

Institution: University of Plymouth

Unit of Assessment: 1

1. Unit context and structure, research and impact strategy

Context

The UoA1 submission of the University of Plymouth comprises the clinical and translational research of our Faculty of Health (FoH) and includes research from our Schools of Medicine and Biomedicine. The unit seeks to develop solutions to pressing clinical needs with a focus on cancer, neurodegeneration and infection/immunity/inflammation (3Is). Since the last REF UoA1 has **grown by 67% (FTE), increased PGR completions by 63%, launched 3 spin-out companies** with a market value of **£9M**, and **driven development of three NICE guidelines**. UoA1's integrated research laboratories in the Derriford Research Facility (DRF) are adjacent to University Hospitals Plymouth and the Plymouth Science Park (jointly owned by the University and Plymouth City Council). This **co-localization of health delivery, health research and health enterprise** facilitate a **translation pipeline of health innovation**. It brings our researchers into daily contact with care and enterprise professionals.

The unit comprises 28 category A staff (24.2 FTE), 8 of whom are working clinicians. It sits within the new **strategic Plymouth Institute of Health and Care Research (PIHR)** which coordinates health research across the University; UoA1 is a significant component of the 'PIHR: Frontiers in Discovery Science' and 'PIHR: Mind & Brain' themes. PIHR was launched in 2020 as a strategic investment to coordinate and integrate the universities' health research with a mission to impact areas that are priorities for our local, relatively deprived, urban-rural and maritime populations and similar communities worldwide. PIHR supports our UoA1 research by maintaining a vibrant network of interconnected researchers. It adds value by enabling and accelerating research, supporting new and productive collaborations, and multiplying the quality and the impact of our work. It is a responsive and dynamic organization that avoids the limitations of siloed and divisive organisational structures, and generates an **interlocking matrix** where our **clinical and translational UoA1 research aligns seamlessly with our applied health research in UoA3 and our psychology research in UoA4**.

Since 2014 there has been an increase in UoA1 size (14.5 to 24.2 FTE), in part following a re-organization of the university structure which reflected the strategic aim to prioritise translational research. UoA1 has benefited from substantial University investment including construction of the **3,463m² DRF** opened in May 2018. The DRF was a **£17.4M investment by the University** and is 90% occupied by UoA1; it houses flexible wet-lab space and an array of **fully-equipped specialist suites that are core funded and maintained by the university** (see section 3). This investment has completed a strategy to bring all our translational research into one juxta-clinical setting.

There has also been rapid growth and increased emphasis upon enterprise. Examples of this include our spin-out companies (see section 4). We continue to build strong clinical relationships, including in brain tumour research (now a Centre of Excellence of the charity Brain Tumour Research), key partnerships with the University Hospitals Plymouth NHS Trust (which changed to its new name in 2018 to reflect the growing relationship with the University) and with local stakeholders such as charities and patient advocacy groups (see section 4).

Current Position and Developments Since 2014

The UoA1 strategic aims outlined in 2014 followed a period of re-organization at the University, including separation of the Peninsula College of Medicine and Dentistry from a joint venture with Exeter University. The current submission follows a consolidation of the Faculty of Medicine and Dentistry and the Faculty of Health and Human Science to form a new Faculty of Health in September 2019, leading to a re-alignment of the UoA1 submission. As a result, our applied health and dental research has been moved into our UoA3 sister unit. This also aligns our submission with the new PIHR themes. Launched in 2020, PIHR incorporated the work of three smaller existing institutes, including the Institute of Translational and Stratified Medicine (ITSMed) which featured in 2014.

The UoA1 key strategic aims described in 2014 were: 1) build research capacity through 2021 by increasing staff numbers, 2) extend the Derriford campus, and 3) invest in infrastructure/core equipment. We have delivered these aims. Although our applied health research has been moved into UoA3, we have increased the number of category A staff in UoA1 by 87% (from 15 to 28). We have completed construction and commissioning of the DRF, delivering a **110% increase in research space for UoA1**, and we have equipped the new facility with an array of resources such as mass spectrometers, animal facility, imaging suite and a biosafety Cat III (BSL-3) laboratory (see section 3).

In addition to these strategic aims, three specific areas were highlighted for development in 2014 all of which we have been delivered. The first was to support three research themes: **1) clinical neuroscience** (current submission: **Affourtit, Barros, Fern, Glebow, Hanemann, Kramer, Luo, Parkinson, Mullins**); **2) cancer** (**Ammoun, Hanemann, Patra, Rule**); and **3) a theme described in 2014 as genomics/diagnostics which has evolved into our infection, immunity and inflammation (3Is) theme** (**Carre, Cramp, Danda, Hoare, Fejer, Felmlee, Foey, Jarvis, Joshi, Madgett, Martin, Sharma, Sheridan, Upton, Warburton**).

The second area for development was to forge closer links with biomedicine. In 2014 the School of Biomedical Sciences was moved from the Faculty of Science & Engineering into the FoH and the research active staff (**Affourtit, Fejer, Foey, Jarvis, Joshi, Madgett, Sharma, Upton, Warburton**) incorporated in UoA1 and housed in the DRF.

Third was the promotion of **cross-cutting interdisciplinary activity**. This development area has benefited from the relocation of all laboratory research onto the one Derriford site to enable linkage between basic and clinical scientists based at the adjacent University Hospitals Plymouth, achieving a seamless, geographically focused research entity. Our success in this aim is evidenced by the interdisciplinary outputs presented here (which cover 10 main subject areas; SciVal) and in our close and productive links into industry (see section 4).

Cancer - Research Highlights

The population of the peninsula is elderly, with a high incidence of cancer/tumour -in particular of the brain -a priority both for UoA1 and the University Hospitals Plymouth. Our cancer theme laboratory heads are: **Hanemann**, a clinician-scientist who leads on brain tumour research who works closely with **Ammoun; Rule**, a clinician-scientist leading the translation of a new class of treatment for mantle cell lymphoma (see Rule impact case study); **Ji-Liang Li** (2016-2019) and **Patra**, basic scientists who specialize in immuno-therapeutic approaches to cancer treatment; **Parkinson** and **Barros** with interests in cell signalling in cancer and **Xinzhong Li** (2014-2019) who

takes a bioinformatics approach including machine learning and next-generation sequencing in diagnostics.

Hanemann conducted and published a first-in-man clinical trial, based on the group's *in vitro* work, in patients with the tumour predisposition syndrome neurofibromatosis 2. Hanemann's success is highlighted by continuous funding since 2014 from Brain Tumour Research for our internationally recognised centre, which brings together and supports basic and clinical UoA1 members. Examples of work by the centre include a collaboration with Vivace Therapeutics to test a first-in-class drug in two different brain tumour models, while one of our ECRs (**Ammoun**) was funded by the Great Ormond Street Hospital Children's Charity and SPARKS to examine cellular prion protein PrPC in neurofibromatosis type II related tumours. **Barros** is focusing on brain tumour initiation and growth and identification of novel genes controlling glioblastoma initiation. This is one of many examples of staff in the group transferring expertise between areas of excellence, in Barros's case between fly neurodevelopment and cancer.

The Brain Tumour Research Centre of Excellence has built a large tumour collection, mostly of meningioma and schwannoma but also gliomas and ependymomas. Since 2016 this collection has included blood samples and allows the stratification of meningiomas into genetically defined subtypes. The centre aims to discover biomarkers and new drug targets for meningioma of different defined make up (tumour grade and genetic subtype). They have finished a first unbiased screen for proteins, activated proteins and miRNAs and started collaborations within the International Meningioma Consortium (ICOM), Response Evaluation in Neurofibromatosis and Schwannomatosis (REINS) and the Liquid Biopsy Consortium. This approach has already resulted in a number of biomarker candidates for tumour progression as well as drug target candidates.

The clinical mantle cell programme is conducting two major trials within PenCTU. **Rule** is leading the **ENRICH** trial, the only study in the world randomising between chemotherapy and a non-chemotherapy approach as front line therapy. This trial is currently open across the majority of hospitals in the UK and also the Nordic countries. An interim analysis has now triggered the randomised phase III component of the trial. Samples from this study are being analysed centrally, looking at minimal residual disease using both molecular and flow-based techniques. Rules' other major trial is a prospective patient registration/biobank study looking at newly diagnosed patients in the UK. At present the study is collecting over 30% of all newly diagnosed patients, making it the largest collection in the world. The first 220 patients are starting with a minimum of one year follow up and, using clinical parameters, have shown those features which predict a more indolent phenotype. A variety of correlative studies are at an advanced planning stage with teams in Kiel, New York and Vancouver.

Clinical Neuroscience - Research Highlights

The peninsular has a high prevalence and incidence of neurodegenerative disease, like many similar deprived and aged populations. Our clinical neuroscience theme has a particular focus on neurodegeneration. **Luo's** work on the role of autophagy and cell death in Huntington's disease has produced a number of strong findings, including a study on autophagosome synthesis and aggregation-prone protein toxicity in dementia. **Glebov** was appointed in 2019 to investigate insulin degrading enzyme in neurodegenerative disease with a focus on dementia and the role of microsomes. **Kramer** was appointed in 2016 and is leading investigating the role of cell surface protein signalling in the pathogenesis of neurodegenerative disorders with a particular focus on Parkinson's disease, while **Mullins** is a clinical scientist with a focus on the

glucocerebrosidase pathway in this disease. **Parkinson** has developed models to investigate peripheral nerve injury and regeneration, in addition to his work on tumours. **Fern** studies the vulnerability of white matter to the induction of a human tau mutation associated with dementia. He has led an international collaboration with colleagues at the Universities of Bilbao and Malta to develop new combination treatments for diseases that involve damage to the white matter (MS, stroke, traumatic brain injury, cerebral palsy); work that has led to the filing of an international patent around selective block of novel glutamate receptors. **Tieu** (2013-10/2016) secured funding from the MRC and US NIH to investigate mitochondrial fusion pathways in models of Parkinson's disease while **Barros** harnesses fly genetics to study pathways that regulate neural development and which are significant in disease.

3Is - Research Highlights

3Is is another priority health area for the South-West and similar populations world-wide. **Joshi** is an ECR interested in antimicrobial resistance and infection prevention and control. She has led collaborations with key leaders in the field, resulting in multidisciplinary studies with Chile (Universidad Andres Bello, Chile/ Texas A&M University), Sweden (University of Umea, Sweden) and USA (Texas A&M University). **Jarvis** and **Upton** have combined their expertise to develop new vaccines to combat antimicrobial resistance including proof-of-concept work in bovine mastitis and a recent venture that will combine strengths in the UK and China to develop and test new vaccines for use in pigs. **Jarvis'** expertise in the development of novel vaccines is evidenced by his inclusion as a key partner in a £7M project sponsored by the US DARPA programme, aimed at helping to protect US troops from zoonotic infections in the field. His spinout company (**The Vaccine Group: TVG**) is developing vaccines for this project, which is led by the UC Davis School of Veterinary Medicine; TVG's work on Covid vaccines is rapidly developing (see COVID, section 4). **Upton's** spinout company (**Amprologix**) was awarded £1.2M by the Department of Health and Social Care to progress the lead antimicrobial candidate through pre-clinical evaluation. The aim is to initiate a phase 1 human trial with the lead agent (see section 4). Upton also works to train international partners in natural product discovery approaches, with a focus on marine sponges. This is part of a University of Plymouth work-package in the £20M One Ocean Hub project, led by the University of Strathclyde and funded by the UK Research and Innovation Global Challenges Research Fund.

Dhanda is part of a UK-wide consortium aiming to minimise death from alcoholic hepatitis as part of the MRC Stratified Medicine initiative and is now recruiting patients for clinical trials at 40 centres across the UK. Dhanda is also leading a project to investigate the circulating microbiome in patients with alcohol related liver disease in collaboration with other members of 3Is including Upton. **Cramp** is a member of the **Lancet Standing Commission on Liver Disease** in the UK and co-authored their 5th report into alcohol-induced liver disease, examining the impact of escalating alcohol consumption on health in the UK. Their recommendations are likely to directly inform government policy relating to controlling alcohol-related disease. Cramp works collaboratively with **Sheridan** and **Felmlee** in a large clinical-basic research group that has done ground-breaking work on Hepatitis C therapies and recently to develop a serological approach to Covid testing.

Excessive inflammation and aberrant immune responses are a feature of many diseases and understanding how the immune response is triggered and controlled is an important area of our research. **Fejer** is using novel non-transformed alveolar macrophage models to study respiratory viral and bacterial infections. In addition, he is researching in collaboration with partners in multi-disciplinary areas, the role of the environment on infectious challenges to human health. This includes how particulate

matter air pollution can induce or exacerbate lung infections and how microplastics might spread antimicrobial resistance in seawater and rivers.

Research Strategy

The areas of research focus for UoA1 will remain clinical neuroscience, cancer, and 3Is; but we will be adaptable as opportunities arise. **Greater research volume while retaining quality and impact is our priority** and will be targeted by following 6 strategic aims:

1) Resourcing excellence. Our UoA1 strives for high levels of focused research excellence and this will be supported by continued resource allocation such as those provided by the DRF, through university PGR studentships, through faculty research funding, and through the support and training of our faculty.

2) Focus and flexibility. We see ourselves as a focused centre of research excellence and will follow an appropriate hiring strategy with recruitment of clinical scientists on split hospital/university contracts and translational basic scientists largely within our established areas of expertise. We will however be ready to exploit new opportunities to expand from these areas as the science evolves and as opportunities present themselves.

3) Increasing income. Building our research income will expand research volume and will be achieved through greater professionalisation of our research application process across the FoH, with an increased use of external reviews, more professional training, and a slower application cycle with greater levels of scrutiny to build quality. This process started in 2019 and has contributed to a doubling in annual award capture (~£10M in 2019-2020 compared to a prior 3-year average of £4.1 M) across the FoH.

4) Exploiting synergies. The dissolution of barriers between our two health-related faculties and our three health-related institutes has enabled collaboration between areas of research strength. The opportunities afforded by seamless links with Nursing, Dental, Health professionals, Psychology and beyond are exciting and we will ensure that these broader relationships will enhance the research portfolio of UoA1.

5) Securing intellectual property. UoA1 has a strong record of enterprise activity (see section 4) and we have developed a faculty KE-Enterprise Committee with budget authority tasked with commercializing our research.

6) Developing our ECRs and junior faculty. We are serious about building our staff careers, widening participation in research, and developing our ECRs. We will build on our staff mentoring programs, developmental support mechanisms and training opportunities to expand the pipeline of junior faculty coming through into more senior roles and developing larger research programs.

Impact Strategy:

From licensing of patents to the co-development of novel technologies with industry, the launch of spin-out companies and the improvement of clinical delivery; innovation from UoA1 is realising economic, patient and public benefits outside of academia and across healthcare, business and society. This is facilitated by the co-localization of clinical, academic and enterprise on one geographical site, by the integration of translational and clinical faculty in the same research space and by an effective system for identifying and promoting impact and innovation. The **Faculty KE-commercialization Committee** runs regular open calls for development projects

(£130K budget in 2019-20) such as proof of concept, pump-priming, project development or marketing surveys. In a process managed by the ADR, selected projects are then developed by a university Priority Bid Program offering enhanced support and project management. Since 2014 we have for example generated a pipeline of commercial activity, including several international patents and working relationships with industry and **three successful spin-out companies with a current market valuation of £9M** (see section 4). Impact through clinical practice is developed through the units' joint clinical appointments and our translational researchers with links into the PenCTU, RDS, etc. A wide variety of public-engagement activity (see section 4) is important for delivery of societal and economic impact of our research; support for these activities has evolved from the structures of the Institute of Translational and Stratified Medicine into those of the newly launched PIHR.

Further evidence of our success is illustrated by our three case studies which have heavily influenced NICE guidelines for the treatment of Hepatitis C (**Cramp** has shown that specific anti-virals cure Hepatitis C infection in over 95% of cases); Mantle cell lymphoma (**Rule** has shown that specific novel therapies double mean life expectancy, leading to international licensing in 90 countries and over 200,000 patients treated); and development of Cardiac Computed Tomographic Angiography (**Roobottom's** work has led to NICE recommending CTCA as the primary diagnostic tool for all chest-pain patients in the UK, 340,000 patients per annum).

Future Research and Impact Plan:

Future research expansion will be achieved following the Research Strategy (above). We will continue to support and grow our focused areas of research excellence in UoA1. Growth will be achieved through strategic recruitment into these established areas while remaining nimble and responsive as opportunities arise. We will continue to assist staff who have an emphasis on teaching to develop their research interests (see Section 2); a focus that aligns with the University's 2030 aim to increase the proportion of research active staff. Our new research facility (DRF: see section 3) provides a permissive environment for increased collaboration between UoA1 faculty, and expansion of research volume as grant capture accelerates (see section 1: Research Strategy and section 2: Staff development and support). These changes will also promote impact growth which will be coordinated through the new PIHR. Clinical impact will be expanded through advanced plans for a funded Joint Clinical Research Office, jointly owned by University Hospitals Plymouth and the University of Plymouth.

Interdisciplinary Working

Our success in this area is evidenced by the interdisciplinary range of our UoA1 outputs, which cover a wide research terrain (10 main subject areas; SciVal), the integration of translational and clinical research and in our close and productive links into industry (see section 4). The DRF is organized on the principle of barrier-free shared resource allocation, with flexible group sizes and open-frame space allocation, an arrangement that is conducive to collaborations (section 3). PIHR is a strategic investment with a specific remit to increase interdisciplinary and collaborative working across all three university faculties, and to forge links that cross school, faculty and university boundaries and with the NHS and social care.

Research and Impact Strategy Delivery

Research across the FoH is overseen by an Associate Dean-Research (ADR, **Fern**), and research in each school is managed by an Associate Head of School-Research. Representatives of all research stakeholders attend the faculty Research Committee which drives forward the research strategy and also receives reports from oversight

structures (Research Governance Committee, Faculty Doctoral Committee, Ethics, Animal Welfare and Ethical Review Board, KE-commercialisation, Integrated Academic Training). The ADR represents research at the monthly Faculty Executive Group and wider university bodies (Senior Leadership Forum, Senate, Doctoral College, R&I Committee). This arrangement has clear lines of responsibility to enable an open and collaborative culture. Our research strategy is integrated across the faculty and within the university and the new PIHR is central to this, bringing together groups with shared interests and skills to foster collaboration within the faculty and facilitating research links with regional and national partners. This coordinated delivery of strategy is underpinned through 5 key mechanisms:

1) Organization of the research environment: UoA1 clinician-researchers and basic science-researchers cohabit an integrated laboratory space. **Collaboration is encouraged by an underlying philosophy of shared resource, communal equipment and barrier-free space management.** All staff are invited to a communal weekly research update seminar and cross-pollination between our research themes is common, for example on the interface between clinical neuroscience and cancer. Common compliance structures (Ethics, Health and Safety, Human Tissue Act, Animal welfare, Home office, Biosafety) are coordinated across the unit through a research governance committee which facilitates frictionless clinical-basic collaboration.

2) Strong core of clinician scientists: UoA1 returns 8 working medics (29% of staff) and includes many examples of clinicians collaborating with basic scientists on outputs and grants. **Clinicians running their own laboratory research have bench space alongside basic scientists who wish to translate their findings.** A specific example of excellence arising from this arrangement includes the work of the Brain Tumour Research charities' Centre of Excellence where basic scientists and clinicians utilize a variety of tumour tissues including from local patients at University Hospitals Plymouth to develop and test new biomarkers and clinical interventions. To assist with the integration of clinical and basic science research, the FoH and University Hospital's Plymouth had joint research committees, a structure currently evolving into a jointly funded Joint Clinical Research Office (JCRO) to further enable research integration between the two institutions. In the current REF period 24 Academic Clinical Fellows (e.g., Bennet 2016-; Roy 2017-) and Clinical Lecturers (e.g., **Dhanda** 2014-18; Edlmann 2019-; Offiah 2018-) have worked in UoA1.

3) Cohort of basic scientists aligned to the clinical themes: UoA1 returns 20 basic scientists with a focus on translational research and embedded in one of the three UoA1 themes. The work of the basic research faculty is funded almost exclusively from medical funding bodies such as the MRC and NIHR and medical charities such as BRACE and Huntingdon's Research. For example, **Luo** runs an MRC-funded laboratory that investigates the cellular mechanisms underlying Huntingdon's disease. Luo has forged close links with local stakeholders who regularly hold fund-raising events to provide equipment for his research. He holds Royal Society Newton funding for collaboration with groups in China which have proved fruitful, for example, the publication of a paper in Nature that was **ranked as No.2 in the world for impact by that journal for 2019.**

4) Integration with impact levers to transform research excellence: A particular feature of UoA1 is its integration with enterprise, clinical trials and outreach. There has been significant growth of enterprise activities flowing from basic research conducted in UoA1 since 2014 leading to real-world impact, e.g. from spin-outs and patent licensing. Examples include spin-outs such as **The Virus Group** and **Amphologics** and patent protections for multiple sclerosis therapies and diagnostics.

5) A geographically focused, well-equipped, facility supported by the university:

UoA1 has close proximity to a major teaching hospital, which is essential for effective clinical-basic collaboration. University Hospitals Plymouth has >1,000 beds and is the largest hospital in the South-West peninsula. We also directly adjoin Plymouth Science Park and the resources provided there for spin-out enterprise. The science park has a particular emphasis on health technology. The unit receives significant support from the University. For example, the group has had 20 PhD students supported from University-funded studentships and key pieces of equipment have been supplied by the University, including confocal microscopes, a deconvolution microscope and a suite of mass-spectrometers.

Section 2.

Staffing Strategy and Staff Development

Our 28 category A staff have primary appointments in either the Peninsular Medical School or School of Biomedical Sciences, which hold Athena Swan Silver awards. There is a 79/21 male/female ratio and 26.4% identify as BME. Our staff strategy aims for a mix of clinical and basic scientists and provides for a flexible research allocation of between 20-80% dependent upon research success. In line with University strategy we develop teaching-only faculty into active research using mentoring, annual personal development review, a staff development fund (£1,000 pa., each for training and development needs), access to a **Faculty Research Development fund** to assist award development (see under), our Faculty **KE-commercialization Committee funding calls** (see section 1), and permissive access to facilities. We operate an open, shared-resource research model, with **no access charges for our facilities** for faculty lacking external funding support. This covers all the facilities of the DRF including the animal facility (free rodent maintenance and support [within reason]), imaging, mass spectrometry, gas supply, nitrogen storage, etc. Access to the fully-supported main campus electron microscopy suite is also free of charge for unfunded work, and strong publications not covered by RCUK block grants are covered by the faculty. This approach is **highly accommodating of both junior faculty development and of funding breaks for more senior researchers**, and in combination with regular university PGR studentships (£2500 annual bench fee) and support for masters and undergraduate student research projects (£750 and £250), it allows our faculty to maintain active research programs independently of fluctuating grant success.

We have implemented the Concordat to Support the Career Development of Researchers and were among the first 35 European HEIs to receive the EU HR Excellence for Researchers kitemark. An example of good practice is the University of Plymouth Research Leadership Programme, delivered by the external providers Barefoot Training. This is a year-long programme consisting of an intensive three-day summer course, followed by four half-day workshops, and a series of one-to-one meetings with the instructors across the year to help set research objectives and find ways to plan and implement them. Two UoA1 staff have progressed successfully through the program in the last two years (**Madgett** and **Glebov**). We also run a faculty-wide research support program where staff can **consult personally with external professionals** (e.g., Parker- Derrington Ltd) to improve their grant writing and submission. This can involve several 1-2-1 sessions and reviews of grant drafts (e.g., **Glebov**). Regular group sessions are delivered by external consultants (e.g., day workshops from Andrew Derrington) and through the university Funding Advisory Service who bring in research council staff to provide tailored advice.

There is a clear pathway for the review of all grants. This includes mentorship throughout the grant writing process (arranged through schools), mandatory independent peer review and a standardised risk assessment of impact on staff workload, resources and finances. Applications are registered and tracked through the online Award Manager system, which alerts individual Associate Heads of School-Research as soon as an interest is logged, allowing them to mentor and support the development process. There is a **FoH Research Development Fund (£55K in 2020)** used to provide external paid reviews of pre-submitted applications, in addition to the internal expert review system.

All new staff are enrolled in an induction process which plays an important part in settling staff into their roles and is supported by an overarching university Induction Policy & Procedure. As part of induction, staff are required to complete e-learning programmes including Unconscious Bias, Diversity in the Workplace, Health and Safety and GDPR and Information Security. The effectiveness of training is actively monitored through the staff survey feedback. The annual staff Performance Development Review (PDR; conducted by the line manager) provides for monitoring of performance and discussion and recording of staff development. PDR is used to look back over training and development, to plan and support the next steps forward and to identify appropriate needs and linked opportunities for the future. To support and train the people undertaking the PDR process workshops are offered including a workshop on “having difficult conversations”, in addition to PDR calibration meetings to ensure a uniform standard is applied. We have a monthly Faculty Newsletter that is circulated to all staff and further information disseminated by the Heads of School to ensure that everyone is aware of all potential training and development opportunities. The newsletter celebrates staff achievements at all levels.

All UoA1 members develop a personal research plan and have regular discussions with their Associate Head of School-Research, facilitating planning of sabbaticals and analysis of workload. Progress in research is monitored by their Associate Head of School-Research as well as through PDR. Changes in research responsibilities are managed through the PDR process with a flexible approach to FTE allocations, and successful researchers can for example reduce teaching/admin loads and vice versa (within a 20-80% band). Career progression requirements and progress are also discussed in this forum. FTE-bearing research roles that become available are publicly advertised to allow all faculty the opportunity for leadership experience. Leadership opportunities are offered in major university committees such as the R&I Committee, where there are designated places for early- and mid-career researchers.

Open Research Environment

The FoH values open access to outputs and data and has mechanisms to provide these that dovetail with those at University level (Open Access policy and Research Data policy). The ADR manages a budget that supports open-access publishing costs, and the Faculty Research Support office helps monitor and assist with output and data management lodging on open-access platforms such as PEARL.

Early Career Researchers

ECRs are assigned a research mentor to guide the development of fundable ideas. The mentor also has an important role in pastoral support, helping integrate new staff into the culture and processes of the unit. The requirements of the Concordat to Support the Career Development of Researchers are embedded in University HR policies, under which our ECRs have representation at Faculty and School Research Committees. ECRs are supported for attendance at national and international meetings and conferences for presentations and networking through School staff development funds, this equates to approximately £1000 per member of staff. The

University Doctoral College runs a range of developmental workshops for postdoctoral and ECR Researchers on all aspects of professional practice. There is an active **Faculty ECR Forum** that encourages peer support.

Equality and Diversity

The FoH Athena Swan Self-Assessment Team meet every two months, reports to the Faculty Executive Group, and monitors our equality staff survey. In 2020 **93% of respondents were aware of our equality and diversity principles**. This is consistent with the latest e-learning completion rates: Diversity in the Workplace – 97%; Unconscious Bias – 96%; Mental Health Awareness -78% (2020). 85% of respondents strongly agreed/agreed that the FoH is committed to supporting all staff and students with protected characteristics. These strong numbers underscore our firmly embedded equality ethos; as also evidenced by recent actions such as the **ongoing decolonisation of our syllabus**, and **supportive messaging** (e.g., **Black Lives matter**). To further widen reach, we extend our equality training to all Honorary Associate Lecturers and encourage all staff in the unit to undertake further equality and diversity training in Transgender Awareness, Mental Health Awareness, Prevent training, Intercultural Communication and Dementia Awareness. In 2019 we introduced a **Faculty-wide equality pledge programme** where all staff are expected to generate a pledge for action they will take to improve equality, diversity and inclusion. The FoH conducted an Equality Impact Assessment to identify patterns and areas for increased support to achieve equality and encourage diversity and have actively engaged with staff to create a programme of development and support including:

- University Network of Dignity and Respect Advisors (trained, confidential volunteers who offer a listening ear and guidance).
- Gender split on all recruitment panels; all panellists undergo appropriate inclusion training.
- Academic Women for Women sessions to foster collaboration and provide a safe environment for exploring aspects of promotion.
- Twenty people have received leadership training over the past three years with a gender split of 15F:5M. Training has ranged from the Aurora programme (for female Associate Professors) to our University Research Leadership Programme (run by the Barefoot Training Company Ltd).
- Women's Mentoring Scheme which aims to enable women to realise their potential at the University of Plymouth and beyond. We also support a Women in STEM Network which celebrates the work and achievements of women.
- Springboard scheme for female ECR researchers which covers areas such as career development, building confidence, assertiveness, aspects of being a woman, identifying priorities.
- LBGT+ Staff Forum which provides network opportunities internally and externally.

Staff welfare promotes staff retention and reduces erosion in under-represented groups. We have developed a progressive program of welfare activities that includes providing administration support for working groups (lunchtime walking, 3 free Pilates session a week), as well as 'pop-up' mindfulness sessions and the provision of a permanent wellbeing room.

Research Students

We have successfully completed **62 PGRs this REF period, a 63% increase** from the last REF (38). PGRs are funded through a mix of university studentship and charitable sources (e.g., the dementia charity BRACE funded 6 full PhD studentships in UoA1). **University-funded studentships are a significant form of institution support to the unit**; within the FoH there were an average of 10 awards annually, representing ~£800K pa., in direct (bench fee, stipend) and differed (fee) costs.

Completion rates have remained high, achieved through a well-regulated safety net of support that includes a Director of Studies leading on supervision and by co-supervisors, who together act as a supervisory team. All teams strive for gender balance and have at least one senior academic with extensive supervisory experience including successful completions. Good supervisory practice training is mandated to all supervisors. Research proposals are subject to a pre-approval revision prior to the start of studies for quality assurance and new students benefit from an induction session run locally, in addition to the mandatory induction by the University Doctoral College. All UoA1 PGRs also receive dedicated laboratory induction and safety training.

Study progress is monitored online, with recorded supervisory meetings every 3-6 months at the minimum. Students complete a Project Approval stage 3-5 months after starting. 12-15 months into their studies students undergo a Confirmation of Route/ project transfer to PhD, and submit a study report detailing progress and future work. At this stage, they also give an oral presentation to the Faculty and sit a 'transfer viva' chaired by at least one independent expert commentator (internal). This structured process serves to ensure that the student is supported, makes good progress and is well prepared for the final write-up and *viva voce*. Student welfare is central and in addition to the supervisory team, students can consult a Postgraduate Research Coordinator based in their school as well as a range of well-being services offered by the University, including one-to-one counselling and mental health appointments, personal and group support and development sessions. In addition, Disability Assistance Services help any PGR student with a disability with their study support requirements.

In addition to providing pastoral support to students, school PGR Coordinators monitor and overseeing admission and supervisory team nomination, quality assurance, annual monitoring, etc. The PGR program within the Faculty is overseen by a Faculty Doctoral Committee, which reports to the University Doctoral College Board, and is chaired by a faculty Deputy Director of the Doctoral College (UoA1 **Barros**, 0.8 FTE total). PGR students are directly represented on the committee, which in addition to regulatory processes monitors student welfare, training and satisfaction. An Annual Monitoring exercise completed by PGR students as well as Directors of Studies (the principle supervisors) in all schools, covers student experience and progress. We are proud to be a diverse learning community and any student at the faculty can become a member of the Equality, Diversity and Inclusion Committee, which ensures the faculty remains an inclusive and welcoming place to work and study.

The student experience is enhanced by a variety of research, personal and transferable skills training opportunities offered by the University's Doctoral College Researcher Development Program, including Knowledge and intellectual abilities, Personal effectiveness, Research governance, and Engagement, influence and impact. A PGR Training and Career Development lead at the Faculty provides additional support. There is also a faculty **PGR conference fund** that helps students attend conferences, and the Faculty holds an **annual Research Event** where students submit posters and give oral presentations. In addition, UoA1 students benefit from a variety of seminar series, such as weekly unit research update presentations and monthly research talks by external speakers. These communal events foster a sense of community for our students who all have allocated office desk spaces and access to computers, in addition to unfettered access to our research services and facilities.

Section 3.

Grant Income

Award income for the unit during the REF period was £11.4M, a 25% increase compared to 2014, despite the transfer of several high-income capture Category A staff returned in UoA3 in this submission. Highlights of research income include:

- Our Brain Tumour Research Centre of Excellence has been supported by awards to **Hanemann** that total ~£3M (Cancer Research UK, Brain Tumour Research) with additional support from commercial sources (Takeda UK Limited) of over £240K. **Rules'** clinical studies on novel treatment approached to mantle cell lymphoma have also been funded through charitable (Cancer Research UK: 290K) and commercial (Janssen: 580K) routes. **Ammoun**, an ECR, was awarded >£220K from several charities including SPARKS and Action Medical Research. **Xinzhong Li** (2013-2019) led a €3.5 EU-funded European Training Network award (AiPBAND), Integrated Platform for Developing Brain Cancer Diagnostic Techniques.
- Development of **Upton's** spinout company, Amprologix, has been supported by a £1.2M award from the Department of Health and Social Care and was launched with a package of £562K from the BBSRC and Innovate UK. Innovate UK also funded **Jarvis** (£720K including funding from MRC) to commercialize his spin-out TVG and is a principal partner in an international team awarded \$9.37M by the US government's Defence Advanced Research Project Agency (DARPA).
- **Teiu's** (2014-10/2016) work on Parkinson's disease and mitochondria was supported by US NIH programme funding (\$730K -awarded to PU in 2014) and the MRC (£430K-2014). It is an example of our integrated working that **Fern** was a CI on both these awards, and on a £420K MRC award to **Luo** which formed part of the ~£600K captured by him in this REF period that includes a Royal Society-NSFC (China), Newton Advanced Fellowship in 2018.
- Numerous smaller awards are typified by **Barros** who received £410K from the BBSRC for her work on neural stem cells, and **Fejer** captured £350K (NERC and NC3R) to explore the potential of novel macrophage cell lines in alternative testing. Also in the field of immunology, the clinical research conducted by **Cramp** in hepatology was supported by over £520K largely through commercial and charitable sources; and **Dhanda** has received £480K from the MRC and the JP Moulton Charitable Trust.

Infrastructure and Facilities

The Derriford Research Facility (DRF) is a 3,463m², 4-storey BREEAM II Excellent research facility, an integral part of the University's investment to accelerate the translation of medical research into patient care. In combination with the linked John Bull Building it provides space designed to facilitate collaboration and flexibly team working. Operational from October 2017 and **90% occupied by UoA1 staff**, the DRF was a landmark investment by the University. Located at Plymouth Science Park and adjacent to the University Hospitals Plymouth NHS Trust, it places well-equipped research laboratories next to a 1000 beds specialist teaching hospital encouraging cross-organisation collaboration and enriching effective collaborations with the Hospital and enterprise; it is co-located with the PenCTU and the NIHR Peninsula Clinical Research Network on Plymouth Science Park. The building incorporates the Plymouth University Systems Biology Centre and Plymouth Light Microscopy Service (both 100% UoA1 facilities) and provides a rich, collaborative, interdisciplinary

environment for UoA1 clinical and basic science researchers. Specific features include:

- Open-plan, flexibly designed, **100% BSL-2 wet laboratory space**
- **Fully equipped BSL-3 containment facility** for working with high-level pathogens such as hepatitis C and SARS-2 COVID
- **7 Cell / tissue culture rooms**
- **Flow cytometry / FACS suite**
- **HPLC / LCMS laboratory**
- Microarray platform technology
- Extracellular Flux Analysis
- **HTA accredited tissue storage, biobanking** facilities and sample collections
- **Systems biology suite with 4 mass spectrometers, including Malditof** used for biomarker work
- **Centrally-supported (2.5 FTE technical specialist) in vivo facility integrated into the design**, including **behavioural and surgical suites, 900 cages, quarantine area**, and **biohazard room** (viral transfections)
- **Electrophysiological laboratory with intra-cellular, extra-cellular, ion-sensitive microelectrode and patch rigs**
- **Centrally supported (0.8 FTE technical specialist) imaging suite housing three confocal microscopes** (Zeiss 510/710, Leica SPE, Leica SP8) and **4 specialist light microscopes** (Nikon Eclipse with Arcturus, Nikon Eclipse with two cameras, Leica DM6b with Stereology, Leica DMI8 with Deconvolution), **2 fluorescent live-imaging set-ups** (spinning disk) and **single-cell PCR**.

4. Collaboration and contribution to the research base, economy and society

UoA1 has a strong relationship with the **Peninsular Medical Foundation (PMF)**, an independent charity fundraising through work with individuals, communities, businesses, trusts and foundations. PMF has raised **almost £4 million since 2002**. PMF is motivated by a belief in the high-quality basic research of Plymouth's Peninsula Medical School and channels the majority of its funding into UoA1. The **ADR (Fern)** sits on the various boards of the charity which organizes regular donor visits to the DRF. The Huntingdon's research group led by **Lou** has a strong relationship with local patient groups who hold sponsored events to support research and make regular visits to the DRF. Our dementia scientists have been central to the award and leadership of the **Alzheimer's Research UK (ARUK) South-West Dementia Network** which provides pilot funds, support to attend meetings and organizes annual research days where local patient groups meet and interact with the researchers. An example was the inaugural meeting in 2015 with a Plenary lecture from Gail Johnson from Rochester University (USA) and attended by over 110 researchers, patients and advocacy groups. UoA1 organizes annual research taster days for 120 5th year students from 12 local schools to experience a research laboratory environment, spending 4 hours rotating through a number of small research projects conducted by members of the groups (**Parkinson**).

UoA1 held a symposium to mark the opening of the DRF which included presentations by Dame Pamela Shaw (Director, Sheffield Institute for Translational Neuroscience) and Mark Fidock, Vice President, Precision Medicine Laboratories, AstraZeneca. The units' Brain Tumour Centre of Excellence has developed a close relationship with local patients and their families and runs 6 laboratory tours/year for them and other members of the public to engage with our research. Several UoA1 members are particularly active in public engagement to increase awareness of our research, as for example shown in 2019 by shortlisting for the national Antibiotic Guardian Awards in Public Engagement. As part of these activities, **Joshi** has spoken

at several national events and she appeared in the BBC documentary The Truth About: Antibiotics. Joshi was also recognised as the 'Jewel of India' by the Indian government for her international impact in the field of molecular microbiology; she has been particularly active in the media during the pandemic including BBC1, Channel 5, Fox News and NBC.

Impact Indicators

Amongst our translational scientists, **Jarvis** has made an important contribution to raising the awareness of zoonotic-infection in human health (Invited Speaker: British Society of Immunology, Cardiff; Emerging Zoonoses, Kansas, USA; Jenner Institute, University of Oxford; Pirbright Institute, UK; Chair, Vaccine Session, International Filovirus Symposium, Marburg). **Fern** has made important progress in the area of white matter injury recognized by speaker invitations (Plenary talks at Malta Medical Conference; 5th annual World Congress of Cell and Molecular Biology, Nanjing, China; Cerebral Palsy–NET, Toronto) and membership of the Science Advisory Council, Ontario Brain Institute and membership, Ontario Brain Institute and membership of the CP-NET Science Innovation Team. **Parkinson's** eminence is indicated by numerous Invited speaker roles (Jack Griffin lecturer, Peripheral Nerve Society, Baltimore; Chair plenary speaker session European Glial Cell, Edinburgh). He is also on the board of the European Society of Peripheral Nerve Repair. **Upton** has continued his leading role in the commercialization of anti-microbial resistance approaches giving invited talks at the Gulf Congress on Clinical Microbiology and Infectious Diseases, Bahrain and the International Biodegradation and Biodeterioration Society triennial meeting, Manchester. He has also been an invited attendee at BBSCR/NERC workshops on AMR in the Environment in both Argentina and India.

Amongst our clinicians, **Roobottom** has organised the UK Radiology Congress three times (2016-19) and advised DoH and NICE on CT. **Playford** (2014-18) has been President of the Association of Physicians (2016) and is a member HEFC Healthcare Education Advisory Committee. **Hanemann** gave The Sir Geoffrey Jefferson Lecture, Society of British Neurological Surgeons and invited talks at the 4th UK Pharmacogenetics & Stratified Medicine, London and the World Federation of Neuro-oncology Societies Conference, Zurich. He sits on the Board of Brain Research UK and on the scientific board of the European Association of Neuro-oncology. **Cramp** has been the President of British Association for the study of the Liver (BASL; 2017-19) and **Rule** the Chair of the National Cancer Research Network (NCRN) Low Grade NHL Committee from 2013, member of the Cancer Research UK Clinical Trials Advisory Committee (2012 -), and President of the British Society for Haematology (2019). **Martin** sits on the Board of the National Institute of Academic Anaesthesia, is Deputy Lead for the National Institute for Health Research Clinical Research Network Specialty Group for Anaesthesia, and sits on the Perioperative Medicine and Pain Management Council of the Intensive Care Society. He was awarded an OBE for his contribution to the countries' Ebola response. UoA1 staff sit on numerous journal editorial boards including Cancer Letters (**Hanemann**), Frontiers in Cellular Neuroscience (**Kramer**), European Journal of Nutrition (**Foey**), Journal of Chemical Neuroanatomy (**Fern**) and Scientific Reports (**Dhanda**) -who also is Lead of the British Association for the Study of the Liver Alcohol-related liver disease Special Interest Group (elected position).

Covid-19

UoA1 moved quickly to respond to local and national needs as the pandemic evolved. Equipment was **loaned from the DRF through the second logistic division to the Lighthouse testing centre in Northern Ireland**, including a number of PCR machines, quantities of small lab equipment and large safety cabinets. UoA1 also

loaned equipment, including large bench-top centrifuges, to the local testing laboratory at the University Hospitals Plymouth. At the first peak of the epidemic, the hospitals testing laboratory lacked sufficient trained staff and UoA1 established a live document of **volunteers with PCR skill from our laboratories with 48 individuals on call**. While complying fully with government measures, we put considerable support in place to maintain our UoA1 virus research programme. This included clinical serology research into the virus (**Cramp**) and our own vaccine development programme (**Javis**) spearheaded by our spin-out TVG. Support included keeping our research faculties open for vaccine development with special safety measures in place. Through contingency-planning, when lock-down first eased we were well prepared with risk-assessments and safety equipment to re-start our research which was fully operational since July 2020.

Lighthouse Plymouth

As of September 2020, **UoA1 support of Covid-19 vaccine development**, in combination with our unhesitating support for local and national testing, was a strong factor in the selection of Plymouth for a **40K sample/day Lighthouse testing centre** in Estover, close to the DRF. The laboratory became operational from February 2021 and will employ ~400 biomedical staff. **UoA1's Fern sits on the Lighthouse steering committee and coordinates between the university, council and trust**. In addition, by contact with other trusts (Truro and Exeter) with LAMP programmes, he is helping to manage a coordinated hiring and management strategy across the region.

Two of our spin-out companies are particularly well-positioned now to rapidly expand as they develop to meet the pandemic crisis (included in next section).

UoA1 Spin-out Companies.

Our 3 spin-out companies currently have a combined market value of £9M.

The **Vaccine Group (TVG)**, founded by **Jarvis** in 2017 developed a vaccine to prevent the spread of *Streptococcus suis* (S.suis). S.suis is currently treated with antibiotics, but there is growing evidence that it is becoming resistant and that effective vaccines remove the need for antibiotics in animals. TVG's novel herpesvirus-based platform technology generated a single-use vaccine for use in pigs, with **Upton's** research group is identifying targets for other new vaccines being developed by TVG. This work is progressing with Chinese partners, including the Shanghai Veterinary Research Institute at the Chinese Academy of Agricultural Sciences, and the Shanghai Jiao Tong University (Pulike Biological Engineering Company is the commercial partner). **TVG** is also playing a central role in a project to protect military forces from Ebola, Lassa fever and other deadly zoonotic viruses that jump from animals to humans. On the 23rd June 2020, TVG released a press announcement describing their rapid progress toward Covid-19 vaccine. In confidence and not included in that release, **TVG have started three in animal trials** (hamsters). If these preliminary trials are successful, TVG will quickly move into non-human primate trials (rhesus macaques). **The company's primary differentiator is the targeting of a strong T-cell response** to address a 'weak spot' for the current vaccine candidates that have released data publicly, which appear to have low impact on viral shedding.

Amprologix was founded in 2018 to commercialise the work of **Upton** on the development of a new class of antibiotics to help tackle drug resistant infections. Amprologix is working in partnership with world-leading biotechnology and synthetic biology company **Ingenza Ltd**, focused on developing their first lead compound, epidermicin, for commercial use; discovering additional sources for new classes of

antibiotics; using AI to improve antibiotic properties, working with Ingenza, IBM and the National Physical Laboratory, and; developing efficient techniques to manufacture antibiotics at scale. In a relevant infection model, a single dose of epidermicin is as effective as six doses of the current standard of care in killing harmful bacteria, including MRSA. The antibiotic was initially recovered from a skin bacterium named *Staphylococcus epidermidis*, but can now be produced in a microbe suitable for industrial scale-up, using synthetic biology methods developed by Ingenza, which has a stake in the new business. **Epidermicin N101 is currently undergoing final evaluation before a proposed Phase 1 clinical trial in 2021** and Amprologix is actively involved in broadening its portfolio of candidate antibiotics using a combination of rational drug design and traditional antibiotic discovery approaches.

A rapid water testing kit developed **MolEndoTech** is being rolled out commercially in the UK and Ireland. The SirenBW system developed by MolEndoTech (established to commercialise the work of **Jackson**), can dramatically reduce the time required for authorities to assess the quality of recreational water from two days to 20 minutes. The commercial roll out is being carried out by Palintest, a subsidiary of FTSE 100 group Halma plc, and will initially focus on the UK and Ireland and include the establishment of a number of demonstrator sites. It follows a successful technical evaluation and demonstration during the 2018 bathing water season. The technical demonstration programme has also begun at several iconic Australian locations to accelerate the global roll out of the SirenBW during the southern hemisphere summer. MolEndoTech is also working with other commercial partners in food and beverage production, developing methods for detecting pathogens on fresh produce and in the water used to irrigate it.