

Institution: University of Exeter

Unit of Assessment: 1

1.0 Unit context and structure, research and impact strategy:

UoA1 has achieved sustained and dynamic growth during the current REF cycle. Key achievements include:

- Almost 3-fold increase in research capacity from <25FTE in REF2014 to >69FTE.
- Tripling of PGR students from 33.5 to 99FTE, with 63 successful completions.
- More than doubling of research awards coupled with a 48% rise in research income per staff FTE
- £6M award from Research England to establish a Centre of Excellence in Diabetes

UoA1 is homed within the College of Medicine and Health (CMH), an entity which was established in 2018 and is the most rapidly expanding of the six constituent colleges of the University of Exeter (UoE; see **1.3, Institutional-Level Impact Statement (ILES)**). CMH was created by incorporation of the existing University of Exeter Medical School (UEMS; formed in 2012) with Medical Imaging (from the Department of Physics) and a newly formed Academy of Nursing. These were brought together to create a **world leading, impact driven, interdisciplinary centre of healthcare research and education operating in a mutually supportive and synergistic environment**. Our research programmes are underpinned by access to state-of-the-art facilities and a pool of highly talented staff. They are coordinated and administered via two College wide Institutes; Institute of Biomedical and Clinical Science (IBCS – total of 157.5FTE contracted research staff; Director - *Morgan*) and Institute of Health Research (IHR – 196.4FTE; Director - *Hulme*). The present submission covers staff homed in IBCS.

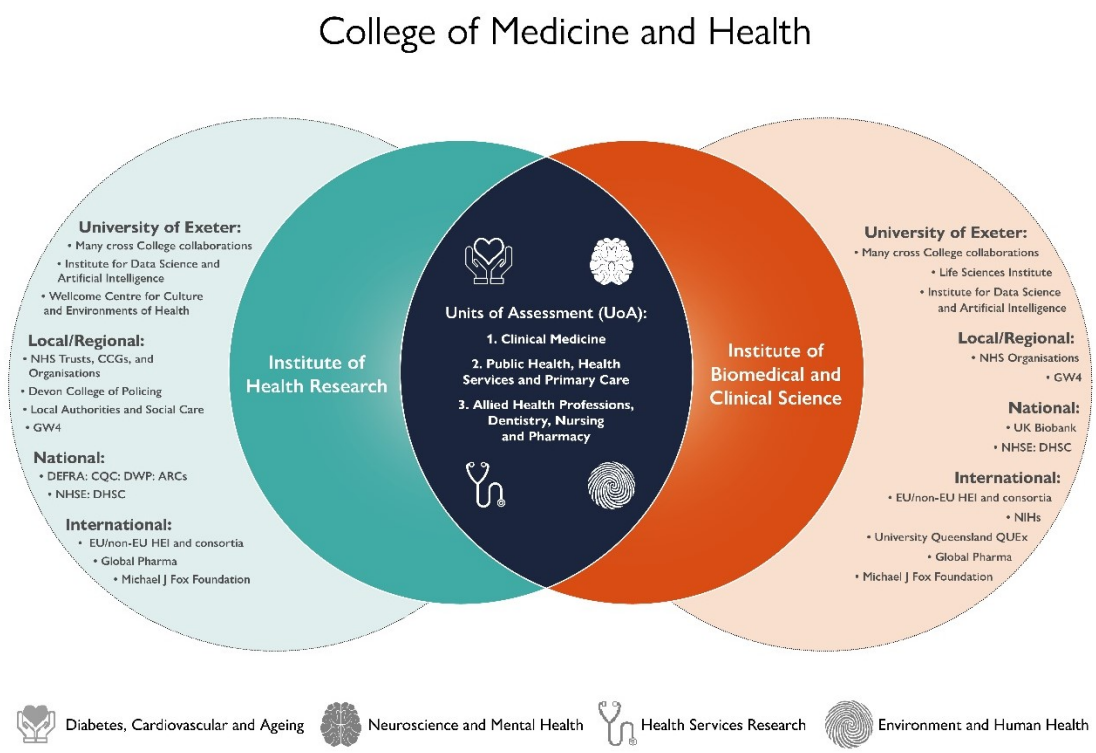


Figure 1: Structure of the University of Exeter CMH; links illustrative only

The over-arching mission of IBCS is to **pursue timely, innovative, impactful, inter-disciplinary research that will lead to disease prevention, improved therapies and sustained health**. We nurture a cohort of graduates and researchers who are critical thinkers, able to respond rapidly and with insight to meet emerging challenges and to achieve globally significant impact in innovative ways. We identify and address important clinical questions and aim to swiftly turn new discoveries into effective treatments and therapies.

Staff in IBCS are homed across five sites: Streatham Campus; St Luke's Campus; the Royal Devon and Exeter (RD&E) Hospital in Exeter; the Royal Cornwall Hospital, Truro and University of Exeter Campus at Penryn (see **1.2 ILES**). Experimental neuroscience is focussed largely at Streatham while other clinical and biomedical research takes place at St Luke's and on the nearby RD&E hospital site. Our work on antimicrobial resistance is based in Cornwall. The newly constructed rodent housing and surgical facilities are located in the state-of-the-art Living Systems Institute on the Streatham Campus and are adjacent to the University's newly expanded Aquatic Resource Centre, in which are housed our colonies of zebrafish. This distributed structure allows us to interact effectively with colleagues in allied disciplines and to respond swiftly and innovatively to emerging developments. This is exemplified by our responses to the COVID-19 crisis and to calls for novel multi-disciplinary solutions to alleviate metabolic comorbidities which are now of global significance.

Our research adopts an outward-facing stance to exploit fully the opportunities offered by interdisciplinarity. We collaborate with, and contribute to, the missions of other UoE Colleges (especially departments such as Sport and Health Sciences, Psychology, Biosciences, Physics and Engineering) as well as inter-disciplinary Research Institutes across the University. Seven PIs are embedded in the Living Systems Institute, four in the Environment & Sustainability Institute and our bioinformaticians are affiliated with the University's Institute of Data Science and Artificial Intelligence. We also collaborate extensively with local NHS Trusts, primary care and community services, social care, local authority, patient groups and public fora. We are principal investigator partners, together with the Universities of Bristol, Cardiff and Bath, in the Great Western Alliance (GW4) allowing us to compete effectively for resources and infrastructure nationally and to participate in multi-disciplinary initiatives within the region. Examples include an expansion of the cohorts available to us for studies of the aetiology of type 1 diabetes, a programme to improve the understanding of Alzheimer's disease and regional collaboration to drive forward our new clinical research programmes in MRI and PET-CT imaging. Thus, we ensure that **our research brings early benefit to the public in the South West, positively influences the health and wellbeing of the nation and exerts reach and influence across the world**.

We employ a truly multi-disciplinary approach to research and, in line with this, a number of colleagues homed within IBCS are returned in other UoAs. For example, staff working in the field of Environment and Human Health are returned in UoA7, while others are returned in UoAs 10 (Mathematics) and 11 (Computer Science). In addition, still others are returned, for the first time, in UoA3, following the establishment of our Academy of Nursing. More widely, CMH staff working in the arenas of public health, health services research and primary care research are returned in UoA2. Despite these strategic transfers, **the number returned in UoA1 has increased from 24.9 to ~70FTE (280%) since REF2014, reflecting our stated ambition to achieve early and substantial growth over the period**.

Given that CMH research spans from basic through clinical science to clinical trials and the implementation of change, the College aims to ensure that **the two internal research institutes, IBCS and IHR, work together on their core activities in an interdisciplinary manner**.

1.1 Research strategy:

During the REF period, IBCS research activity within UoA1 was focused around two principal themes:

- Diabetes, Cardiovascular Risk & Aging
- Neuroscience & Mental Health.

Our strategy has remained firmly aligned to the strategic aims articulated in our 2014 REF submission and is set out more fully below (section 1.3).

1.2. Achievement of strategic objectives since 2014:

At the time of the last REF in 2014, UEMS had emerged as a leading medical research institution with a steeply rising research income and a burgeoning international reputation. Nevertheless, because of our relative youth, we were small in size by comparison with other research-intensive medical schools. Therefore, a primary goal has been to expand our research base and we have achieved an unprecedented increase in staff since REF2014 (from 24.9 to 69.7FTE) and this growth continues. For example, in 2020, a new research theme was established covering “*Infection and Immunity*” to complement and expand existing activities. Immunology research has always featured within our core theme areas, but it has not previously achieved sufficient critical mass to progress independently. Two factors have now changed this situation. The first is the recruitment of new staff with strong expertise in Immunology to support the broadening of our diabetes base via the “E3: Expanding Excellence in England” £6M award supported by Research England. Allied to this, we are privileged to benefit from the transfer of the world-leading MRC Medical Mycology Unit to Exeter. The latter is a multi-disciplinary unit of global renown among whom are a core group (currently four PIs) with a firm clinical focus, homed within CMH. When coupled with our existing immunology expertise in respiratory pathophysiology and antimicrobial resistance, this has allowed us to consolidate immunology research to create a new theme area with a strong base and firm potential for continued expansion. Our plans, now, are to build on this in the immediate post-REF period as a means to stimulate innovative approaches to the study and treatment of disease in each of our core areas.

Across each research theme, our work is pursued to the **highest standards of scientific, scholarly and professional integrity (2.9 ILES)** conforming to University and health research ethical policy and frameworks. Support is provided via the University’s online Research Toolkit, CMH ethics committee and the University Integrity, Ethics, Animal Welfare and Research Governance processes. We actively promote an **open research culture** advocating open access principles in scholarly communication and actively managing (100%) ORCID registration. The University Open Research team (**2.8 ILES**) manage the institutional repository and research data services to provide open access to research datasets. Institutional subscription to major health research publishers (eg BioMed Central and Springer) has resulted in discounted or no cost open access publishing, accelerating the visibility and accessibility of our research globally.

1.2.1 Strategic overview:

UoE’s research strategy is designed to foster vitality and sustainability in health research, particularly STEMM (see **1.4 ILES**). During the rapid expansion of UoA1 we have maintained a clear focus on areas of strength and on the recruitment and career development of women, thereby enabling staff and their research to develop and flourish. In IBCS, there has been a doubling in research awards from £5.6M in 2013/14 to **£11.3M** in 19/20 supported by the continued enhancement of our infrastructure and facilities across all sites. Within UoA1, our total research spend during the REF period has exceeded **£51M** and our **income per staff FTE has risen by 48%**. In line with our strategy, we have:

- (i) **continued to build critical mass and world leading quality;**
- (ii) **worked with people and communities to benefit health;**
- (iii) **provided a supportive environment where researchers can reach their full potential.**

1.2.2 Build critical mass and world-leading quality:

Strategic appointments have been made across all of our target research fields to enhance our expertise and interdisciplinarity. As indicated, we have developed a new theme of “Infection and Immunity” and we have also targeted drug discovery as an area for focussed investment thereby enhancing our capacity to exploit both chemical and *in silico* approaches. We have sustained our success in retention and recruitment of outstanding independent research fellows and have succeeded in embedding a vibrant and productive research culture in which staff at all levels can thrive.

Establishment of the Exeter Centre for Excellence in Diabetes (EXCEED):

A notable success is the award of **£6M** from Research England (2019) as part of their “E3: Expanding Excellence in England” initiative to create the **Exeter Centre of Excellence in Diabetes (EXCEED)**. This was one of only 13 successful bids to Research England and was the sole national success in biomedicine. This award has allowed for a doubling of our critical mass in Diabetes, Cardiovascular Risk & Aging to 26 FTE at PI level. Candidates were appointed from an exceptional field of applicants to achieve the recruitment of 2 full Professors, 1 Associate Professor, 3 Senior Lecturers, 5 Lecturers and 4 independent Fellows, including colleagues from complementary disciplines such as Artificial Intelligence (*Vaughan*; returned in UoA11) and Bayesian Statistics (*McKinley* (returned in UoA10), *Owens*, *Bowden*), to create a world-leading centre of excellence.

Formation of a Centre of Excellence promoting the “3Rs” agenda:

A second Centre of Excellence was created in 2019, supported by a major award (initial investment of **£0.6M**) from Animal Free Research UK. This recognises a ground-breaking approach (pioneered by *Harries*) to explore the repurposing of existing drugs for new indications in totally humanised cell culture systems. This new Centre has been guaranteed ongoing support for an initial 9 year period and will train the next generation of researchers, empowering them to develop and exploit novel technologies to promote the “3Rs” agenda.

Recruitment of Gillings Professorships:

We have benefitted from receipt of the University’s largest ever philanthropic donation; **£10M** from the Gillings Foundation to appoint two internationally renowned research professors within IBCS (*Ryu & Thirlwell*) to broaden our portfolio in developmental neuroscience and neuroendocrine tumours. A third outstanding colleague, *Lamb* (returned in UoA2) was also recruited and subsequently appointed Associate Dean for Research in CMH. These appointments have enhanced our expertise in clinically applied research and in pre-clinical models and have also created champions to promote our ambition to ensure that women achieve their full potential in science and medicine.

Expansion of Clinical Trials Capacity:

Another milestone has been the establishment of the **Exeter Clinical Trials Unit**, to build capacity in clinical trials. The Unit is led by a newly recruited female Professorial Director, *Creanor*. Our activities across the clinical arena have also been facilitated by the formation of a Joint Research Office (**1.7 ILES**) bringing together CMH research with NHS-led activity at the RD&E hospital. Our capacity to deliver large scale clinical trials has been further facilitated by transfer of the **NIHR Research Design Service South West** (RDS SW) to Exeter in 2018. The RDS SW is supported by a five year grant from the NIHR (its third successive award) and is hosted by Royal Devon and Exeter NHS foundation Trust. The director, Professor Gordon Taylor, is based at the University of Exeter but the service strengthens our regional connectivity via hubs in Bournemouth, Bristol and Plymouth giving a total staff commitment of 15.8 FTE among 25 methodologists and support staff (all of whom are returned in other UoAs).

Enhanced capacity in Bioinformatics and Data Science:

Our key expertise in bioinformatics and data science has been recognised by membership of the Turing Network (in 2018) such that we are now one of 13 partners. We are proud to host 2 of the current 25 Alan Turing Institute Fellows within IBCS. These actively promote the application of

advanced computational methodologies in biomedicine to enhance our interdisciplinary capacity in data science.

Sustained vibrancy of our PhD programmes:

The University has established new collaborative exchange programmes with internationally excellent research-intensive institutions (**1.9 ILES**) and we have exploited these opportunities by developing research projects and appointing jointly supervised PhD candidates with institutions such as University of Queensland, Chinese University of Hong Kong, Duke University, Nanyang Technological University, Singapore and University of British Columbia. When combined with success in domestic initiatives, PGR student numbers have risen from 33.5FTE in 2014 to the current head count of 113 (99FTE) with **63 successful completions achieved during the REF period**. The expansion of our PGR activity has been underpinned by a series of additional notable successes. These include the award of a doctoral training centre by Alzheimer's Research UK, success in the regional MRC-funded GW4 DTP programme (**1.8 ILES**) Wellcome-funded GW4 Clinical Academic Training programme and BBSRC and NERC Funded DTP programmes, as well as the award of 13 studentships as part of the Research England "Expanding Excellence in England" initiative. As a means to cement and champion the vibrancy of our PhD programme we have actively promoted interdisciplinary research by the establishment of jointly supervised PhD projects where supervisors must be drawn from different academic disciplines. Currently **34 of our 113 PhD students (30%) have at least one supervisor from outside CMH and 25 (22%) have co-supervisors based in the NHS**. Two staff from IBCS (*Scotton & Richardson*) were appointed as Associate Directors of PGR in 2020 (in support of the College Director, *Morris*) to increase the first-hand support available to doctoral students within the institute.

1.2.3 Created New Research Facilities:

New Buildings:

In July 2014, we celebrated the opening of the **Wellcome Wolfson Medical Research Centre** (WWMRC) providing 3248m² of laboratory, teaching and clinical research space (within a total floor area of 7535m²) in collaboration with the RD&E Hospital. This has dramatically enhanced our laboratory capacity in biomedicine and provided new clinical research facilities. The facility was provided at a total cost **£27.5M** and was assisted by a contribution of **£4.75M** from a Wellcome Wolfson Biomedical Capital Award. It is widely recognised as a global centre of excellence and provides state of the art scientific and clinical research facilities as well as access to high performance computing and bioinformatics technologies. It also houses an expanded NIHR Exeter Clinical Research Facility (5-year renewal of NIHR infrastructure funding in 2017, **£5.27M**) comprising 3 x four bedded wards, exercise suite, research outpatient and individual intensive study rooms, as well as staff offices, seminar rooms and a new Postgraduate Education Centre.

To complement our studies of human disease we also opened (in 2016) **a new, state-of-the-art, rodent facility** (877m²) with animal holding capacity for ~4000 mice plus ~500 rats as well as surgical, procedure and behavioural suites for neuroscience and diabetes research. This facility is housed within the newly constructed Living Systems Institute on the Streatham Campus and has been extended further in 2020 to incorporate a new infection suite for the MRC Medical Mycology Group. Collectively, the LSI and its associated facilities represent a **£52M** investment and houses seven PIs from CMH in a world-leading interdisciplinary environment (**4.16 ILES**). This has been supplemented by the dramatic enlargement of the University of Exeter's **Aquatic Resource Centre** which now houses 3000 tanks for zebrafish research. A Gillings Professor, *Ryu*, and an appointee to EXCEED, *Yang*, lead teams who are actively employing zebrafish to model disease. Our Neuroscience laboratory and animal facilities in the University's Hatherly Building have also been increased from 730m² in 2014 to 1000m² to support the broader expansion in Neuroscience & Mental Health. This space provides electrophysiology laboratories, confocal microscopy, tissue culture, animal behaviour rooms, as well as staff offices and writing areas.

A further major strategic initiative has been the development and construction of the **Mirielle Gillings Neuroimaging Centre** (supported by the **£10M** donation noted above) in new, self-contained, premises immediately adjacent to the Wellcome-Wolfson Medical Research Centre

building, on the Royal Devon & Exeter Hospital site. An internationally renowned Director has been recruited (*Politis*) and the facility is equipped with a Biograph Vision 600 PET-CT scanner and Magnetom Prisma 3T MRI scanner to support diagnostic and research activities. This has enhanced our capacity in neuroimaging and offers new opportunities for in vivo monitoring of the progression of neurodegenerative and metabolic diseases in human subjects. The new PET-CT facilities also strengthen regional collaboration as they are included among the portfolio of instruments forming a GW4 facility coordinated centrally by Professor Chris Marshall (Cardiff).

We have redeveloped (in 2020) space on the St Luke's campus to provide 28 new places for Early Career Researchers (ECRs) and doctoral students, 3 double occupancy staff offices and an additional meeting room within a total area of 166m². CMH has also refurbished 3710m² of additional office space elsewhere on the St Luke's campus (opened in 2015) to accommodate health researchers and the Exeter CTU and NIHR SW Research Design Service. The latter has allowed current space, particularly in the building housing the WWMRC, to be better utilised thereby allowing increased expansion of IBCS activity.

New Equipment & Facilities:

An investment of ~£2M has allowed the acquisition of additional upright fluorescence, standard, wide-field and multi-photon confocal microscopes together with a state-of-the-art Vectra™ Polaris® fluorescence slide scanning system for immunopathology in the WWMRC. The latter is one of the few such instruments available in the UK and has transformed our capacity to exploit advances in digital pathology. We have also installed a 3rd generation Pacific Biosciences nucleic acid sequencing instrument and, with the aid of a multi-user equipment award from Wellcome Trust (£1.6M; led by *Mill*) a state-of-the-art Oxford Technologies Nanopore Promethion system to maintain our world-leading position in the molecular genetics of diabetes and neurodegenerative diseases. We also have access to the University's core cytometry facility offering advanced multi-parameter and quantitative imaging cytometry, single cell genomics and Luminex multiplexing systems.

An important objective has been to support the collection and analysis of large datasets by provision of state-of-the-art high performance computing infrastructure. This includes ring-fenced access to a 90 node cluster for biomedical-facing research plus an additional 275 nodes shared across the university. Two bespoke servers support specific work focused on genome sequences, clinical data for personalised medicine, CPRD database analyses and large-scale genetic association based analyses and image processing.

Most recently, CMH has contributed to the installation of a state-of-the-art multidisciplinary VSimulator, funded by EPSRC (£4.5M) and the University (£7.2M). This forms part of a new 1200m² research facility housed on Exeter Science Park. This facility comprises a 4x4m motion platform, virtual reality technology and motion capture and is used by academics and industry to support multi-disciplinary human factors research and innovation with a key theme on health and wellbeing.

1.2.4 Excelled in Research:

Five colleagues (*Frayling, Mill, Weedon, Bowden & Hattersley*) are currently placed among **the world's most cited scientists in biomedicine**, with *Hattersley* among the most cited scientists of all time (>85000 citations; <http://www.webometrics.info/en/hlargerthan100>). Our excellence has been recognised by the award of 28 highly competitive research Fellowships over the REF period (including Sir Henry Wellcome, Henry Dale, RD Lawrence, JDRF and MRC scientific and clinical awards). In addition, our early career researchers and PhD students have received more than 100 prizes and awards from national and international bodies.

We have capitalised on the award of £1.5M to the University from Wellcome Trust's Institutional Strategic Support Fund (ISSF) to develop new collaborative interdisciplinary projects. This has been achieved by recruitment of ISSF Fellows to work with colleagues in CMH for 6 month secondment periods. The awards are offered in open competition and promote discipline-breaking

approaches to problem solving. Examples include joint projects to develop the use of mathematical modelling to better understand immune cell infiltration in the pancreas in diabetes; methods for segmentation of images for digital pathology and the application of statistical approaches to the handling of patient data in biomedicine. We have also exploited the reverse opportunity by placing ECRs researching problems in biomedicine as seconded Fellows embedded within mathematics.

Flexibility in our research mission remains a critical core attribute as exemplified by the rapid response of staff to the COVID-19 pandemic. We loaned key equipment to support national initiatives (including PCR and tissue culture cabinets) and colleagues (including *McDonald*, *Ellard (UoA3)* and *Harries*) have developed novel, robust diagnostic resources and innovative RNA-based analyses to enhance the national testing programme. *Dennis* has won competitive external support to discover the factors leading to increased susceptibility of people with diabetes to COVID-19 (one of only two awards made by Diabetes UK) and *Hattersley* is leading Exeter's contribution to the nationwide, £20M, viral sequencing programme. *Warris* (with *Campbell*; UoA2) heads an arm of the international BRACE trial testing the efficacy of a BCG vaccine in COVID-19 patients, with support from the Gates Foundation.

1.3 Future strategic aims and goals:

Our aims over the period to 2025 are to strengthen our research culture, collaborations and partnerships, and our operational structures (see 2.1 ILES). We will:

1.3.1 continue to build critical mass and world leading quality:

Investment in people:

We will continue to build research volume and critical mass by additional strategic appointments, promotion of excellent staff and recruitment of "rising stars" holding international Fellowships to our junior faculty (with offers of full proleptic academic appointments). These developments will be supported by income from rising undergraduate student numbers, increased philanthropic activity and strategic investment.

Our objectives are underpinned by the desire to achieve the ever more **effective translation of personalised medicine approaches into clinical practice**. Within the theme of Diabetes, Cardiovascular Risk & Aging, this will involve, for example, implementation of approaches to improve the diagnosis of diabetes in primary care contexts (via the use of effective software-based technologies developed in Exeter (*Oram*, *Weedon*, *Shields*, *Hattersley*)); improvements in the efficacy of therapeutic interventions based on the description of aetiopathological endotypes of type 1 diabetes in children (*Morgan*, *Richardson*) and by the development, patenting and commercial exploitation of novel chemical structures capable of ameliorating disease complications (*Whiteman*). A particular focus is the exploitation of patented mitochondrial-targeted hydrogen sulphide generating small molecules (such as "AP39", invented in Exeter by *Whiteman*) which ameliorate primary mitochondrial diseases and have entered clinical trials to monitor safety and efficacy.

We are also engaged actively in a programme of sustained investment to **enhance the contribution to translational neuroscience in dementia research and drug discovery** as a means to complement our existing internationally-renowned strengths in neuroscience (involving world leaders in applied dementia research, such as *Killick* and *Ballard (UoA2)*). We have recruited research leaders who are working to promote industrial interactions (*Francis*), the development of small molecules targeted to ameliorate the progression of degenerative disease (*Cairns*) and the deployment of *in silico* modelling techniques (*Ulmschneider* (0.19 FTE) and *Khan*). Specific aims now, include the use of *postmortem* human brain to examine the relationship between synaptic markers and cognitive and behavioural symptoms and the provision of clinical and neuropathological insight for novel studies on the epigenetics of dementia, building on the established expertise of *Mill & Lunnon*.

Building on our discoveries in the developmental genetics of both diabetes and dementia, we plan additional strategic staff appointments in stem cell biology to facilitate the early clinical translation of our findings. Recruitment will be aligned with appointments in the Living Systems Institute following the arrival, in autumn 2019, of the new Director, Prof Austin Smith (previously Director of Cambridge Stem Cell Institute). In support of this objective, one of our ECRs, *de Franco*, has received a prestigious external Fellowship from Diabetes UK to develop stem cell expertise in house and will collaborate with a leading centre in Finland to transfer relevant technologies to Exeter. We have also appointed an outstanding candidate with a strong track record in stem cell biology, *Guo*, to the LSI (homed in CMH) who will embed stem cell research within our portfolio.

Our new “Infection and Immunity” theme will be enhanced by additional appointments and the cementing of strategic alliances with staff in the MRC Centre for Medical Mycology, which relocated from Aberdeen in 2019, four of whom (*Brown, Warris, Coelho, Cook*) are returned in UoA1. This will also draw in colleagues (*Gaze, Vos, Leonard, Murray (UoA7)*) from the European Centre for the Environment and Human Health who are leading authorities in antimicrobial resistance and will contribute fully to the vitality of this research theme.

Our sustained programme of growth is supported and complemented by a College-wide global strategy to facilitate researcher interactions overseas, enabling the recruitment of excellent international students and staff as a means to enhance research skills. Specialist support services and advice to underpin this are provided via our Research Development and Management and Research Finance teams and by the Innovation, Impact and Business team (**4.6 ILES**).

Investment in infrastructure:

CMH is developing a new capital infrastructure plan to support the provision of additional laboratory space to underpin sustained growth. In the short term, we are redeveloping laboratory space in the WWMRC to provide additional specialist tissue culture facilities for stem cell research (completion in Spring 2021). We will also continue our programme to refresh and enhance the infrastructure underpinning our high-performance computing and state-of-the-art nucleic acid sequencing facilities to sustain our world-leading capability.

1.3.2 Work with people and communities to benefit health:

An innovative and effective patient and public involvement (PPI) programme has been established via NIHR Exeter Clinical Research Facility (CRF) and the UKRI-funded Catalysts for Public Engagement (1 of only 8 in the UK). These have embedded public engagement with research in University policies, procedures and practices and PPI now forms a routine component of our research planning processes. Indeed, many of our research programmes are founded on patient-informed principles and we engage fully with relevant constituencies in developing our research agenda. These direct approaches are supplemented by close links to relevant charities who also champion PPI including, for example, Juvenile Diabetes Research Foundation International, Diabetes UK, Alzheimers Society, and the British Heart Foundation.

A great success has been the ambitious recruitment to our “**Exeter 10000**” cohort of community-dwelling, local volunteers (**2.7 ILES**) and we plan to expand this cohort still further to go beyond the initial target figure. These individuals comprise a rich research bioresource focussed around “research ready” volunteers who are consented for recruitment into clinical trials and more fundamental clinical studies. Their tissue samples and baseline research and health data are stored and available. Accessibility to this resource dramatically improves research efficiency and allows patient selection by genotype or phenotype. Championing of this approach has allowed us to embed the conduct of research within clinical care as a means to facilitate the rapid translation of discoveries to effect changes in care.

1.3.3 To provide a supportive environment where researchers can reach their full potential:

We strive to **instil a culture of ambition and success** across all categories of staff. We will further improve our mentorship, supervision and personalised development programmes for all staff, by active engagement in relevant human resource strategies. This will involve the implementation of changes to our current promotion procedures so that all staff are reviewed for promotion at least biannually. We are also developing a local action plan to promote our commitment to the Research Concordat for early career researchers. We will reinvigorate the provision of active mentoring of all staff seeking external 3-5 year competitive fellowship support and continue to offer generous “in kind” support (e.g. matched funding for equipment; PhD studentship) to promote their success, as well as guaranteeing a tenured academic post (proleptic) on completion of their fellowship (**3.8-3.13 ILES**).

The College has been actively developing a workload allocation model in accord with the principles articulated by the University (**3.4 ILES**) and is committed to the provision of dedicated time for those involved actively in the development of research impact. We promote the operation of networks for Early Career Researchers and Parent and Carers’ groups to enable peer support and to act as change agents within CMH. One part of this ambition is to maintain an **actively “family-friendly” culture** in line with the receipt of our Athena Swan Silver award to ensure that all staff have an appropriate work-life balance. We adopt a proactive stance to all EDI issues and pursue an absolute policy of non-tolerance with respect to any form of discrimination.

We contribute actively to the promotion of **a culture in which Responsible Metrics are championed** in considering all appointments, cases for promotion and personal development. To this end, we have nominated a CMH “responsible metrics champion” who engages with broader University initiatives and serves as a conduit to promote a change in philosophy and practice among CMH staff.

2.0 People

Our staff profile includes both clinical and non-clinical research staff and we aim to create an environment in which **staff at all levels and from all career pathways feel valued, thrive, and are rewarded for success**. Our growth has led to a substantial change in the UoA’s demographics, with a particular influx of early career researchers and a rising proportion of women. We are truly collegiate and are active in mentoring and internal peer review as a means to develop the careers of others.

2.1 Environment, Culture, Equality, Diversity & Inclusion:

UoA1 is committed to **equality of opportunity across all protected characteristics**. EDI training is mandatory for all staff; this is refreshed every two years and forms a core element of routine performance development review and probation. Appointment panels are actively managed to ensure gender balance and clear guidance is provided to panellists in respect of the use of language and panel documentation. Our College EDI Group has representation from all grades, including ECRs and PGR students. We have an active approach to EDI to drive out racism, bullying, harassment, and discrimination of any kind. The College has Speak Out Guardians, Dignity and Respect Advisors and sector leading parental leave arrangements, return to work policies and a staff wellbeing Employee Assistance Programme. All staff involved in reviewing REF outputs have undertaken compulsory training to mitigate bias in decision making & EDI is a mandatory element of researcher training and in agendas for all research meetings and committees. EDI issues were considered explicitly during output and impact case study selection to ensure a representative balance. Disability issues were taken fully into account to ensure ease of access and non-discrimination during the design of new buildings and when planning refurbishment of laboratory and/or office space.

We are proud of our **Athena SWAN Silver** departmental award (renewed in 2019), and our ambition is to apply for Gold status within the next REF cycle. Through the Athena Swan programme, the College developed a pilot mentoring programme for both mentors and mentees. This has recently been further developed into the One Step beyond programme (**see 3.6 ILES**).

The number of women at senior level within the College has risen markedly since 2014, with an increase in **women in the professoriate** from 22% to 37%. This follows the introduction of enhanced, tailored support and development for individuals as part of the promotions process, as well as a number of significant external appointments such as three Gillings Professorial Fellows. We have also improved our pipeline for the future, with **women accounting for 63% of all promotions to Associate Professor** in the same period. We have recently adopted the BMA Race Equality Charter as a core element of UOA/College activity. To ensure achievement of our ambitions in respect of race/ethnicity, we have appointed a Race Equality Resources Officer alongside our existing Senior Academic Lead for BAME Students, and a member of our faculty has been appointed as the University's inaugural Associate Academic Dean for Racial Equality and Inclusion.

Staff wellbeing (including the maintenance of good mental health) is an important aspect of College life and opportunities include on-site exercise facilities as well as access to wellbeing officers and 24/7 online wellbeing advisors through our Employee Assistance Programme. Staff at all levels are briefed fully on our annual employee engagement survey, with clear responsive action planning undertaken at College and Institute level.

The University has been committed to the Researcher Development Concordat since 2008, as demonstrated through our accreditation under the European HR Excellence in Research Award. We recently passed our eight-year review, and published our immediate Action Plan (**2.9, 3.8 ILES**). UoE is a signatory to DORA (San Francisco Declaration on Research Assessment), providing a framework and guiding research strategy and delivery in respect of recruitment, promotion and probation practices; best practice, governance and reporting processes; audit implications; communications and research metrics; (**2.8, 2.9 ILES**). DORA participation will provide and underpin future major research bids within this UoA. From 2020, we will align our procedures with the revised three 2019 Research Development Concordat principles and obligations: environment and culture, employment, and professional and career development.

The University and CMH engage in annual staff surveys to understand the needs and concerns of all colleagues and local development plans are actioned in response to issues raised. These have resulted in, for example, a change in the hours during which meetings are scheduled and the establishment of more frequent dissemination activities to ensure that colleagues have opportunity to input and respond to development proposals. The postgraduate student body is consulted as part of this process but also feeds back independently via the national PRES survey and by College-based liaison fora. Responses to such consultation are communicated both orally (at "all-staff" meetings) and via published action plans. The outcomes of additional surveys such as the Principal Investigators and Research Leaders Survey (PIRLS), and the Careers in Research Online Survey (CROS)) are also used to inform action planning at College level.

2.2 Research groups:

CMH does not have a traditional departmental structure but our staff operate across two Research Institutes and within interdisciplinary themes:

2.2.1 Diabetes, Cardiovascular Risk and Aging:

This theme spans basic science/methodology through experimental medicine to clinical trials, health research and policy change. In **UoA 1, 13 Professors** (3 clinical) (*Hattersley, Shore, Ellard (returned in UoA3) Harries, Morgan, Frayling, Winyard, Whiteman, Melzer, Thirlwell, Barroso, Bowden, Wright – three of whom (Harries, Whiteman & Wright) were promoted internally in the period; 8 Associate Professors* (Reader equivalent) (*Murray, Richardson, Weedon, Freathy,*

Ellacott, Oltean, Oram & Flanagan – all promoted or recruited in the period), **6 Senior Lecturers** (*Gilchrist, Shields* (returned in UoA3) *Whatmore, Kos, McKinley* (returned in UoA10) *Strain, Tyrell*), **9 Lecturers** (*Hope, Jackson, Laver, Owens, Russell, Rackham, Eichmann, Yang and Wood*) **2 Senior Research Fellows** (*Beall, Jones*), **35 postdoctoral researchers** currently align to this theme. These staff are highly collaborative and their research spans fundamental cell and molecular biology, physiology, pre-clinical disease models, genetics, human (patho)physiology and clinical medicine.

This theme has been enhanced by the creation of a Centre of Excellence in Diabetes (EXCEED) which is now staffed to the initial target capacity after a highly successful, fully competitive, recruitment programme in 2019. This has achieved a broad interdisciplinary profile covering statistics, bioinformatics, artificial intelligence, cell biology, immunology, genetics and clinical medicine. It has also allowed the appointment of a full complement of newly funded, high quality, PhD students (13 in total) who work as a cohort in collaboration with doctoral students supported by other funding agencies.

2.2.2 Neuroscience and Mental Health:

Neuroscience research (which includes the study of stress and depression as well as neurodegenerative diseases and aspects of cellular and molecular neurobiology) has been developed and expanded during the REF period by strategic appointments at senior (*Killick, Ryu, Francis, Cairns, Politis*) and more junior (*Oguru-Ando, Belle, Craig, Housden, Migdalska-Richards, Mosienko, Witton, Zhang*) levels. *Lunnon* was promoted (initially to Associate then to full Professor) during this period. Collectively, this raises the academic staff numbers in neuroscience research from a minimal foundation (in 2012) to its present **45.3FTE**.

Work within this theme includes drug discovery (exemplified by funding from industry; e.g. £2.5M from City Electrical Factors) for identification of promising targets to enhance the clearance of neurotoxic protein aggregates in neurodegenerative disorders such as Alzheimer's and Parkinson's disease. Funding from the Michael J Fox foundation (**\$1.2M**) underpins research to explore early biological signatures in Parkinson's disease and the underlying genetic aetiology. A research partnership has also been established with UCB Pharma to undertake phase 1 and phase 2 clinical trials of monoclonal antibody therapies in subjects with progressive supranuclear palsy. Colleagues with this theme are also now part of an Alzheimer's Centre of Excellence (**£1.8M**) which interfaces with the work of *Ballard* who employs exciting new approaches to understand and improve brain health in older adults.

During the REF period, staff in neuroscience have raised **£11M** in external funding including major awards from Medical Research Council (MRC), the Royal Society, the National Institutes of Health (NIH), Autism Speaks, the Biotechnology and Biological Sciences Research Council (BBSRC), the Economic & Social Research Council (ESRC), the Brain & Behaviour Research Foundation, the British Medical Association, the National Institute of Health Research (NIHR), the American Asthma Foundation, the Alzheimer's Society and Autism Speaks. Recent success includes a £1.6M MRC Clinical Research Infrastructure award to fund single-molecule real-time (SMRT) sequencing capability.

2.2.3 Infection and Immunity:

The development of this theme has been catalysed by newly appointed chairs *Brown* and *Warris*, with recruitment of *Cook* (proleptic appointment; awarded a Wellcome Trust Sir Henry Dale Fellowship - **£1.1M** - with effect from early 2020) and *Coelho* at Lecturer level. *Scotton* (Senior lecturer) and *Mitchelmore* (Clinical Lecturer) have joined, bringing expertise in pulmonary immunology associated with lung infection and fibrosis. The group is cross-fertilised by input from, and into, our research activity in type 1 diabetes (*Morgan, Richardson, Oram, Jones and Hattersley*) where immune dysfunction is paramount. Joint PhD studentship support is promoted actively; as an example, the study of fungal disease in diabetes serves as the latest topic area (student appointed in autumn 2020 with *Cook, Richardson* and *Morgan* as supervisors).

The Medical Mycology Unit (*Brown, Warris, Coleho, Cook*) aims to reverse the devastating effects of fungal infections which currently cause more than 1.5 million deaths annually worldwide, not least in children. Staff have ambitious plans to expand internationally by facilitating a network of new research activity in low- and middle-income countries which suffer from the greatest burden of fungal-related diseases. A satellite unit is already established in Cape Town, South Africa, to serve as a research and training hub for the whole of Africa. In future, the group aim to open similar hubs in South America and Asia. Their work will synergise with our well-established, world-class, research into the mechanisms of anti-microbial resistance (led by Gaze) within the interdisciplinary European Centre for the Environment and Human Health (returned in UoA7). It also encompasses clinical trials in rare lung diseases (e.g. cystic fibrosis) and capitalises on our existing pre-clinical and clinical expertise in pulmonary disease (*Scotton, Mitchelmore*).

2.3 Employment:

The CMH human resources group adopt Concordat—working in setting of policy and practice for staff recruitment and development so that our recruitment, progression and promotions procedures are open, transparent and merit based. Managers undertake mandatory people management courses provided through the University's people development programme to ensure excellent people management (including annual appraisals and duty of care). We are conscious of the difficulties faced by researchers on fixed term contracts and have launched our FEFA (Fair Employment for ALL) promoting permanent over fixed term contracts; (**3.1 ILES**). For those coming to the end of their contracts, we have a policy that ensures they are offered an interview for any upcoming research vacancies, and recruitment policies that ensure income preservation through early career research appointments.

2.4 Professional and Career Development:

Our staff are our greatest asset and we seek to promote a culture of reward and recognition where success and career advancement follow as a natural outcome of the professional development of talented colleagues. Staff development is at the centre of our activities and aligns fully with Exeter's institutional policies including the 'Exeter Academic' Framework and the Academic Professional Programme (**3.3;3.5 ILES**). Staff are allocated a senior line manager to support career development, and we operate a robust annual ePersonal Development Review process, which involves target setting and identification of further training or learning opportunities to support career progression and promotion. In addition, we offer a process of externally supported 360 degree review for senior colleagues.

We pride ourselves that our academic staff and early career researchers are enabled to achieve their best, as evidenced by the number of promotions in the period and by the multiple national and international awards received. We provide close supervision and mentorship, actively encourage collaboration and deploy a development budget to ensure colleagues acquire skills, visit other laboratories and exploit external development opportunities. Career advice is given at all academic stages and funds are made available internally to support travel to national and international meetings as well as external collaborations, following setting of objectives during the PDR process.

Our mentoring system is well-developed with all early career researchers and newly appointed Lecturers offered mentorship advice by more senior colleagues drawn from across the College, who undergo mandatory training to fulfil their roles. Mentors are allocated without reference to specific disciplinary boundaries to ensure that engagement in the mentoring process yields advice, career support and the development of life-skills using a broad-based approach. Mentorship lies outside the Performance Development Review (PDR) process although career advice, promotion options and the uptake of wider collegial roles are considered at PDR.

Those at early stages of their career participate in the researcher development programme (a series of University-wide courses focussing on translational skills and developmental opportunities (**3.8 ILES**)) including exposure to non-academic career options and a realistic self-appraisal. IBCS

benefits from a vibrant, well led Early Career Researcher group who provide regular input to institute meetings, raise awareness of opportunities and training, and facilitate collaborative problem solving. ECRs also feed into Liaison Forums, through which they have formal strategic representation across the University. An annual IBCS-funded annual residential conference for all PIs and Early Career Researchers (held at a location outside Exeter) provides an ideal opportunity for integration, development review and aspirational goal setting among junior colleagues.

Early career researchers (ECRs) and research students can apply for funds for Researcher-led Initiatives to develop and deliver transferable skills training such as 'The Bees Knees' – where PGRs facilitate Data and Discourse Bees to share and problem solve qualitative analysis issues. A recent (March 2020) example is a hands-on course in the widely applied (but frequently misused) technique of Western Blotting, which was led by a postdoctoral colleague, *Dhaya*, with external commercial expert support. Early career staff and students are encouraged and supported to develop their academic skill set through involvement in college ethics committee or working group membership, Masters supervision and undergraduate teaching and small group facilitation.

A mid-career group for Senior Lecturers/Senior Research Fellows, Associate Professors and Professional Services staff was established in 2018 with funding from the college's Equality and Diversity group. This has enabled an external facilitator to run Action Learning Sets which have continued as self-facilitated groups upon completion of the original programme. In addition, junior staff have the opportunity to participate in a programme of expert life-coaching delivered on a one-to-one basis by an external consultant.

The Institute Director holds a budget for staff development and staff of all grades have opportunities to develop their skill set by being involved in teaching, outreach, public engagement and both CMH and University committees. Examples of PDRA involvement include first year tutors to undergraduate medical students, small group and laboratory class facilitation for BSc Medical Sciences; membership of the Athena Swan working group, participation in schools outreach programmes (developed in-house), Soapbox Science, Sidmouth Science Festival and Pint of Science. During the REF period, we have supported 9 female colleagues, including 3 early career researchers, to undertake Advance HE's Aurora leadership training as a means of career enhancement and personal development. This programme is designed to address the under-representation of women in leadership positions in the HE sector.

2.5 Building research reputation:

Staff, including PDRA's, are encouraged to develop research ideas through critical reading, mentorship, discussion and regular seminar series or in bespoke learning opportunities (e.g. covering evidence-based medicine, statistics, study design). PDRA's are encouraged to lead applications for small grants from local and national sources to begin to establish their research credentials independently and, increasingly, they are encouraged to become Researcher-PIs on UKRI grant applications alongside more senior colleagues. Writing of papers is expected, with training given (including external courses) and authorship determined according to contribution.

Where sufficient potential is identified, junior colleagues are mentored to apply successfully for fellowships with funding underwritten to support excellent staff and to provide longer-term security of employment. When appointed to a Lectureship or Senior Lectureship, start-up funds enable pilot data collection and purchase of essential equipment. Larger items of equipment and relevant platform technologies are shared between groups, providing access to state-of-the-art instrumentation for all (service contracts are supported from College resources) and additional opportunities for networking.

To develop grant writing skills, we convene learning and development courses, mentorship is provided and peer review given by the Institute Director and senior research staff. Annual competitions are held for places at a 3-day residential research school with the NIHR Research Design Services, to receive intensive feedback on grant applications. Opportunities are also offered to attend a 2-day annual *off-campus* writing retreat to enable staff to work on grant proposals and papers. Networking is also encouraged actively via regular local interdisciplinary

workshops (e.g. between colleagues in IBCS and Living Systems Institute, each attracting 30-50 delegates).

Access to Seed Corn funding is offered via Wellcome Trust & MRC support to the central university and has resulted in Confidence in Concept awards and MRC cross-disciplinary skills training Fellowships (e.g. *Thomas, Wedgwood*).

Examples of our success in nurturing the careers of staff within the UoA include:

- >2,500 impactful papers have been published by IBCS researchers since 2014 and these have been cited > 50,000 times.
- 15 external competitive fellowships are currently held by early career staff, amounting to **£5.2M** of research income. Exeter holds the largest number of current Diabetes UK fellowships (4) and three of our scientists hold the leading UK Diabetes early career fellowship – RD Lawrence fellowship (*Beall 2015, Yaghootkar 2017, de Franco 2019*)
- *Oram* holds a Harry Keen Intermediate fellowship; *Richardson* held a USA Juvenile Diabetes Research Foundation 5yr Career Development Fellowship (ended in 2019) one of only 3 awarded in the UK since 2003.
- *Jones* and *McDonald* have highly competitive NIHR 5yr senior clinical fellowships. *Freathy* has a Wellcome Trust Senior Fellowship, *Flanagan & Cook* hold Wellcome Sir Henry Dale fellowships, *Weightman-Potter* a JDRF Junior Postdoctoral Fellowship and *Patel* a Wellcome Trust Intermediate Clinical fellowship.

2.6 Education:

All staff have the opportunity to contribute to the College's education portfolio via leadership of small group sessions, placements, project supervision, skills training workshops, practical classes, lectures etc, as appropriate. All Lecturer level staff complete the postgraduate certificate of academic practice which is recognised by HEA at fellowship level. Staff who undertake teaching and research have dual line managers to ensure a balanced workload and to enable flexibility when dedicated research time is needed (e.g. when a major grant application is in preparation).

2.7 Postgraduate students:

Doctoral students are critical to the vibrancy and success of a strong research community, and we emphasise the recruitment, education, support and development of our PhD students (**3.9-3.13 ILES**). As indicated earlier (section 2.1) we pay careful heed to the voice of our PGR community, which forms an important component of the cultural ethos of the Unit, As a result, we seek to respond actively to issues raised via both national surveys (e.g. PRES) and locally. In the REF period, CMH has achieved 106 doctoral completions compared with 54 in the previous REF period. This has been supported by the award of a doctoral training centre by Alzheimer's Research UK, success in the regional MRC-funded GW4 PGR programme, award of 13 studentships as part of the Research England expanding excellence in England initiative and 12 studentships as part of NIHR PenARC.

Across CMH, we currently have 226 registered PhD students with a wide international reach, including students from Saudi Arabia, Qatar, Canada, India, Malaysia, Uganda, Nigeria and China. We are keen to encourage clinicians from all disciplines to develop research careers and support applications for PhD Fellowships and pre-doctoral awards to enable them to develop strong application for PhDs. Our thriving programme of Academic Clinical Fellows (ACF) provides a platform to gain experience and develop projects and applications for PhD training positions. We currently host 20 ACFs and 4 ACLs (4 and 3 locally funded) and jointly supervise 4 clinical PhD students based in sub-Saharan Africa.

Prospective PhD projects and candidates are reviewed rigorously by CMH research degrees committee and the University Doctoral College. We also ensure excellent student supervision

through regular reporting mechanisms, the use of a structured e-log to monitor supervision, and a formal upgrade presentation and viva within the first 9-12 months.

Doctoral skills training is provided by bespoke courses (e.g. workshops in statistical methods and individual clinic sessions with expert statisticians, evidence based medicine, journal clubs, bioinformatics or systematic reviewing sessions) and via a plethora of tailored courses available within the University skills development programme (<http://as.exeter.ac.uk/rdp/>). External courses (including UKRI) are also promoted. Generic skills training is facilitated by the University of Exeter Doctoral College and supplemented by courses to address the specific needs of the student as identified at initial skills review and annual update reviews (see: <http://as.exeter.ac.uk/support/development/researchstudents/>).

Research students attend and present at an annual (off-site) 2-day residential Research Student Conference in a context of friendly but rigorous peer and supervisor review. This event is free of charge and all students give either a 10 minute oral presentation or present a research poster and discuss their projects with a large group of senior staff. Senior PhD students chair sessions.

The well-being of research students is of critical importance to us and we actively monitor this in parallel with their academic progress via regular supervisory meetings documented through the online MyPGR system. All doctoral students have access to a desk and computer within their research group area and a locked space for personal belongings. Pastoral tutors are assigned whom the students can contact confidentially and each has an independent mentor. Open plan coffee areas at all sites encourage networking and peer support. The wellbeing of PhD students is supported by central services available across the University. These include a dedicated post graduate research student well-being advisor, who provides support and advice to all. This individual has access to experts who offer a range of services including support and advice for personal problems or emotional difficulties, mental health advice and support and information about self-help and peer support resources at the University. Peer-to-peer support is encouraged by networking, seminars and residential research events.

3.0 Income, infrastructure and facilities

3.1 Research Income:

As noted above, our goals are delivered through a multi-disciplinary approach combining knowledge and skills in basic science, clinical expertise, primary care, public health, data science, translational medicine and implementation. As a relatively youthful UoA, we have developed strategies to assist staff in securing research support by, for example, active management of educational and administrative loads; provision of resources to facilitate both outward (to collaborators) and inward travel as well as the offer of administrative support to assist those leading and/or contributing to international consortia or developing industrial or commercial links. As a result, IBCS grant awards reached £7.4M in 2018/19, including major project grant, fellowship and infrastructure support from Research Councils (MRC; BBSRC), NIHR, The Royal Society, major charities (Wellcome Trust; British Heart Foundation; Diabetes UK) European Union and international funding agencies (e.g. NIH and JDRF) including industrial partners (Eli Lilly, GSK, Astra Zeneca, Bayer Pharma AG, UCB Pharma and Bridge to Life).

The delivery of high impact research is a key objective of all staff in UoA1 and we have appointed a Director of Impact (*Murray*) to facilitate this. Those involved in the drafting of REF impact case studies receive external consultancy support to assist in narrative development, data collection and impact assessment and regular meetings are held across all three UoAs in the College as a means to streamline and promote impact activities. Whole day conferences are convened (across UoAs) to allow colleagues to present and elaborate impact strategies and all speakers receive peer feedback as a means to hone their objectives.

Continued success in attracting grant income is underpinned by a process of rigorous internal peer review. This is convened internally by a group chaired by *Frayling* and all staff are encouraged to present their ideas orally to a sympathetic but critical audience of peers as their grant and fellowship proposals are developed. These sessions offer an opportunity for colleagues from multiple disciplines to provide early feedback on the research plans and proposed methodologies. Such presentations are mandatory for both early career researchers and those planning Fellowship applications prior to sign-off for submission by the Institute Director. Multiple practice interviews with panels of varying composition (for fellowship candidates) and comprehensive mentoring and review (for all staff) ensure that final submissions are of the highest quality. A two day off-campus residential event for all academic staff and ECRs was initiated in 2017 and is repeated annually (supported by IBCS funds) at which collaborative grant ideas are discussed, major equipment bids planned, fellowship applications developed and research collaborations fostered.

3.2 Infrastructure and facilities:

The College strategy aims to provide state-of-the-art platform technologies in order to promote and sustain the activities of multiple researchers. All equipment is deemed as open access (most is bookable via an online system open to all members of IBCS) and service contracts for specialist “high-end” items are covered from central resources to ensure efficiency of operation. This level of support was prioritised and sustained during the COVID-19 crisis, despite the compromised financial situation. Since the last REF, each suite of laboratories across IBCS sites has received dedicated administrative and technical support including the appointment of laboratory managers. An equipment budget is held by the Institute Director and is used strategically to support external bids and to ensure that pump-priming activities requiring access to specialist items are supported.

The Institute laboratories provide open access to confocal, widefield and multi-photon microscopes; a BD FACS Aria flow cytometer and cell sorter, Illumina HiSeq2500, PacBio, Oxford Nanopore and 10X nucleic acid sequencers; newly installed 3T MRI and PET-CT scanners and proteomic technologies. In addition, extensive bioimaging, CARS and Raman spectroscopy, super-resolution & TIRF microscopy, EM & cryo-EM as well as mass spectrometry pipelines are available within central facilities. Computational modelling and analysis of big data are supported by high performance computing which now encompasses a total of 360 nodes across the University (90 of which are dedicated wholly to the support of medical research). The system was designed and integrated by HPC storage and analytics integrator OCF, using Lenovo, DDN and Mellanox technology. It provides CPU performance of 250 TFLOPs and incorporates Intel MIC accelerators totalling 2.3 TFLOPs and GPU acceleration totalling 11 TFLOPS.

A Biomedical Informatics hub, funded by Wellcome Trust (£1.5M) operates as a virtual hub to help maximise output from emerging technologies and large datasets. It supports highly talented emerging researchers to generate preliminary data in support of applications for independent fellowships and research grants. It is staffed by motivated and talented researchers who understand and are keen to overcome the barriers to progress created by bottlenecks in data analysis.

As a means to facilitate the early translation of our research findings to achieve clinical and real-world efficacy, the College will continue to underwrite initial patenting and commercialisation costs of relevant developments. This is achieved by ring-fencing of a College-wide fund to prioritise support in response to strategic bids from staff, after assessment by our Research Executive, guided by advice from a dedicated business partner based in the University's department for Innovation, Impact and Business. We have also established a development fund to support pump-priming collaborations across traditional disciplinary boundaries and joint supervision of interdisciplinary PhD studentships. Spin-out companies are already in development with both *Whiteman* (“MitoRx”) and *Harries* (“Senisca”) preparing to launch entrepreneurial ventures in early 2021 and such initiatives will form an increasingly significant component of our portfolio moving forward. From summer 2020, *Francis* was appointed as Associate Dean (Business) to champion and enhance these opportunities.

4.0 Collaboration and contribution to the research base, economy and society

4.1 Overview:

A focus on societal impact is at the centre of our research strategy and we seek to “answer the questions that really matter to people” in our locality and beyond. We aim to improve the health of the population and have established explicit processes to engage with members of the public, service users and those who provide health care either as clinicians and practitioners or organisationally. Within CMH, we have established major scholarly activity researching optimal approaches to engaging with the public and with users around research strategy, design, delivery, and dissemination. Although we maintain a focus on regional engagement, our reach is truly international and, for example, we receive samples from across the world on a weekly basis, as the leading global centre for genetic analysis of subjects with neonatal and early-onset diabetes.

4.1.1 Patient and Public Involvement (PPI):

Members of the public and service users are involved in all our activities including the selection of research questions as well as in the design and conduct of studies. For example, we have well-established PPI groups facilitated within the Clinical Research Facility who are engaged regularly by staff developing research projects (both those with overtly clinical outcomes and those addressing scientific questions of more fundamental importance). Administrators charged with responsibility to develop the agenda and to schedule staff involvement, convene meetings on a bimonthly basis. Feedback is incorporated into emerging grant applications and directs project development.

4.2 Enhancement of the research base:

IBCS staff are involved in collaborations with universities across the UK and internationally. These have resulted in multiple jointly authored outputs, grant applications and implementation of research outcomes.

IBCS researchers influence the research base and contribute to strategy through membership of multiple Science and Research Advisory Boards (SRAB), research committees, funding boards and fellowship panels and by holding other official positions. These include e.g. Wellcome Trust Expert Review Group (*Hattersley*), Wellcome Trust Physiological Sciences Funding Committee (*Frayling*); Diabetes UK SRAG (*Morgan* Chair, *Shore* member; 2014-2017); Diabetes UK Clinical Study Groups (*Beall*, *Richardson*); Diabetes UK Research Committee (4 staff), Diabetes UK Clinical Fellowship and PhD student committees (3 staff), British Heart Foundation Fellowship committee (*Frayling*), Director, UK Biobank (*Hattersley*); British Microcirculation Society (Treasurer *Whatmore*); European Society for Microcirculation (Treasurer *Shore*); European Foundation for Study of Diabetes grant panel (*Richardson & Jones*); European Council for Cardiovascular Research (*Shore*). Both *Ellacott* and *Harries* sit on MRC and BBSRC grant boards (since 2017) and *Morgan* has been appointed an external scientific advisor to the Danish Ministry of Science and Education Agency’s research panel from 2021.

In terms of contributions to European FP7 and European Research Council (ERC), *Pawlak* has served as Vice Chair, Life Sciences Panel, EU Commission FP7 Initial Training Networks and Vice Chair, EU commission FP7 Individual Fellowships; *Shore* is a member of the ERC Starting Grant Evaluation panel for Life Sciences – Physiology, Pathophysiology and Endocrinology. Staff have collaborated in and contributed to, a range of EU-funded projects and, collectively, members of the UoA have networks of partners reaching across lower and higher income countries in North and South America, Asia, Africa, Australia, and Europe.

Regional collaboration is targeted mainly via the GW4 with whom we contribute to joint applications for PhD studentships, pump-priming grants and consortium meetings. Regional collaborative workshops are led by Exeter staff and frequently hosted at local venues.

4.3 Influence on policy:

IBCS staff have also made significant contributions to influence policy nationally and internationally. Colleagues serve on the editorial boards of a range of journals and participate in or lead multiple EU Horizon 2020 or IMI projects with European and industrial partners including: complications of diabetes (SUMMIT; *Shore, Strain, Whatmore (completed 2019)*) the aetiology of type 1 diabetes (PEVNET (completed 2016) INNODIA and INNODIA-HARVEST (both ongoing): *Morgan, Richardson*) and the genetic basis of pancreatic diseases (CEED; *Hattersley*) worth in excess of Euro 1.5M to UoE. *Morgan* and *Richardson* are approved investigators of the (USA-based) JDRF-network of pancreatic organ donors (nPOD) consortium and are members of the tissue prioritisation committees of INNODIA (*Morgan*) and JDRF-nPOD (*Richardson*). *Brown* is one of only two UK members of the PharmaCog IMI-large collaboration between multiple pharma companies and academia. *Hattersley* and *Jones* lead the MASTERMIND consortium which links academia, the NHS and industry to generate innovative solutions to diabetes diagnosis and treatment. *Melzer, Frayling, Hattersley, Weedon, Wright, Murray Mill, Lunnon, and Crosby* collaborate internationally in the USA, Europe and Asia to access and analyse very large datasets for genome-wide association studies of disease-associated, epigenetics and phenotypic traits. *Crosby* and *Baple* have established regional, staffed Centres and infrastructure for population genetics research studies, community outreach, and the provision of molecular diagnostic testing services in Northern India, Pakistan, Oman and among the Amish (Ohio, USA) for international community genetics programs.

4.4 Collaboration with industry:

In line with national priorities such as the Industrial Strategy, collaboration with industry features increasingly prominently in our portfolio and has been a focus for strategic development during the REF period. To further enhance industrial-facing research, *Francis* has been appointed as Associate Dean with an industrial portfolio and, in partnership with the central Innovation, Impact and Business team, will actively secure collaboration. As examples of ongoing activity, staff are developing diagnostic and therapeutic products in collaboration with Randox, Vantix, Dow Chemicals, Roche Diagnostics, Galderma, Moor Instruments, Mesocure Discovery, and Photocure. These include impactful smartphone applications for diabetes diagnosis which are now in use among GPs and examples are included among our submitted impact cases. UEMS has developed a strategic partnership with IQVIA (formerly Quintiles) with Exeter now being a UK prime site for clinical trials. This partnership has increased the number of clinical trials coming to the area and we have capitalised on this relationship to establish placement opportunities for students and researchers at the parent company.

We are also developing mechanisms to build on the University's success in launching spin out companies (**1.10 ILES**) with both *Harries* and *Whiteman* currently preparing to launch product portfolios in the areas of cellular senescence and mitochondrial disease, respectively.

4.5 Awards reflecting international reach and significance:

Colleagues within IBCS have consistently received acclaim for their impactful research and extensive international reach. This has been recognised by the receipt of multiple awards for excellence, including:

Team awards:

Diabetes Team of the Year 2016; Diabetes Nursing Team of the Year 2017; ISPAD award for Innovation in Paediatric Diabetes Care, 2014. The Queen's Anniversary Prize (2019) was awarded to *Harries* in collaboration with colleagues in Biosciences, for work on the influence of microplastics in the environment.

Individual awards for early career researchers:

In the last 8 years, six Exeter-trained scientists have won the leading UK award for early career researchers in Diabetes (RD Lawrence lecture) including, in 2021, *Richardson*. Seven ECRs have won leading European awards for early career researchers in Diabetes (EASD rising stars) while two Exeter trained scientists (including *Frayling*) have won the EASD Minkowski Prize for the leading European researcher under 45y. Two have also received the G.B. Morgagni top young investigator in metabolic research in Europe.

Senior awards:

These are manifold and include: The election of *Hattersley* and *Brown* as FRS within the REF period. *Hattersley* also received FMedSci & CBE and has won 11 international research awards in Diabetes and Endocrinology including the Novo Nordisk Foundation Prize in 2018 (£0.65M) as well as 9 UK awards for research excellence. *Shore* received the Malpighi Gold Medal of the European Society of the Microcirculation and *Morgan* the Dorothy Hodgkin Award from Diabetes UK. *Mill* & *Lunnon* have received Distinguished and Young Investigator Awards, respectively, from the Brain & Behavior Research Foundation, *Mill* was also given an Advanced Investigator Award from the American Asthma Foundation and the British Medical Association's Margaret Temple Award. In 2017, *Mill* was awarded the ISPG Theodore Reich Prize for 'exceptional work in psychiatric genomics' at the World Congress of Psychiatric Genetics. *Lunnon* received the 2018 Cavanagh Prize of the British Neurological Society. *Mill* was funded as part of the NIH Epigenomics Roadmap Initiative, representing the only award made under this scheme outside of North America and putting him at the forefront of complex disease epigenomic research. *Mill's* team is also the only UK group involved in the PsychENCODE consortium, profiling epigenomic variation in autism brain and across neurodevelopment.

Summary

Over the last two decades the University of Exeter has invested heavily in staff, infrastructure, and resources to develop our activity and profile in clinical and biomedical research. UoE remains committed to further strategic expansion in these key areas of importance to the NHS, the pharmaceutical industry and other health care providers, with a view to extending both the scope and reach of this exciting set of core activities. Within UoA1, we remain ambitious for further success and continued growth amongst an already burgeoning group of highly talented individuals who have contributed to the success and impact achieved within this unit of assessment.