Institution: University of Exeter

Unit of Assessment: UoA1

1.0 OVERVIEW

This submission is from the Institute of Biomedical and Clinical Sciences (IBCS), University of Exeter Medical School (UEMS). In RAE2008 IBCS staff were included in the Peninsula Medical School (PMS) submission to UoA4. PMS, a partnership between the Universities of Plymouth and Exeter, was one of the most successful of the new medical schools in RAE 2008. This success was built on a vigorous and focussed research strategy. Over time, the two partner universities noted changes in the external Higher Education environment and different emphases on various aspects of vision and priorities emerged between the two organisations. As a result a joint decision was taken in 2012, to demerge the partnership to allow each University to take its own individual research approaches forward. Accordingly, each has now developed its own independent Medical School and the present submission encompasses both phases of this development. It builds on the excellence of research undertaken by University of Exeter staff within PMS and emphasises the development of a renewed vision and investment by the University of Exeter since 2012.

The newly emergent University of Exeter Medical School (UEMS) is one of six Colleges in University of Exeter (UoE); an institution which joined the **Russell Group** of research intensive universities in 2012. Exeter's Research Awards have risen from £42 million 2008-09 to £81 million in 2012-13. It is placed in the **top 10 for student satisfaction**, was named **Sunday Times University of the Year 2012/13** and is ranked amongst the **UK's top 10 universities** in the Higher Education league tables. It is placed in the **top 150 universities worldwide**.

Research in UEMS is organized into two Institutes, Institute of Biomedical and Clinical Science (IBCS; Director - *Morgan*) and Institute of Health Research (IHR; Director - *Logan*) and is overseen by the Vice Dean Research (*Shore*). Across the two Institutes, research is focused in four research themes or groupings:

- Diabetes, Cardiovascular Risk & Aging;
- Neuroscience & Mental Health;
- Environment and Human Health
- Health Services Research

Each of these encompasses a spectrum of activity ranging from basic science and methodology to clinical trials, health policy and healthy communities. IBCS staff who are working in the first two themes are returned here. Those staff working in the public health, health services research and primary care research aspects of each theme are returned in UoA2. Staff from both Institutes who are working in the Environment and Human Health theme are returned in UoA7.

2.0 RESEARCH STRATEGY

2.1 Achievement of strategic objectives since 2008. By the time of the last RAE submission, PMS had emerged as a leading medical research institution with a steeply rising research income and an international reputation. Our primary goal over the present REF period has been to build on this platform and, across UEMS, we have increased by 3-fold (to £18M) the value of new research awards received annually (2012/13 vs 2007/08); retained and attracted high quality staff, dramatically enhanced our infrastructure and facilities and maintained a record of publication in world-renowned journals.

The strategic objectives articulated in our Research Strategy for the REF period were to (i) **build critical mass** by new academic appointments whilst **focusing on our strengths**; (ii) **create new facilities**; (iii) **improve research income**; (iv) **nurture staff in post**, and (v) **increase PhD student numbers**.

Across the Medical School, we have made excellent progress against these strategic objectives.
Built critical mass, nurtured staff in post, increased PhD student numbers.

- Appointed 39 academic staff to UoE (14 in IBCS): 16 Profs, 11 Senior L, 7 Lecturers, 5 Fellows.
- Promoted 12 staff internally, including 6 to professorial level.
- Graduated 54 doctoral students (37 in IBCS); an increase of 48% from RAE2008.
- Increased total PGR students from 34 FTE in 2007/8 to 72.5 FTE (33.5 in IBCS) in 2012/13.
- Become the Second UK Quintiles Prime Site, the Peninsula Prime Site, led by the Medical School Dean (*Thornton*) in collaboration with the NHS.

- Become a founder member (1 of 8) of the NIHR National School for Public Health Research (NSPHR – leaders *Melzer* and *Abraham*): £1.6M
- Achieved Bronze Athena Swan Award 2013
- Co-Led the successful application of the South West Peninsula Academic Health Science Network (SWPAHSN) with NHS and HEI partners from Cornwall, Devon and Somerset.

Created New Research Facilities

- Raised funding and built the Wellcome Wolfson Medical Research Centre (WWMRC; total floor area 7535m^2) in collaboration with the Royal Devon & Exeter Hospital NHS Foundation Trust. (Total cost £27.5M, including a £4.75M Wellcome Wolfson Biomedical Capital Award); opened Nov 2013.
- Developed new animal facilities and completed large scale laboratory refurbishment (730m^2) for neuroscience, funded by the University Capital fund (£3.77M cost); opened July 2013.
- Secured £14.2M capital and infrastructure investment to create the European Centre for Environment and Human Health (ECEHH – leaders *Fleming* and *Depledge*) from European Regional Development Fund and European Social Fund, plus £5.8M matched funding from the University. Opened in 2010, ECEHH now hosts 48 staff and 18 PhD students.

Increased Research Income:

- Boosted the number of *active research awards* from 167 in 2007/8 to 275 in 2012/13.
- Increased *annual research income* by 276% from £4.7M in 2007/8 (UoE staff in PMS) to £13.0M for UEMS in 2012/13.
- Increased the value of *new research awards* from £6M (UoE staff in PMS) in 2007/8 to £18M for UEMS (£9.9M in IBCS) in 2012/13 from a wider spread of research funders
- Received an award of £10M for PenCLAHRC (2013-2018); renewal of one of the 9 original CLAHRCs with our NHS and HEI partners in the South West
- Awarded £5.4M for Experimental Medicine in Exeter (2012-2017) to support the NIHR Exeter Clinical Research Facility (Directors *Hattersley* and *Shore*).

Excelled in Research

- Published *51 papers in world-renowned journals*, e.g. Science, Nature, PNAS, New Eng J Med, Lancet, Nature Genetics, Cell, JAMA, Circulation across the medical school (IBCS 29, IHR 22)
- Achieved 74th place in the world for Biomedical and Health Sciences (14th in UK) in the 2013 CWTS Leiden Rankings (http://www.leidenranking.com/ranking) based on citations
- Identified novel genetic forms of neonatal diabetes, increasing the known causes from around 60% of cases in 2008 to nearly 80% in 2013.
- Received *21 Fellowships* (15 in IBCS) and *more than 100 prizes and awards* (70 in IBCS) to junior researchers and PhD students (see section 3.7).

2.2 Future strategic aims and goals:

The UEMS Research Strategy 2012-17 emphasises the importance of a continued focus within our target themes (see 1.0 above) as a means to build our research strengths and to pursue research which tracks "through discovery to personalised care and healthy communities". Our strategic aims for the next 5 years are:-

To continue to build critical mass and world leading quality by:-

- ~20 new academic appointments in biomedicine (IBCS) and health research (IHR),
- Creation of 3710m^2 new research buildings for IHR staff at a projected cost of £12.48M.
- Facilitation of increased growth and collaboration within the Diabetes, Cardiovascular Risk and Aging theme by bringing together staff in the new state of the art WWMRC located on the Royal Devon & Exeter Hospital site. Currently these staff are housed in four different buildings across two cities.
- Renovation of additional laboratories and provision of new imaging facilities for neuroscience.
- Increasing UEMS research income to £20M by 2018, by targeting national and international priorities, increasing large consortia bids, further strengthening mentorship, peer review and training in successful grant writing, appointing additional excellent staff with proven track records.
- Investment in a strategic development fund, to ensure that equipment remains state of the art; development of shared "high end" facilities in a 4 university partnership across the South West.
- Increasing doctoral student FTE (external and internal funding and business collaborations);

improved completion statistics; enhanced mentorship, supervisor training and governance.
- Maximising the potential of the new Living Systems Institute to make biomedicine a predictive science.
- Creation of a new UEMS international strategy to facilitate researcher interactions overseas, enable recruitment of excellent international students and staff and enhance research skills both in the UK and internationally.

To work with people and communities to benefit health by:-

- Expanding our innovative patient and public engagement (PPE) programme via our *NIHR Exeter CRF PPE groups* for experimental medicine, the *PenCLAHRC PPE* initiatives, and the RCUK-funded *Catalysts for Public Engagement* (1 of 8 in the UK) which embeds public engagement with research in University policies, procedures and practices.
- Increasing the number of volunteers in "Exeter 10000" from 7000 to 10000. This research bioresource provides "research ready" volunteers (consented to be approached and health records accessed), with samples and baseline research data available. It improves research efficiency and allows patient selection by genotype or phenotype.
- Working with the AHSN to develop a comprehensive database of health and well-being information as a means to facilitate clinical care and clinical research.

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

- Provide enhanced mentorship, supervision and personalised development for all staff. Create a promotion champion to encourage individuals who are reluctant to nominate themselves.
- Promote networks for Early Career Researchers and Parent and Carers' groups to enable peer support and to act as change agents for UEMS
- Reinforce the change in culture in line with the achievement of Athena Swan Silver award

2.3 Research groupings:

Diabetes, Cardiovascular Risk and Aging: contains a total of **33 academic staff** (23 in UoA1, 10 in UoA2) whose research spans basic science/methodology through experimental medicine to clinical trials, health research and policy change.

In **UoA 1, 8 Professors** (3 clinical) *(Hattersley, Shore, Ellard, Morgan, Frayling* (ERC senior fellow), *Winyard, Thornton, Melzer*), **1 Associate Professor** (Reader equivalent) (*Whiteman*), **10 Senior Lecturers** (*Weedon, Murray, Cory, Scotton, Whatmore, Eggleton, Harries, Kos, Strain, Curnow* - 4 of whom were promoted in the period), **3 Lecturers** (*Welters, Allard, Shields*) **1 Senior Research Fellow** (*Osborne*), **29 postdoctoral researchers**, **25 doctoral students** currently align to this grouping. These staff have expertise covering cell biology, biochemistry and pharmacology (*Harries, Whiteman, Eggleton Winyard, Morgan, Allard, Curnow, Scotton, Welters, Whatmore, Cory*) genetics (*Hattersley, Frayling, Weedon, Murray, Freathy, Ellard, Melzer*) and human physiology (*Shore, Strain, Kos*). An additional 5 UoA1 staff, including 1 Prof, remained with University of Plymouth in the disaggregation and are not included in this return.

The future strategy is to build research volume by further new appointments, promotion of excellent staff and to move the majority into the new WWMRC (see 4.2) with easy access to human samples via the co-located NIHR Exeter Clinical Research facility.

Selected achievements and discoveries in UoA1 in the REF period include:-

- Identified 17 genetic loci that influence the timing of menopause and 32 loci for age at menarche, which highlight key biological pathways involved in determining female reproductive lifespan (**Nature Genetics,** 42:1077-1085, 2010; 44:260-268, 2012).
- Discovered that alternative splicing is deregulated during human ageing, which may explain the deterioration in function and the reduced capacity for cellular adaptation seen in the elderly (**Aging cell,** 10:868-878, 2011; 12:324-326, 2013).
- Demonstrated for the first time that the environmental chemical Bisphenol A may contribute to the development of coronary artery disease in humans. (**Circulation,** 125: 1482-1490, 2012)
- Identified the first alleles associated with both low birth weight and increased risk of type 2 diabetes (**Nat Genetics,** 45: 76-82, 2013).
- Using genetic approaches, identified a causal role of reduced circulating Sex Hormone Binding Globulin (SHBG) with increased risk of type 2 diabetes. (**Hum Mol Genet,** 19: 534-544, 2010)
- Identified novel genetic forms of neonatal diabetes that give critical new insights into human

pancreatic development (**Nat Genetics**, 2013. doi: 10.1038/ng.2826)

- Discovered a novel biomarker of rheumatoid arthritis, based on the detection of human serum autoantibodies directed against oxidatively modified forms of type II collagen (**Arthritis and Rheumatism**, 65:1702-1712, 2013).
- Developed a method to create nitrate-depleted beetroot juice, and the translation of this "placebo control" to industrial production (with a commercial partner) and patient studies showing the effects of oral nitrate-rich beetroot juice ingestion on blood pressure, exercise capacity and cognitive performance (> 100 research studies worldwide; e.g. **J Appl Physiol**, 107: 1144-1155, 2009).

Funding: Total research income to this group in REF2014 (excluding NIHR income "in kind"): **£17.56M**; new research awards to this group in 2012/13: **£8.32M**.

Neuroscience and Mental Health: comprises a total of **18 academic staff (9 in UoA1, 9 in UoA2)** whose work spans basic science and methodology through experimental medicine to clinical trials, health research and policy change.

In **UoA1** this research group currently comprises **4 Professors** (*Pawlak, Randall, Crosby, Mill*), **1 Senior Lecturer** (*Chilton*), **1 Lecturer** (*Lunnon*) **3 Research Fellows** (*Brown, Walker, Dempster*)**, 8 postdoctoral researchers, 7 doctoral students**. UoA 1 scientists are working on mechanisms underlying anxiety, Alzheimer's disease, motor neurone degenerative disease, and developmental biology. During the demerger of PMS, 1 Prof, 2 Senior Lecturers and 2 Lecturers in UoA1 remained with University of Plymouth thus reducing the critical mass of this grouping. Their work is not included in this return. To compensate and further strengthen the UEMS Neuroscience and Mental Health theme in UoA1, considerable recruitment of additional staff (4 Chairs; 3 Senior Research Fellows) has taken place since 2012.

Major strategic investment is planned to bolster the theme further. Recurrent funding has been allocated for an additional ~ 3 PIs within 36 months. *Ellacott* (SL) will join in January 2014 with research which links obesity and brain function. Further recruitment will follow in the period to 2016 with development of the "Living Systems Institute". The Neuroscience and Mental health grouping interfaces well with the wider emphasis on control of behaviour and the implementation of behaviour change in the Sir Henry Wellcome Mood Disorders Centre, Psychology, UoE.

The UoA 1 academics with experimental models of disease are housed in the newly refurbished Hatherly building with new laboratory provision for electrophysiology, imaging and animal behaviour studies (completed in Nov 2013) adjacent to the new animal facilities. Remaining UoA1 staff will soon move to the new WWMRC from temporary accommodation elsewhere.

Selected achievements and discoveries in UoA1 in the REF period:

- Identification of mutations in the *CHN1* gene as a cause of Duane Syndrome. (**Science,** 321: 839-843, 2008).
- Discovery of a novel stress-related pathway in the amygdala linking neuropsin-mediated proteolysis of EphB2 to activity-driven transcription of Fkbp5 (**Nature,** 473: 372-375, 2011).
- Identification of lipocalin-2 as a novel regulator of structural stress-induced plasticity and anxiety-like behaviour in the hippocampus (**PNAS**, 108: 18436-18441, 2011).
- Discovery of GPCR/G-protein signal trafficking in the limbic system as a novel form of experience-dependent neuronal plasticity (**Molecular Psychiatry**, 18: 1136-1145, 2013).
- Identification of early Alzheimer's disease biomarkers in blood that are also present in individuals with mild cognitive impairment (**J Alzheimer's Dis,** 33: 737-753, 2013).
- Use of in vitro and in vivo methods to identify novel neurophysiological hallmarks of circuit dysfunction in rodent models of dementia-associated amyloidopathy and tauopathy and models of schizophrenia and Down's syndrome (e.g. **Neuropharmacology,** 59: 243-257, 2010)
- Identification of multiple forms of activity-dependent, long-lasting, intrinsic neuronal plasticity in neurones of the mammalian limbic system (**PLOS One,** e30402, 2012)
- Establishment of regional, staffed Centres and infrastructure for population genetics studies, community outreach, and the provision of molecular diagnostic testing services in Northern India and in the Amish (Ohio, USA) for our international community genetics programs.

Funding: Total research income to this group in REF2014 (excluding NIHR income "in kind"): **£0.74M**; new research awards to this group in 2012/13: **£1.58M**.

3. PEOPLE: 3.1 Staffing strategy: After the initial expansion of biomedical research during the development of PMS, (RAE2008 period), the strategic staffing priority for 2008-13 was to build critical mass in the Institute of Health Research (IHR) whilst building new laboratory facilities to enable further expansion of IBCS from mid-2012 onwards. Although the uncertainty over the future of PMS led to a hiatus of recruitment for 2 years, the Medical School has, overall, appointed 39 University of Exeter Staff over the REF period (16 Profs, 11 Senior Lecturers, 7 Lecturers, 5 Fellows). Close mentorship and provision of personal development for staff at all levels has also facilitated staff achievements.

Over the REF period, IBCS **appointed** 5 professors (*Crosby* 2013, *Mill* 2012, *Pawlak* 2012, *Randall* 2013, *Thornton* 2010), 3 senior lecturers (*Cory* 2009, *Kos* 2009, *Scotton* 2013) 4 lecturers (*Allard* 2010, *Lunnon* 2013, *Shields* 2008, *Welters* 2010), and 2 fellowship holders (*Brown* 2012, *Walker* 2013) to UoE; **promoted** 6 staff, 2 to Professorial level (*Whiteman, Frayling*) and 4 fellowship holders, (three to SL and one to L (2 RCUK fellows, (*Harries, Chilton*) 2 charity fellows); **retained** 88% of RAE2008 staff in the parent universities of PMS. Two staff moved to industry posts (*Young, Chibber*), one to another HEI (*Cobbold*), one to promotion externally (*Tooke*). 10 IBCS staff in PMS who were employed by UoP remained with Plymouth Medical School.

3.2 Career Development: We pride ourselves that our academic staff and early career researchers are enabled to achieve their best, as evidenced by the 6 promotions in the period, including 3 fast tracked to SL, 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 (e.g. *Shields* (L) given MSc Statistics supported by leave and payment of fees; *Eggleton* (SL) 12 month sabbatical at University of Alberta). Career advice is given at all academic stages. **Postdoctoral** scientists participate in *the researcher development programme* (a series of courses on translational skills and careers specifically targeted at PDRA) including exposure to non-academic career options and a realistic self-appraisal. At **Lecturer** level, promotions, career plan and personal development are part of *the professional development programme* (with automatic promotion to senior lecturer on successful completion at 5 years or earlier for high fliers). These issues are discussed at the *annual professional development review* for academic staff at **SL level and above**, with whom key objectives are set and reviewed 3 monthly. These objectives inform the allocation of funds for research visits, sabbatical leave, conference attendance and influence the deployment of resources to support research projects, PhD studentships etc. Institute Directors hold *budgets for staff development* and encourage staff to *apply for promotion* when appropriate. Staff of all grades have *opportunities to develop their skill set* by being involved in teaching, outreach, public engagement and both UEMS and University committees. Examples of PDRA involvement include first year tutors to MBBS, 2nd year small group facilitators for BSc Medical Sciences; membership of the Athena Swan working group, participation in "Men in White" (an outreach programme developed in-house) and in the UoE's "Grand Challenges" programme for undergraduates. UEMS promotion workshops are held regularly to ensure staff and managers know the procedures and staff have the opportunity to talk to individuals who have achieved promotion.

3.3 Building research reputation: Staff, including PDRAs, 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 credentials. *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 successfully apply for fellowships* (e.g. Richardson, Freathy) with funding underwritten to support excellent staff and to provide security (e.g. Baple, Richardson). When appointed to a Lecturership or Senior Lectureship, start-up funds enable pilot data collection and purchase of essential equipment. Larger items of equipment and facilities are shared between groups, providing access to state of the art instrumentation for all and additional opportunities for networking. To develop grant writing skills, learning and development courses are available, mentorship is provided and peer review is given by the Institute Director and a subject expert. Each year a competition is held for places at a 3 day residential research school with the NIHR Research Design Services, to receive intensive feedback on grant applications. Networking

is also encouraged by running regular local interdisciplinary workshops (e.g. in 2012/13: cardiovascular, dementia and systems medicine workshops have been held; each attracting 30-50 delegates). Collaboration with external investigators is encouraged and supported by funding for travel, including via *Outward Mobility Awards* which enable staff to carry out research internationally (e.g. *Frayling* to Switzerland in 2010/11; *Eggleton* to Canada in 2012/3). The University's *Wellcome Institutional Strategic Support Fund* has provided grants to *Murray* and *Weedon* to reduce their teaching commitments. The *Exeter Science Exchange*, funded by EPSRC Bridging the Gaps, has facilitated interdisciplinary research (e.g. *Lunnon*; £10,000 for vascular dementia and epigenetics).

3.4 Teaching: All staff have the opportunity to teach in small groups, placements or lectures 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).

3.5 Wellbeing: Staff are allocated a desk, computer and personal lockable space. They are located in groups where all grades of staff and students in one research group can interact effectively. PDRAs are often in open offices, Lecturers (both senior and junior) in shared offices and Profs in single offices. Exercise facilities are available on both University campuses and are open before, during and after the normal working day. University wellbeing officers are available to advise staff. UEMS has recently approved a central hours (10-4) approach for main committees and business so that those with parenting or caring responsibilities are able to contribute fully.

3.6 Postgraduate students: Doctoral student FTE within UoA1 has reached 33.5 in 2012/13 (with a further 16 transferred to "writing-up" status) and our 4-year completion rate exceeds 70%. In addition, IBCS staff have supervised a further 17 doctoral students to completion in other HEIs. Prospective projects, supervisors and candidates are reviewed rigorously by our Research Degrees Committee (RDC) prior to acceptance. RDC also ensures excellent student supervision by regular reporting mechanisms, the use of a structured log book (online for post 2012 students) to monitor supervision, and a formal mid-term upgrade presentation and viva. Doctoral skills training is provided by bespoke courses established within UEMS (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 UoE skills development programme (http://as.exeter.ac.uk/rdp/). External courses (including RCUK) are also promoted. Research students attend and present at the annual (off-site) residential Research Student Conference in a context of friendly but rigorous peer and supervisor review. Senior PhD students chair sessions. The wellbeing of research students is important to us. All students have access to a desk and computer within their research group area and a locked site for personal belongs. UEMS has a disability officer and pastoral tutors whom the students can contact confidentially and each has an independent mentor. Open plan coffee areas at all sites encourage networking and peer support.

3.7 Awards and Prizes: The level of excellence achieved by our young researchers is evidenced by many prizes and awards. Highlights include: NHS Young Healthcare Scientist of the Year, 2013 (*McDonald*); European Association for the Study of Diabetes (EASD) Junior Research Prize, 2011 (*Shields*); Royal College of Nursing, Marjorie Simpson New Researcher Award, 2009 (*Steele*); Association of Clinical Biochemists, Young Researcher Award 2008 & 2010 (*McDonald*), Diabetes UK, Nick Hales Young Investigator Award 2010 & 2012 (*Lango, Shields*); British Microcirculation Society, Moor Instruments Innovation in Technology Award 2012 (*Bell*), International Society for Study of Fatty Acids and Lipids (ISSFAL) Young Investigator Award, 2012 (*Stone*) and Terence Ryan Award 2011(*To*). They have also won 9 prizes for best oral or poster presentation and multiple travel awards to international and national meetings including American Diabetes Association, EASD, European Society for Paediatric Endocrinology.

Senior investigators have also been honoured with awards. *Hattersley* was elected Fellow of the Royal Society (2010), received, with *Ellard*, a Wellcome Senior Investigator award in 2012 and a NIHR Senior Investigator award (2012); he received the Society for Endocrinology Gold Medal in 2009 and the Moxon Trust Medal (Royal College of Physicians, London) 2011 among many other honours. The EASD's prestigious Minkowski Prize and The University of Padova, Morgagni Silver

Medal Award 2012 were presented to *Frayling*, the American Asthma Foundation Senior researcher prize 2012 to *Mill*. Diabetes UK's RD Lawrence Award, which is given annually to a single outstanding and influential researcher having less than 20 years postdoctoral research, was awarded to Exeter trained staff in 2009, 2011, 2012, and 2013. The International Society of Paediatric and Adolescent Diabetes Prize for innovation in Paediatric Diabetes Care, 2012, was awarded to *Ellard*, *Hattersley* and their team.

UoA 1 Staff have been awarded 15 prestigious Fellowships over the REF period. These include: Sir Henry Wellcome postdoctoral awards (*Perry* 2010, *Freathy* 2008); Alzheimer's Research UK Senior Fellowship (*Brown* 2013); Royal Society Industrial Fellowship 2013 (*Randall*) Clinical fellowships from Diabetes UK (*Besser* 2008, *Oram* 2011) MRC (*Clissold* 2012); MRC Bioinformatics Fellowship (*Walker* 2012) NIHR (Clinical Scientific Officer Fellowship; *McDonald* 2013, Clinical Fellowship *Jones* 2011 and Clinical Doctoral fellowship to *Steele* 2009) Vandervell Fellowship (*Weedon* 2005-9); Juvenile Diabetes Research Foundation Research Fellowship (2009-2011, *Welters*), DRWF non-clinical Research Fellowship (2010-2013, *Richardson*), Daphne Jackson Fellowship (*Smallwood)*.

4. INCOME, INFRASTRUCTURE AND FACILITIES

4.1 Research Income: IBCS *grant awards* increased from £2.2M in 2007/2008 to £9.9M in 2012/13 (*income* from £2.17M to £5.7M) including 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). Comprehensive mentoring, advice and peer review ensures that grant submissions are of the highest quality.

4.2 Infrastructure and facilities: UEMS provides *platform technologies* which sustain the activities of multiple researchers. These include confocal microscopes; Illumina HiSeq2500 next generation DNA sequencer; a 1.5T Phillips Research Only MRI scanner and proteomic technologies. In addition, extensive bioimaging, CARS and Raman spectroscopy, TIRF microscopy, multi-photon imaging, and mass spectrometry pipelines are available through UoE collaborations and have spawned more than 115 joint publications since 2008. £1.4M has also been secured via successful external funding bids; the most recent (in 2013) being £350K from Wellcome Trust for multiuser robotic sequencing technology (lead *Frayling*, UEMS). Numerical modelling work is supported by *high performance computing* via UEMS Sun computing clusters and the UoE High Performance Computing facility "Zen", a Silicon Graphics Altix ICE 8200 with a peak performance of 22 TFlop/s. Future provision is currently under review. A *Bioinformatics hub*, funded via Wellcome Trust's Institutional Strategic support fund, provides researchers with advice, support, training and expertise to maximise outputs from emerging technologies and big data sets.

4.3 Infrastructure projects: To enable expansion of biomedical research in UEMS additional laboratory facilities, a bioinformatics hub and animal facilities have been created in Exeter**,** at a total cost of **£33.5M**. The new **£27.5M WWMRC** has been constructed to house researchers working within the Diabetes, Cardiovascular Risk and Aging theme in a single facility. It provides 3248m^2 of laboratory, teaching and clinical research space (within a total floor area of 7535m^2), state-of-the-art equipment for genetics, cell and molecular biology. It also houses an expanded *NIHR Exeter Clinical Research Facility* (5 year renewal in 2012, £5.4M) comprising 3 four bedded wards, exercise suite, research outpatients and individual intensive study rooms, as well as staff offices, seminar rooms and a new Postgraduate Education Centre. UEMS *Neuroscience laboratory and animal facilities* (730m^2) have been created to support the expansion in Neuroscience & Mental Health (cost **£3.77M**). These facilities include electrophysiology laboratories, confocal microscopy, tissue culture, animal behaviour rooms, as well as staff offices and writing areas. Further laboratory refurbishment will take place throughout the next REF period. UEMS is a major collaborator in the **£50M Living Systems Institute** (completion 2016) to establish world-leading interdisciplinary expertise in Systems Medicine. It will contain a new state-of-the-art animal facility to underpin the ambitious growth projections in biomedicine. As a prelude, a UoE-wide initiative for PhDs in Systems Medicine (with supervisory teams including colleagues from engineering and mathematical sciences) commenced in 2013/14 (4 students) and will continue annually. In addition to the biomedical infrastructure projects, UEMS has also refurbished 2265m^2 of previous student residences on the St Luke's campus in Exeter to provide offices, meeting and teaching rooms to accommodate health researchers (cost **£2.08M**). A third phase opens in 2015 (3710m^2; **£12.48M**).

5. COLLABORATION OR CONTRIBUTION TO THE DISCIPLINE OR RESEARCH BASE

UEMS promotes **innovation and economic regeneration** regionally as well as in the wider world. We play major roles in regional clinical/NHS infrastructure as Directors of topic specific (Stroke, Diabetes, Mental Health and Primary care) and the comprehensive UKCRN local research networks, as NHS R&D directors for two NHS Acute Trusts; as lead of the Quintiles Peninsula Prime site and Directors of the NIHR Exeter CRF. We also participate in the newly formed GW4 collaboration between the Universities of Exeter, Bath, Bristol and Cardiff which will support ambitious programmes of research that would be beyond the scope of the individual institutions.

Exeter IBCS researchers **influence research base and strategy** through membership of multiple Science and Research Advisory Boards (SRAB), research committees, funding boards and fellowship panels and by holding other official positions; e.g. Wellcome Trust Expert Review Group (*Hattersley*), Wellcome Trust Physiological Sciences Funding Committee *(Frayling*); MRC population and Systems Medicine Board 2009-2013 (*Thornton*), Diabetes UK SRAB (*Morgan* Chair, *Shore* member); Clinical Molecular Genetics Society SRAB (*Ellard* Chair); Alzheimer's Research UK SRAB (*Randall* member); Action Medical Research SRAB (*Thornton* member), Royal College of Obstetrics and Gynaecology SRAB (*Thornton* Chair); US National Institute of Environmental Health Sciences SRAB (*Fleming* member); Diabetes UK Research Committee (4 staff), Diabetes UK Clinical Fellowship and PhD student committees (3 staff), Alzheimer's Research UK Fellowship Panel (*Randall*), British Heart Foundation Fellowship committee (*Frayling*), Director, UK Biobank (*Hattersley*); British Microcirculation Society (Treasurer *Whatmore*); European Society for Microcirculation (Treasurer *Shore*); Clinical Molecular Genetics Society (Treasurer *Ellard);* European Council for Cardiovascular Research (Secretary, *Shore* to 2009).

In terms of contributions to European FP7 and European Research Council (ERC), *Pawlak* is 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.

IBCS staff have made significant contributions to **influence policy nationally and internationally** (see Impact template). IBCS staff are editors of 7 Journals and editorial board members of a further 9 including Am J Perinatology, Am J Medical Genetics, Diabetologia, & Microcirculation.

In national and international collaborative research consortia we both lead and participate in multiple EU Framework 7 or IMI projects with European and industrial partners in: biomedical implications of oxidative stress (REDCAT; *Winyard; Eggleton; Whiteman*) complications of diabetes (SUMMIT; *Shore, Gates, Strain, Whatmore*) the aetiology of type 1 diabetes (PEVNET: *Morgan*) and the genetic basis of pancreatic diseases (CEED; *Hattersley*) worth in excess of Euro 1.5 million to UoE. *Randal* and *Brown* are the only UK members of the PharmaCog IMI-large collaboration between multiple pharma companies and academia. *Morgan's* group lead two tasks within a pan-USA-European consortium (nPOD-V; $3M JDRF) to establish the molecular aetiology of type 1 diabetes. *Melzer, Frayling, Hattersley, Weedon, Murray Ellard, Mill, Lunnon, Crosby* collaborate internationally in USA, Europe and Asia to access and analyse very large datasets for genome-wide association studies of disease-associated, epigenetics and phenotypic traits. Crosby has established regional, staffed Centres and infrastructure for population genetics research studies, community outreach, and the provision of molecular diagnostic testing services in Northern India and among the Amish (Ohio, USA) for international community genetics programs.

Collaboration with industry features prominently in our portfolio, with diagnostic and therapeutic products under development in collaboration with Vantix, Dow Chemicals, Roche Diagnostics, Galderma, Moor Instruments, Mesocure Discovery, Photocure. *Randall* is recipient of a Royal Society Industry Fellowship (in collaboration with Lilly). Additionally, 7 jointly–funded industrial studentships have been supported by companies such as AstraZeneca. Lilly and Boehringer-Ingelheim (*Randall, Gaze, Morgan, Welters*). In 2011 UEMS with its NHS partners, created a strategic partnership with Quintiles, to become the second UK prime site for clinical trials, Peninsula Prime Site. This partnership increases the numbers of clinical trials coming to the area and will enable students and researchers to benefit from placements with Quintiles.