

Institution: University of the West of England, Bristol

Unit of assessment: 3 Allied Health Professions, Dentistry, Nursing and Pharmacy

Section 1. Unit context and structure, research and impact strategy

1.1 Overview

This submission includes research from biomedical sciences and diagnostics through to novel patient care delivery. Our research is organized under five well-established and integrated themes. 1) *Biomedical Research and Diagnostics*, 2) *Appearance and Health*, 3) *Child Health*, 4) *Long-term Conditions* and 5) *Emergency Care*. These research themes are strategically aligned to three University Research Centres; the Centre for Research in Biosciences (CRIB), the Centre for Appearance Research (CAR) and the Centre for Health and Clinical Research (CHCR), which provide research focus, direction and infrastructure. The Unit also has strong links to the University Institute of Bio-sensing Technology (IBST) and the newly established Health Technology Hub in the University Enterprise Zone (UEZ). Both IBST and UEZ facilitate regional, national and international collaborations, support knowledge exchange with industry and healthcare providers, advance technology to enable people to live independently and manage their health and wellbeing.

The main beneficiaries of the Unit's research are the health sector (particularly patients and health professionals) and industry. There are four main types of impact related to the Unit's research, i) **Commerce and economic impacts**, including evidence of improved effectiveness in diagnostics and healthcare delivery, the development and adoption of new products in industry achieved by *Biomedical Research and Diagnostics* and *Long-term Conditions*. ii) **Health, welfare and third sector impact**, including documented changes to guidelines, cost saving for healthcare, improved care delivery and clinical outcomes and enhancement of patient experience achieved by *Biomedical Research and Diagnostics*, *Appearance and Health*, *Long-term Conditions*, *Child Health* and *Emergency Care*. iii) **Public policy and services impact for patient benefit**, including input and influence to policy debate and change achieved by *Emergency Care* and *Long-term Conditions*, and iv) **Building skills, networks and capability**, including upskilling healthcare professionals nationally and globally achieved by *Biomedical Research and Diagnostics*, *Long-term Conditions*, *Appearance and Health*, *Child Health* and *Emergency Care*. There is a strong collaboration within and between these research themes with staff returned to other UoAs, notably 6 and 20.

1.2 Achievement of strategic aims for research and impact during the assessment period

The Unit's vision in REF 2014 was to '*deliver excellent user-informed research to generate new scientific knowledge, and lead to improvements and positive impact on the health and wellbeing of society.*' To achieve these aims, the Unit has delivered on its strategic plan, which was aligned to the University's Research and Impact Strategy 2020. Key examples are provided in this section (a-f) and further examples and details are outlined in the relevant parts of Sections 3 and 4.

a) '*To ensure ongoing development of established and emergent areas of research excellence, addressing national, international, industry and health priorities and ensure long-term sustainability and benefit*'; To achieve this, in the period 2014-2020 the Unit has benefitted from University infrastructure investment (£12.5M), secured £16.5m of external research income, made new strategic academic appointments and built staff and PGR capacity through competitive calls for internal and external funding. These investments supported research and impact in a range of areas as outlined in b-f, below.

b) '*To maintain and sustain our collaborative partnerships with academia, industry and healthcare providers to enhance research and to achieve impact*'; The Unit secured £17.6M funding for health-related research during the REF period, of which £4.5M was received in collaboration with industry. Highlights include AIRWAYS-2 (out-of-hospital airway management) funded by the NIHR (£858K) and led by **Benger** with **Voss**, the results of which were assessed by the International Liaison Committee on Resuscitation (ILCOR) as a "*high priority*" and informed the publication of the ILCOR

and Emergency Cardiovascular Care Science with Treatment Recommendations. A further example is the point of care immunoassay diagnostic device with enhanced sample processing and multiplexing capabilities developed by **Luxton**, which has been used for rapid diagnosis of Urinary Tract Infection in GP clinics. This interdisciplinary project was funded by the NIHR (£1.2M). Furthermore, **Killard** created the spin-out company *BreathDX* with the NHS and *Metabolic Support UK*, formerly *Climb* (a leading patient organisation for inherited metabolic disorders). **Killard** developed and evaluated a device measuring ultra-low concentrations of breath and blood ammonia in collaboration with the Birmingham Children's Hospital (£169K).

International collaborations across the USA, Canada, Asia, Africa, Australia and Europe have been maintained and strengthened to support research (£4.4M total project funding), publications and impact. For example, **Mytton** established the Nepal Injury Research Centre funded by the NIHR (£2.5M) to address the growing problem of injuries affecting the people of Nepal. Three impact case studies submitted for this Unit (**Saad, Stock and Walsh**) further evidence international collaborations and impact.

We have strengthened our collaborations nationally through continuing membership of the Applied Research Collaboration (ARC) West (formerly CLAHRC West), the West of England Academic Health Science Network (WEAHSN), Bristol North Somerset and South Gloucestershire Clinical Commissioning Group (BNSSG CCG) and Bristol Health Partners (BHP). BHP is one of eight partnerships awarded an Academic Health Science Centre (AHSC) designation in 2020 for the next five years. This is a strategic partnership between local universities and NHS organisations that combines excellence in research, health education and patient care. We lead four Health Integration Teams (HITs) supported through BHP/AHSC to address key health issues through research and innovation. The Bristol Bones and Joints HIT led by UWE (**Dures**) has secured £400K from NIHR Research for Patient Benefit. Our work with BNSSG CCG has led to joint appointments including a Professor to support knowledge mobilization and impact and to several research support roles including two jointly funded posts supporting the preparation of NIHR grant applications. This collaboration is presented as part of an impact case study (**Walsh**). Our strategy also includes jointly funded PhD studentships with the health sector, the third sector, industry and academia.

These collaborations with healthcare providers and commissioners across the South West, which includes patients and public groups, have supported the development and implementation of the Research in Emergency Care Avon Collaborative Hub (REACH). This is led jointly by UWE and the University of Bristol to provide academic support to local and national healthcare services for the 70,000 people attending Accident and Emergency and the 1M attending GP appointments each day in England.

c) *'To strengthen our relationship with patients and the public to ensure their involvement in our research activities'*; The involvement of patients and public remains core to the design and execution of our research. The University leads the People in Health West of England (PHWE) public involvement team, which supports collaboration across four health networks within the region including; ARC, WEAHSN, the NIHR Clinical Research Network and BHP/AHSC. This leadership role integrates public involvement in all our health research and includes leadership of a work package on public involvement in a major £6.6M UK non-communicable disease prevention project funded by the UK Prevention Research Partnership. PHWE was recognised as a unique and innovative approach to developing public involvement by NIHR INVOLVE in 2016. The Unit also supports a wide range of public engagement activities (see section 4.5).

d) *'To target investment in staff and infrastructure to support excellent research and achieving impact'*; We have strategically invested in our staff and infrastructure, which included the external appointment of 8 research leadership posts (Associate Professor and Senior Research Fellow posts), 16 staff internally promoted and £12.5M infrastructure investment. Key appointments include a new Professor and two permanent Wallscourt Research Fellows supported through a major University research investment in priority areas; seven academic posts with 50% ring fenced time for research and impact, aligned to the priorities of the Government's Industrial Strategy and UK

Research and Innovation, and 14 new appointments and internal promotions at Associate Professor and Professorial levels.

The unit has benefitted from University schemes to support novel and collaborative research for staff in different stages of their career, including early-career, cross-university and cross-faculty research initiatives such as the Vice-Chancellor's (VC's) Early Career Researcher Awards and the VC's Interdisciplinary Research Challenge Fund. Investment has also been made in an Enterprise Lead to facilitate the interaction between our partners to support pathways to impact, alongside an Impact Champion and a Research Fellow to support the achievement and evidencing of impact. The University has also invested in a full-time technician post specifically to support collaborative research between the Health Technology Hub and *Biomedical Research and Diagnostics*.

e) '*Research capacity building to ensure our talented early/mid-career researchers and research students are well placed to lead future research excellence*'; Our strategy has been to ensure succession planning and growth in key research areas. We made twelve mid-career appointments and promotions (Senior Lecturer, Research Fellow). Development support for preparing high quality bids is provided by the VC's Accelerator Programme for Mid-Career Academics. University-wide investment through the VC's Early Career Researcher Awards has supported eight researchers in this Unit and has led to prestigious funding including three Wellcome Trust SEEDS awards, a NIHR Knowledge Mobilization Fellowship and an NIHR Applied Research Collaboration (ARC) West post-doctoral research fellowship. Eight academics in the Unit are being supported to complete doctoral studies as part of the Faculty health-related Doctoral Capacity Building Programme. The Unit has invested in Doctoral Training Partnerships (DTP) including six Doctoral Training Alliance (DTA) partnership PhDs in Applied Biosciences for Health (£423K), two ESRC funded South West DTP PhDs and 20 partnership PhDs from the BBSRC South West Biosciences (SWBio) DTP (£3M). We also supported six postgraduate research studentships that include 50:50 partnership PhDs co-funded with industry (CEMAG & Aryballe Technologies, Colgate-Palmolive, GeneTools LLC) and the health sector (West Wales Prostate Cancer Charity Partnership, BRACE, BNSSG CCG). The Faculty of Applied Sciences, which hosts this Unit, has created a strategic lead for postgraduate research funding whose role is to drive the development and implementation of the Faculty strategy for attracting external funding for postgraduate research. We have also supported doctoral students into research posts at UWE with subsequent promotion to Senior Research Fellow, two of whom are leading Impact Case Studies (**Saad** and **Stock**).

f) '*Making a positive contribution to our student experience through the integration and dissemination of our research findings into undergraduate, postgraduate and professional curricular*'. The Unit continues to integrate its research into learning and professional practice. During the REF period, academics obtained £14.5M for Knowledge Exchange, which includes consultancies, health education and training. The University has developed *Future Space*, which connects entrepreneurs and tech innovators with scientists, researchers and graduate talent. *Future Space* provides internships for our undergraduate students to gain entrepreneurial skills with the Enterprise Lead facilitating the interaction between the various partners and students. The research findings from the NHS 100,000 Genomes project are used directly in the MSc Genetic Medicine programme run in collaboration with the University of Exeter, providing training for postgraduate life and health science students. Further professional development in genomics is offered to nurses, funded by Health Education England and Macmillan Cancer Support (**Varadi**). A new interdisciplinary MSc in Health Technology, based on our biosensing, biomedical and health research has been developed (**Conway**). Additionally, three of the Unit's impact case studies (**Saad**, **Stock** and **Walsh**) provide further evidence of national and global professional training.

1.3 Future strategic aims and goals for research and impact

The Unit's vision is to continue delivering excellent user-informed research, which generates new scientific knowledge and leads to improvements on the health and wellbeing of local and global societies. We will continue to ensure that the principles of Equality, Diversity and Inclusivity are maintained in our research. To achieve these aims the Unit's ten-year strategic plan, which reflects the UWE Bristol Strategy 2030: Transforming Futures, will focus on:

- Maintaining and resourcing existing research excellence with impact and emerging research strengths aligned to one of four University beacons '*Health and Wellbeing*' including biosciences, health technologies, mental health, long-term conditions, healthy aging, wellness and wellbeing, and global challenges
- Continuing investments to develop and support early/mid-career researchers to lead future research excellence and impact in health and wellbeing
- Establishing new posts in health technology and ophthalmology to address cross disciplinary and multi professional healthcare challenges
- Enhancing our newly established Bladder and Bowel Confidence (BABCON) HIT and emerging continence care research bringing together expertise from basic biomedical research and clinical practice
- Developing and applying the use of big data in healthcare in collaboration with internal and external expertise
- Enhancing clinical trial capabilities and collaborations with industry and healthcare, incorporating this into our teaching portfolio
- Achieving outstanding and far-reaching research impacts on business, government, the NHS and other stakeholders, communities, society and the third sector
- Maintaining, supporting and further developing existing mechanisms to achieve impact including expertise in realist evaluation and knowledge mobilization
- Proactively driving business and community engagement, drawing on our research to inform and engage on key challenges and issues
- Supporting and driving the development of a new university Enterprise Park, business collaboration and tailored programmes in support of skills and innovation

1.4 How these relate to the structure of the unit and will be achieved

Responding to priorities and initiatives – The Unit's research aligns to wider international and national research priorities including the Global Challenges Research Fund (GCRF), the Government's Industrial Strategy and UKRI strategy. These priorities are reflected in UWE's Research Strategy 2030 which includes the '*Health and wellbeing*' beacon. Within this beacon there are a number of priorities that closely align with the Unit's research including biosciences, health technologies, long-term conditions, wellbeing and healthy aging. We will continue to access internal investments available through University and Faculty research schemes in order to develop capacity to deliver research with impact and bid successfully for external funding. These include the Vice-Chancellor's Early Career Researchers (VCECR) awards, VC Interdisciplinary Research Challenge Fund, Partnership PhDs, Faculty-funded schemes including Research Establishment Time for newly appointed academics (in the first 3 years of their appointment), interdisciplinary collaborative grants, funded research time and cross faculty collaboration opportunities. These schemes support staff in their research development at various points of their career in activities such as developing external collaborations, responding to external funding calls, the dissemination of research and generating impact.

Enhancing our research excellence – The Unit will maintain and enhance the existing structure supporting research excellence across all five themes noted above. New areas of research in health technology, ophthalmology and continence care will be located across *Biomedical Research and Diagnostics* and *Long-term Conditions* allowing opportunities for novel cross-cutting interdisciplinary research. The new technology-facing appointments located in the Health Technology Hub will broaden capacity for interdisciplinary research and further integration with industry. Collaboration with the UWE Centre for Fine Print Research, recipient of Expanding Excellence in England (E3) funding in 2019 (£7.7M), will provide opportunities to enhance our biosensing research capacity through the development of innovative technologies and new research appointments. Recent significant investments (£5.4M) to support the newly established Optometry and Clinical Skills space and a Senior Research Fellow post in Emergency Care (**Schofield**) will provide infrastructure to develop these areas of research. This initiative will also draw on our partnership with the Bristol Eye Hospital where the National Eye Research Centre (which funds eye research throughout the UK) is based. The Unit's public facing optometry clinic will also provide additional research opportunities. Big data and clinical trial expertise will be

integrated across the existing five themes. Our aim to build big data expertise will in part be achieved through the recent strategic appointment of a Wallscourt Fellow (**Smith A**) and a Senior Lecturer (**Greenhough**) with 50% research time for three years. Previous investment of Higher Education Innovation Fund (HEIF) monies in a dedicated bio-informatics facility to support health data use for research will continue enabling the close relationship with the Research Design Service Southwest. This will enhance existing support for clinical trials going forward. The Unit will continue to enhance its commitment to public involvement across all its themes, drawing on the newly appointed Faculty lead for public involvement in research and through continued use of mechanisms that exist via the UWE led PHWE.

Promotion of research activity, culture and dissemination – We will continue to promote our research activities in a number of ways. Our research centres will support interdisciplinary working, and cross-University, national and international collaborations. Our research centres will continue to facilitate research seminars and annual conferences that include presentations by both internal and external academics and postgraduate students. Our postgraduate students also run their own series of biweekly research seminars. Attendance at international and national conferences will continue to be supported, alongside wider dissemination methods such as web site development, media presentations, blogs, podcasts and social media. We will continue to develop and promote our outreach activities with local schools and at science fairs; members of the Unit collaborate with the UWE Science Communication Unit (a University Centre of Excellence) who provide expertise on public engagement in science. This will build on previous initiatives such as a joint project with **Varadi** to contextualize STEM curricula in schools and raised awareness of the NHS 100,000 genomes project through the BoxED Genomics Medicine Outreach Programme. This was developed in partnership with Health Education England (£10K) and delivered to over 22,000 children in the southwest region and nationally and featured in the Royal Society of Biology 'Global Challenges' ITN production in 2018.

Supporting impact – We will continue to invest to support and enable research impact across the Unit, including through the Impact Champion and Research Fellow (0.4 FTE). Planned impact is mapped using a simple Logic Model which enables the Unit to target resources to develop impact and collect evidence. Our Unit will continue to draw on the existing expertise available in the University's Research, Business and Innovation team (RBI), as outlined in the Institutional Environment template, and IBST. Led by **Luxton**, IBST has more than 50 industry partners, a network of over 800 companies, a total research income of over £30M and three spin-out companies. IBST plays a prominent regional role through the Local Enterprise Partnership Health and Life Sciences Sector Group and works closely with MediLink SouthWest, the regional industry network for the life science and healthcare sectors. **McCalley's** impact, as described in his case study, benefitted from IBST through collaborative work with Agilent Technologies in chromatographic instrument design leading to more efficient separations of molecules of pharmaceutical and biomedical importance. IBST's £1.5M Health Technology Accelerator Programme, which funded the newly created Health Technology Hub located in UWE's Enterprise Zone, will continue to support academics in the translation of research findings into industry. The Unit will capitalize on this mechanism going forward through working closely with the newly funded Faculty Enterprise Knowledge Exchange Lead. Our continued involvement in the WEAHSN will accelerate the spread of innovative, evidence-based care to improve health care quality building on the approaches used to support knowledge mobilisation (as illustrated by **Walsh's** impact case study).

1.5 Research integrity and governance

We will continue to maintain and develop our research governance (RG) in line with internal and external requirements. Unit staff are able to access well established structures for the ethical review of research. Researchers working in the health service are also able to obtain advice and guidance on external ethics review processes, research passports and NHS Research and Development from the Faculty Research Ethics Committee and RBI support services. The Principal Investigator for all research projects is required to complete a RG Record which captures information on all aspects of governance that are appropriate, including the use of endorsed risk assessments. Staff from the Unit are members of both the University and Faculty Research Ethics Committees, and

University-wide committees based in the Faculty that cover Biological Safety, Animal Welfare and Ethics, Genetic Modification Safety and the use of Human Tissue (led by **Conway**). A University-wide RG Manager oversees the development of RG policy, which is driven in the Faculty by the RG academic lead who chairs a Research Good Conduct Group to support and ensure delivery of good practice in line with the Concordat to Support Research Integrity and the University's Code of Good Research Conduct. All research data collection must conform to the GDPR2018 regulations and projects are required to have a Data Management Plan. Regular training sessions are put in place in the Faculty to ensure all staff are aware of the RG requirements and are kept up to date with new regulations, procedures and good practice.

1.6 Open research

UWE's open access policy and strategy have been developed by the Library Services in consultation with the research community. Academics and doctoral students are offered training on open access principles and practices and funding is available to support open access charges for UKRI and other funded research. Academics use a Worktribe repository and an e-Prints data archive to preserve and make their data accessible. With the exception of embargoed theses, all doctoral students deposit their data at the time of completion. To support the reproducibility of data we follow the standard reporting guidelines such as the Journal of Cell Biology, Cochrane review and Consort guidance. Orchid ID was implemented by all academics. We will continue to employ the Open Science FAIR principles (Findable, Accessible, Interoperable and Reusable) by complying with funders' requirements for open access publication.

Section 2. People

2.1 Internal promotions and new appointments

The Unit has worked to ensure succession planning and to strengthen industry and clinical practice links through new strategic appointments, and the development and internal promotion of staff. The University, through the Wallscourt Foundation, has invested in two new Fellows (**Smith A, Martin**) to enhance our Health Technology and Data Science research; **Martin** was recently promoted to an Associate Professor at Coventry University. An appointment at Associate Professor level (**Tume**) was made to support the *Child Health* theme for a period of three years, prior to her promotion to a post at the University of Salford. The Unit has benefitted from three new appointments offering 50% research time for three years at Senior Lecturer level; **Ndosi, Lewis** and **Flurey** (*Long-term Conditions*) and **Greenhough** (*Biomedical Research and Diagnostics*). Internal professorial promotions include: **Conway** (*Biomedical Research and Diagnostics*), **Mytton** (*Child Health*) and **Cramp F, Walsh** (*Long-term Conditions*). Internal promotions to Associate Professor include: **Mansell** and **de Lacy Costello** (*Biomedical Research and Diagnostics*), **Cotterill, Cramp M, Dures, Voss, White** (*Long-term Conditions*). *Biomedical Research and Diagnostics* has also benefitted from the promotion of **Saad** to Senior Research Fellow (SRF) and *Appearance and Health* research from the promotion of **Stock** to SRF. Furthermore, the Unit invested in eight early career researcher posts (**Clark, Greenhough, Honeychurch, Lewis, Llewellyn, Pearson, Thomas A, Williams**). Three new Associate Professor roles, a Wallscourt Professor and Fellow (Mental Health and Wellbeing) have been created to support the Unit's future research ambitions. An additional newly appointed Associate Professor post in Food Systems provides opportunities for collaborative research with UoA6.

2.2 Facilitation of joint appointments and succession planning

To facilitate health service and charitable research, a number of joint initiatives have been supported. **Benger** is seconded to the Unit from University Hospitals Bristol (UHB) NHS Foundation Trust and is the National Clinical Director for Urgent Care, NHS England. He leads the Emergency and Critical Care research team as part of REACH at UWE, which includes **Voss**. Following the retirement of **Hewlett**, **Dures** was promoted to lead the UWE rheumatology team based in Academic Rheumatology at UHB. The team includes **Robson**, a Consultant Senior Lecturer in Rheumatology, undertaking research in giant cell arthritis and **Ndosi**, a Senior Lecturer in Rheumatology Nursing. **McCabe** leads a team researching pain, including **Llewellyn**, a Senior Research Fellow, based at Dorothy House Hospice. The Centre for Academic Child Health, a joint

initiative between the University of Bristol and UWE, promotes the academic study of child health. Led by **Mytton**, the UWE team members include **Deave** and **Beckett**. Staff are embedded in external organisations such as the WEAHSN (**Walsh**), North Bristol NHS Trust and ARC West (**Cotterill, Moule, Cramp M**), University of Bristol and BHP (**Mytton**) to maximise the potential to undertake research with a clearly defined public health and clinical commissioning need. Since promotion, **Cotterill** has been awarded an Emerging Leadership Scholarship by the Florence Nightingale Foundation.

The Unit is supported by a number of Professors Emerita who were included in the REF2014 submission and retired during the current REF period (**Hewlett, Greenman, Rumsey, Salisbury**). These appointments provide important mentorship and have formed part of succession planning in priority areas. For example, **Rumsey** and **Greenman** supported the development of two of the Unit's impact case studies (**Stock** and **Saad**, respectively). Our commitment to succession planning is further evidenced by staff represented in the Unit's submission, 18% of whom are Early Career Researchers.

2.3 Staff development and support

Academic staff are supported in the following ways: *i)* All new colleagues are offered Research Establishment Time (half a day a week for two years for career development purposes; **Thomas A, Clark, Honeychurch, Lewis**); *ii)* Research Progression Time (half a day a week for two years) is available for those staff who wish to further develop or re-establish their research career (**Vahabi, Thomas R, Craig, Turton**); *iii)* researchers in emerging areas of research excellence have been supported through Vice-Chancellor's Early Career Researcher Awards with a total value of £110K over the period (**Pearson, Clark, Greenhough, Craig, Lewis, Stock, Thomas R, Thomas A**); *iv)* researchers are allocated a mentor to support their transfer to the University and aid in the development of research capability; *v)* specialist training and mentoring are provided for bid preparation, project management, financial and risk management; *vi)* induction/early mentorship, appraisal and career development is provided, which includes Doctoral Capacity Building that currently supports eight academic staff; *vii)* a performance and development review (PDR) is undertaken by all staff and used to inform career pathways for research as well as other activities, in line with strategic priorities. The annual PDR process has informed the internal promotion of twelve research academics in this Unit. Three research grade staff in the Unit have secured permanent academic positions as Senior Lecturers at UWE (**Honeychurch, Lewis, de Lacy Costello**). The principles of the Concordat to Support the Career Development of Researchers (2008, revised in 2020) have been actively implemented in the Unit in line with the University's strategic priorities. As a consequence, UWE has held the HR Excellence in Research award since 2012. The Researchers' Forum provides a platform for research grade staff across the institution, giving them a voice and supporting their career development. Its steering group is attended by **Deave**. It runs two dedicated events each year as well as feeding into the University's research staff development provision. Examples of former early career staff who were supported in the REF period who have made a significant contribution to this submission as key researchers include **Saad** and **Dures**. To further support staff development, interdisciplinary funding is available through competitive tendering with colleagues in other Faculties. Recipients include **Mansell** who created functionalised bone biomaterials and **Lewis** who developed a visual hand illusion for the treatment of chronic pain, both with engineering colleagues. Additionally, academics were recipients of the VC's Interdisciplinary Research Challenge funds (£25K each); **Conway** to study the effects of dementia with academics from psychology and engineering; **Tume** to use artificial intelligence techniques to analyse data from patients in intensive care focusing on sedation, nutrition and ventilation, to improve treatment in collaboration with academics from computing. Recent cross-research centre collaborations were supported (£20K each) to develop new testing for diabetic foot ulcers (**Ndosi, Saad, Varadi**); to combine biosensing and bioinformatic analysis for the diagnosis of colorectal cancer (**de Lacy Costello, Ratcliffe, Smith A**); and to study the impact of COVID-19-related death on citizens in collaboration with the Science Communication Unit (**McCabe**).

2.4 Research students

The Unit provides an integrated training, support and learning environment for its postgraduate research (PGR) students and draws on the UWE Graduate School and Code of Practice for

Postgraduate Research Study in this work. A dedicated Faculty Director of Postgraduate Research Studies (**Moss**) liaises with the Centres to deliver PGR training. An additional Lead for Postgraduate Research Funding enables a coordinated response to external PGR funding opportunities.

Over the assessment period there were 123 doctoral completions (see REF4a). Currently the Unit supports 45 FTE doctoral students including 17 studentships funded externally from a range of sources such as overseas Governments (Saudi Arabia, Malawi and Nigeria), industry (Gene Tools LLC; Colgate-Palmolive; CMAG Consulting, Aryballe Technologies, Petroleum Technology Development, Invatech Health Ltd and Airbus); charities (West Wales Prostate Cancer Charity, Arthritis Research UK, Alzheimer's/BRACE); and UK health research funders (MRC, Public Health England; NIHR, Solent NHS Trust; NHS Blood & Transplant, Maidstone and Tunbridge Wells NHS Trust; University Hospitals Bristol; Avon and Somerset Police).

We have six Doctoral Training Alliance Applied Biosciences for Health programme PhD students. This DTA programme is funded across 20 Alliance Universities and partner institutions, building on the industry and health focus of the universities. In addition, the Unit's success in REF2014 enabled it to become a member of the ESRC South West Doctoral Training Partnership (SWDTP) and to date has benefitted from two fully funded studentships. UWE received support for 20 match-funded PhD student positions and five fully funded CASE studentships as part of a £18.5M investment in the South West Biosciences Doctoral Training Partnership from BBSRC. We were also awarded two industrial CASE studentships (AstraZeneca/MRC, EPSRC/Philips) and three NIHR Clinical Doctoral Fellowships. As a result of its strong international reputation, the Unit also attracts self-funded doctoral students. In this REF period, we have hosted 39 international PGR students from countries including Saudi Arabia, Nigeria, Hong Kong, Italy and the Netherlands. Nine doctoral graduates completing during this period went on to secure Lectureships or Research Fellow roles at the University. To further demonstrate effective support and supervision of our PGR students the PRES 2019 data showed 100% student satisfaction in these aspects. To enhance future research capability, recent Nursing, Midwifery and Allied Health Professional graduates will be supported through an ARC West and UWE Internship programme (led by **Cramp M**) from 2021.

The UWE Code of Practice for Postgraduate Research Study is aligned to the QAA Code of Practice that includes the requirement for annual progression reports from the student and the supervisory team, and a viva at the end of the first year of full-time study (pro-rata for part-time students). All students linked to the Unit are members of a Research Centre which provides a substantial research community and opportunities for personal and academic development. Students are required to attend the programme of external seminars and present their work as internal speakers at the annual Postgraduate Forum. They are also expected to actively participate in an annual review day to showcase research activity organised by their Research Centres. Biosciences students have access to a newly refurbished graduate centre (£273K) and a dedicated laboratory bench space and individual workstations. Internationally located students are supported through regular virtual discussions, as well as having face-to-face support and delivery as part of an on-going programme of staff visits. All PGR students are members of the UWE Graduate School (see Institutional Statement). This provides a supportive environment from application through to graduation. It offers a range of bespoke services to meet individual needs, which includes a training and development programme for students and supervisors mapped to the Vitae Researcher Development Framework. The Graduate School also provides networking events and access to regional and national support. Additionally, UWE offers PGR students opportunities for teaching supported by a formal training programme.

2.5 Equality, Diversity and Inclusivity

The University's Equality, Diversity and Inclusivity policy seeks to develop inclusive and supportive research environments for all students and staff, where all individuals have the opportunity to fulfil their potential. This Single Equality Scheme is embedded in the Unit to ensure that Equality and Diversity covers all aspects of research and knowledge exchange activity. An on-line equality and diversity training programme is mandatory for all staff. UWE is a Disability and Mindful employer.

The University supports a range of staff Equality & Diversity (E&D) networks such as those for Lesbian Gay Bisexual Trans (LGBT) and Black Minority Ethnic (BME) staff, as well as a Women's Staff Forum and Disabled Staff Forum. We host expert external speakers including Ruth (now Baroness) Hunt, former Chief Executive of Stonewall. The Faculty supports an Equality, Diversity and Inclusivity Task Force, a Widening Participation (WP) Team, a BME Project Officer, and a BME Task Group to drive equality and diversity agendas. The WP team organizes the Annual UWE BME conference hosted in the city. Its work includes student research conferences, regular workshops, one to one BME sessions, staff training and coaching on inclusion and unconscious bias. As part of the WP initiative staff have access to a number of resources including a monthly newsletter and WP information board. E&D training is compulsory in all staff inductions, and there is a specific session on E&D in the Learning Development Centre management training programme, which has been rolled out over the last two years. Unconscious bias and inclusivity training is provided for all staff by external trainers.

The University supports the Aurora Advance HE scheme and support for women researchers is also provided in the Unit as part of the University Women in Research Mentoring Scheme. This scheme supports women to strengthen their research portfolios to achieve senior research positions (**Saad**) and has enabled two women in the Unit to achieve early career researcher grants (**Thomas R, Stock**). The Unit includes 60% women, 10 of whom are part-time and four who have had periods of maternity leave in this REF cycle. The University supports academic research career progression through an award-winning city-wide Stepping Up BAME Leadership Programme. Unit staff (**Varadi**) have benefitted from this through widening their research networks, having access to external mentoring and acting as ambassadors for equality.

As well as an institutional bronze Athena SWAN award, three departments linked to this Unit hold current Athena SWAN bronze awards and one a Silver Award. Our commitment to Athena SWAN principles is evidenced in a number of ways. Senior research leads at Associate Dean and Centre Director levels are all female. Eight of the 12 professorial/associate professorial promotions over the period were of females. Maternity, paternity, shared parental, adoption leave, and mentoring support are provided to all academics and doctoral students. Four colleagues whose work is included have benefitted from this support including one impact case study lead (**Stock**). Similarly, support following long-term ill health and extended compassionate leave for carers has been provided for four staff in the Unit. The Faculty also supported flexible retirement of five Professors enabling effective succession planning. As part of our commitment to inclusive principles, significant investment was made in our laboratories to meet the particular needs of a wheelchair user that enabled her to undertake laboratory-based studies.

Within the Unit, staff have been identified as having significant responsibility for research, being independent researchers, and outputs have been selected in strict accordance with the University's Code of Practice. This includes selecting outputs on the basis of their quality as determined through a thorough peer review process involving a panel of senior researchers in the Unit. As stated in the Code, there was no expectation about the number of outputs any one individual contributed to the submission. Where it was necessary to choose between outputs of the same quality in order to reach the required number, account was taken of the distribution of outputs between individual and across the subject areas of the submission.

Section 3. Income, infrastructure and facilities

3.1 Research income

The Unit has a total research income of £16.5M during the REF period and has in addition secured £14.5M for Knowledge Exchange. Research funding has been secured from Research Councils (MRC, EPSRC, BBSRC), Government (NIHR), Charities (Wellcome Trust, Versus Arthritis, BRACE, Scar Free Foundation, Breast Cancer Now, Healing Foundation, Best Beginnings, Prostate Cancer UK, Reflex Sympathetic Dystrophy Syndrome Association, Abbeyfield), industry (Colgate-Palmolive, GlaxoSmithKline, AstraZeneca), the European Union and other international bodies (Celator Pharmaceuticals; Agilent technologies; Skan AG, Gene Tools LLC; Shriners hospitals for children; RSDSA; Suva; Scleroderma Clinical Trials Consortium).

There has been particular success with NIHR grant funding, especially collaborative projects with NHS colleagues. Key examples include: **Luxton** £646K to develop a rapid diagnostic tool which can be used in GP practices to identify urinary tract infection caused by bacteria and inflammation; **Walsh** £598K to evaluate first contact physiotherapy in General Practice (GP); **Benger** £566K to evaluate the impact of GPs working in emergency departments to develop the most efficient models of care; **Pollard** £29K to study the selection, application and usefulness of quality indicators for community nursing; **Moule** and **Turton** £250K to evaluate the use of prism glasses in stroke patients in improving spatial awareness; **Beckett** £193K NIHR Knowledge Mobilisation Research Fellowship to use participatory theatre to enrich trauma practitioners' knowledge of the psychological impact of injury and help them test new strategies to improve patient care; **Voss** £124K to evaluate the true burden of dementia on pre-hospital care. Additionally, EPSRC funding has been secured by **Turton** £334K and £113K to develop wearable devices to assist mobility. We have also been successful in obtaining funding from industry. **Saad** secured £92K from Philips to develop and test a novel tongue brush and mouthwash to reduce oral malodour; **Saad** also obtained £410K from Colgate-Palmolive to test a novel toothpaste formulation; **Dures** obtained £120K from Pfizer to develop a skills training package for rheumatology teams, and **Killard** secured £78K from Skan AG to test the use of a hydrogen peroxide sensor in a pharmaceutical process control system. **Ratcliffe** and **de Lacy Costello** secured £212K from 30 Technology, £143K from Thirty Holding Ltd, £100K from Givaudan and £117K from Edixomed for their volatile detection research.

The Unit also benefits from a significant donation of £1M from the Vocational Training Charitable Trust Foundation (VTCT), which has enabled the expansion of the support provided to charities working directly with people and their families who are living with visible difference as outlined in **Stock's** *ICS*. The Federation of Ophthalmic and Dispensing Opticians, the leading membership organization for eye health providers, donated £450K towards the purchase of equipment for optometry research and education.

3.2 Operational infrastructure supporting research

The Unit's operational infrastructure for research is coordinated through University Research Centres led by Directors covering the areas of biosciences, health and appearance research. The Centres implement the University's research strategy, support postgraduate research students, provide a forum for interdisciplinary collaborations and host research events. A dedicated technical team supports laboratory and clinical research. Centre members provide links with external clinicians, partners, organisations and funders. For example, two dedicated co-funded posts with the BNSSG CCG support NIHR bidding (2 x 0.5 FTE). RBI supports all Research Centre activities through a range of operational services including support for bidding, business liaison, technology transfer and skills development. As part of RBI's service, a Senior Research and Business Development Manager is provided to work with the Faculty. An RBI Impact team liaises with impact champions associated with this Unit to help plan and support the implementation of impact activities, including the development of case studies. All research events including conferences are supported through a Research and Enterprise Event coordinator.

3.3 Specialist facilities supporting research

The Faculty has strategically invested in a leadership role for Public Involvement in Research which seeks to integrate public involvement across all our health research. We take an inclusive approach and involve service users and carers in developing research bids, in research delivery and in dissemination with a view to creating impact. The University-led PHWE public involvement team plays an important part in supporting staff in the Unit. PHWE has a database and issues regular newsletters which help connect researchers to potential public contributors. For example, PHWE helped **Cotterill** to identify a new area of research related to continence issues in Inflammatory Bowel Disease and Multiple Sclerosis (MS). The findings of the latter pilot study were presented to the Progressive MS Alliance Scientific Congress in 2018.

UWE's Science Communication Unit (SCU) forms collaboration with researchers and practitioners on projects that aim to close the gap between science and society. For example, SCU worked with

Craig and **de Lacy Costello** to disseminate their research findings and make them accessible via practical public engagement projects facilitated by UWE's BoxEd scheme, a schools-based programme designed to help children aged 5-14 develop new interests and skills through creative and innovative learning activities.

3.4 Specialist research infrastructure and facilities

The University has recently invested over £7.1M in 6,500 m² of laboratory infrastructure to support *Biomedical Research and Diagnostics*. This new refurbishment includes: an electron microscopy suite; molecular biology laboratories; volatile analysis laboratory; electrochemical sensor laboratory; microbiology laboratories; and a bioluminescence suite. In addition, a new bioinformatics hub with a dedicated server and 12 workstations has been developed (£77.7K). A clinical trial facility has also been created (£23.5K). These facilities are supported by dedicated technical staff.

Long-term Conditions has also benefitted from University investment in a new Optometry and Clinical Skills space (£5.4M in total), which includes £359K investment in equipment to support research and teaching, and £480K for Physiotherapy suites. Further investments from the Biosciences Research Centre (£25K) were targeted to build a clinical trial room for data collection and to support new collaborative work with Colgate-Palmolive and Aryballe (*ICS - Saad*).

The Unit benefits significantly from the University Enterprise Zone (£16.5M; 4,100 m²) established in 2016, as one of four in England, match-funded by the Department for Business Innovation and Skills and the West of England Local Enterprise Partnership (LEP). UWE Bristol 'Future Space' offers flexible support for businesses to grow and develop, providing specialised workspaces and laboratory infrastructure, and a 'Launch Space' to assist entrepreneurial students and academics. Co-located is the Health Technology Hub, funded through the European Regional Development Fund and LEP (£5M), which provides commercial and advanced technical support to life science start-ups. It currently hosts more than 30 companies, many in the life science sector: Atlas Genetics; CPP Analytics; DoDxAct; eXmoor Pharma Concepts; Merck Serono (CRISPR), and Pertinax.

The University is committed to fully recognizing technicians as contributors to research projects and research outputs as a founding signatory to the Technician Commitment (see Institutional Statement).

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

Unit staff have worked with a wide range of international and national partners.

4.1. Health partnerships and networks

The Nepal Injury Research Centre was established through a grant from the NIHR (£2.5M). Led by **Mytton**, the Centre addresses an increasing number of injuries from natural disasters, traffic, home and the workplace affecting the people of Nepal. This collaboration between UWE and the Kathmandu Medical College also involved the Nepal Red Cross Society and Swatantrata Abhiyan (a non-governmental organization, NGO) and Mother Infant Research Activities NGO. *Appearance and Health* is part of the EU-funded COST Action Appearance Matters network, involving collaborators from 35 countries across Europe. **Williamson** and **Harcourt** conducted a feasibility study to inform a randomized control trial to evaluate an online psychosocial intervention for young people with visible difference (YP Face IT) funded by the NIHR (£270K). Further feasibility studies were conducted nationally and internationally to implement and evaluate the delivery of YP Face IT to patients with burn injuries (£141K). Additionally, international research led by **Walsh** has impacted on the work of physiotherapists in the Health Authority of Hong Kong. The evidence from the intervention called Facilitate Activity and Self-Management in Arthritis (FASA) underpinned a culturally adapted version. **Walsh's** intervention has been adopted by the NHS and subsequently delivered to over 20,000 patients resulting in savings of £26.2M to date (*ICS – Walsh*). Further *Long-term Conditions* research was conducted by **McCabe** that focused on the development of an international register for Complex Regional Pain Syndrome (CRPS) which established a large,

international network (with over 50 members) of patients, academics, clinicians and representatives of industry. Related work underpins the development of European and UK guidelines/standards of care for CRPS, and the development of a new medical device for pain relief. Furthermore, European collaborations of **Ndosi** have informed the European League Against Rheumatism (EULAR) recommendations for the role of the nurse in the management of chronic inflammatory arthritis. His work also informed the current International Working Group on Diabetic Foot guidelines on the diagnosis and treatment of foot infection in persons with diabetes.

Key areas of research excellence with potential for impact are being enabled through a number of local and national initiatives. One such example is the ongoing research of BHP/AHSC, established in 2008. A strategic collaboration between the city region's major health and academic institutions, the BHP/AHSC main strategic priority is to develop excellent multi- and interdisciplinary research that translates into practice and education. This is being delivered through 18 HITs, with four led by Unit staff (**McCabe, Deave, Dures** and **Cotterill**). HITs are cross-organisation interdisciplinary groups set up to harness research, innovation and education, to tackle major health priorities by working together in new and different ways. A number of academics from this submission (**Alford, Cotterill, Conway, Cramp F, Deave, Dures, Harcourt, Mansell, Mytton, Palmer, Robson, Ndosi**) are members of the HITs related to Long-term Conditions, Emergency Care and Child Health. The WEAHSN aims to improve the identification and implementation of healthcare innovations across the region, ensuring that these translate into patient and economic benefit and are supported by public involvement. The WEAHSN has supported 70 entrepreneurs and attracted £19.5M funding into the region. The Unit benefitted from WEAHSN investment in evaluative research (**Moule** and **Pollard**).

A newly established Knowledge Mobilisation team bridging the gap between research and practice supports evidence-based commissioning and research-informed practice in primary care. This is funded through the BNSSG CCG and led by a jointly funded UWE Professor post whose work is presented (*ICS – Walsh*). A new appointment of a Researcher in Residence (2018) was made to support Emergency Care research through this fund. In addition, this new initiative led to six new externally funded projects, a jointly funded DTP PhD student (**Walsh, Moule, Pearson**) and contributed to a range of impacts (*ICS – Walsh*). Further impact includes **McCabe**, who is developing a commercially available sensory training system for use at home by people with persistent limb pain in partnership with the Royal United Hospitals Bath NHS Foundation Trust, and **Voss** working with the NHS Ambulance Trusts has developed revised guidelines for the management of out-of-hospital arrest.

Biomedical Research and Diagnostics academics were involved in obtaining National Genomic Medicine Centre status for West of England (WEGMC) in 2015, as part of the Government's NHS 100,000 Genomes Project. The Centre was formed by 20 organisations with education and training being led by UWE (**Varadi**) (£150K). Strategic investment has been made to develop genetic screening/testing to detect: *i*) white matter brain injury in premature newborns in collaboration with North Bristol NHS Trust Bristol Genetics Laboratory and the University of Bristol and *ii*) inherited haemoglobin disorders in collaboration with Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates (**Varadi**). **McCalley** worked in collaboration with the Antimicrobial Reference Laboratory, North Bristol NHS Trust to develop tests for monitoring the level of toxic antibiotics. These commercial tests are now used across Europe leading to enhanced patient safety and have brought economic benefit to the NHS of approximately £125K to date (*ICS - McCalley*).

Through collaborations with the University of Nottingham, **Deave** (Child Health) was co-applicant on a NIHR Programme grant to produce an Injury Prevention Briefing for early years practitioners to use with families to reduce home injuries in the under 5s. This document was endorsed by NICE in 2016 and was adopted as a NIHR Signals document in 2017.

4.2 Partnering with charities

Funding from the VTCT (£1M) is facilitating work with the Appearance Collective – a group of charities that support people with visible differences. The research aims to impact on the work of organisations including Changing Faces, Cleft Lip and Palate Association, Katie Piper Foundation, Alopecia UK and Children's Burns Trust. With the Scar Free Foundation (£157K), **Harcourt** is

testing the psychometric properties of the CARE Burn Scales – a set of burn specific PROMS that are being taken up and used by NHS burns teams across the UK, these have also been translated into Finnish. In addition, **Williamson** and **Harcourt** are working with the Scar Free Foundation (£322K) and various military charities, predominantly the CASEVAC club to develop support interventions for military service personnel and their families, with appearance-altering conflict wounds. Breast Cancer Now (£242K) funds a study led by **Harcourt** to evaluate the intervention to facilitate patient-centred consultations and shared decision-making (PEGASUS) with women contemplating breast reconstruction.

Further appearance-related research is undertaken by **Stock** who is involved in a cleft lip gene bank and birth cohort study drawing on Avon Longitudinal Study of Parents and Children (ALSPAC) data. This provides an opportunity to develop genetic testing with the potential for national/international impact. **Stock's** work in collaboration with The Cleft Lip and Palate Association (CLAPA) and NHS based clinical units specializing in cleft, has developed a psychological care pathway for people affected by craniofacial conditions and their families (*ICS – Stock*). **McCabe** is the Head of Research at Dorothy House Hospice, with an aim to enhance and expand its research activities. In her role as a Florence Nightingale Foundation Clinical Professor in Nursing, she also hosts charity-funded interns. **McCabe**, **Cramp F** and **Ndosi** host Versus Arthritis internships for graduate nurses and AHPs.

Conway's research on Alzheimer's disease is supported by two PhD studentships from the charity BRACE. A further PhD project investigating a novel antibacterial titanium implant technology for total joint arthroplasty is funded by Versus Arthritis (**Mansell**) (£111K). **de Lacy Costello's** research on the detection of Volatile Organic Compounds for Bladder Cancer Diagnoses was supported by Cancer Research UK. **Ladomery's** research to develop molecular tools to target specific oncogenes was funded by a Research Innovation Award from Prostate Cancer UK (£136K). **Greenhough's** research to understand hypoxia-induced signaling mechanisms for cancer was funded by the Wellcome Trust (£95K) and the effects of aspirin on rectal cancer by Bowel Cancer UK (£25K).

4.3 Partnering with industry

The Unit has excellent links with industry across various sectors. For example, Unit researchers (**Saad, Varadi, Ratcliffe, de Lacy-Costello, Killard, Mansell**) collaborate with industry to produce non-invasive point of care devices aimed at improving disease diagnosis with patient benefit. **Saad** works extensively with industry. Of note, **Saad** initiated a collaboration between Aryballe and Colgate-Palmolive, who now work together in testing malodour products. The Unit benefits from two partnership PhDs with Colgate-Palmolive and CEMAG & Aryballe Technologies (**Saad, Varadi**). Joint working also exists with Philips and Helperby Therapeutics Group Ltd. (£250K). Through these partnerships the efficacy of malodour products released onto the market has been improved and secured significant economic, health, commercial and social impact (*ICS – Saad*). Further distinctive research on volatile organic compounds (VOCs) in health and disease is being used to analyse patterns of VOCs from a range of body sources in a number of disease conditions including gastro-intestinal disease, bladder and prostate cancers, inflammatory bowel disease and genitourinary disorders (**Ratcliffe, de Lacy Costello**). UWE's IP (patent EP10788038.7) led to the formation of a new spin-out company NidorDX, created with the Universities of Liverpool and Bristol with funding from the Wellcome Trust. This will commercialise the OdoReader to diagnose irritable bowel syndrome. Research-related consultancy projects (totaling £203K) for 30 Technology Ltd allowed the development of new wound dressings which generate gas to aid the healing of diabetic ulcers. Promising clinical trial data on wound healing and lung infections helped the company raise £30M of venture capital funding. Additional support for the development of smart dressing was obtained from EdixoMed Ltd. (£109K) and Thirty Holdings Ltd. (£143K). Research projects with Givaudan UK (£117K) have developed odour suppression technologies to aid new product development.

Killard, through the spin-off company BreathDX, evaluated a device measuring ultra-low concentrations of breath ammonia (AmBeR) and blood ammonia (AmBIT). The company also investigates the viscoelastic behaviour of blood during coagulation and has given new insights into

a range of haemostatic processes such as clot kinetics and structure. These sensors are intended to provide self-testing diagnosis allowing the public to self-manage conditions such as Urea Cycle Disorders, Organic Acidaemia and Chronic Liver Disease. The development of the technology was funded as part of grants from FP7-ICT Smart Integrated Miniaturised Sensor Systems (£395K), Innovate UK Biomedical Catalyst (£169K) and Science Foundation Ireland (£19.6M).

Mansell is undertaking collaborative research pertaining to the biological-functionalisation of bone biomaterials, specifically titanium and hydroxyapatite, funded by NIHR (£372K). This research links to product development with the dental implant company OsteoCare Ltd in the formulation of antibacterial coatings for dental implants. The work is also supported by the National Biofilm Innovation Centre (NBIC) funded by the BBSRC and Innovate UK (£29K).

McCalley works with Glaxo-Smith-Kline (GSK) to improve methods to determine the impurities in ethical pharmaceutical preparation using a HILIC chromatography approach (*ICS – McCalley*). Further work with GSK undertaken by **Greenhough**, is identifying drugs that can selectively kill hypoxic cancer cells. This is funded by the Elizabeth Blackwell Institute, University of Bristol and the Wellcome Trust. Collaboration with GeneTools LLC and OncoTools LLC, Oregon, US led to **Ladomery** testing antisense morpholinos targeted against oncogenes (£23K). His research contributed to the development of a novel anti-angiogenic therapy and to a spin-out company Emenda Therapeutics.

4.4 Esteem

Recognition of personal contribution to research – The work of two Professors has been recognized through the award of an OBE; for services to people with arthritis and to nursing research (**Hewlett**), and for developing services for people with disfigurement (**Rumsey**). **McCalley** was recognized as one of the World's 100 most influential analytical scientists by the Analytical Science EPSRC Web site.

Personal research awards – The Florence Nightingale Foundation awarded **McCabe** one of seven prestigious Clinical Professor in Nursing posts that started in 2015. A post-doctoral Nursing Research Fellowship from ARC West in 2017, a Florence Nightingale Foundation Emerging Leaders Scholarship in 2018 and a mid-Career Investigator Award from BNSSG CCG Research Capability Funding in 2019 were made to **Cotterill**. A further Fellowship was awarded to **Deave** by the Institute of Health Visiting in 2015.

Esteemed appointments – **Mytton** was appointed as a Faculty of Public Health representative on an advisory group for a National Accident Prevention Strategy launched in Parliament and led by the Royal Society of Prevention of Accidents and Public Health England. She provided expert advice on the Quality Standards Advisory Committee for National Institute for Health and Clinical Excellence (NICE) on “Preventing unintentional injury in under 15s. Quality standard 107” in 2015. She was also a peer reviewer for WHO on ‘Preventing Drowning; an implementation guide’ in 2016. **Cotterill** advised Government as a member of an All-Party Parliamentary Group for Continence sitting in 2019. **Alford** was an expert advisor for the UK Government Committee on Toxicity which informed the European Food Standards Agency caffeine statement in 2015. Further Government level advice is provided by **Benger** who was selected as a National Institute for Health Research Senior Investigator. This recognises national leaders in health research and reinforces UWE Bristol's position as an internationally leading institution in emergency care research. Further expertise is provided to the NIHR by **Stock** who is an invited board member of the Cleft and Craniofacial Clinical Studies group, a post held since 2017. Additionally, **McCabe** is South-West Hub lead for the NIHR 70@70 Senior Nurse and Midwife Research Leadership Programme that started in 2019 and **Palmer** is expert reviewer for the NIHR clinical and senior clinical lectureship awards. **Conway** is a Scientific Advisor for the Alzheimer's charity BRACE and committee and conference panel member for ARUK, while **Cramp F** was appointed to the Clinical Affairs Committee, British Society of Rheumatology and the National Early Inflammatory Arthritis Audit Project Working Group. Further rheumatoid expertise was provided by **Dures** to the Scientific Sub-Committee of the European League Against Rheumatism Standing Committee of Health Professionals in Rheumatology (2018) and the UK Occupational Therapy Research Foundation

Advisory Group (2017). A further appointment in the field of rheumatology was made to **Flurey** in 2018 as President of the British Health Professionals. Further prestigious rheumatology work is being undertaken by **Ndotsi** who, as a scientific committee member for the European League against Rheumatism, is involved in planning the EU Congress of Rheumatology (2019-2021). The UK National Ambulance Research Steering Group that represents 13 NHS Ambulance Trusts is supported by **Voss**, whose invited membership commenced in 2019. Appointments to the Swiss National Science Foundation, Action Medical Research and EPSRC grant panels were made to **de Lacy Costello** in 2018/19. **McCabe** was appointed to the Chief Nursing Officer for England COVID-19 Legacy Nursing Steering Group, as the Nursing Academic Representative.

Invited presentations – **Conway** was an invited speaker on the Thiol-based Redox Regulation and Signalling Gordon Research Conference (Vancouver, USA) in 2015 and Thiol-based Redox Switches in Life Sciences EMBO Conference (Girona, Spain) in 2016. As a leader in the CRPS field, **Lewis** was invited to present at an all-party parliamentary group on CRPS in 2016 and in 2018 was a member of the development panel for UK guidelines on the diagnosis, referral and management of the disease. The Health Authority of Hong Kong Annual Conference keynote address was delivered by **Walsh** in 2018.

Conference hosting – **Saad** hosted the International Malodour Conference co-funded by Colgate-Palmolive and Takasago at UWE in 2019. **Luxton** chaired the 6th International Conference on Bio-sensing Technology, held in Malaysia (2019). In a role as Treasurer for the International Executive Committee for CRPS Special Interest Group, **Lewis** has organised meetings in Spain, USA and the Netherlands, with **McCabe** co-chairing meetings for the group in Japan and Ireland. A conference officer role was held by **Ndotsi** between 2015 and 2019, for the British Health Professionals in Rheumatology. **Benger** with **Voss** ran a large-scale dissemination event in London (2018) following the publication of the Airways2 trial when approximately 200 paramedics attended. A further event in Bristol was attended by 50 GPs, Emergency Department staff and commissioners. The trial outcomes have also reached more than one million people on Twitter and the study is profiled on YouTube.

Workshop facilitation – two stakeholder workshops were hosted by **Mytton** for representatives of Government Departments, police and non-Government organisations in Nepal with the aim of informing policy and legislation development to reduce road injuries in children. **Hewlett** and **Dures** delivered a fatigue training day for 40 Rheumatology Nurses in Oslo, Norway (organized by Novartis), presented at a Regional Postgraduate meeting in Nijmegen, Denmark ('Fatigue: Meaning, mechanisms, measurement and management') and gave invited presentations to a range of health professionals at various UK locations.

Journal editorship – Biosensing researchers have been instrumental in forming and maintaining the International Association of Breath Research and an associated academic journal published by the Institute of Physics, 'The Journal of Breath Research' (**Ratcliffe**). **Conway** is an Associate Editor for the Journal of Alzheimer's Disease. In a role lasting four years, **Deave** was editorial manager for BMC Health Services Research. For the period 2017-2020, **Ndotsi** was Assistant Editor for Rheumatology Advances in Practice. The Cleft Palate-Craniofacial Journal invited **Stock** to be sectional editor in 2017.

4.5 Public engagement

Engagement with patients and the public has been central to our research, involving a range of media, schools and the wider public. The Appearance Matters podcast presented by Unit staff has attracted nearly 70K listeners in 230 countries and is consistently listed in the iTunes top 100 podcasts for higher education. Everybody's Different, an appearance board game was developed in 2017 to promote the acceptance of the diversity of appearance and positive body image amongst 9-12 year olds. **Saad** was interviewed on the popular BBC science show, 'Trust me I am a Doctor,' focusing on health, diet and lifestyle stories in 2016. Further engagement included **Saad** and **Varadi**'s contribution to the Bristol Festival of Nature (2018), which attracted over 15,000 visitors. Prostate research by **Ratcliffe** and **de Lacy Costello** was featured on Canadian Radio and on BBC Points West (2016). **McCabe** filmed a discussion with patients on CRPS for BBC Inside Out

West. **Mansell** provided expert input related to his work on titanium plates for orthopaedic surgery featured on ITV West. Furthermore, **Greenhough** was interviewed by BBC Radio on his research in hypoxia (2018) and provided an expert review of the work of the Nobel Prize winners for Physiology or Medicine (2019) for the *Guardian*.