte" means cell. The cells which transport oxygen and carbon dioxide. They normally live about 100 days	Red cells contain haemoglobin (Hb) (see below) which carries oxygen from the lungs to the organs and carries carbon dioxide back to the lungs where you breathe it out. If there is problem with their production, if you bleed, or if they break down (haemolysis) levels are low. Haemoglobin contains iron, therefore, if iron stores are low (see Ferritin below), fewer cells are produced and they are smaller. B12 and folate are needed for cell DNA production. If levels are low, fewer cells are made, but they are bigger because the parents of the red cells have grown but do not divide at the right time. There are other medical conditions also associated with large red cells.	3.8 - 5.8 trillion per litre
Erythrocyte Sedimentation Rate (ESR)	The rate at which red cells sink in plasma in mm/hour	Erythrocytes (red blood cells) are slightly heavier than plasma, so they sink. When inflammation is taking place, they clump together and sink (sediment) faster, so the sedimentation rate is higher.	M: < (age ÷ 2) F: < (age+10÷2)
C-reactive Protein (CRP)	A protein present in plasma.	CRP levels rise in response to infection and inflammation. Levels can go up and down quite quickly. This is frequently tested when there is suspicion of infection where the level can be very elevated. CRP levels should normalise as the infection settles. It is important to remember that use of immunosuppressant medication such as steroids can blunt the CRP response. Even if the CRP level is low, if it clinically appears to be an infection, it should be treated as such.	<5 mg per litre
Reticulocytes	Immature red blood cells. "Reticulo" means a net. Under the microscope, you can see a network which is absent in mature cells.	Reticulocytes are formed in the bone marrow and mature into red blood cells after a few days in the circulation. A raised level shows that the body is increasing production to restore normal levels of red cells (to correct anaemia).	0.2 - 2.0% of red cells
Haemoglobin (Hb)		The haemoglobin molecule is made of 4 protein chains, 2 alpha and 2 beta. Each one is folded into a "cage" which has one iron atom and carries one oxygen molecule or one CO2 molecule. Less haemoglobin is made if iron stores are low.	

	The protein in red blood cells which carries oxygen and carbon dioxide.	Haemoglobin is one of the main measures used to understand if you are anaemic and whether you are haemolysing. It is a measure used in PNH clinical trials to understand if a drug being tested for PNH is impacting the amount of haemolysis. This is also a measure used to decide if you need a red blood cell transfusion and different hospitals have different Hb thresholds before a transfusion is given. Men and women have different 'normal' ranges of haemoglobin.	Male; 140-180 Female 120-160 grams per litre
Haem	The part of the haemoglobin molecule that contains iron and holds oxygen. "Haem" means iron.		
Name	**Description**	**Why it matters**	**Reference Range**
Ferritin	A protein used to carry iron in the blood stream. From Latin "ferratus", bound to iron.	Most of the iron in your body is in your red cells, in a protein called haemoglobin. The rest of is it stored as ferritin, in all cells but particularly the liver. A small amount is in the blood stream, and the level indicates how full your stores are. If you have had lots of red blood cell transfusions, your ferritin may be high. Ferritin is also another marker of inflammation.	13 - 150 µg/L
Haptoglobin	A protein present in the blood used to 'trap' free haemoglobin. "Hapto" means it sticks to.	Haptoglobin is made in the liver. In haemolysis, it binds to the haemoglobin and takes it to the liver where it's excreted as bile. Its levels drop as a result, and it's one of the tests used to assess anaemia. Its level can also be low if the liver isn't working properly as not so much is made.	0.3 - 2.0 g/L
White Blood Cells (WBC, leucocyte)	White cells are the policemen of the blood. There are three sorts; Granulocytes, Lymphocytes and Monocytes.	Levels of white blood cells are high in infection or inflammation. They may be low in autoimmune conditions	4-11 billion per litre
Granulocytes	There are 3 main types: 1) Neutrophils 2) Basophils 3) Eosinophils	They are called granulocytes because they contain granules of enzymes. They live around 2 days. Granulocytes are used as a measure of a PNH Clone (see below) i.e., the percentage of cells coming out your bone marrow which are PNH cells (and are missing the inhibitors on the cell surface)	

	1) Neutrophil	Neutrophils are the most common. Their granules kill bacteria when the cell eats them. If levels are low (neutropenia), e.g. in aplastic anaemia, you're prone to infection	2.2 - 6.3 billion per litre
	2) Basophil	Basophils are active in allergic reactions, and in inflammation. Their granules contain histamine.	0 - 0.1 billion per litre
	3) Eosinophil	Eosinophils are active in allergic reactions. They also attack fungi, and worms and other parasites and help to clear viruses.	0 - 0.4 billion per litre
Monocytes	There are two types of monocyte. One type tells the immune system which cells to attack. The other type swallows those cells (phagocytosis)		0.2 - 1.0 billion per litre
T Lymphocyte	T cells are concerned with immunity. They are present in blood as well as lymphoid tissue such as tonsils, lymph nodes and spleen.	T lymphocytes are called "T" because they mature in the thymus gland. They live in lymph nodes. There are four types: 1) Memory T cells hold your immune memory. 2) Killer T cells kill germs and unrecognised cells. 3) Helper T cells tell other cells what to do. 4) Suppressor T cells stop other T cells from attacking the body's own cells. If your Memory T cells forget that your cells belong to you, the Killer T cells get activated and kill those cells. Monoclonal antibody medications are available that latch on to activated Killer T cells and inactivate them. T Lymphocytes live for up to 20 weeks	1.3 - 4 billion per litre
B Lymphocyte	B cells are also concerned with immunity.	B lymphocytes produce antibodies which may be either secreted or set into the plasma membrane of B cells as receptors. When B cells are activated by an antigen, they multiply and differentiate into plasma cells. B cells also process antigens from bacteria and present them to T cells so that they will remember them for any future infections. B cells, unlike the other two classes of lymphocytes, T cells and natural killer cells, express B cell receptors (BCRs) on their cell membrane.[1] BCRs allow the B cell to bind to a foreign antigen, against which it will initiate an antibody response.[1]	
Platelets	Also called thrombocytes. They react to injury to a blood vessel by clumping together and starting a clot.	In PNH, platelets don't function properly so either the blood clots too easily leading to **thrombosis**, or not easily enough meaning there's a	

		tendency to bleed (especially if the number of platelets is low due to aplastic anaemia)	
Complement	The complement system contains over 20 proteins. It's always active, but normally controlled by inhibitors on the cell surface. It is actually the first line of the body's immune defence but it was discovered after the lymphocyte/antibody system so it was thought to be "complementary".		
Clones			
GPI anchors	GPI anchors are the inhibitors on the cell's surface which normally control the complement system. In PNH some of these inhibitors (CD55 and CD59) are missing.		
PNH Clone	The word "clone" comes from the Greek word for twig. Every twig on a tree is genetically the same. A clone in PNH refers to a group of blood cells that come from the same parent cell and therefore all carry the same genes including all mistakes/mutations. A PNH clone is measured using granulocytes.		
Type I PNH clone	This is the proportion of granulocytes that are normal.		
Type II PNH clone	This is the proportion of granulocytes that have some GPI anchors but not the complete amount.		
Type III PNH clone	This is the proportion of granulocytes that have no GPI anchors at all.		
Red cell PNH clone	In untreated PNH, affected red cells only last about 10 days instead of the usual 100 days (as they are being haemolysed), so the percentage of abnormal cells measured is less than the percentage of abnormal cells produced. That's why the red cell PNH clone size is lower than the others and not used to measure someone's PNH Clone (the white cell granulocytes are used to measure this)		

Thrombosis	Clinical event when a blood clot forms. This can be obvious like a Deep Vein Thrombosis (DVT), but in PNH tends to be more silent such as in the liver or lungs. The consequences however can be much more serious. This is the reason why PNH patients get routine assessments of their liver and spleen (via an ultrasound scan) and their lung/heart (via an echocardiogram), so as not to miss an emerging problem.

BLOOD CHEMISTRY			
Liver function			
Name	**Description**	**Why it matters**	**Reference range**
Alanine transferase (ALT)	An enzyme found mainly in the liver.	Raised levels occur in liver cell damage, or while taking certain medication.	5 - 55 IU per litre
Alkaline phosphatase (ALP)	An enzyme mainly present in the liver and bone but other tissues too.	Raised levels indicate liver or bone disease including Vitamin D deficiency.	30 - 130 IU per litre
Aspartate transaminase (AST)	An enzyme found in heart, liver, skeletal muscle, pancreas, kidney and red blood cells.	Raised levels indicate cell damage in any of the organs which contain it.	10 - 50 IU per litre
Bilirubin (Total)	When a red cell is destroyed, the haem inside it is broken down in the spleen to form (yellow) bilirubin and iron. The iron is used to make more red cells, and the bilirubin returns to the circulation bound (or conjugated) to albumin. When it passes through liver, it is separated (unconjugated) from the albumin and excreted into the gut as bile. Some of the bile is reabsorbed, the rest is metabolised into a brown pigment, which is why your poo is brown.	If red cells are breaking down (haemolysing) and releasing haem faster than the liver can conjugate it and excrete it in the bile, then unconjugated bilirubin levels rise. If the liver is conjugating it but bilirubin can't get into the gut due to blockage, then conjugated bilirubin levels rise. If the liver isn't working properly, it becomes less able to conjugate bilirubin so unconjugated levels rise. Gilbert's Syndrome is where the liver is healthy but just doesn't process bilirubin very well so levels are a bit high. In cirrhosis of the liver, bile drainage may be impaired within the liver, so even bilirubin which been conjugated can't be excreted and conjugated levels rise as well. If bilirubin isn't being excreted then you go yellow, and your poo which would normally be brown, becomes pale.	3 - 20 µmol per litre
Kidney function			

Name	Description	Why it matters	Reference range
Creatinine	A by-product of muscle metabolism. “Creat” means muscle	The level of creatinine is raised in kidney impairment (because of reduced excretion) or increased muscle growth or breakdown (increased production). Also raised after strenuous exercise	M: 60-120 µmol/L F: 50-110 µmol/L
Urea	A by-product of protein metabolism. It means urine. It was the first biological (organic) chemical to be synthesised in the lab, in 1828	The level of urea is raised in kidney impairment (because of reduced excretion). Also raised if you eat a lot of protein (including if you bleed into your stomach)	2.5 - 7.8 mmol/L
Estimated Glomerular Filtration Rate (eGFR)	A mathematical estimate of kidney function using creatinine level, age, sex and race. Varies with body surface area. In Latin, a glomerulus is a small ball of thread. That’s what the filtering unit in the kidney looks like under the microscope.	It is reduced in kidney impairment.	>90 ml/min/1.73m2
Gamma-glutamyl transferase (GGT)	An enzyme found in the liver.	Raised amounts are found in liver disease but also in many other conditions including diseases of the pancreas, heart, lung and kidney as well as diabetes and alcoholism.	Men: 11 - 50 IU/L Women: 7 - 32 IU/L
Lactate Dehydrogenase (LDH)	The enzyme LDH is present in almost all cells where it is part of the process that changes the food you eat into energy you can use.	In haemolysis, the LDH from red cells is released into the blood and the levels can go up significantly. This is one of the main measures used to understand if you are haemolysing and is a measure used in PNH clinical trials to understand if a drug being tested for PNH is impacting the amount of haemolysis. Upon successful treatment/resolution of haemolysis the LDH should reduce.	< 240 IU/L