

Research and Development

Strategic Plan 2015-20: Improving outcomes for patients and donors

June 2015



Strategic Intent and Goals

Strategic intent

We continue to require a world-leading research and development (R&D) programme to underpin our strategic objectives in transfusion, transplantation and regenerative medicine, and thereby to benefit the healthcare in the UK and beyond. This document sets out our plans to drive forward our operational strategies by delivering a complementary innovative and translational R&D programme which, through strong academic partnerships based around our unique capabilities, will continue to deliver improvements in donor care and patient outcomes.

We will deliver this strategic intent through eight goals:

Goal 1: To establish and ensure delivery of NIHR Blood and Transplant Research Unit objectives through partnership working

Working with the Directors of the NIHR BTRUs we will support delivery of the objectives of each of these research units and the translation of their outputs into clinical practice.

Goal 2: To enhance our programme of research in transfusion/transplantation microbiology and virology to maintain blood, tissue and organ safety

- Working in partnership with Public Health England we will focus on hepatitis E (HEV) and hepatitis B (HBV) in the early years of this strategy and emerging infections throughout to maintain transfusion and transplant safety

- We will work with the University of Cambridge and clinical colleagues to fill the vacant lectureship in virology and appoint a successor to the current Director of the Blood Borne Virus Unit
- We will conclude development of potential screening and confirmatory assays for vCJD. Any further evaluation of assays developed by others or epidemiological studies will form part of the UK Blood Services safety programme.

Goal 3: To deliver clinical trials to support patient blood management

- We will complete ongoing studies focussed on the appropriate use of platelets and red cells in the multi-transfused, neonates, and patients with low platelet counts
- We will conduct a clinical trial on patients requiring coagulation replacement; this was identified as a priority by the Patient Blood Management strategy group. Different funding sources will be explored.

Goal 4: To strengthen our position in the development, assessment and clinical delivery of regenerative medicine based therapies

- We will conduct a first-in-man clinical trial of manufactured red cells to compare the survival of red cells manufactured from stem cells with that of standard red cells from blood donors
- We will continue to support pre-clinical science on manufactured red cells and platelets with cell biology research to understand how stem cells turn into blood cells.

Goal 5: To establish a Behavioural Research programme to identify behavioural change interventions which significantly increase donation and consent rates

- We will establish a Donor Behaviour research strategy group across blood, tissues and organs that will develop a programme of research in behavioural change interventions
- We will prioritise behavioural change interventions which could have a positive impact on organ donation and utilisation rates in support of the Taking Transplantation to 2020 strategy.

Goal 6: To establish a Translational Data Science programme to build and exploit big data resources that deliver improvements to our services

- We will develop a Translational Data Science function by investing in people with relevant quantitative inter-disciplinary expertise for building and exploiting big data resources for donor and patient benefit
- We will prioritise and deliver studies using these unique linkages e.g. applying genomics data to donor management and the identification of donor factors which predict component storage characteristics and post-treatment effects of transfusions and transplants.

Goal 7: To provide facilities and resources to support an innovative research programme

- We will work with our academic partners to ensure that our scientists and clinicians are embedded within environments which facilitate the successful delivery of innovative research programmes

- We will continue the practice of providing core funds to our PIs through rolling workpackages prepared in conjunction with the Research Strategy Groups and approved by the R&D Committee
- We will introduce a specific funding stream of up to £50,000/project to support pilot and preliminary studies to help secure external grant funding.

Goal 8: To ensure that our workforce have the skills and expertise to deliver the R&D Programme

- We will establish a tenure track programme to support mid-career researchers linked to succession planning, starting with one post in 16-17
- We will aim to increase the proportion of female group leaders and Principal Investigators, in line with the Athena SWAN programme for academic centres;

Through our investment in these initiatives we will deliver improvements in the quality and effectiveness of the products and services which we offer to donors and patients. The R&D programme will continue to support the delivery of operational objectives and inform future operating strategies. This 5-year R&D strategy represents an effective use of available resources and will address the highest priority research questions in transfusion and transplantation.



Contents

Section One:	Development of the Strategy	6
Section Two:	Prioritisation and Delivery	12
Section Three:	Strategic Goals	18
Section Four:	Financial Profile	23
Section Five:	Targets and success	24
Section Six:	Appendices	26

Section One: Development of the Strategy

Overview

The success of NHSBT's strategy to achieve long-term improvements in patient outcomes requires an innovative research programme. The effective application of novel technologies, processes and products drives the advancement of clinical practice, but this can only be accomplished by having an integrated R&D programme which supports organisational priorities. This requirement to undertake or commission R&D is within our statutory instrument.

Our R&D Programme is unique – within the public, private and academic sectors there are no other organisations capable of delivering an R&D programme that spans all our products and services. This is due to the combination of our partnerships with top class universities, our clearly defined operational objectives and our expertise in translation into new products, services and clinical guidelines.

A key change delivered by the 2010-15 strategic plan was to organise R&D into 8 themes, linked to service areas through research strategy groups. Through these strategy groups, staff involved in research, development and operational delivery agree R&D priorities for their area and develop plans for delivery. Section 2 describes the R&D plan in detail and shows how the proposals link to strategy group priorities.

In developing this strategy, we also considered:

1. How best to build on the successes of the 2010-15 strategy.
2. How to assess and maintain scientific quality.
3. Changes to the UK scientific environment, notably in regenerative medicine, and also in the approach to R&D by other Blood Services internationally.
4. The views of internal and external stakeholders.

1. Building on the 2010-15 R&D Strategy

The previous R&D Strategy has seen a transition from multiple small investigator-led projects to fewer larger strategic projects, with successful delivery of:

- QUOD – a National Biobank of samples collected from consented organ donors which will form the basis for future studies to improve the quality of transplanted organs
- INTERVAL – a large randomised trial of inter-donation intervals which will inform future donation practices
- High quality clinical trials (TAPS, TOPPS, TRIGGER), which were published in leading journals and are informing national guidelines.

These major national projects demonstrated the feasibility of embedding research activity in the operational environment, a key principle for future work.

Our research projects also delivered a number of specific improvements in patient care, which include:

- An internationally recognised donor/recipient study on hepatitis E, which is feeding directly into SaBTO policy making
- The Tissue Development Laboratory having developed a decellularisation process for tissue grafts with this new product (dCELL® Human Dermis) significantly improves the treatment of non-healing ulcers
- A new kidney allocation scheme was developed which has led to a greater number of patients receiving a kidney transplant
- Routine molecular epidemiology investigations have been implemented in all new Hepatitis B virus infections in blood donors following a 5 year study
- Translation of next generation sequencing for HLA in our histocompatibility and immunogenetics laboratories.

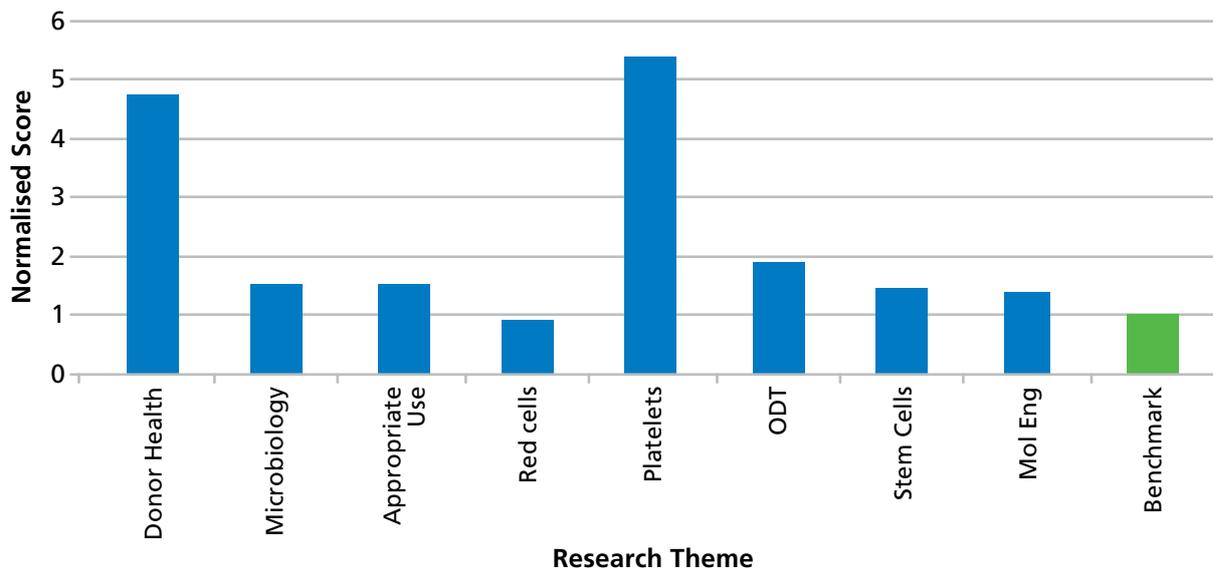
The 2015 – 2020 R&D Strategy will build upon these achievements by continuing to focus on key strategic initiatives and creating a budget for a small number of innovative start-up projects/year. We have also responded to changes in the research environment and funding arrangements. The scope of the strategy includes research and development activities.

2. Maintaining scientific quality through external assessment

A. An independent bibliometric analysis of the 1,100 publications from NHSBT's PIs and senior scientists for the period 2002 – 2012 concluded that "...the research potential of the current staff at NHSBT should be considered excellent which provides confidence that it will continue to produce

publications that can push the boundaries of science and gain recognition for this." Publications from seven of the eight research themes were ranked above world average, with the eighth just below the benchmark (Figure 1).

Figure 1: Our Research Publications rank above the benchmark world average



B. Peer review of the entire research programme was conducted in November 2013, with all work being scored for quality and relevance to NHSBT, leading to recommendations being made on whether specific activities should be decreased, maintained or increased. The strategic recommendations from this review were that the 2015 – 2020 R&D Strategy should:

- Capitalise on the INTERVAL cohort
- Maintain but not increase virological/ microbiological safety research
- Agree a funding level for clinical trials
- Bring low priority research to a close
- Provide a mechanism to support pilot and spin-off studies.

These recommendations are being acted upon now and will be progressed further as part of this strategy.



3. Changes to health and scientific environment

In developing this strategy, a number of external factors have been considered:

A. Technological advances reflected in government policy

Since the approval of our last R&D Strategy in March 2011, there have been significant advances in a number of fields which have informed our strategic intent:

- 100,000 Genomes project¹ – advances in DNA sequencing technology and the use of DNA data enable the rapid sequencing of whole genomes. Genomics England Limited, a company owned by the Department of Health, will sequence the genomes of 100,000 individuals, focusing on those with rare diseases and common cancers. It will provide the investment and leadership needed to dramatically increase the use of high-throughput DNA sequencing in our diagnostic laboratories and drive down costs. One of our PIs, Professor Willem Ouwehand is leading the enrolment of participants with a rare disease to form the NIHR BioResource for Rare Diseases.
- Regenerative Medicine - considered by the UK Government to be one of its eight great technologies, given the possibilities of transforming the clinical management of degenerative disease for both health and economic benefit. As established by the “Taking Stock of Regenerative Medicine in the UK”² report and the recent House of Lords report³, the UK retains a strong position globally in the science of stem cell and regenerative medicine. Both reports identified an important role for NHSBT, the later noting “the UK possesses a key advantage in the delivery of cell based products in the form of NHSBT and its devolved equivalents, which have the logistical capability to collect, produce, store and transport components of regenerative medicine”. Figure 2 shows the range of regenerative medicine products manufactured for clinical trials by NHSBT to date. Our stem cell transplantation and donation (SCDT) and Cellular and Molecular Therapy (CMT) strategies are a response to the increasing activity in new cell therapies and position us as a key participant in Regenerative Medicine.
- The Cell Therapy Catapult has been established to support the development of a world-leading cell therapy industry in the UK, and to drive the growth of the industry by helping cell therapy organisations translate early stage research into commercially viable therapies. In conjunction with DTS, we will ensure the development of an effective relationship with the Cell Therapy Catapult. As regards our own research programme, this will focus on the clinical translation of blood cells generated from stem cells, and the support of SMEs and academic units undertaking clinical research in the field of cell therapy.
- The UK Strategy for Unrelated Donor Stem Cell Transplantation - updated in 2014 by the Oversight Committee, has seen the successful alignment of the three UK stem cell registries, the creation of a fit panel of young adult donors HLA typed to high resolution, and an increased UK inventory of high quality cord blood donations. In its 2014 report, since endorsed by the ministers for Life Sciences and for Public Health, the Oversight Committee recommended that the UK’s ‘fit panel’ should expand to 150,000 donors and an inventory of 30,000 cord blood donations should be established by 2018. NHSBT’s SCDT and CMT strategies address these recommendations and are critical to the development of future cell therapies.
- Care.data - in May 2014, the Care Act made clear a statutory basis for information sharing to support tracking patient outcomes across health and care services. Care.data will eventually create a national picture of health patterns which can be used to study issues such as diagnosis and patterns of disease. We will consider how best to capitalise on this resource while providing assurance to donors and patients regarding the integrity of their data. The use of “big data” has been recognised as one of the Eight Great Technologies⁴, along with the potential for the UK to be a global leader in this area.

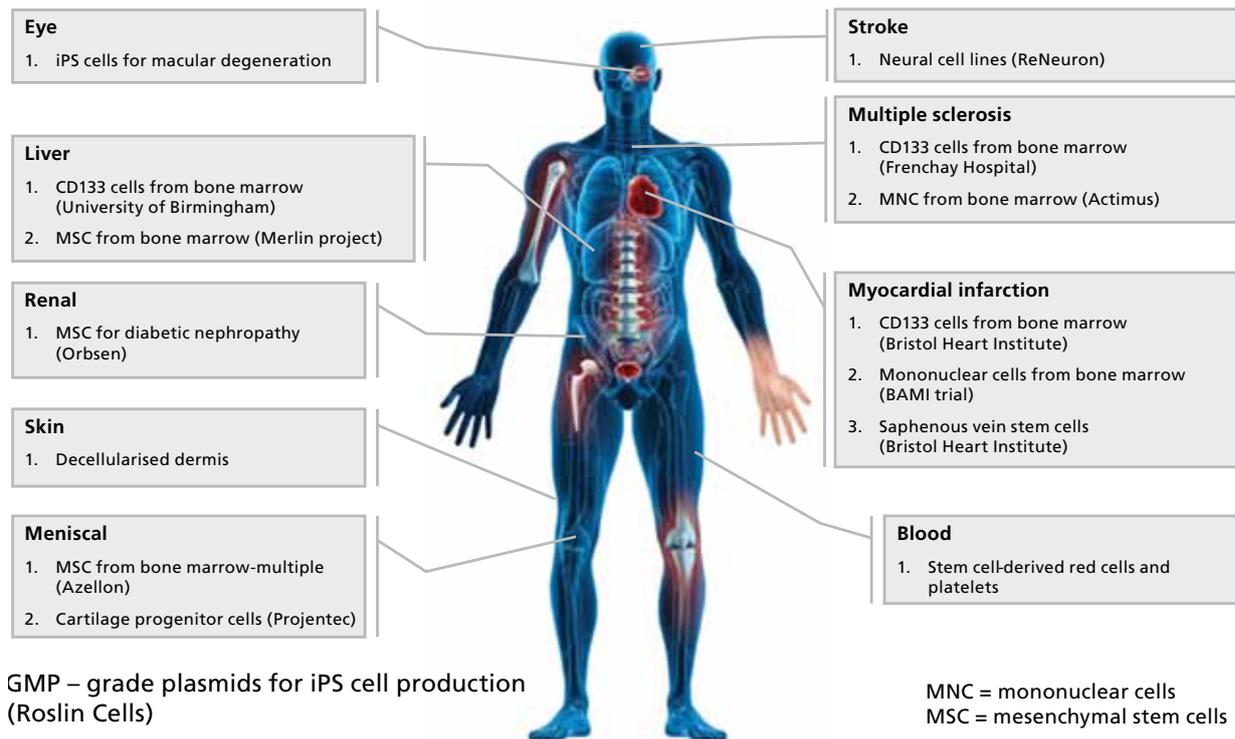
1. <http://www.genomicsengland.co.uk/>

2. Department of Business, Innovation and Skills, Taking Stock of Regenerative Medicine in the United Kingdom (2011).

3. House of Lord’s Science and Technology Committee. Regenerative Medicine report (2013).

4. <http://www.policyexchange.org.uk/images/publications/eight%20great%20technologies.pdf>

Figure 2: Regenerative Medicine Cell Therapies Produced by NHSBT



B. Changes to National Institute for Health Research (NIHR)/DH arrangements for research funding

The National Institute for Health Research is a major funder of research in England whose vision is to improve the health and wealth of the nation through research. It aims to achieve this by “providing a health research system in which the NHS supports outstanding individuals working in world-class facilities, conducting leading-edge research focused on the needs of patients and the public.” In 2010, in support of this vision, NIHR awarded four programme grants to NHSBT to support our translational research programme. These programme grants, which represent £2.8m per annum funding, end on 30th September 2015.

Renewal has been through bids from universities to host research units against priorities identified by us. Funding from NIHR of £12.1m for translational research in blood and transplantation has been awarded over 5 years from 1st October 2015 to support three Blood and Transplant Research Units (NIHR BTRUs). These will be Centres of Excellence in human experimental medicine related to blood and transplantation and have a strong focus on translation. They will be based in leading Universities and will form an integral part of our R&D programme. NIHR BTRUs will be established in:

- Donor Health and Genomics (University of Cambridge)

- Organ Donation and Transplantation (University of Cambridge with University of Newcastle)
- Haematopoietic Stem Cell Transplantation and Immune Therapies (University College London).

A further £3m NIHR funding has been made available to fund a fourth NIHR BTRU on the “*Manufacture and clinical assessment of cultured red cells*”. A second round competition has been run and a decision in this priority area is expected soon.

As part of this strategy we will work with the designated NIHR BTRU Directors to ensure the translation of research outputs into improvements in donor and patient outcomes (see Section 3).

As a result of the transition from NIHR Programme grants to NIHR BTRUs, Research Capability Funding (RCF) received from NIHR is anticipated to fall, due to the different levels of RCF associated with Programme Grants (currently 41p/£) compared to Research Units (currently 19p/£). A reduction in RCF from £1.4M/yr to £0.6M/yr is forecast over the duration of this strategy.

In addition, the Department of Health (DH) have indicated that Programme funding (formerly Grant-in-Aid (GiA)) should no longer be used to fund research activities. As a consequence, we have ceased funding research through GiA.

C. The Alliance of Blood Operators R&D Group.

In late 2013, the Alliance of Blood Operators (ABO) established an R&D working group. This working group is focused on common issues that affect the management, administration and leadership of R&D Programmes in member organisations. Chaired by Dr Dana Devine (VP Medical, Scientific and Research Affairs, Canadian Blood Services), the group is:

- Developing proposals for robust assessment of the performance and outputs from individual research programmes

- Developing proposals for collaborative working to make the most efficient use of resources
- Establishing shared processes for working with industrial partners.

As part of this strategy we will work with the ABO group to inform, review and implement its recommendations. Targets for publication output, external grant income and translating research outputs into service have been proposed against these key performance indicators (Section 6).

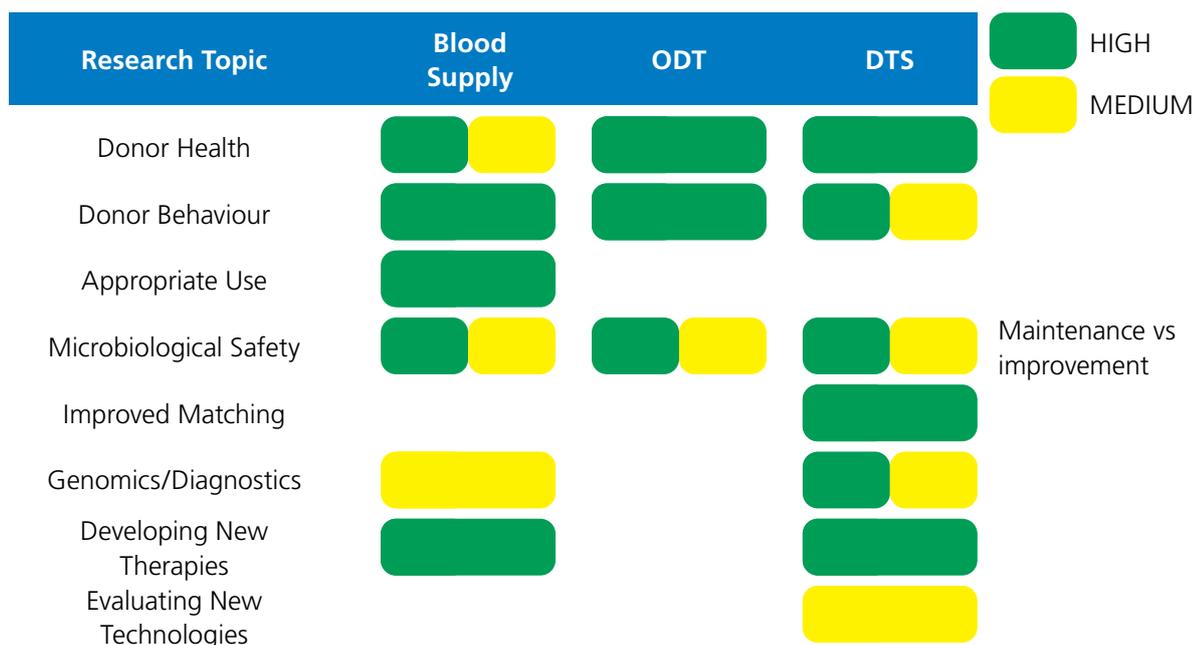
4. Consultation and stakeholder engagement

A. External stakeholders

The objectives in this strategy address priorities identified by external stakeholders who were asked to answer the question “New Horizons: how should NHS Blood and Transplant’s Research and Development shape the future?” at our corporate

stakeholder event in 2013. Delegates prioritised the vertical research themes in the context of our operational directorates (Blood Supply, ODT and DTS) as either a high, medium or low priority (Figure 3).

Figure 3: High and medium priorities as assessed by external stakeholders.



Donor Health and Donor Behaviour were ranked as a high or high-medium priority for Blood Supply and ODT. The Appropriate Use of Blood Products and Developing New Therapies, namely the production of blood cells from stem cells, also scored highly. Improved Matching was identified as a high priority

in relation to stem cell transplantation. There was also consensus that Microbiological Safety should be split into Maintenance, which is a high priority to maintain our exceptional safety reputation, and Improvement which is a lower priority.

B. Internal stakeholders

In September 2014, a survey to determine the opinions of staff across all directorates on draft proposals was undertaken. There was strong support (>96 % of respondents) for the continuation of an R&D programme, with the following activities being seen as important:

- Developing new or improved products and diagnostic services (95 %);
- Advancing knowledge and the understanding of the biology of blood, tissues and organs (85 %);
- Generating evidence to inform national safety policies and clinical practice (80 %);
- Collaboration with university partners (92%)

Staff felt that research should be directed towards understanding the effectiveness of the services which we offer. A new area of research, supported by the survey and which is being taken forward as part of his strategy, is the development of studies which design and test interventions aimed at improving recruitment/retention/consent.

5. SWOT analysis

An internal SWOT analysis of the R&D programme identified our unique capabilities in transfusion and transplantation as well as the opportunities presented by our academic partnerships and need to succession plan (Appendix 1). As an organisation we have a unique relationship with blood and organ donors and should take the opportunity to build on this relationship to establish National resources. Our strategic initiatives in organ donation (QUOD) and blood donation (INTERVAL) capitalise on this unique position. In this strategy we will develop these capabilities further by developing new outcome databases in transfusion and stem cell transplantation. Our expertise in the biology and immunology of transfused and transplanted cells is being directed towards the manufacture of blood cells from stem cells. In this area, our knowledge of GMP manufacturing processes and our ability to run clinical trials will enable us to deliver a clinical trial of manufactured red cells as part of this strategy. Our strong partnerships with leading Universities and the establishment of NIHR BTRUs will support the further development of centres of excellence in research aligned to our organisational needs.

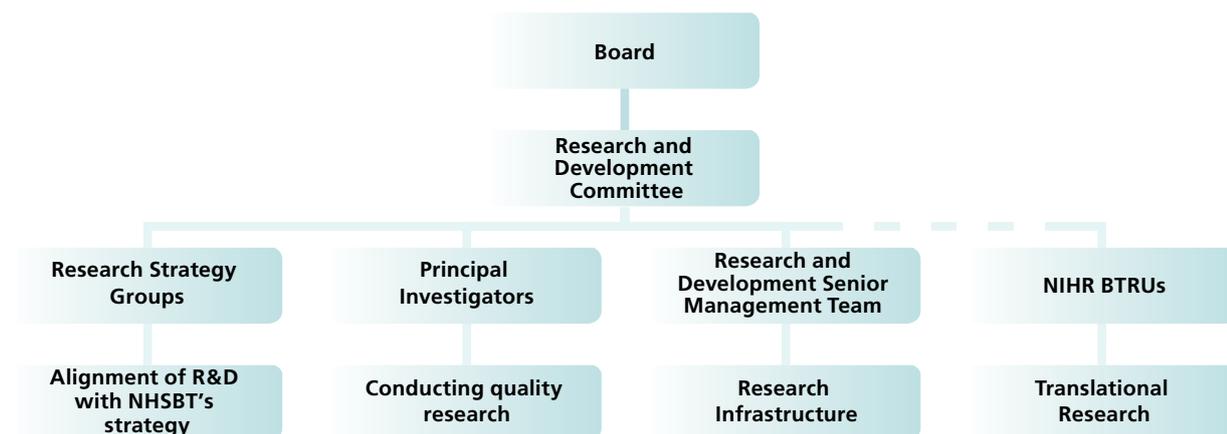
There is an identified need to succession plan and develop our R&D facilities to deliver this strategy; both of these will be addressed through specific strategic goals.

Section Two: Prioritisation and Delivery

1. Research Organisation and Governance

The structure which supports the delivery of our R&D Programme is shown in Figure 4 below.

Figure 4: Overall organisation and responsibilities



The R&D Committee has delegated authority from the Board to provide strategic oversight of the programme to ensure a balance of short and long term objectives which meet the requirements of the organisation. Its members include 3 NEDs (including the Chair), 4 Executive Directors, 3 international experts, along with 3 PI observers on a rotational basis. Principal Investigators present costed 5-year plans (work packages) for approval and the RDC also monitors high level progress through annual reports against pre-defined milestones.

The Research Strategy Groups (RSGs), which are chaired by operational Assistant Directors, are responsible for identifying priorities and developing research proposals to address these. An independent assessment of the effectiveness of the RSGs carried out in 2013 by PwC concluded that the structure of the R&D Committee and Strategy Groups was helping to transform the way that R&D was governed, and provided more effective links between research and business objectives. We will continue to develop the research programme from priorities identified through the RSG structure.

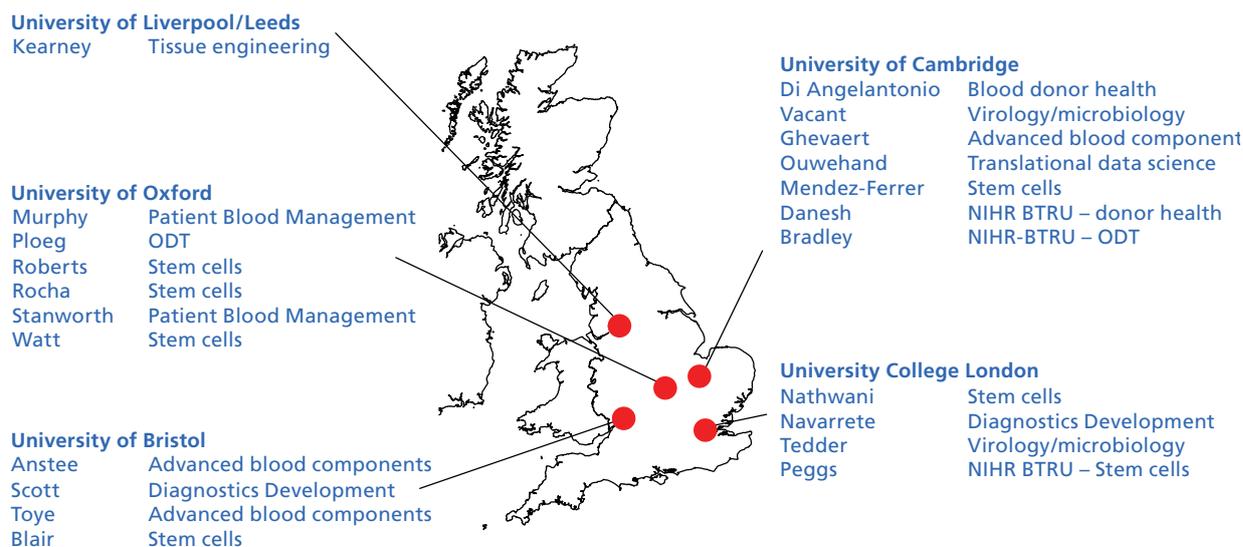
The R&D Senior Management Team (SMT) is chaired by the Medical and Research Director, supported by an Assistant Director, R&D. It has responsibility for the management, governance

and delivery of the R&D programme. Supported by a centralised office team in Filton, it monitors progress of strategic projects and receives reports on related development activities. Protecting and exploiting knowledge generated from our R&D programme continues to be an important role delivered by the R&D SMT. We will continue to work with our academic partners to identify, protect and exploit our intellectual property (IP). IP will be managed in line with our corporate policy and best practice in the NHS. It is our strategic intent to only proceed to National Phase filing of patents where there is a clear market opportunity.

The Principal Investigators (PIs) and their teams deliver the R&D programme through horizon scanning, working with operational staff to identify problems and testing hypotheses to address these using scientific method. They are largely embedded within partner universities, a practice which helps to attract the best scientists and ensures the international standing of our R&D Programme (Figure 5 below). Succession planning and proposals for new PIs are discussed further under Strategic Goal 8.

The NIHR BTRUs are new partnerships between top universities and NHSBT, and will deliver in 4 of our research themes.

Figure 5: Our academic partnerships



2. Development and Translation

There are a number of functions which will support the delivery of the research programme, but which also undertake development projects. Reporting and management of these functions is largely through operational directorates, but with close links to research through the RSGs and in some cases representation on R&D SMT. These include:

- i) The Component Development Laboratory (Cambridge), whose remit is to develop novel methods for producing blood components, to evaluate commercial products designed to improve blood safety/quality and to advise operational departments on methods for quality monitoring. The relocation of the laboratory from Brentwood to Cambridge is facilitating linkage with research groups developing methods for producing platelets and red cells from stem cells. Because of the close links to both the safety programme and strategic projects on manufactured blood cells, this laboratory is managed within the Clinical Directorate, and has a work-plan agreed through the Component Strategy Group.
- ii) The Systematic Reviews Initiative (Oxford) is a unique, evidence-based resource for the transfusion medicine community. Its aim is to improve practice by initiating, supporting and disseminating systematic reviews of both randomised and non-randomised controlled trial literature. Since 2010, 44 national/international guidelines have been informed by our reviews. In 2013, 8 full systematic reviews and 5 additional associated papers were published; there are currently 12 systematic reviews in preparation. The Transfusion Evidence Library (www.transfusionevidencelibrary.com) was redeveloped and relaunched in October 2013 with a commercial partner: Evidentia Publishing. It now contains over 700 systematic reviews, 3,800 randomised controlled trials and 60 economic evaluations, and is endorsed by the Cochrane Collaboration, the gold-standard organisation in this area. This activity links closely with the Patient Blood Management team, who also have oversight of the Systematic Reviews Initiative workplan.
- iii) Statistics and Clinical Studies (Oxford, Cambridge and Bristol) provide the infrastructure to support clinical trials approved by the R&D Committee or funded externally. This team also supports many service activities, notably within ODT, and will continue to provide the supporting infrastructure which enables us to undertake clinical trials in the use of blood components and other products and services. It also supports ODT Research, including the new NIHR BTRU at the Universities of Cambridge and Newcastle.
- iv) The Transfusion Microbiology laboratories (Colindale) undertake in-house development and evaluation of bacterial and microbiological assays. This work is complementary to R&D within the Blood Borne Virus Unit at Public Health England and is overseen by the microbiology strategy group.
- v) The Clinical Biotechnology Centre (CBC) is a specialist GMP-grade DNA plasmid manufacturing facility managed through DTS which will continue to support research activities in regenerative medicine, both internally and across academia/SMEs.
- vi) The Diagnostics Development Function has developed diagnostic blood group and antibody

assays which are used in the investigation of transfused patients, as well as evaluating new technologies from industry. During the 2010-15 R&D Strategy, improved governance and linkage to operations was achieved by moving close to patient services previously under the R&D SMT to Diagnostics and Therapeutic Services. Specifically, line management and oversight of IBGRL Reference Services and Diagnostics Development transferred to DTS on 1st April 2015 and a new Head of Diagnostics Development and Reference Services has been appointed. This will also improve the translation of research outputs into new products and services.

- vii) The Tissues Development Function has been essential for improving and validating the processes and procedures used for the retrieval, processing, banking and supply of TS. This work is fully funded by tissue services and overseen by the New Product Development Group.

3. Research and Development Themes

A. Vertical themes. We will continue to organise our research programme in a matrix of vertical themes mapped to business areas. In order to improve cross-theme learning and to better reflect the new focus on the manufacture of blood cells from stem cells, we will merge the current separate themes on red cells and platelets. The new vertical themes are:

1. Blood donor health
2. Transfusion and transplantation virology/microbiology
3. Patient Blood Management
4. Advanced blood components
5. Organ donation and transplantation
6. Stem cells and immunotherapies
7. Tissue engineering.

B. Cross-cutting themes. During the lifetime of this strategy we will introduce two new themes which apply across multiple vertical themes. These new cross-cutting themes are (1) Behavioural research, to develop a rigorous evidence base for strategies that will change donor/family consent rates and clinician behaviour (2) Translational data science, making use of 'big data' for donor and patient benefit.

C. Regenerative medicine is a broad term for a therapeutic approach which aims to restore normal function through a process of replacement, engineering or regeneration of human cells, tissues or organs. The House of Lords Science and Technology Committee report on the inquiry into regenerative medicine clearly identified NHSBT as a 'natural partner' in many aspects of regenerative medicine. The Regenerative Medicine Expert Group (RMEG) report calls on us and other UK blood services to review the human and capital infrastructure available to pursue the government's regenerative medicine agenda. We support the view that the RMEG strategy should seek to build upon these existing capabilities rather than recreate them under the Cell Therapy Catapult. This view features in the Stem Cell Oversight Committee Report which we sponsor. The emerging RMEG strategy will require "centres of excellence" from which such treatments will be delivered on a regional basis.

To date, our involvement in regenerative medicine research has focussed on the understanding of biological and molecular processes which control cell function. For example, we have been able to identify the master controllers of blood cell formation and are now using these to produce platelets in the laboratory. We have also been supporting successful gene therapy trials for treating haemophilia B and developing GMP protocols for the production of blood cells from haematopoietic stem cells. In this strategy, regenerative medicine features in several research themes:

- Theme 4: Manufacture of blood cells from stem cells (Goal 4 below and subject of a fourth NIHR BTRU (decision expected soon));
- Theme 6: The development of novel cellular therapies and the use of gene therapy to correct inherited blood cell disorders (NIHR BTRU in stem cells and immunotherapies);

Through these initiatives we will deliver a focussed, translational regenerative medicine research programme. The production of blood cells from stem cells will act as a lead product from which we can gain expertise in the development, manufacture, regulation, scale-up and clinical translation of advanced therapeutic medicinal products (ATMPs). Our recently approved SCDT and CMT strategies will be key to the successful translation to the clinic of outputs from our regenerative medicine research activities.

4. Proposed Research and Development activities by theme.

1. Blood donor health

In support of Blood 2020⁵, research will focus on investigation of strategies to allow existing donors to donate as efficiently as possible, including the completion of INTERVAL in 2016. The investigation of long term effects of component donation, through linkage studies, has been identified as a priority. In addition, there is a need to stabilise and, if possible, reverse the decline in the donor database by understanding motivations to donate and factors impacting on decisions to attend sessions. These priorities will be addressed through Strategic Goals 1 and 5 below, with investment and delivery through the NIHR BTRU in Donor Health and Population Genomics in partnership with the University of Cambridge. Development activities will include assessment of non-invasive haemoglobin assessments, dietary advice to reduce deferral rates due to low levels of iron and an assessment of iron supplementation.

2. Transfusion and transplantation virology/microbiology

Understanding the epidemiology and risk associated with emerging pathogens has been identified as a priority, with hepatitis E a prominent new threat. These will be addressed through Strategic Goal 2 below.

Development activities include ensuring the optimised performance of detection assays, working with Tissue Services to generate data to support a move to sample collection up to 48 hours post-mortem. In Bacteriology, planned activities will support operations through evaluations and validations of technologies designed to reduce/detect bacterial contamination. This includes a retrospective validation of the BacT/ALERT system and determining the growth kinetics and detection of bacteria in platelet additive solution and plasma. We will evaluate pathogen inactivation systems in collaboration with manufacturers to determine what advantages these technologies may offer. It is recognised that implementation of pathogen inactivation would have major impacts on future research priorities in this area.

3. Patient Blood Management

In order to make further improvements in the management of transfused patients, clinical trials are needed on the management, including diagnosis, of acquired coagulopathy. This area has been prioritised because of the uncertainty regarding effectiveness of fresh frozen plasma, the significant increase in use of cryoprecipitate in hospitals, increased off-licence use of fibrinogen concentrate and variability in practice as demonstrated in a recent national comparative audit in cardiac surgery. New guidelines in the management of major trauma also raise new questions about optimal component use in this setting. The priority will be addressed through Strategic Goal 3 below.

4. Advanced blood components

There is a need to continue the development of blood components (platelets and red cells) from stem cells which have the potential to improve transfusion outcomes for specific patient groups (hard to match and multi-transfused). In order to develop this programme of research there is a need to understand donor factors that they may affect the efficacy or safety of components. These priorities will be addressed through an NIHR BTRU (Strategic Goal 1) and further internal investment to support a first-in-man clinical trial and parallel research activities (Strategic Goal 4).

The Manufacturing Development Team and Component Development Laboratories work with R&D and Operations to assess and introduce new technologies into the blood supply chain. Specific live projects include the use of platelet additive solution as a vCJD risk reduction measure, further automation of the platelet pooling process and assessment of pathogen reduction systems. Work is beginning on the next contract for the Eurobloodpack which may require an assessment of the impact of novel plastics and additive solutions on component quality. In the longer term, studies will assess the vCJD risk reduction benefits of blood components collected from individuals born on or after 1 Jan 1996 and development work on plasma, such as in liquid or spray dried form, will be undertaken. Studies on serum eyedrops will support the validation of alternative sterile processes to enable current increases in demand to be met.

5. <http://www.nhsbt.nhs.uk/download/blood-2020.pdf>

5. Organ donation and transplantation

In line with our published strategic objectives outlined in 'Taking Organ Transplantation to 2020'⁶, the priority is to support research that will i) lead to increased rates of donation from deceased donors, ii) increase quality and numbers of organs transplanted, iii) improve the quality and length of survival of transplant recipients iv) increase organ utilisation v) Increase understanding of the long-term impacts of living donation. These priorities will be primarily addressed through the NIHR BTRU at the Universities of Cambridge/Newcastle, supporting the QUOD National BioBank and developing a programme of behavioural research (See Strategic Goals 1 and 5 below).

The establishment of the Research, Innovation and Novel Technologies Advisory Group (RINTAG) will provide a route for understanding current innovations and supporting the implementation of appropriately approved and funded research, innovations and service development in organ donation and transplantation. Through horizon scanning and working with commissioners and others this group will ensure the introduction of novel approaches to improve the outcomes of patients undergoing solid organ transplantation, in line with the UK Strategy 'Taking Organ Transplantation to 2020'

6. Stem cells and immunotherapies

The recently approved Stem Cell Donation and Transplantation and Cellular and Molecular Therapies strategies set out our strategic intent to maximise the number of patients offered a curative stem cell transplant and to establish NHSBT as the preferred provider of cell therapies to the NHS. In Cellular and Molecular Therapies, the product development pipeline will primarily be achieved through close collaboration with the NIHR BTRUs in Haemopoietic

Stem Cell Transplantation and the Manufacture and Clinical Evaluation of Cultured Red Cells. In the short term, technical advances in the way that services are delivered will be achieved through the provision of T-cell-depleted and virus-specific products, the provision of mesenchymal stem cells for treating steroid-resistant chronic graft-versus host disease and the further deployment of closed processes and isolator-based processing. In Stem Cell Donation and Transplantation, the procurement of donor-derived stem cells and tissues for research and service development provides NHSBT with a unique advantage compared to other NHS and academic organisations. A particular focus currently is the derivation of mesenchymal stem cells from umbilical cords. These cells show significant promise in the treatment of autoimmune disorders, steroid-refractory graft-versus host disease, and a range of regenerative medicine therapies.

7. Tissue engineering.

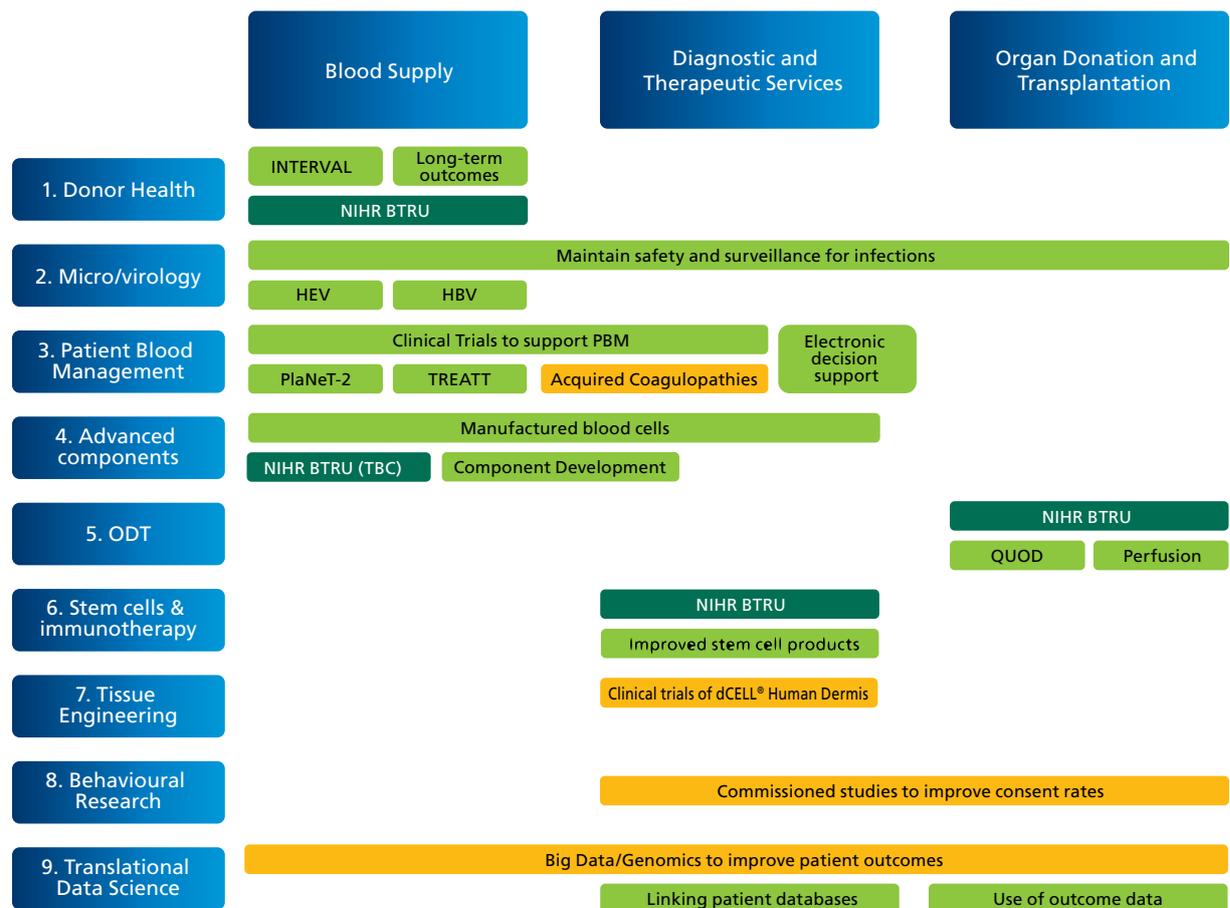
In this theme, research that will provide stronger evidence for the efficacy of dCELL[®] Human Dermis has been identified as a priority, with the aim of increasing uptake by hospitals. Joint funding for a clinical trial in diabetic leg ulcers is being sought through the NIHR Health Technology Assessment programme. Development of further products will be considered through Tissue Services, and will be dependent upon increased revenue as outlined in the Tissues Services Strategy.

An overview of the research priorities together with the research and development activities that will address these is provided in Appendix 2 and Figure 6 below. Research priorities in the two new cross-cutting research themes (Behavioural Research and Translational Data Science) will be addressed by Strategic Goals 5 and 6.



6. http://www.nhsbt.nhs.uk/to2020/resources/nhsbt_organ_donor_strategy_long.pdf

Figure 6: Overview of activities in support of priorities identified by Research Strategy Groups



Notes: A second round competition for an NIHR BTRU in the manufacture and clinical assessment of cultured red cells has been run and a decision in this priority area is expected soon

Activities to be funded through future proposals are highlighted in orange

Section Three: Strategic Goals

Goal 1: To establish and ensure delivery of NIHR Blood and Transplant Research Unit objectives through partnership working

The awarding of funding to Universities in support of translational research in the fields of transfusion and transplantation will significantly enhance our R&D Programme over the duration of this strategy. We will work with the Directors of the NIHR BTRUs to ensure delivery of these ambitious research units and the translation of their outputs into improvements for donors and patients. Specific objectives which the NIHR BTRUs will deliver are:

A. Donor Health and Genomics (Director: Prof John Danesh, University of Cambridge)

This NIHR BTRU will address major questions about the impact of donation on the health of blood donors and produce evidence-based strategies to enhance donor safety while ensuring sustainability of blood supply. The NIHR BTRU will i) identify what determines levels of iron stores and blood cell characteristics in donors, ii) identify health consequences of blood donation and susceptibility to these, iii) define how donation approaches can be more personalised, iv) build capacity by training a future generation of researchers and v) establish a national and international resource for generation of research to inform policy setting on donor health and genomics. The objectives of this NIHR BTRU are synergistic with our ambitions in translational data science.

B. Organ Donation and Transplantation (Director: Prof Andrew Bradley, University of Cambridge)

This NIHR BTRU will develop and evaluate novel approaches and technologies that aim to increase the availability of suitable donor organs for transplantation, while improving graft survival. The key objectives will be to i) improve donor management and evaluate novel interventions in deceased donors, ii) develop novel approaches for assessing thoracic and abdominal organ quality, iii) evaluate normothermic ex-vivo perfusion as an approach for assessing the function of extended-criteria thoracic organs and kidneys and iv) reduce the demand for re-transplantation through improved understanding of donor/recipient compatibility.

C. Stem cells and immunotherapies (Director: Dr Karl Peggs, University College London)

This NIHR BTRU will facilitate the clinical translation of scientific advances to facilitate optimal donor selection and to develop new and improved stem cell-based treatments. The NIHR BTRU aims to i) define genetic profiles that predict when the risk of graft-versus-host disease (GvHD) is highest, ii) selectively remove the immune cells that are the main cause for GvHD, iii) genetically modify immune cells to re-direct them to specifically target cells that form blood cancers, iv) use gene therapy technologies to correct inherited blood disorders and v) automate the production of these cellular therapeutics to increase availability to patients.

D. Manufacture and clinical assessment of cultured red cells

A second round competition for an NIHR BTRU in the manufacture and clinical assessment of cultured red cells has been run and a decision in this priority area is expected soon. The proposed unit will focus on using manufactured red cells as a lead product from which we can gain expertise in the development, manufacture, regulation, scale-up and clinical translation of advanced therapeutic medicinal products (ATMPs) and generating a small-scale red blood cell product suitable for clinical scenarios in which there is currently an unmet need.

Goal 2: To enhance our programme of research in transfusion/transplantation microbiology and virology to maintain blood, tissue and organ safety

This is a key area of research which directly feeds into operational activity to ensure the continued microbiological and virological safety of blood components, tissues and organs.

We have built strong and productive partnerships with Public Health England (PHE), the University of Cambridge and University College London in this area, which facilitate responses to known and emerging transfusion and transplantation transmitted infections (TTTIs) through the jointly-funded Blood-Borne Virus Unit (BBVU) at PHE Colindale. **This programme will focus on hepatitis E (HEV) and hepatitis B (HBV) in the early years of this strategy** and emerging infections throughout. As a top priority, we will conduct studies to inform SaBTO policy on HEV: (i) understanding its changing epidemiology in the UK (ii) gaining evidence regarding the clinical burden of HEV in stem cell and organ transplant recipients (PI: Professor Richard Tedder).

We will strengthen our relationship with PHE research through Dr Lorna Williamson's membership of the Steering Committee for PHE's new Health Protection Research Unit on Blood-borne Viruses (Director: Professor Caroline Sabin). Further development of the partnership will be in the context of any strategic decisions made at PHE relating to the location of their Colindale.

Goal 3: To deliver clinical trials to support patient blood management

NHSBT's programme of research in the appropriate and safe use of blood, platelets and plasma informs national and international transfusion practices. Ongoing studies are focussed on the appropriate use of platelets and red cells in the multi-transfused, neonates, and patients with low platelet counts (PIs: Professor Mike Murphy and Simon Stanworth). Using external funding for 5 years, we have appointed an additional consultant in Oxford to support this programme and in consideration of succession planning.

It is our intention to undertake one new strategic clinical trial in support of patient blood management priorities during the lifetime of this strategy.

We will consider a new strategic partnership with PHE, the University of Cambridge as well as the European Bioinformatics (EBI) and Wellcome Trust Sanger Institutes at the Wellcome Trust Genome campus. We have strategically positioned ourselves to ensure that our partnerships in donor and patient TTTI research will be enhanced through the exploitation of new sequencing technologies and population health "big data" in the study of TTTIs.

Therefore, we will as a priority, work with the University of Cambridge to fill the vacant lectureship in virology (recently vacated by Dr Lars Dolken). We will also need to appoint a successor to the current Director of the BBVU (Professor Richard Tedder), and will work with PHE to achieve this. Finally, we will identify and support talented individuals who are aiming to achieve PI level to ensure that future capacity in this field is maintained. This will be done through the clinical fellow programme (funded in clinical budget) and a new tenure track programme as part of Goal 8 of this strategy.

We will conclude development of potential screening and confirmatory assays for vCJD. Any further evaluation of assays developed by others and epidemiological studies will continue as part of our safety programme, co-ordinated by the UK Blood Services Prion Working Group.

The diagnosis and management of patients with acquired coagulopathy (abnormal blood clotting due to e.g. major trauma or sepsis) has been identified as the highest priority by the Patient Blood Management strategy group. This links to our strategy for frozen products and possible alternatives for coagulation replacement. Since clinical trials are expensive, we will initially seek external or matched funding in support of this trial.

We will continue our practice of supporting externally funded/international clinical trials through baseline funding to the Clinical Trials Unit to ensure effective, efficient and high quality research.

Goal 4: To strengthen our position in the development, assessment and clinical delivery of regenerative medicine based therapies

NHSBT has been identified as a key organisation in the UK's successful delivery of regenerative medicine based therapies (House of Lords and RMEG reports). We have world-leading positions in the production of red cells and platelets from stem cells and will exploit this to deliver a first-in-man clinical trial of manufactured red cells (PIs: Professor David Anstee and Dr Ashley Toye, Bristol). The trial will compare survival in the circulation of red cells manufactured from (i) stem cells from adult blood and (ii) stem cells from cord blood with that of standard red cells from blood donors. This work will make use of the expertise of our GMP SCI labs, our Component Development Laboratory which has recently relocated to Cambridge, and our Clinical Trials Unit which has previously conducted similar first-in-man studies using antibody-coated red cells and platelets. We will use this trial to generate organisational learning in GMP translation, and how to work with MHRA on a new Advanced Therapeutic Medicinal Product, thereby strengthening our position in the field of regenerative medicine therapies. Significant investment will be required during this 5 year period to optimise manufacturing and storage, and perform first-in-man studies. This work will be carried out in collaboration with and part-funded through the fourth NIHR BTRU (subject to final NIHR approval); thus the proposals in the NIHR BTRU and internally funded activities are complementary, with no duplication or gaps.

Goal 5: To establish a Behavioural Research programme to identify behavioural change interventions which significantly increase donation and consent rates

Blood supply and ODT have prioritised behavioural research as a mechanism for improving blood donor recruitment and organ donation consent rates respectively. We have therefore established a cross-cutting Donor Behaviour research strategy group that will develop a programme of research in behavioural change interventions to improve delivery of operational targets such as consent rates. As we lack internal expertise, we will develop a research brief and run an external competition against this. The result will be new academic and/or commercial partnerships with behaviour change experts that deliver high quality studies which drive changes to clinical practice.

The initial focus will be on identifying behavioural change interventions which could have a positive impact on organ donation consent rates in support of the *Taking Transplantation to 2020* strategy. Significant variations in consent and organ utilisation rates exist that are driven by differences in clinical practice. Adopting the best clinical practice requires evidence-based change and we will commission

We will continue to work with others involved in red cell manufacture, including the SNBTS-led BloodPharma and the Sanquin-led Cellular Therapy programmes. Professor David Anstee and Dr Cedric Ghevaert are named investigators in BloodPharma. It should be noted that BloodPharma have requested that we carry out the first-in-man trial of their lead product (scheduled for 2018/19).

We will continue to support pre-clinical science on manufactured red cells (PIs: Prof David Anstee and Dr Ashley Toye) and platelets (PI: Dr Cedric Ghevaert) with cell biology research to understand how stem cells turn into blood cells. This will deliver improvements in the quality of the final manufactured red cells, and pave the way for a first-in-man study of manufactured platelets beyond 2020.

Underpinning science on blood cell production will be strengthened by the appointment of a new PI: Dr Simon Mendez Ferrer will take up a post as Reader in Transfusion Medicine at the University of Cambridge. His work on the bone marrow micro-environment will complement that of Drs Ghevaert and Toye.

We will also develop a long-term service strategy which best exploits our intellectual property in this area. This may include on-going manufacture in-house or a planned exit and transfer of manufacturing to industry.

a study to identify and trial behavioural change interventions that drive improvements in consent and/or utilisation rates. This targeted research will complement existing activities led by Comms/ODT aimed at changing societal attitudes towards organ donation.

We have chosen to prioritise organ donation consent rates initially but, subject to available funding, will later commission studies impacting upon the blood supply and the provision of stem cells. These interventions will complement existing research in donor health and will specifically support our Single Equality Scheme objective of understanding the drivers of donation in BAME communities.

Through Dr Simon Stanworth, we currently collaborate with Dr Jill Francis, City University, on an NIHR programme grant (AFFINITIE) comparing different strategies to influence clinician behaviour regarding blood prescribing. We will look for further opportunities to develop externally funded studies on clinician behaviour.

Goal 6: To establish a Translational Data Science programme to build and exploit big data resources that deliver improvements to our services

Several of our organisational requirements can be increasingly addressed by new tools and approaches associated with the data science revolution. Harnessing the full potential of developments requires a strategic response in two inter-related areas. First, we will develop the personnel, expertise, and tools (e.g., computing capabilities) to exploit and link large and complex data-sets. This will include linking our unique datasets to external resources being established in major international initiatives⁷. We will explore the delivery of early gains in donor and patient care by linking these publically available data with datasets unique to ourselves and Public Health England. Second, we currently lack a systematic approach to the creation of big data resources. Our ability to combine serial access to very large numbers of donors and patients, biological samples, and consent of donors for use of their samples and e-health records for research purposes means that we have the potential to become leaders in this field. The vast potential in this domain has been illustrated by success in recent years of initiatives such as INTERVAL and QUOD. In order to deliver these benefits, we will develop a Translational Data Science function by investing in people with relevant quantitative inter-disciplinary expertise for building and exploiting big data resources for donor and patient benefit (e.g., bioinformatics, computational biology, statistical genomics, mathematical modelling, software engineering). To realise this goal, an options appraisal will be

conducted, taking into account the government's "Strategy for UK Data Capability"⁸ to establish the optimal capacity, best location, management arrangements and funding mechanism for a new translational bioinformatics and statistical genomics laboratory.

Early gains will be delivered by focusing on two areas:

- i) Understanding whether whole-genome data can be used to accurately determine donor blood groups at scale; this would transform donor/patient matching and eventually remove the need for physical 'cross-matching' of donor and patient blood. It may also hold the key to revolutionising the way in which we manage our donors by rapidly and cost-effectively providing unrivalled information on essential donor characteristics such as the full range of blood and platelet groups or HLA (tissue) type needed for stem cell and organ matching).
- ii) Understanding whether we can extract clinical data on transfused patients from hospital databases with the aim of better understanding blood use and building a national ongoing database of transfusion practice.

The successful delivery of this strategy requires appropriate resources, infrastructure and personnel. Two further goals will support these areas:

Goal 7: To provide facilities and funding to support an innovative research programme

Facilities. Our well-developed strategic partnerships with Universities are essential to maintain the excellence of the R&D programme. These partnerships, which will continue to be underpinned by Memoranda of Understanding, allow us to embed PIs and Scientists in academic departments, something that will continue. For the R&D strategy to succeed our researchers, both wet-lab and dry-lab (computing), need access to state-of-art facilities and environments. The expansion of the biomedical campus at the Clinical School in Cambridge provides opportunities to relocate our scientists into new, state-of-the-art laboratories. There are advanced plans for new Institutes for Stem Cell and Heart/Lung research which could be optimal locations for some of our Cambridge-based research teams. R&D management will work with estates and facilities

and our partner Universities and other organisations eg PHE to conduct option appraisals based on these opportunities and strategic alignments. Where appropriate, and supported by a future business case which sets out the fiscal, scientific and strategic advantages, we will relocate R&D activities into state-of-the art University accommodation, thereby releasing space within our estate.

Funding. Funding will be provided from (i) NIHR (ii) internally through prizes and (iii) from competitive external grants obtained by our PIs. We will continue the practice of providing core funds to our PIs through rolling workpackages prepared in conjunction with the Research Strategy Groups and approved by the R&D Committee. Over the past 5-years, this approach has increased alignment with

7. For example, ~£400m has been invested by the MRC, NIHR and Wellcome Trust in the 100,000 Genomes Project [75K NHS patients with inherited diseases, 20K NHS patients with cancer], UK Biobank [0.5m healthy individuals], INTERVAL [50K NHSBT donors, co-funded by NHSBT]

8. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254136/bis-13-1250-strategy-for-uk-data-capability-v4.pdf

operational requirements and improved translation of results into service delivery. A summary of the PI-led workpackages which support the delivery of this strategy are shown in Appendix 2.

Securing funding from external sources is highly competitive and for our PIs to succeed preliminary data are required. Funding to support these pilot and preliminary studies has been provided by the Trust Fund and frequently these modest investments have helped secure external grants. This fund is now

exhausted, so we will introduce a specific funding stream for pilot studies up to £50k/study, subject to available funds.

Successful delivery of the R&D programme depends on a mixed portfolio of funding, with external academic funding⁹ complementing internal support. We will therefore introduce internal peer-review prior to submission of external grant applications with the aim of increasing success rates.

Goal 8: To ensure that our workforce have the skills and expertise to deliver the R&D Programme

PIs: Succession planning and development of new areas. The PI cadre has been refreshed in the last four years with the appointment of seven new PIs as part of succession planning. A reduction in the number of PIs is planned over the **duration** of this strategy due to known/forthcoming retirements (from 17 to approximately 12). In line with the objectives of the NIHR BTRUs to build capacity in priority areas, we will work with the Directors to maximise the opportunities presented by these centres of excellence. To support this, we will provide Honorary Principal Investigator status to all Directors. We will appoint a new PI in microbiology/virology in Cambridge (closely linked with PHE), and establish a new 5-year non-tenure Lecturer position in Translational Bioinformatics & Statistical Genomics.

Tenure-track posts. We will develop a tenure-track scheme to identify and support early- to mid-career scientists and clinicians who will become candidates for future Principal Investigators. We will appoint tenure-track scientists at our partner Universities through a competitive process in high-priority areas.

Equality and Diversity. In line with our corporate Single Equality Scheme (SES) we aim to increase the proportion of female group leaders and Principal Investigators as part of this process. Work has begun to achieve the Athena SWAN charter mark, which outwardly displays our commitment to Women in Science. It is anticipated that we will meet the criteria for a Bronze award in the first instance because of our inclusive culture and a well developed corporate single equality scheme. We intend to develop and implement a plan to progress to a Silver award during this strategy.

Clinical researchers. We have successfully funded 6-8 full-time medically-qualified research trainees using funds allocated from within the Clinical Directorate budget. This funding supports a 3-year period of full-time research leading to a PhD for individuals from a range of clinical specialities. Clinical Fellows supported by us have gone on to become Principal Investigators (Drs Simon Stanworth, Oxford and Cedric Ghevaert, Cambridge) as well as NHS consultants with a transfusion interest. Former clinical fellows in ODT are progressing through training. We will continue to fund Clinical Fellows over the duration of this strategy and focus investment in the NIHR BTRUs to support capacity building.

We also benefit from allocated posts from the NIHR-funded academic training pathway for doctors which exposes specialist registrars to academic research alongside their accredited training. Each year we have 2 new funded Academic Clinical Fellows (pre-PhD, 25% time for research), plus 1 Clinical Lecturer (post-PhD, 50% time for research). We will continue to align these posts with research priorities and locations.

Leadership skills. We will actively promote and encourage staff to access our development programmes (e.g. AIM, REACH Higher, Hubbub, SLDP). Where possible we will look for secondment opportunities for staff within research and development to work in operational directorates to encourage cross-directorate working.

9. For example: European Commission, MRC, NIHR, Wellcome Trust and the major disease-specific UK charities for cancer, heart and kidney.

Section Four: Financial Profile

The five-year financial plan (2015 – 2020) for the R&D programme is shown below.

Description	2015/16 Revised Forecast £	2016/17 Forecast £	2017/18 Forecast £	2018/19 Forecast £	2019/20 Forecast £
NIHR Programme grants	1,496,599				
NIHR – BTRU's	1,474,712	3,017,593	3,244,000	3,176,578	2,814,955
Research Capability Funding	1,207,585	1,075,000	875,000	675,000	675,000
Income total	4,178,896	4,092,593	4,119,000	3,851,578	3,489,955
Expenditure by theme					
Theme 1: Blood Donor Health	1,010,957	205,756	40,000	0	0
Theme 2: Transfusion & Transplantation Virology & Microbiology	597,360	516,887	418,801	420,424	422,152
Theme 3: Patient Blood Management	442,828	387,637	393,262	288,963	204,553
Theme 4: Advanced Blood Components	808,581	997,788	1,007,724	1,018,680	1,027,758
Theme 5: Organ Donation & Transplantation	318,486	300,000	300,000	300,000	300,000
Theme 6: Stem Cells & Immunotherapies	705,412	609,211	618,922	528,706	471,702
Theme 7: Molecular & Tissue Engineering	153,291	100,000	75,000	50,000	25,000
Theme 10: Administration, Support, Equipment Maintenance	1,129,137	1,067,916	1,076,846	1,085,864	1,094,973
Theme 4: Manufactured red cells – clinical study and manufacture		374,723	511,607	556,700	331,476
Completion of NIHR Programmes (6 months)					
Programme A	335,573				
Programme B	355,187				
Programme C	292,701				
Programme D	328,164				
PI Core Funding	0	100,000	100,000	100,000	100,000
PI Core Funding	40,000	80,000	80,000	40,000	0
Tenure Track Programme		100,000	100,000	100,000	100,000
BTRU – External Costs	1,474,712	3,017,593	3,244,000	3,176,578	2,814,955
Expenditure total	7,992,389	7,857,511	7,966,162	7,665,915	6,892,568
I&E position	(3,813,493)	(3,764,918)	(3,847,162)	(3,814,337)	(3,402,613)
Blood Price Levy	3,100,640	3,100,640	3,100,640	3,100,640	3,100,640
ODT Levy (GiA)	318,486	300,000	300,000	300,000	300,000
Under/(Over) committed	(394,367)	(364,278)	(446,522)	(413,697)	(1,973)
Savings identified	237,716	451,050	354,637	254,521	154,497
Overall Under/(Over) position – Revised	(156,651)	86,772	(91,885)	(159,176)	152,524
Severance Costs Associated with projects ceasing	(380,000)				
Overall Under/(Over) position – Revised	(536,651)	86,772	(91,885)	(159,176)	152,524
Projects Yet To Be Agreed:					
Theme 3: New Clinical Trial		200,000	200,000	200,000	200,000
Theme 7: dCELL® Human Dermis clinical evaluation		200,000	200,000	0	0
Theme 8: Behavioural studies		200,000	200,000	200,000	200,000
Theme 9: Translational data science		300,000	300,000	300,000	300,000

Notes: Shows NIHR BTRU funding awarded to Universities and under the control of Unit Directors. Subject to final decision of award of fourth BTRU in manufacture of red cells;

The revised forecast in 2015/16 reflects a £168k reduction in RCF.

Section Five: Targets and success

The successful delivery of this strategy will be monitored by the R&D SMT on an on-going basis and the R&D Committee which meets twice-yearly. New KPIs will be introduced as shown below, using the definitions agreed by the Alliance of Blood Operators R&D group to enable benchmarking against peer organisations. Strategic targets over the duration of the strategy are detailed against the objectives with growth being driven by the success of the NIHR BTRUs as they develop into centres of excellence.

R&D Targets	2015/16 Plan	2016/17 Plan	2017/18 Plan	2018/19 Plan	2019/20 Plan
Scientific publications	150	150	150	160	160
External grant income	£5m	£5m	£5m	£5m	£5m
% of R&D projects reporting as green	90%	90%	90%	90%	90%
% of trials recruiting to target	80%	80%	80%	80%	80%
Patents filed	1	1	1	1	1
New products, services or policies developed from programme	2	2	2	3	3
Value and Impact – case studies ¹⁰	5	5	5	5	5
External Scientific Review				Review	



10. Impact is defined as outputs that have “led to modifications of existing or creation of new operations in the institution, an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia”. It will be measured by case studies reviewed by the R&D Committee.



Section Six: Appendices

Appendix 1: SWOT

A Summary of Strengths, Weaknesses, Opportunities and Threats of our R&D Programme

Strengths	Opportunities
<ul style="list-style-type: none"> • Access to donors and support of bio-resources • Expertise in the biology and immunology of transfused and transplanted cells • Strong partnerships with Universities supporting the embedding of staff in academic environments • Successful Partnerships with NHS clinicians • NHSBT has access to long-term stable funding • Strong presence in ODT • Knowledge of GMP processes • Participation in International Clinical Trials • Access to unique reagents (Red Cells/Abs) • PIs and teams are world leading experts • Research findings lead to a world-class publication output • Successful in obtaining external funding to supplement internal investment 	<ul style="list-style-type: none"> • Translation of research findings (e.g. genomics knowledge) into service • Increasing interactions between Scientists and Service staff • Identification of commercial opportunities and improved business development • Career progression and development of talent for succession planning • MD/PhD training linked to University and key clinical needs • National collaborations in organ donation and transplantation • Joint centres with local partners • Development of centres of excellence built on existing strengths • Closer working with Diagnostics laboratories • Directed Research from Strategy Groups
Weaknesses	Threats
<ul style="list-style-type: none"> • Infrastructure and buildings are dated and compare poorly to purpose built facilities • Lack of internal informatics expertise • Workforce dispersed across the country with limited opportunities for interactions • Lack of specialist facilities and core support for these (eg. flow sorter) • NHSBT is not fleet of foot, but can work with flexible partners (eg. University) • Career structure within R&D is lacking • Slow and restrictive procurement environment 	<ul style="list-style-type: none"> • Lack of recognition of NHSBT as a credible R&D organisation by external funders • Lack of ability to attract Top Quality Staff which is mitigated by partnership with top University • Managing fixed-term funding and uncertainty of future funding • Current academic hospital partners have a limited number of patients which requires working with other trusts and developing larger collaborative networks • Age profile of current workforce and loss of expertise • Increasing International competition

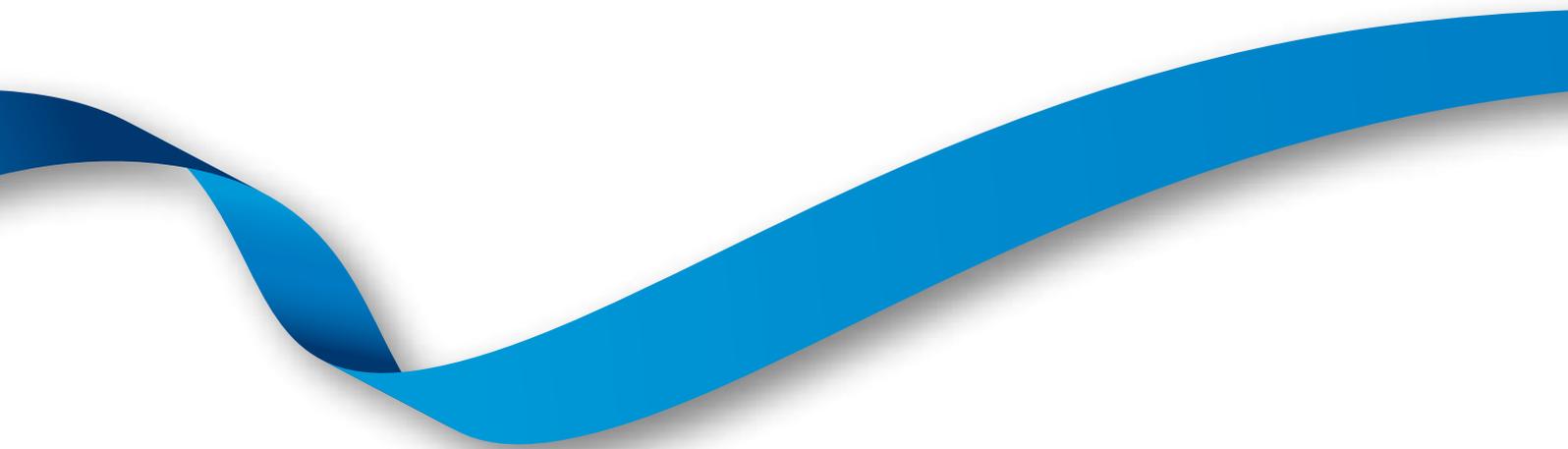
Appendix 2: Research and Development activities in support of priorities identified by Research Strategy Groups (2015 – 2020)

Theme	Priorities	Research Activities	Development Activities
1. Blood Donor Health.	<ol style="list-style-type: none"> To investigate strategies to allow our existing donors to donate as efficiently as possible. Validation and implementation of non-invasive haemoglobin assessment to support the efficiency of donation sessions and the potential of implementing a haemoglobin testing strategy. Investigation of long term effects of component donation, through linkage studies. To stabilise and, if possible, reverse the decline in the donor database by understanding motivations to donate and factors impacting on decisions to attend sessions. This should be particularly concentrated on donor segments with vulnerable blood groups or BAME ethnicity. 	<p>Completion of the INTERVAL trial (Danesh/Roberts).</p> <p>Understanding the long-term effects of whole blood and platelet donation (di Angelantonio).</p> <p>Establishing behavioural research theme (Strategic Goal 5).</p> <p>NIHR BTRU in Donor Health and Genomics (Danesh):</p> <ol style="list-style-type: none"> genetic determinants of iron stores and blood cell characteristics health consequences of blood donation personalised donation approaches capacity building research resource for policy setting. 	<p>Dietary advice to reduce deferral rates due to low levels of iron.</p> <p>Assessment of non-invasive haemoglobin measurements.</p>
2. Transfusion and transplantation microbiology and virology.	<p>Research that will lead to improvements in:</p> <ol style="list-style-type: none"> The microbiological safety of blood components, tissues and organs (where appropriate). The understanding of the epidemiology and risk associated with emerging pathogens. 	<p>Focus on hepatitis E (HEV) and hepatitis B (HBV) in the early years of this strategy and emerging infections throughout (Tedder).</p> <p>For HEV, understanding its changing epidemiology in the UK and gaining evidence regarding the clinical burden of HEV in stem cell and organ transplant recipients.</p> <p>Appointment of a new PI in virology/ microbiology (Strategic Goal 2).</p>	<p>Optimised performance of detection assays. Evaluation and validation of technologies designed to reduce/detect bacterial contamination.</p> <p>Population prevalence study of prions in blood (subject to approval of funding).</p>

Theme	Priorities	Research Activities	Development Activities
3. Patient Blood Management.	<ol style="list-style-type: none"> 1. Studies on the management, including diagnosis, of acquired coagulopathy. 2. Understanding the impact of transfusion on specific patient groups, for example, neonates. 3. Understanding the basis of haemostasis and impact of blood components both for prophylaxis and in bleeding patients, specifically FFP, cryoprecipitate and fibrinogen concentrate. 	<p>External funding of a clinical trial (Strategic Goal 3).</p> <p>Ongoing clinical trials (PlaNet-2 and TREAT).</p>	<p>Innovation in hospital transfusion to incorporate electronic decision support for blood transfusion. Focus on developing the technology in centres of excellence, wider roll-out and quantifying the economic and healthcare benefits. (Murphy).</p>
4. Advanced blood components.	<ol style="list-style-type: none"> 1. Development of blood components from stem cells. 2. Understanding donor factors where there is evidence through clinical studies that they may affect the efficacy or safety of components in specific patient groups. 	<p>Manufactured red cells - parallel science (Anstee).</p> <p>Studies on erythropoiesis and improving the maturation and yield of cultured human reticulocytes (Toye).</p> <p>Production of platelets from stem cells (Ghevaert).</p> <p>Conducting a first-in-man trial of manufactured red cells (Strategic Goal 4).</p> <p>NIHR BTRU Manufacture and clinical assessment of cultured red cells (decision from NIHR pending):</p> <ol style="list-style-type: none"> i) Manufactured red cells as a lead advanced therapeutic medicinal product ii) Generating a small-scale product suitable for clinical use. 	<p>Ongoing work conducted by the Manufacturing Development Team and Component Development Laboratory, (e.g. the use of platelet additive solution as a vCJD risk reduction measure, further automation of the platelet pooling process and assessment of pathogen reduction systems).</p> <p>Development work on liquid and spray dried plasma.</p>

Theme	Priorities	Research Activities	Development Activities
<p>5. Organ donation and transplantation.</p>	<ol style="list-style-type: none"> 1. Support research that will lead to increased rates of donation from deceased and living donors or will improve to increase quality and numbers of organs transplanted or improve the quality and length of survival of transplant recipients, in line with our published strategic objectives outlined in 'Taking Organ Transplantation to 2020'. 2. Work closely with clinical partners at both national and international levels to promote our aims by provision of skills, knowledge, information, resources, expertise and national and international colleagues and organisations within our current resources. 3. Promote research and clinical audit within ODT and in collaboration with stakeholders. 4. Ensure ODT is recognised, nationally and internationally, as a leader for research in organ donation and transplantation. 	<p>Establishing behavioural research theme (Strategic Goal 5). QUOD National BioBank (Ploeg). NIHR BTRU in Organ Donation and Transplantation (Bradley):</p> <ol style="list-style-type: none"> i) improve donor management and evaluate novel interventions ii) develop novel approaches for assessing organ quality iii) evaluate normothermic ex-vivo perfusion iv) reduce the demand for re-transplantation through improved donor/recipient compatibility. 	<p>Establishing the Research, Innovation and Novel Technologies Advisory Group (RINTAG) to support the implementation of innovations and service development in organ donation and transplantation. Continued support for Statistics and Clinical Studies to maintain and analyse the transplantation database.</p>

Theme	Priorities	Research Activities	Development Activities
6. Stem cells and Immunotherapies.	<ol style="list-style-type: none"> 1. Research to improve the stem cell graft and improve donor selection, including early phase clinical trials. 2. Research into gene modification of haemopoietic stem cells but including inherited genetic (as well as malignant) disorders, including early phase clinical trials. 3. Research to prevent relapse, including early phase clinical trials. 4. Research to unlock the inventories of cord-blood banked worldwide. 	<p>NIHR BTRU in Stem cells and immunotherapies (Peggs):</p> <ol style="list-style-type: none"> i) define genetic profiles that predict GvHD risk ii) selectively remove the immune cells causing GvHD iii) genetic modification of immune cells to re-direct them to blood cancers iv) correct inherited blood disorders using gene therapy v) automate production processes. 	<p>Provision of T-cell-depleted and virus-specific products.</p> <p>Provision of mesenchymal stem cells for treating steroid-resistant chronic graft-versus host disease.</p> <p>Deployment of closed processes and isolator-based processing.</p> <p>Derivation of mesenchymal stem cells from umbilical cords.</p>
7. Tissue Engineering.	<ol style="list-style-type: none"> 1. Research that will lead to increased adoption of dCELL® Human Dermis. 	<p>Support the clinical evaluation of this product in the short-term (Subject to external funding application).</p>	<p>Development of new products subject to increased Tissue Services revenue.</p>
8. Behavioural Research.	<p>See Strategic Goal 5 for details of this new theme</p>		
9. Translational Data Science.	<p>See Strategic Goal 6 for details of this new theme</p>		



NHS Blood and Transplant

NHS Blood and Transplant (NHSBT) saves and improves lives by providing a safe, reliable and efficient supply of blood and associated services to the NHS in England and North Wales. We are the organ donor organisation for the UK and are responsible for matching and allocating donated organs. We rely on thousands of members of the public who voluntarily donate their blood, organs, tissues and stem cells.

For more information

Visit nhsbt.nhs.uk

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