



DEPARTMENT OF HEALTH & SOCIAL CARE DESIGNATED ACADEMIC HEALTH SCIENCE CENTRE (AHSC)

2018/19 ANNUAL REPORT

Note: Please note this form should be completed in font no smaller than 10-point Arial.

1. ACADEMIC HEALTH SCIENCE CENTRE DETAILS

Name of the Department of Health & Social Care Academic Health Science Centre:

Imperial College Academic Health Science Centre (AHSC)

Contact details of the DHSC AHSC lead to whom any queries and feedback on this Annual Report will be referred:

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2. OVERVIEW OF ACTIVITIES (no more than 4 pages)

Imperial College AHSC strategic progress

In 2017, a new strategy and vision was agreed reflecting the AHSC's expanded membership. In the 12 months from April 2018, the focus has been on starting to deliver on those aims by building capability in the disease areas of interest, progressing activities in the priority programmes and pursuing estate developments that support the vision of the Imperial College AHSC as an international powerhouse for the life sciences sector.

The AHSC has also progressed expansion of its membership, to include the Institute of Cancer Research (ICR) over the last year. The ICR has committed to signing the AHSC Joint Working Agreement and DHSC approval has been obtained. This development represents the first time in 170 years that all the research-intensive NHS and higher education institutions in the sector have agreed to align strategically around their research, education and patient care missions.

West London estate developments: An enduring feature of the Imperial College AHSC strategy is spatial adjacency and co-location of a critical mass of clinicians and scientists from healthcare, academia and industry. This allows development of fruitful, collaborative relationships that are vital for the iterative cycle of laboratory and clinical studies required for experimental medicine. Our 2013 application focussed on plans agreed by the founding AHSC partners, Imperial College London (Imperial) and Imperial College Healthcare NHS Trust (ICHT) for the Hammersmith Hospital/White City campus. Progress this year across West London and all partners is detailed below:

North: The White City Campus is near to completion with respect to 2013 ambitions. The iHub (see Contribution to Economic Growth section) opened in 2016 and the Molecular Sciences Research Hub in the autumn of 2018. The latter brings together Imperial Dept. of Chemistry with clinicians, engineers and business partners in a new state-of-the-art building. The Sir Michael Uren Biomedical Engineering Research Hub will open in autumn 2019 and provides multidisciplinary research space for biologists, clinicians, engineers and data scientists. During 2018, Imperial launched a £100m fundraising campaign to support the new School of Public Health building. Half of the funding has been secured and staff will relocate onto a single site at White City, for the first time, by 2023. At Hammersmith Hospital, Imperial announced its commitment to build a new cardiorespiratory research facility, adjacent to the Imperial Centre for Translational and Experimental Medicine, expanding the sector's experimental medicine research capability. Together with the £75m build for the MRC London Institute for Medical Sciences, the Hammersmith/White City campus will be the largest, single, biomedical research campus in London with a unique critical mass of scientists from the life sciences, engineering and public health sciences co-located with clinical services.

Central: The Royal Brompton & Harefield NHS Foundation Trust (RBH) began building works on a new state-of-the-art clinical imaging facility at its Sydney Street site in April 2019, adjacent to Imperial's National Heart & Lung Institute. ICHT and Chelsea & Westminster NHS Foundation Trust are integrating their children's services across the Chelsea and St Mary's site, with a planned implementation date of April 2020. The new "integrated children's hospital" for West London is a major development for children's services in the sector, having previously been hampered by organisational barriers for several decades. The new "integrated children's hospital" will focus on common diseases and will be accompanied by new academic investment by Imperial. AHSC workshops to establish an integrated clinical academic model from the outset are scheduled for the summer of 2019. A new paediatric clinical research facility at St Mary's Hospital opened in 2018 and this will be accompanied by additional research facilities at Chelsea & Westminster hospital in due course.

South: The Royal Marsden NHS Foundation Trust (RMH) has submitted plans for a new facility, the Oak Cancer Centre, at its Sutton site, with building work expected to begin by the end of the year. The new centre will allow research collaboration between ~300 scientists and clinicians and include a new Rapid Diagnostic Centre. The £70m build has already secured more than half of the funding required through philanthropic support including a £25m donation from the Oak Foundation. This development will be co-located with the planned London Cancer Hub, which is being led by ICR in partnership with Sutton Council and RMH. The new Hub will ultimately provide 280,000m² of space for cancer research, diagnosis, treatment education and industry collaboration.

Contribution to economic growth

Estate developments at Sutton and Hammersmith/White City specifically have, or will in the future, attract inward investment from industry. At Hammersmith/White City, the iHub provides incubator and office space for ~55 start-ups, spin-outs, tech companies and major corporations, with 30 percent of the resident companies in the life sciences sector. In the first 18 months of operation (to August 2018), the White City incubator created >100 jobs and attracted £85m of investment. In addition, Novartis announced that it was relocating all its UK activity to White City in December 2019 citing the clinical and multidisciplinary opportunities created by the new campus as a key factor in its decision.

The AHSC programme updates report on project-specific collaborations with industry. Major strategic

investments in-year include the Vaccine Manufacturing Innovation Centre (VMIC), a £66m award between Imperial, Oxford and the London School of Hygiene and Tropical Medicine. As well as providing national capability for vaccine manufacture in the event of a future pandemic, VMIC will allow small scale production facilitating academic and industry collaboration in vaccine development, design and manufacture. VMIC also secured funding from Janssen, MSD and GE Healthcare. In partnership with UCL and Eli Lilly, Imperial was awarded funding for innovative medicines manufacturing and awarded a Research England Med Tech Super Connector, working with eight other London research organisations.

AHSC Programmes

The AHSC partners are focussed on three areas for cross-organisational alignment i) six disease conditions where there is high disease burden and the partnership has critical mass in terms of academic expertise and clinical service provision, ii) education and training and iii) priority programmes in health informatics, clinical image analytics and prevention and early detection of cancer.

Progress in these areas is provided below. Of particular note is the AHSC's success in securing significant grant funding based on its convergence science approach to major health challenges and the strategic planning focussed on cardiovascular disease, respiratory medicine and cancer to ensure the sector maximises opportunities for collaboration ahead of the next NIHR Biomedical Research Centre (BRC) competition.

Health Informatics: 2017 objectives to develop infrastructure to automate data capture from routine electronic NHS data at each partner institution has been achieved through active participation by all partners in the NIHR Health Informatics Collaborative (NHIC) and on which all AHSC NHS partners are now engaged at NHIC Board level. Also achieved is the certification of multiple Imperial environments to host sensitive NHS data (ISO27001 certification). Currently, the partners are sharing experience of tools for free-text analysis with a view to maximising opportunities for collaboration going forward. In addition and following a positive outcome of initial scoping work, the partners will look to align their research consent processes for tissue, data and consent-to-contact in 2019, with ICHT leading through its implementation of the Imperial Knowledge Bank in July.

The AHSC partners have furthered plans to incorporate local primary care data for secondary analyses during 2018. The North West London Sustainability and Transformation Partnership's (STP) integrated care record (Whole Systems Integrated Care (WSIC)) brings together the health and social care information of all 2.3m patients in the sector, is available for clinical use across all providers and is a leading partner in the One London Local Health Research and Care Exemplar (LHRCE). All AHSC NHS partners have active WSIC projects to identify patient cohorts and evaluate service developments. Research ethics approval has been gained for access to de-identified WSIC data and, through Imperial College Health Partners (ICHP), WSIC is the IT platform on which a North West London registry of consented patients for future research studies (the DISCOVER programme) has been developed, providing North West London with the infrastructure for real world evidence studies and large scale clinical trials in primary care. To maximise the potential of WSIC and the DISCOVER programme, the AHSC convened a workshop in March 2019, attended by >70 clinicians and researchers. Since the AHSC workshop, clinicians from primary care, Imperial Clinical Trials Unit and DISCOVER are scoping projects with pharma to trial the sector's capability in real-world evidence observational studies in primary care and digital decision aids for general practitioners.

Coupled with the enhanced informatics infrastructure across the AHSC, Imperial has recently secured funding for an UKRI Centre for Doctoral Training (CDT) for Artificial Intelligence (AI) in Healthcare led by the Imperial Data Science Institute. The CDT will train 100 PhD students, including clinical fellows, in five cohorts. The AHSC is facilitating development of PhD project ideas for students by bringing together AHSC clinicians and Imperial AI experts.

The AI capability of the partnership was demonstrated in several key publications in 2018 (see also Digital clinical image analytics section); the "AI clinician", a new, Imperial-developed machine learning tool to aid clinical sepsis management was published in Nature Medicine (<https://hdl.handle.net/10044/1/61246>) and the first organisation-wide evaluation of a healthcare smartphone application (Streams) within the NHS was initiated at ICHT and funded by the HDR-UK Sprint Exemplar programme. ICHT also won the BMJ Digital Innovation Team of the Year 2019, for its work with Imperial researchers to develop an algorithm to analyze unstructured, free text responses from the NHS Family and Friends Test.

Digital clinical image analytics: The unified radiology platform for the North West London STP has been procured and will include a research archive to facilitate the partners' research programmes in AI and clinical radiology. In 2018, Imperial agreed a commercial collaborative partnership with Bayer using AI to develop new targets for cardiac disease based on imaging and genetic data. It also published a new machine learning tool to diagnose small vessel disease by CT in dementia and stroke to guide treatment (<https://doi.org/10.1148/radiol.2018171567>), new AI algorithms to predict outcomes and response to treatment from ovarian cancer using CT (<https://www.nature.com/articles/s41467-019-08718-9>) and quicker detection of faulty pacemaker devices by X-ray (<https://hdl.handle.net/10044/1/67610>) At RBH, clinicians were awarded an NIHR i4i grant to develop AI tools for microscopic diagnosis of primary ciliary dyskinesia.

To complement its digital capability in radiology, the AHSC NHS partners are exploring opportunities to

align pathology services through affordable service digitisation, supported by ICHP, which will also provide the sector infrastructure for digital pathology research and eventually data-driven integrated diagnostics. Imperial pump-primed digital pathology research projects in each NHS partner during 2018.

Cancer: This year, in partnership with ICR, Imperial was awarded a CRUK Major Centre (Darzi & Workman) to bring together the strengths of ICR in cancer biology and Imperial's critical mass in multidisciplinary discovery science to tackle major challenges in cancer research. The award builds on the Imperial/ICR Cancer Research Centre of Excellence and going forward, with ICR joining the AHSC, will accelerate translation of the partnership's exciting scientific discoveries and technology developments into clinical cancer research. To support the CRUK Major Centre, Imperial will build a physical hub for convergence cancer science at its South Kensington campus, with funds already committed from philanthropic sources.

The AHSC has established a group to review opportunities to align cancer research activities across the Imperial and RMH BRCs. It will report to the Joint Executive Group (JEG) in September.

RMH is leading on North Thames genetic cancer sequencing as part of the new Genomics hub and has been selected to be a NHS England CAR-T cell therapy centre. In addition, Imperial has attracted funding to establish a myeloma research centre, was awarded an Ovarian Cancer Action Research Centre and new funding from Prostate Cancer UK for three projects on reducing side effects of treatment and identifying new targets for advanced and metastatic disease. Imperial and RMH/ICR are also partners in the new CRUK National Cancer Imaging Translational Accelerator award.

AHSC Working Groups oversee activities to harness the multidisciplinary strengths of Imperial and NHS partner interests in the priority programme on Prevention and Early Detection of Cancer. Following development of protocols in 2018, cross-partner sub-studies on genetic signatures for colorectal cancer and exposomics and smoking cessation in lung cancer have been integrated in RM Partners' programmes in colorectal and lung cancer screening. A lung radiomics sub-study including all partners is also planned for later in 2019. Imperial has been awarded £4.5m from NIHR i4i programme (Kinross) to develop its iEndoscope technology for precision phenotyping of colonic adenomas and early colorectal cancer. The colorectal cancer AHSC Working Group has expanded its remit to cover early detection of all gastrointestinal tumours and identified opportunities for collaboration around the Imperial-developed breath test technology, which has been shown to detect distinct chemical signatures for oesophageal, gastric, pancreatic and colorectal cancer. In the secondary prevention of colorectal cancer, a feasibility study jointly between the School of Public Health and RMH dieticians to assess lifestyle interventions following a diagnosis of cancer will begin in autumn 2019, this building off a systematic review completed last year. Another early detection programme progressed in 2018 through CRUK funding to a multidisciplinary team of engineers and clinicians is the development of a microRNA platform for prostate cancer screening.

Cardiovascular disease: The Imperial BHF Centre of Excellence renewed successfully in 2018 with increased funding (Wilkins). In the next quinquennium, the Centre will focus on developing personalised treatments and healthcare management strategies drawing explicitly on interdisciplinary expertise at Imperial in engineering, AI, computing, imaging, genetics and genomics and population sciences. A multidisciplinary team of Imperial/RBH clinicians and physicists were awarded a BHF Programme grant to study the microstructure of the heart (Pennell) and ICHT secured funding from NHS England for a new endovascular hybrid theatre at St Mary's.

Cross-partner research collaborations continue to progress in pulmonary arterial hypertension, with new BRC funding across RBH, ICHT and Imperial to investigate MRI risk stratification in patients and a publication on the genetics of the disease and new drug targets ([https://doi.org/10.1016/S2213-2600\(18\)30409-0](https://doi.org/10.1016/S2213-2600(18)30409-0)). Similarly in cardiomyopathy, AHSC researchers demonstrated that alcohol use and titin mutations predispose to heart failure (<http://www.onlinejacc.org/content/71/20/2293>).

A cross-partner Working Group scoped opportunities for translational and multidisciplinary research across the AHSC during 2018 to inform planning for the next NIHR BRC competition. The AHSC-approved plans for developing the areas identified and progress will be monitored by the AHSC JEG.

Respiratory disease: Strategic development of the partnership's research programmes for the next BRC competition has also been reviewed in 2018-2019 and, as with cardiovascular medicine, the focus was on new opportunities to address unmet clinical needs by harnessing expertise in Imperial's non-medical Faculties and School of Public Health. Professor Edwin Chilvers was appointed as the new Head of the National Heart & Lung Institute in autumn 2018, strengthening the partnership's academic leadership in this speciality.

The partnership's cystic fibrosis research programmes were boosted in 2018-2019 with a new collaboration with Boehringer Ingelheim to develop a new viral vector-based gene therapy for clinical evaluations, building on the encouraging results of the UK Cystic Fibrosis Gene Therapy Consortium. The AHSC was also awarded a new Cystic Fibrosis Trust (CFT) Strategic Research Centre for its work on fungal disease, complementing the existing CFT centres on pseudomonas infection and the national patient registry. A study led by RBH clinicians showed that a new triple combination therapy in cystic fibrosis was more effective than placebo or dual combination therapy (NEJM DOI: 10.1056/NEJMoa1807119).

Other developments in-year include an EU Advanced Research Grant award for asthma pharmacology (Johnston), an NIHR EME clinical trial for paediatric severe asthma (Saglani) and an

EU202 grant on ventilation in critical care (Patel). Two pioneering treatments for respiratory disease led by RBH clinicians were also approved by NICE during 2018 - endobronchial tubes for COPD and bronchial thermoplasty for severe asthma.

Neurological and Neurodegenerative Disease: Imperial was awarded the UK Dementia Research Institute (DRI) Care Research and Technology Centre (CRT, Sharp) in 2018 building on Imperial's successful bid to be a DRI centre the previous year. Leveraging the multidisciplinary capability provided by the White City campus, the CRT Centre will develop patient-centred technology to help patients live better and longer in their own homes. The first UK centre for Psychedelics Research also opened at Imperial in April 2019.

In other neurological conditions, Dr Nir Grossman received the 2018 Science & PINS Prize for Neuromodulation for his research on non-invasive brain stimulation, which has a wide range of clinical applications. Imperial also secured funding from Biogen to undertake a real-world pharmacovigilance study in multiple sclerosis and an Imperial start-up, GyroGear secured Horizon 2020 funding to develop a new device to stabilise hand tremor in patients with Parkinson's disease. Building on the Imperial-developed GripAble technology, an AHSC team were awarded NIHR funding to develop a web-based multi-player videogame to improve outcomes for patients with physical and cognitive arm disability.

Metabolic medicine: A collaboration between ICHT clinicians, Waitrose and an Imperial start-up, DnaNudge (<https://www.dnanudge.com/>), begun a pilot study using an App, which uses a patient's genetic information to inform food shopping choices in people at risk of developing diabetes. Imperial researchers also secured EU Advanced Research Grant funding in 2018 (Ferrer) to understand the genetics of monogenic diabetes.

Infectious disease and antimicrobial resistance: In 2018-2019, Imperial secured £8.4m from the Coalition for Epidemic Preparedness Innovations to accelerate the development of vaccines for known and unknown pathogens using a sRNA vaccine platform. Imperial BRC also secured new NIHR capital investment for its infection/antimicrobial resistance theme.

Imperial and ICHT researchers, as partners in the CHERUB HIV collaboration and in collaboration with UCL Oxford and Cambridge, reported in Nature on only the second person in the world to achieve sustained remission from HIV-1. The patient's recovery follows a stem cell transplant at ICHT in 2016. The donor had a genetic mutation preventing expression of CCR5, an HIV-1 receptor (<https://www.nature.com/articles/s41586-019-1027-4>). Translational research led by Imperial BRC demonstrated that a digital early warning alert for sepsis increased early prescribing of antibiotics, reduced numbers of patients having an extended stay and reduced in-hospital mortality by a third. This work is now being extended to other BRCs.

Education & Clinical Academic Training: For its medical undergraduates, Imperial will launch a new curriculum in autumn 2019, which will have a stronger flipped classroom and blended learning focus. Already science rich, and one of only a few MBBS programmes that offers a BSc to all undergraduates, Imperial's research offering to medical students will be enhanced further through expansion of its MBBS-PhD programme. Imperial, in partnership with ICR, secured CRUK funding in 2018 for new MBBS-PhD students, which together with College funding streams will provide additional opportunities for undergraduates wanting to pursue a PhD during their medical school training. As part of the wider transformation of Imperial's postgraduate teaching programmes, the Faculty of Medicine is launching its first fully online Masters programme in 2019. The new Masters in Global Public Health will have 250 students per annum at steady state with hundreds able to access study modules.

The AHSC Education Committee oversees alignment of the partners' clinical academic training and support activities for medical and healthcare professional staff, with the support of the Imperial Clinical Academic Training Office (CATO, see website¹ for AHSC support provided). New for 2018 was the launch of the Imperial Healthcare Professionals Academic Group (HPAG) in the Faculty of Medicine. HPAG is the focal point for healthcare professional-led research in the university, providing a route for academic career progression at the university as well as in the partners NHS Trusts. The AHSC also developed a Clinical Skills Framework to accredit staff in core research skills and knowledge, facilitating the AHSC ethos and mission. It is applicable to all staff wanting to or currently engaged in clinical research, whether supporting the delivery of studies or pursuing an independent research career.

The AHSC re-ran its Leadership Development Programme with the Business School in 2018 following a successful inaugural programme in 2017. The AHSC Seminar Series also continues to flourish with an annual calendar of events across all NHS partners; the seminars are well attended (~60-80 attendees average) with increasing numbers of patients and members of the public.

Changes in leadership and governance arrangements

There has been no change to the governance arrangements for the Imperial College AHSC in year although work was completed in revising the Joint Working Agreement to allow ICR to join the partnership. In year leadership changes on the AHSC JEG and Strategic Partnership Boards have been as follows:

Imperial: Professor Jonathan Weber was appointed formally as the Dean of the Faculty of Medicine in April 2018, in addition to his ongoing role as AHSC Director. Mr Martin Lupton replaced Professor Desmond Johnston as Vice-Dean for Education.

ICHT: Professor Tim Orchard was appointed CEO and Professor Julian Redhead Medical Director in June 2018. Ms Paula Vennells was appointed Trust Board chair from 1st April 2019.
RMH: Mr Karl Munslow-Ong replaced Dr Liz Bishop as Chief Operating Officer in November 2018.