NIHR | Blood and Transplant Research Unit in Donor Health and Genomics at University of Cambridge

In collaboration with
- Guy's and St Thomas' NHS Foundation Trust
- University College London Hospitals NHS Foundation Trust
- University of Oxford
- NHS Blood and Transplant

Transfusion Practice Panel

Plain English summary for the HAEM-MATCH Consortium

The role of extended matching for red cell transfusion to improve outcomes for patients with sickle cell disease

Sickle cell disease (SCD) is the name for a group of inherited health conditions that affect red blood cells (RBCs). It is a serious and lifelong health condition, frequently causing debilitating symptoms from early childhood.

RBCs are the cells that carry oxygen from the lungs to the various tissues of the body. People with SCD produce RBCs with an unusual "sickle" (hence the name) shape, which do not work properly. These cells do not live as long as healthy RBCs and can block small blood vessels because of their unusual shape. These blockages cause periodic "sickle crises", which can last several hours and cause extreme pain because oxygen cannot get to body tissues. SCD patients have a greater risk of developing other problems such as kidney failure and stroke. Patients commonly need frequent blood transfusions to treat or prevent a crisis or other complications.

Although there are over 200 blood group systems, the three most important blood group systems for transfusion are ABO, Rh and Kell. These are also known as antigens and are labels on a blood cell. There are four main blood groups in the ABO system (O, A, B, AB), five main blood groups in the Rh system (C, c, D, E, e) and one in Kell. The combination of these determines your exact blood type. It is more complicated, however, in that there are more than 300 known RBC antigens that differ between individuals.

At present, for regular patients, hospitals routinely select blood for transfusion that matches ABO and Rh D only. For sickle cell disease and thalassaemia, hospitals match for ABO, all the Rh and Kell. Although this is more than a regular patient, it still means that patients are regularly transfused with blood from donors that have many different antigens from them. If a patient is transfused with donated blood that does not exactly match their blood type, then the patient may develop an antibody to that type. The patient then cannot be transfused again with that blood type because there is a risk of the immune system attacking the transfused blood, which in extreme cases can kill the patient. SCD patients receive many blood transfusions and often develop antibodies against several blood types; in some cases it can become difficult or impossible to identify compatible blood for transfusion. Even when compatible blood exists, finding it can be very resource intensive for laboratory and healthcare staff in the blood service (NHS Blood and Transplant; NHSBT) and hospitals and can lead to a delay in treatment.

In principle, hospitals could match blood between donor and recipient with more precision than we do currently. Technology to measure the blood types of donors at many blood groups simultaneously and affordably has recently been developed. However, there remain practical obstacles. For example:

- Although the technology for rapid blood typing exists, this is recent and it is still in the process of being licensed for use in patients. This means we do not know the full or extended blood grouping for most blood donors as the current method of typing is slow and expensive and is reserved for donors that are most likely to have rare blood groups.
- There is no centralised register of the transfusion history of SCD patients that is accessible to clinicians and NHSBT staff selecting blood
- The computer systems used by NHSBT and hospitals are unable to transfer the information required between them
- Due to limited blood supplies, statistical algorithms are needed to assist clinicians selecting units of blood for transfusion, in order to minimise the overall rate of transfusion of mismatched blood

The overarching objective of the HAEM-MATCH Consortium is to reduce the risks associated with blood transfusion treatment given to SCD patients. It consists of overlapping research projects, underpinned by a bioinformatics (collecting and analysing complex biological data) component, which aim to collate patient data and better understand the transfusion process. Objectives:

- Create and analyse a transfusion database of a large representative cohort of patients with SCD so that we can work out which blood groups beyond ABO Rh and Kell could be safely matched
- Develop platforms to connect key IT systems within NHSBT and between NHSBT and the National Haemoglobinopathy Registry (NHR)
- Explore blood group genotyping options for donors and patients and the feasibility of genotyping a large fraction of blood donors so that we will know the full blood groups of our donor population
- Create and test a statistical algorithm to more efficiently match red cells to patients with SCD