

Application for formal Academic Health Science Centre status: Phase two — February 2009

Imperial College Healthcare NHS Trust was created on 1 October 2007, by merging Hammersmith Hospitals NHS Trust and St Mary's NHS Trust. The new Trust and Imperial College London formed a unique partnership and together they became the UK's first AHSC. On 9 March 2009 official recognition as an AHSC was received from the UK government. This document forms phase one of the application process.

1. Imperial College application for AHSC Designation: Vision and benefits

Our aim is to transform health outcomes in the UK and beyond through the creation of an integrated Academic Health Science Centre (AHSC) that harnesses the scientific innovation of Imperial College London with the unique delivery opportunities that arise from the National Health Service, as represented by Imperial College Healthcare NHS Trust, which delivers the best patient outcomes nationally by HSMR of any multispecialty provider, in the country's largest NHS Trust. Alongside the generation, testing, and deployment of new diagnostics and therapies, we seek to enhance the biomedical and healthcare workforce of the nation, through improved training of scientists and clinicians as the next generation of leaders in the field. Together, the above strategic objectives comprise the primary mission of the AHSC. The achievement of these activities will also help ensure a continued competitive position for the UK in the global biomedical and pharmaceutical industries.

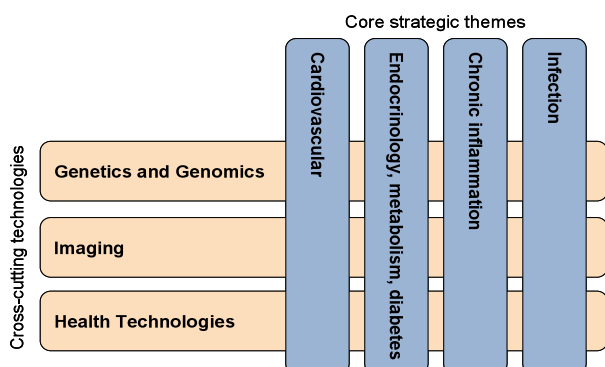
Our goal is to facilitate biomedical research and improve patient care by closing the two gaps in the translational research pathway identified by the Cooksey Review of UK Health Research. These gaps are the translation of basic and clinical research into ideas and products, and the translation of new medical knowledge and advances into everyday clinical practice. Our potential to address both gaps is illustrated by the large number of our staff recognised as leaders in their field by election as Fellows of the Academy of Medical Sciences (61) and NIHR Senior Investigators (13 of first 100).

While the first of these gaps will be bridged predominantly within our AHSC and NIHR Biomedical Research Centre (BRC), addressing the second gap will also require the innovative partnerships we have established with Primary Care Trusts (PCTs) and other local health partners. We have already established an NIHR Collaboration for Leadership in Applied Health Research and Care (CLAHRC) within north-west London to accelerate research into better care, which will be supported by developing a Health Innovation and Education Cluster (HIEC). Effective translation also requires research on the most reliable and effective methods of delivering healthcare to the patient. The NIHR Centre for Patient Safety and Service Quality at Imperial marries research on healthcare delivery with support for practical innovation in the delivery of care.

We believe the triple mission of the AHSC in clinical services, research and education is best served by creating an integrated system that joins the strategic and operational management of these missions in one organisation, though still accountable to two separate jurisdictions. The cornerstone of our strategy is the functional integration of Imperial College and Imperial College Healthcare NHS Trust, which in aggregate gives us the capabilities, scale, and institutional framework to achieve the rapid, safe and effective transmission of ideas from discovery science to application in a healthcare setting. The engine of that discovery is the College's multidisciplinary approach to biomedical research, where translational medicine interfaces with leading-edge biological, physical, mathematical and engineering sciences in a world-class science-based university.

The scale of patient flow through the Trust, with over 1,000,000 patient episodes a year, over 1,500 beds, and access to well characterised patient cohorts in a diversified population of around 3 million people, provides the ideal environment to translate our discoveries into clinical practice. Key to this second translational gap is the creation of a HIEC, to which we bring not only the largest acute Trust in England, but also the exceptional epidemiological and public health expertise of the College in the evaluation of the impact of fundamental health service change on population health outcomes.

Any centre with ambitions to compete globally must set its strategic targets with great care. We have identified four areas of unmet health need where we have the strength to compete at an international level, underpinned by three cross-cutting technologies in which we excel:



We set out below our strategic ambitions in these four core strategic themes, demonstrating where we expect our research to impact patient care over the next ten years. Our capabilities in the three cross-cutting technologies are set out within the text of the document, illustrated by selected case studies.

Strategic ambition 1: Cardiovascular: Heart failure

Cardiovascular disease accounts for around 40% of all deaths in the UK; heart failure is poorly treated with around half of patients dying within 5 years of diagnosis. Our ambition is to rescue the mechanical function of failing heart muscle through cell therapy, gene therapy, and novel inhibitors of cardiac muscle cell death.

Our focus on the cardiomyocyte in health and disease ranges from reductionist analyses of gene and protein function to the understanding of multi-molecular modules, networks and machines; and from the function of intact cells including failing human myocytes, to the integrative physiology of model organisms and clinical subjects. This strategy reflects Imperial's strengths in mouse genetics, stem cell biology, imaging, electrophysiology and complex trait genetics, uniting cardiovascular scientists with Imperial's Faculties of Engineering and Natural Sciences, and the MRC Clinical Sciences Centre, a Division of the Faculty of Medicine (see p.4).

Cardiovascular sciences at Imperial are led by Professor Michael Schneider. Our strengths were recently recognised and reinforced by the award of a £9 million British Heart Foundation (BHF) Centre of Research Excellence and BHF/Medical Research Council (MRC) funds for essential large-mammal facilities. We are home to six Leducq Foundation Transatlantic Networks of Excellence for Cardiovascular Research, more than the rest of the UK combined, and participate in diverse EU-wide consortia, including EURATools, the Engineering and Physical Sciences Research Council (EPSRC) Physiological Flow Network, HAEMODEL, MAIN HeartRepair, and CardioCell.

Strategic ambition 2: Endocrinology, metabolism, diabetes

Metabolic diseases are leading causes of morbidity and mortality in the UK. In particular, the current epidemic of obesity is leading to early death through diabetes, cardiovascular disease and an increased incidence of cancer. Our ambition is to translate our emerging understanding of the molecular, genetic, and epidemiological basis of metabolic disease into targeted interventional public health programmes, novel therapeutics and leading-edge surgical interventions for the prevention and treatment of diabetes and metabolic disease.

Professor Stephen Bloom has developed the gut hormone oxyntomodulin, which he first identified by sequencing the gene, as a novel therapy for obesity. Professor Philippe Froguel has defined genes and gene cassettes associated with the onset and progression of type 2 diabetes in carefully defined ethnic populations. Professor Chris Toumazou's group has developed a biologically inspired silicon beta cell, responsible for insulin secretion in the body, to serve as the main building block of an artificial pancreas. Professor Elio Riboli, through his leadership of the European Prospective Investigation of Cancer (EPIC), has identified strong links between obesity and cancer, and Professor Ara Darzi's health technologies team are developing new surgical interventions for the cure of certain types of diabetes. This work is to be brought together within the AHSC in a new Institute based at the Hammersmith campus.

Strategic ambition 3: Chronic Inflammation

Chronic inflammatory processes are common to a number of debilitating diseases. Rheumatoid arthritis, ankylosing spondylitis, Crohn's disease, ulcerative colitis, and psoriasis are common diseases, the prevalence of which will increase in line with an ageing population.

The development of anti-tumour necrosis factor therapy for rheumatoid arthritis at Imperial College's Kennedy Institute of Rheumatology led to Lasker awards for Professors Marc Feldmann and Sir Ravinder Maini, and transformed treatment guidelines for a wide spectrum of autoimmune diseases. However, whilst treatment with anti-TNF antibody or receptor fusion proteins is safe and effective, the cost is high (about £10,000 per year), leading to rationing. Reducing the cost of therapy, without reducing safety or efficacy, is a goal that would create significant health benefit for patients and financial benefit for the NHS.

Laboratory studies and animal models suggest there are effective approaches to block TNF production and signalling efficiently, such as phosphodiesterase type IV inhibitors, oxidised tryptophan derivatives (e.g. Tranilast) and Toll-like receptor (TLR) inhibitors. We aim to use the resources and scale of the AHSC to broaden the therapeutic base, and to bring the first two of these into clinical trials in the next 12 months.

Strategic ambition 4: Infection

Infectious diseases remain one of the greatest burdens on the NHS and one of the leading causes of morbidity and mortality in developing nations. The support from the Wellcome Trust for the Centre for Respiratory Infection (Professor Peter Openshaw) and from the BBSRC, MRC, Wellcome Trust and NIHR for our UK Clinical Research Consortium for healthcare acquired infections (Professor Jonathan Friedland/Dr. Alison Holmes) is creating a translational network at Imperial for infectious diseases, bringing together the 160 Principal Investigators leading infection-related research with specialists in the clinical care of patients with infectious diseases.

We have invested in extensive laboratory refurbishments and a state-of-the-art animal house designed for infectious disease research, including plans for a Cat3+ facility for work on H5N1 influenza, and are building a new facility for clinical research on respiratory infection. Imperial now has a range of powerful research tools to rapidly investigate the inflammatory pathways triggered by infections, including flow cytometry, genome expression profiling, proteomics and bioinformatic tools. These allow an integrated analysis of proteomic and genomic information to delineate inflammatory pathways involved in specific diseases, leading to new ways to prevent and treat infections. Not only are we uniquely well placed to innovate in the management of existing infections (e.g. HIV, TB, seasonal colds and flu), but are poised to respond to future outbreaks identified as major national threats (e.g. pandemic influenza, bioterrorism).

The first gap: from basic research through preclinical development to first in human trials

Imperial College's multidisciplinary basic research will underpin delivery of the AHSC objectives. The Faculty of Medicine has over 450 Principal Investigators, and an annual research income of £145 million, the largest competitively awarded research income of all UK medical schools, an increase of 50% in three years. The College returned 339 4*(world leading) and 3*(internationally excellent) staff in medical units of assessment in the 2008 RAE, the second highest in the UK. While the Faculty of Medicine provides the primary foundation for our translational research, innovation in the AHSC is also driven by our ability to access the outstanding non-medical scientific research in the Faculties of Natural Sciences and Engineering, and through our multidisciplinary Institutes.

The MRC Clinical Sciences Centre (CSC) is an MRC organisation, embedded in Imperial College as the Division of Clinical Sciences. It is one of three MRC institutes nationwide, with a turnover of £27 million per annum over and above the Faculty total of £202 million. The CSC brings world-class basic science into a clinical environment, and is uniquely well positioned to undertake translational research through its position at the heart of the Hammersmith campus. The CSC has unique expertise in biochemical, cell biological, genomic, physiological and *in vivo* imaging techniques, flow cytometry, transgenic and embryonic stem cell laboratories, high-throughput genomic research, and light microscopy/image analysis tools. It comprises 32 research groups in three sections of Epigenetics, Development and Cancer, Experimental and Clinical Neuroscience, and Genomic, Metabolic and Cardiovascular Medicine.

Cross-cutting themes 1: Genetics and Genomics

Professor Philippe Froguel has developed candidate gene and positional candidate gene approaches in both monogenic and polygenic type 2 diabetes and obesity, leading to the discovery of several genes for diabetes and obesity. He is one of the most cited scientists worldwide in the diabetes field (<http://www.esi-topics.com/diabetes/authors/b1a.html>), and published the first high density SNP Genome Wide Association study in a common disease in type 2 diabetes. Professor Tim Aitman's group at the MRC CSC has combined use of linkage analysis and microarray-based expression profiling to identify CD36 as an insulin resistance gene in rats and humans, and to define the genetic control points for thousands of genes across the genome in a rodent model of the metabolic syndrome. More recently, genetic studies of autoimmune glomerulonephritis showed that a new type of genomic sequence variation, gene copy number variation, is a cause of autoimmune glomerulonephritis in rats, in the common human disease systemic lupus erythematosus, and other human systemic autoimmune disorders.

The Institute of Biomedical Engineering, established with £22 million from the Science Research Investment Fund (SRIF), occupies 4,000m² of laboratory space. The laboratories include a biotechnology centre, with 'wet' and 'dry' labs that provide an innovative environment to integrate molecular biology, materials characterisation, cell culture and flow studies with circuits and electronics, imaging, sensors and robotic surgery, including a virtual operating theatre.

The Institute of Mathematical Sciences is a multidisciplinary enterprise that collaborates with medicine in fields including epigenetics, imaging interpretation, and epidemic modelling. A Maths-in-Cardiology initiative aligned with the BHF Centre of Research Excellence focuses on computational and simulation studies of current flow in normal and diseased hearts, to devise better predictors and therapies for cardiac arrhythmias. Recently they have undertaken complex analysis of electrical stimulation patterns arising in aberrant atrial myocyte activation that occurs in atrial fibrillation.

The Drug Discovery Centre is a novel College initiative that gives academics pharmaceutical industry expertise in assay development, high-throughput compound screening, pharmacology, medicinal chemistry, molecular modelling and project management, through to small molecule optimisation. Its current portfolio encompasses all of this proposal's core strategic themes.

The Institute for Systems and Synthetic Biology was one of the first such centres awarded by the Biotechnology and Biological Sciences Research Council (BBSRC). It seeks to determine how complex biological systems function by integrating experimentally derived information through computing and mathematical solutions, and to design biological tools, such as components for biological microprocessors that might be inserted into the body to monitor health or detect disease. It brings together groups in Bioinformatics, Genetics, and Biomolecular Medicine, including world-leading multivariate metabolic profiling (metabonomics and metabolomics: Professor Jeremy Nicholson) and the statistical integration of multi-omics data.

Our MRC and Wellcome Trust centres

- MRC Clinical Sciences Centre (see p.4)
 - MRC Centre of Outbreak Analysis and Modelling
 - MRC Centre for Environment and Health
 - MRC/Asthma UK Centre in Allergic Mechanisms of Asthma, with King's College, London
 - Wellcome Trust Centre for Clinical and Tropical Medicine
 - Wellcome Trust UK HIV vaccine consortium
- With other university partners, we are leaders in the Wellcome Trust initiatives 'Biological Atlas of Insulin Resistance' and 'Functional Genomic Analysis of Ageing'.

Together with our partners, we have access to the leading **imaging facilities** in Europe for pre-clinical studies. With the MRC and GlaxoSmithKline (GSK), we will shortly complete the only large animal imaging facility in the country to provide PET and 3-Tesla MRI imaging in large mammals. The £46 million GSK Clinical Imaging Centre is the largest purpose-built centre of its kind in Europe, with 2 MRI scanners, 2 PET-CT scanners, 2 cyclotrons, 12 hot cells, image analysis systems, hot and cold laboratories and clinical and patient areas.

This considerable imaging capability is strengthened further by the £26 million collaboration in PET imaging with the MRC and GE through the Hammersmith Imanet. The NIHR has also invested in PET and MRI facilities for our new Clinical Research Centre to be built from April 2009, which we intend to develop as a London Centre in partnership with the MRC, the Wellcome Trust, University College and King's College, London, including the Institute of Psychiatry. These physical facilities are matched by our investment in human capital; we have appointed Professor David Nutt, a leading figure in addiction research and PET Imaging, and have committed to new senior appointments and pre-clinical radiochemistry laboratories to secure this expertise for the UK.

Cross-cutting themes 2: Imaging (Cerebral Palsy)

Cerebral palsy is the commonest disabling condition of childhood and causes huge personal, social and economic costs. Professor David Edwards' group, recently strengthened by a £1 million MRC strategic appointment award, has pursued a sustained, collaborative, bench-to-bedside programme to reduce cerebral palsy. This has now shown that hypothermic neural rescue therapy applied after birth asphyxia reduces cerebral palsy, the first treatment to achieve this and proof of principle that neuroprotection is possible.

The group has created a therapeutic pipeline including laboratory, early and late phase trials, and to speed up the 'first gap in translation' has developed new imaging approaches: with £2.5 million funding from SRIF2 and MRC, a dedicated MRI suite has been established within the neonatal intensive care unit at Hammersmith Hospital, and novel imaging biomarkers qualified for assessing neuroprotective treatments developed. Following the success of hypothermia the group now has MRC funding to test two further neural rescue therapies developed by group members or elsewhere in Imperial College, using this unique imaging approach.

New capital investment: Over the past five years, we have transformed the Hammersmith campus. In addition to the GSK Clinical Imaging Centre, the new Burlington Danes facility now houses an expanded 3,000m² mouse vivarium housing 60,000 rodents. The recently expanded stem cell and immunotherapy GMP laboratory supports the 140 patients a year who have bone marrow transplants and the six programmes of stem cell interventions undertaken in the AHSC. Expansion of the GMP laboratory's capabilities through a recent MRC award permits the development of clinical protocols for processing-intensive cells that require weeks or months of production in culture. A new six-storey, £100 million facility housing 500 staff will comprise a cardiovascular sciences centre, an imaging unit (PET-CT and MRI), an MRC genomics centre, a renal and transplantation research centre, and a Wellcome Trust Clinical Research Facility for first-in-human studies with twenty units (twelve beds, eight recliners), three isolation units, five outpatient rooms and two clinical measurement rooms, which will provide additional capacity to our existing phase I capacity at the McMichael Centre, as set out below.

Clinical research and commercialisation

While the translation of our discoveries through animal models into phase I and II clinical trials begins with the facilities outlined above, it is the clinical infrastructure, both human and material, that is needed to translate this into diagnostics and therapeutics. We have established a **Directorate of Research** under Professor Jonathan Weber, which brings together College and NHS personnel in a single directorate. The Research Office acts as a one-stop shop for the management, governance, and contracting of trials that speeds the passage of research protocols into human studies. This administrative framework removes a historic bottleneck to translational research in an efficient and effective manner, and creates a unit of joint operation that can co-ordinate cross-cutting issues such as the development of information systems in the clinical environment that meet research needs. Furthermore, centralising our regulatory expertise will have particular benefits in cell therapy, gene therapy, and other circumstances where the regulatory burden is most complex.

The McMichael Centre for phase I and II trials consists of two wards: one with fifteen units (nine ward beds, two single rooms, one isolation unit for gene therapy, three recliners) and one with a dedicated day case facility with three outpatient rooms, three clinical measurement rooms and a wet lab. We have recently established an academically-led Clinical Trials Unit under Professor Deborah Ashby, to develop methodologies for innovative early phase clinical trials, particularly around the use of imaging and other novel biomarkers. Embedded in the Trust are six Clinical Research Facilities that are dedicated to later stage clinical investigation and clinical trials, in Neonatology, Rheumatology, Hepatology, Paediatrics, Cardiovascular Medicine and Infection. A new facility in Respiratory Infection will open in 2009. To further strengthen our capacity to facilitate translation, Imperial College will also work in partnership with the NHS to develop a Clinical Research Organisation, which will promote interaction with the pharmaceutical sector on drug development and carry out research on clinical trial methodology, statistical analysis and patient adherence.

Imperial Innovations plc, Imperial College's commercialisation arm, was the first majority university-owned technology transfer company to float on the UK stock market (market capitalisation: £187 million). In 2007/08, 354 inventions were disclosed, 55 patents filed, and 11 new companies formed, making a total of 89 enterprises created. Over 50% of its portfolio relates to biomedical and healthcare companies. Following a third round of fundraising in 2007, the group has the resources to identify, invest in, and incubate new spin-out companies (providing on-campus physical incubator space), thereby playing a crucial role not only in transforming discoveries into products but also in taking those products to application for the benefit of patients worldwide.

A commercialisation case study: Thiakis Ltd

In December 2008, Wyeth pharmaceuticals acquired Thiakis Limited, a company focused on the development of the peptide hormone oxyntomodulin, which inhibits appetite. Professor Stephen Bloom's group at Imperial College first showed in animals and then man that oxyntomodulin potently reduced appetite, and developed the spin-out company Thiakis Ltd with the aim of translating these findings into clinical practice for the treatment of obese patients. Imperial Innovations plc supported Thiakis from its foundation in 2004, through clinical development to its sale. In addition to the value realised from the sale (up to £100million), Imperial Innovations retains rights to royalties on sales of Thiakis' product family through its ongoing exclusive license to IP relating to the use of oxyntomodulin.

The second 'gap': dissemination and application in healthcare delivery

The benefit to patients of our research is illustrated by Imperial's contribution to over 25 recent NICE guidelines, and over 45 national and international standards, including the use of anti-TNF therapy in rheumatoid arthritis, management of hypertension and dyslipidaemia, and treatment of meningococcal disease in children. We believe an AHSC can achieve more such examples, safely and more rapidly. Our AHSC brings together England's largest NHS Trust with Imperial College under integrated management, thereby dissolving the institutional boundaries identified by the Cooksey Review as a critical factor in delaying the translation of discoveries into clinical practice.

Our patient outcomes are excellent, the best of 150 multispecialty NHS Trusts nationally, with an HSMR of 68.6 for the 12 months to November 2008, according to Dr Foster Intelligence. We are committed to delivering clinically-led, high-quality care, benchmarked internationally, that puts upward pressure on standards in London and the UK, and are equally committed to ensuring that patient satisfaction reaches a level commensurate with these outcomes, through the Trust-wide programme to improve patient experience set out in phase 1 of our application. We play a leadership role in ensuring patient benefit from the implementation of the Healthcare for London programme, including centralisation of complex care in specialist centres of expertise, such as our proposals to become a Hyper-acute Stroke Centre and one of four Major Trauma Centres, which have now been recommended by NHS London, subject to public consultation. Our Trauma centre proposal was agreed with a wide local network of providers, and we are working with our PCTs to change the pattern of healthcare to deliver more such integrated services in north-west London.

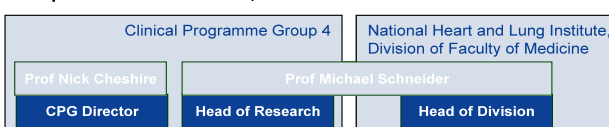
Application and dissemination of research into healthcare delivery beyond the immediate influence of the AHSC requires an even more innovative approach, which breaks down barriers between universities and community, primary, secondary and tertiary care. We have been at the forefront of this revolution, as the only organisation awarded a Comprehensive BRC, two Biomedical Research Units (BRUs), and a CLARHC. We are also developing a HIEC, and, in partnership with local providers, were recently awarded a £36 million contract to deliver a whole system Urgent Care response, including GP-led units alongside A&E at Hammersmith and Charing Cross, combined with seven days a week general practices based on these sites. Positioning these centres in our AHSC will enable innovative approaches such as bringing together preventative, primary, secondary and tertiary inputs into chronic disease management in one organisation.

The AHSC also offers an unparalleled opportunity for research and improvement of population health. We have created a new CPG, **Preventative and Interventional Public Health**, headed by Professor Elio Riboli. This group is addressing two critical areas that span universities, primary, and secondary care: firstly, the role of preventative medicine and public health education in achieving population health gain; and secondly, rigorous evaluation of the efficiency and effectiveness of new interventions of healthcare on the community. We will work closely with the **Business School**, which has recently invested in its health economics capability through the recruitment of Professor Peter Smith, to provide the NHS with robust information based on evaluated health interventions to drive changes in health care delivery that are cost effective, deliver better patient satisfaction and significantly improve public health and patient outcomes, the raison d'être of the AHSC.

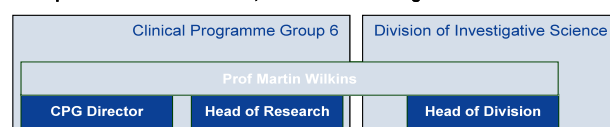
Dissemination and application within the AHSC: Clinical Programme Groups (CPGs)

Our AHSC is structured to optimise alignment of services, research and education priorities, encouraging daily communication between clinicians and researchers. The Trust's seven CPGs are devolved units for the management of patient care, designed to facilitate translational research by being largely matched to Divisions, the analogous structures in the Faculty of Medicine. We have chosen two systems of leadership for CPGs that best match the current requirements of the Trust and the College. In five of the CPGs, the Clinical Programme Director (CPD) leads clinical services, while the Head of Division (HoD) leads all matters of research. Each CPG also has an assigned Head of Education, who is a member of the academic staff of Imperial College. Together they are responsible for delivering the triple mission. In two CPGs we have elected to follow the model employed in the Netherlands and much of the USA, where the HoD is the same individual as the CPD. In all cases the principle is complete devolution of all professional responsibilities.

Example CPG Structure: CPG 4, Circulation Sciences and Renal Medicine



Example CPG Structure: CPG 6, Clinical and Investigative Sciences



These CPG structures, established since April 2008, bring a scientific voice to the management of clinical services and drive the identification and evaluation of new interventions that are effective and appropriate for everyday use in the NHS, and which can be implemented widely into practice. Researchers use feedback from the bedside to adapt and develop interventions to better meet clinical need, supported by the integrated management described in the governance section.

Education: The College is a leader in education of the medical and scientific workforce, in particular clinical academics, with a nationally leading 177 NIHR Academic Clinical Fellows and 59 Clinical Lecturers awarded in open competition from 2006-2008. We have 375 Masters students and 893 PhD researchers, an increase of 53% in four years. In addition to the 25 Wellcome Trust Clinical PhDs referenced in phase 1, the College hosts 12 new Clinical PhD Fellowships in Translational Medicine and Therapeutics funded by the Wellcome Trust and GSK. The Imperial Doctoral Training Centre at the Centre for Chemical Biology was also recently awarded £4 million for 50 new PhD posts over five years from the EPSRC, BBSRC, MRC, GlaxoSmithKline, AstraZeneca and Pfizer.

We have established a **Directorate of Education** under Professor Charles Pusey, who is also College Head of Postgraduate Medicine. A newly established Healthcare Education Board includes the Heads of Education (HoE) in each CPG, and Education Leads for each healthcare profession. The HoEs all hold academic appointments, and direct education for the healthcare workforce, while also providing links with the Divisions in the Faculty. A major initiative this year will be the foundation of a Postgraduate Health Science Academy for postgraduate and post-qualification education for all healthcare professionals, which will include CPD and research training for doctors, nurses and midwives, allied healthcare professionals, pharmacists, healthcare scientists and managers.

We receive over £30 million of NIHR funding to accelerate translation into clinical practice. In November 2006, we were awarded the largest NIHR Comprehensive **Biomedical Research Centre** (Director: Professor Pusey) in England, with funding of £20 million a year for five years. The award was made by an international designation panel in sixteen themes, demonstrating the breadth of our translational research capability¹. BRC funds support existing and new research projects, salary contributions to NIHR Investigators and direct costs of staff and consumables. It provides research expenses for NIHR Academic Trainees, and funds eight Clinical Research Training Fellowships with the MRC. £7 million capital will support the Wellcome Trust Clinical Research Facility cited above.

The £4.5 million NIHR **Imperial Centre for Patient Safety and Service Quality**, one of only two such centres nationwide, determines the information systems and practices needed to deliver safe healthcare, and includes evaluation of robotic surgery areas, such as pharmacy robots and the use of computerised systems for delivering safe prescribing. The centre is part of the Department of Biosurgery and Surgical Technology at the St. Mary's campus (Director: Professor Darzi) whose principal research aim is to improve patient care by leading innovative research into the assessment and delivery of quality and safety in surgery. A recent example of surgical safety research has been the development and evaluation of the WHO Safe Surgery Checklist.²

Cross-cutting themes 3: Health Technologies

Research led by Professor Darzi and Professor Yang in the Institute of Biomedical Engineering aims to substantially reduce surgical complications within five years. Work includes: *Simulation-Based Training*, perfecting technique on a realistic device with objective measurement of technical skill; *Pre-Operative Planning*, designing implants and manipulating the operative field in 3-D, to define the optimal approach for minimal tissue trauma and maximum surgical exposure; *Image-Guided Surgery*, to aid intra-operative decision making, especially for abnormal anatomy, infiltrating tumours and confined operative spaces; *Image Stabilisation*, for use during procedures on a moving target organ (e.g. the heart), providing a still image for greater accuracy; *Safe Zones*, visual, tactile or auditory restraint systems to prevent deviation of the surgeon from the field of interest; and *Non-Invasive Surgery*, to perform a 'scar-less' procedure through a natural orifice. The group has recently received £10 million to establish the Hamlyn Centre for Robotic Surgery and £2 million programmatic funding from the Wellcome Trust to develop the i-Snake robot, a flexible surgical device with integrated imaging and sensing capabilities.

¹ Themes awarded: Cardiovascular Disease, Endocrinology, Metabolism and Diabetes, Infection, Rheumatology, Imaging, Genetics and Genomics, Surgery and Surgery Technology, Respiratory Medicine, Hepatology and Gastroenterology, Cancer, Neuroscience, Renal Medicine and Transplantation, Child and Adolescent Medicine, Reproductive Medicine, Haematology and Public and International Health.

² A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population, *New England Journal of Medicine*, Jan 2009

Dissemination and application beyond the AHSC: regional, national and international

We fully recognise the need to disseminate our own and others' research into clinical practice in the regional and national community, and are committed to forming a **Health Innovation and Education Cluster (HIEC)** to achieve this. Our HIEC will be led from Primary Care by Westminster and Brent PCTs, and will also include our regional NHS partners at Chelsea and Westminster, the Royal Marsden, The Royal Brompton and Harefield, and North West London NHS Trusts/Foundation Trusts. We already work together to educate our 2,000 medical students who rotate through all of these centres bar the Royal Marsden. We will also continue to disseminate our discoveries and best practice through existing regional and national networks such as the Diabetes Research network (which we co-lead) the Medicines for Children Research Network (which we also co-lead), and the West London Cancer network.

Imperial College is also the academic partner in a **Collaboration for Leadership in Applied Health Research and Care (CLAHRC)** with Chelsea and Westminster NHS FT, with £20 million funding over 5 years, which researches service innovations in the community, particularly to improve care for acutely ill patients and patients with chronic diseases. Initial examples include a primary care-led project to develop case management of patients with chronic cardiovascular and respiratory diseases in the community, and a project to further develop and explore the use of care bundles to standardise treatment of patients with pneumonia and COPD. The CLAHRC is led by Professor Derek Bell of Imperial College, based at Chelsea and Westminster.

In addition to our Comprehensive BRC within the AHSC, the NIHR awarded us two **Biomedical Research Units (BRUs)** in cardiovascular and respiratory science in 2008 in partnership with the Royal Brompton and Harefield NHS Trust, worth up to £9 million in operational funding and £4 million in capital over four years. As one illustration of the resulting partnerships, newly created cardiovascular genetics clinics at these hospitals will be able to draw on the leading-edge capabilities for genome-wide association studies and next-generation sequencing based within the MRC CSC at Hammersmith. Imperial College and the Royal Brompton have a long and productive history of collaboration, as reflected by the 24 Imperial College Professors and their staff that work in the Trust. We will continue to deepen these links to reinforce our excellence in cardiovascular and respiratory services, research, and education.

We undertake considerable research in the field of cancer, and are seeking designation as a Cancer Research UK Centre, centred on physics, chemistry, engineering and surgical interventions, with focused areas of excellence such as imaging and certain aspects of cell biology. However, we do not achieve a level of excellence in cancer research or service commensurate with the highest global standards to which we aspire. A partnership of Imperial, **the Royal Marsden and Institute of Cancer Research** would create such an entity, and both organisations have indicated that they wish to construct a novel arrangement to cover cancer services, research, and education. A model already exists with the Imperial College Academic Surgical Unit, established at the Royal Marsden in 2007 by Professor Darzi.

As part of our commitment to international health, Imperial has established an **Institute for Global Health** (Director: Dr. Peter Piot), which will bring together multidisciplinary teams of researchers to tackle infectious diseases, such as AIDS, tuberculosis, malaria and neglected tropical diseases, as well as chronic diseases such as diabetes, cardiovascular diseases and cancer, which are emerging as major health problems in many developing countries, and across Asia and the Middle East. These diseases are also locally relevant to a centre serving a multicultural, mobile population in London. We have an established international presence through the Imperial College Diabetes Centre in Abu Dhabi, dedicated to prevention, treatment, training and research in all aspects of diabetes. We are working with the Qatar Foundation to develop a Biobank and Centre for Genomic Medicine, which, coupled with our research partnership with the Qatar robotic surgery centre, will consolidate our position in the region and support the translation of our research internationally.

We believe that an AHSC of international standing, with integrated governance, management and strategy, provides the optimal framework within which to achieve the benefits here outlined. Through uniting the academic and clinical excellence of the College and Trust, and leveraging our broader innovative partnerships, we will catalyse the development and application of new diagnostics, therapies and techniques to transform health outcomes locally, nationally and internationally.

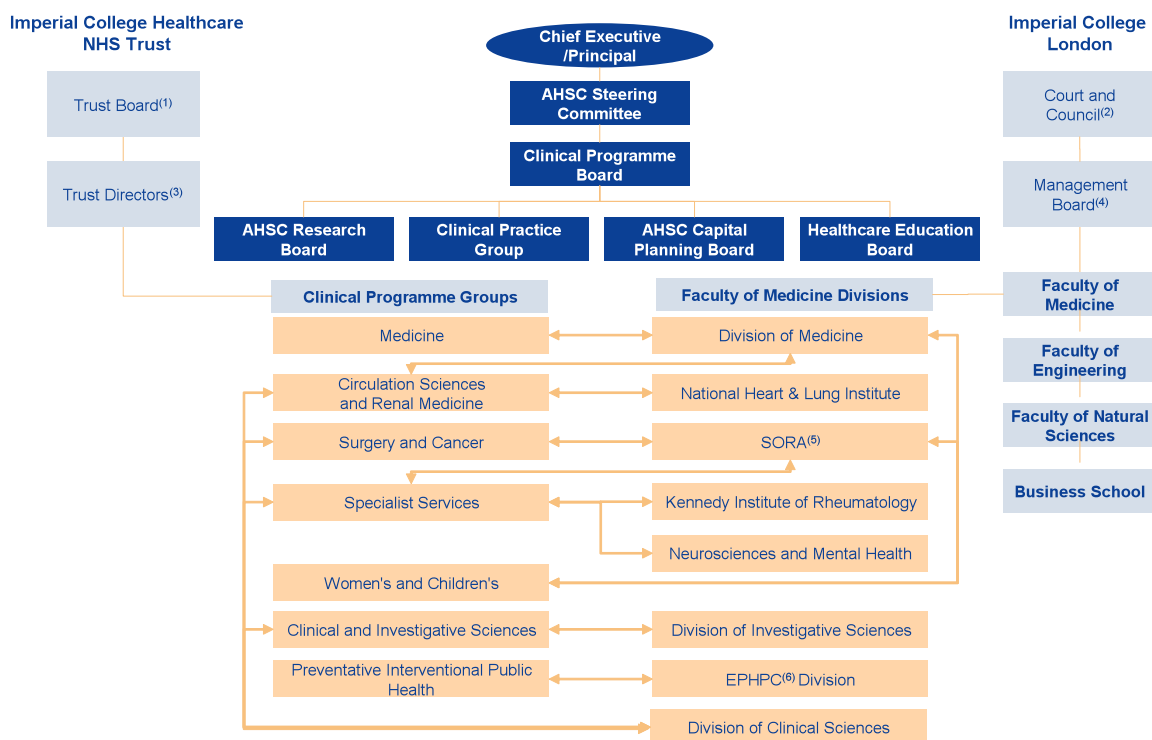
2. Proposed Governance Arrangements

Our governance arrangements seek to empower our leadership and enable the integration of services, research, and education at the level of delivery, while recognising the accountability of the Trust and College to their respective governing bodies. We believe the simplicity of our model, with one Trust and one University, and unified executive authority in the Chief Executive/Principal, gives us the best decision-making framework to deliver our vision.

Governance of Service, Research and Education

Authority for undertaking clinical services is given by the Secretary of State for Health through the Strategic Health Authority to the Chairman of the NHS Trust Board. The Chief Executive/Principal is responsible for management of these services and delegates this through the Managing Director of the Trust to seven CPG Directors. Authority for undertaking research and undergraduate medical education is given by the Council of Imperial College to the Rector, who delegates to Faculty Principals. In the Faculty of Medicine, the Chief Executive/Principal delegates that authority to seven Heads of Division. Integration of service and research is achieved through bipartite relationships in which service is governed by the Clinical Programme Director and research by the Heads of Division in five CPGs and by a single authority in the remaining two. Each CPG has a Head of Education responsible for integration of postgraduate healthcare education with the Divisions.

Since October 2007, we have developed joint posts and hold regular AHSC meetings at board, management, clinical and academic levels, which together deliver an integrated operational framework. A summary organisational structure of our AHSC is as follows:



- Key:
- Formal body of Imperial College Healthcare NHS Trust or Imperial College London
 - Joint body with College and Trust members created to progress AHSC development
 - Clinical Programme Group in Trust or Division of Faculty of Medicine in College

- (1) Rector of the University is a non-executive director on the Trust Board. College Secretary is a co-opted member
- (2) Chairman of the Trust Board attends as an observer
- (3) Deputy Principal of Faculty Of Medicine is a member of the Trust Directors
- (4) Managing Director of the Trust is a member of the College Management Board
- (5) Surgery, Oncology, Reproductive Biology and Anaesthetics
- (6) Epidemiology, Public Health, and Primary Care

The AHSC is characterised by joint working at every level of operation. Dedicated research and education time is allocated to selected NHS consultants for projects and activities; joint approvals are required and joint funding provided for the recruitment of key clinician scientists; and strategy for the development of new physical facilities for clinical service provision, clinical and translational research, and education are jointly agreed, with the ability to ensure that the location of clinical services is in alignment with this strategy.

Integration through elision of people and operations

Our appointments strategy since 2007 has sought to achieve the elision of our two organisations at all levels through integration of people and operations: the Chief Executive/Principal is the first pivotal figure, attending all management meetings, but a series of other positions provide support as well as checks and balances to executive authority throughout the organisation.

- Board level: the College Rector, Sir Roy Anderson, is a non-executive on the NHS Trust Board; the College Secretary, Dr Rodney Eastwood is a co-opted member of the Board; the Chairman of the Trust Board, Lord Christopher Tugendhat, attends the College Council.
- Executive level: the Managing Director of the Trust, Claire Perry, attends all Trust meetings and is a member of the College Management Board. The Deputy Principal of the Faculty of Medicine, Sir Anthony Newman-Taylor, attends the weekly Trust Directors meeting. The AHSC Steering Committee is comprised of the Chief Executive/Principal, Managing Director, College Secretary, Trust Chief Financial Officer, and College Chief Operating Officer, and meets twice monthly to ensure decisions are taken in the interest of the whole AHSC.
- Operational: CPG Directors and Heads of Division meet formally on a 1-to-1 basis each month, and attend each other's management boards, which also occur on a monthly basis. Heads of Division have a formal role in the CPGs as Head of Research, and each CPG also has a Head of Education who holds a university appointment.
- All CPG Directors, Heads of Division and executive team members meet together three times a month including at the Clinical Programme Board, which provides a formal mechanism for management of AHSC business, ensuring priorities are consistent and coherent on a cross-CPG/Divisional basis.
- The Director of Research, Professor Jonathan Weber, holds the position in both College and Trust; the Director of Education, Professor Charles Pusey, is also Head of Postgraduate Medicine at Imperial College.
- A joint capital group chaired by the Trust CFO meets monthly to ensure coherence in capital planning and has had significant success in developing projects and solving issues that had appeared intractable under previous arrangements.

How our structures support joint working and manage risk

We believe that the existing management structures of the College and Trust, combined with the institutional commitment and joint working arrangements outlined above, offer the best solution to ensure that any additional risk arising from the AHSC partnership is identified and resolved early. Risk and financial management remain the responsibility of the two entities and are managed through established College and Trust processes. For areas of joint operation, such as the AHSC Research Office, the parties have developed a relationship deed that defines a framework for how they will co-operate.

This relationship deed will be presented to the Board and Council at their next meetings in April and in May respectively. The relationship deed covers the objectives of the AHSC, the terms of the Chief Executive/Principal post, the establishment and operation of the Joint Research Office, a dispute escalation and resolution process, the handling of confidential information, data protection and freedom of information requests, liabilities and indemnities, use of the Imperial College trademark, Commercial and Intellectual Property arrangements, and termination. It is constructed so that agreements on how to manage future common activities can be appended without formality.

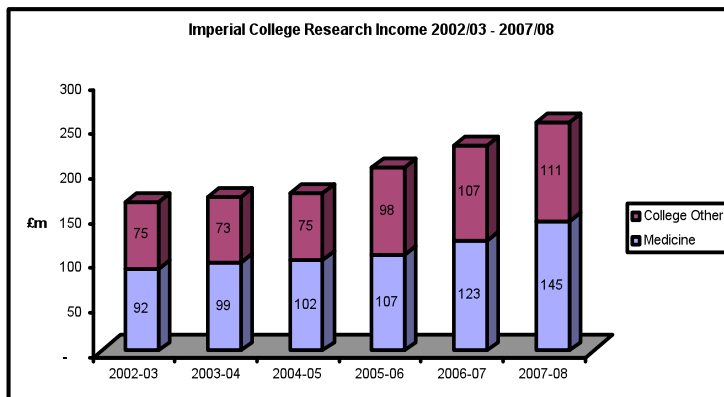
Future structures

Following the completion of the merger of its predecessor organisations, the Trust has now begun the process of applying to become an NHS Foundation Trust, with a target date for authorisation of autumn 2010. We are currently in negotiation with Monitor, the Foundation Trust regulator, to develop a constitution for our Foundation Trust that supports the integration of services, research and education, and balances the management of the College's risk with the need to maintain accountability to patients and the public. These discussions will seek to enable adequate representation for the College on the Board of Governors, and to develop an appointments process to key positions that reflects the commitment of the organisation to research and education, in addition to the usual Foundation Trust focus on clinical services.

3. Financial and operational sustainability

Financial performance and stability

Our constituent organisations have the financial scale and strength to underpin delivery of the vision.



In 2007/08 (year end 31 July) Imperial College London had an annual turnover of £603 million, and research income of £256 million, an increase of 53% over five years. The Faculty of Medicine had research income of £145 million in 2007/08, an increase of 57% from £92 million in 2002/03. In 2007/08, faculty sources of research income were 39% charity, 17% research councils, 14% government, and 29% EU and international.

The College has a strong cash position and operating model that has enabled substantial capital investment over the past 5 years. Since 2002/03, Imperial College London has completed and commissioned around £250 million of capital development at our medical campuses, through a major investment programme and collaborative working with major funders, such as the MRC, Wellcome Trust, Wolfson Foundation, and GSK. The College is rated as “not a higher risk” (the best rating) in the HEFCE risk ratings.

Imperial College Healthcare NHS Trust has an annual income of £838 million, and is the largest Trust in the UK by turnover. It posted a surplus of £13 million in 2007/08 and is forecasting a surplus of £12 million for 2008/09 (year end 31 March). We delivered in year savings of £37 million in 2007/08, and are on track to deliver a similar programme in this financial year. The Trust was rated ‘good’ for its use of resources in 2007/08 and has recently begun the application process for Foundation Trust status with the aim of being authorised before autumn 2010. It has a stable financial history, delivering surpluses in both years of its operation, and continuing to deliver over 1,000,000 patient episodes a year.

The Trust faces some specific financial challenges in future as a result of the standard NHS tariff system’s failure to recognise the inherent additional costs of providing research, education and complex care. Additionally, reform of NHS R&D funding will result in an estimated £27 million loss of income in 2009/10. As a result, we are undertaking a six-month service and site review programme which will aim to reduce the cost base of the Trust by up to 15%, and have recently appointed McKinsey & Company to support the delivery of this review. We are also working with NHS London and the Department of Health to address the immediate financial challenges posed by the withdrawal of transitional R&D funding.

The Trust has a long-term strategic ambition to renew certain elements of its estate that require modernisation. While the Trust currently has a total unused borrowing limit of in excess of £100 million available for strategic capital investment, the immediate priorities are to secure a sustainable surplus and achieve Foundation Trust status so that it can retain these surpluses for investment. Total capital investment in 2007/08 was £72 million, including a major scheme to upgrade critical care at St. Mary’s, and to deliver substantial investment in equipment including MRI and CT scanners, new catheter laboratories, pathology facilities and a birthing centre.

Financial strategy

The College and Trust are both pursuing a strategy of seeking to secure and improve margins on their core sources of income, while looking to diversify their sources of income in the medium-term, through seeking to increase the contributions achieved through philanthropy, private practice and international projects. We have set out above examples of the work of Imperial Innovations plc, which is the commercialisation arm for intellectual property developed within Imperial College. The Trust is currently developing an agreement that would nominate Innovations as its preferred commercialisation partner.

The College has a strong record of attracting charitable donations in medicine, such as funding provided in 2008 by the Hamlyn Trust and Lady Helen Hamlyn for the Centre for Robotic Surgery. Since May 2008 a new, independent charity trustee body has been managing the charitable funds of the Trust. Its assets amounted to £75 million in 2007/08. The charity trustees contributed £3 million in the year (from investment and voluntary income) including the purchase of devices such as a digital x-ray unit, ultrasound scanner and echocardiogram at St Mary's. Trustees also manage special purpose funds (around £11 million of the £75 million) from which a further £3 million was spent during the year on clinical care, research, staff and patients facilities across all sites. In previous years, £8 million had been contributed to the Burlington Danes project and a significant sum to the Hammersmith Hospital Conference Centre.

The Trust is home to the largest private practice within the UK (2008/09 income of £32 million), with leading private obstetrics services at Queen Charlotte's and Chelsea at Hammersmith and the Lindo Wing at St. Mary's. Current Foundation Trust legislation limits the opportunities to expand this within an NHS framework, although this remains under national debate. We are also exploring ways of working through the College to offer an expanded service that could meet the estimated £150 million market for private practice in London, and provide an additional income stream to support the primary AHSC mission. The partnership with the Trust and AHSC designation could also create further potential for the College's international expansion in the Middle East and elsewhere, creating more opportunities to deliver or advise on patient care in addition to research and education initiatives.

Financial impact of the creation of the AHSC

Sir Ian Kennedy's letter of 2 February requested information on the scale in financial terms of any new bodies or vehicles being created as part of the partnership. No new entity has been created in the formation of our partnership, and as such there are no corporate AHSC costs. While some additional posts and costs (e.g. advisory services) have been created, in aggregate as much or more has been released through the merger of two Trust Boards and the creation of the Chief Executive/Principal post. Additional costs have been shared between College and Trust with cost allocation negotiated through the AHSC Steering Committee. Likewise the one-off costs and expansion of the Research Office will be offset by increased research income and increased efficiency following the merger of formerly separate offices.

Operational sustainability and Board-level assurance

The Trust met all its operational targets in 2007/08, a performance all the more creditable in the context of having undertaken the largest organisational merger in the NHS. The Trust achieved all targets for A&E waiting times, 18-week waits from referral to non-urgent treatment, and infection prevention and control, and, as noted by the SHA's letter of support for our AHSC application, plays a key role in ensuring London as a whole meets its performance targets. The Healthcare Commission judged that the Trust had 'fully met' core standards and existing national targets, and was 'good' on new national targets. The College's operational sustainability is demonstrated through its continuing strong financial, research and educational performance, and its overall strength in RAE results over a sustained period.

Sir Ian Kennedy's letter also requested evidence of Board-level assurance that risks associated with development of our AHSC were clearly understood. The Board of Imperial College Healthcare NHS Trust and the Council of Imperial College London have reviewed and discussed the benefits and risks to the partner organisations. Their sustained involvement has dated from the original Joint Steering Committee founded in autumn 2006 (chaired by Lord Tugendhat, who later became Chairman of the merged Trust), their approval of our AHSC vision document in June³ and July 2008⁴, to ongoing scrutiny reinforced by shared membership of the Trust Board and College Council. The Trust Board and College Management Board also receive the Chief Executive/Principal's monthly executive report, which highlights strategy, finance and performance in the NHS and the Faculty of Medicine, and is a prime example of how integration of clinical services, research and education is an intrinsic element of everyday business in our organisation.

³ <http://www.imperial.nhs.uk/aboutus/ourorganisation/boardmeetings/index.htm>

⁴ <http://www3.imperial.ac.uk/secretariat/governance/committees/council/minutes>