

<b>Institution: Coventry University</b>
<b>Unit of Assessment: UoA3: Allied Health Professions, Dentistry, Nursing and Pharmacy</b>
<b>1. Unit context and structure, research and impact strategy</b>

Achievement of strategic research aims from REF2014 has generated significant growth in the current REF period of:

- 45% in research funding, increasing from £8.15M to £11.8M;
- 130% in publications, rising from 318 papers to 731 papers;
- The percentage of papers with international co-authors (based on the authors' affiliation at the time of publication in Scopus) increasing from 17.6% to 60.9%;
- 93% in the number of staff returned with UoA3 up from 17.6FTE to 34FTE;
- 235% in PhD completions, all within 4 years, increasing from 17 to 57.

### Structure of research

Allied Health Research (UoA3) primarily bridges across two inter-disciplinary Research Centres in the Faculty of Health & Life Sciences; viz. the Centre for Sport, Exercise and Life Sciences (CSELS) and the Centre for Intelligent Healthcare (CIH), each led by an Executive Director. The overarching aim of our research is to "Improve the health and well-being of individuals and communities". CSELS and CIH have their own focus and expertise, but together they capture the breadth of research activity across UoA3, with the exception of a small amount of interdisciplinary research with the Centre for Data Science (CDS) and the Institute for Future Transport and Cities (IFTC). In total, UoA3 comprises 35 independent researchers (34 FTE).

Research in CSELS and CIH is organised into Research Themes, each led by a Professor.

**CSELS:** aims to be a research-intensive leader in improving the health and wellbeing of humans by adopting multi-disciplinary approaches to increase our mechanistic understanding of life, from molecules and cells to organs and the whole body.

This breadth of expertise facilitates the evolution of multi-disciplinary teams to address global problems. Research activity is divided into two broad areas; i) Integrative Biosciences (UoA3), ii) Sport and Exercise Sciences (UoA24). This co-localisation of UoA3 and UoA24 encourages cross-UoA interdisciplinary collaboration (e.g. *Renshaw(UoA3)/Turner(UoA24)*; *James(UoA3)/Tallis(UoA24)*; *Maddock(UoA3)/McGregor(UoA24)*). Research within CSELS contributing to UoA3 is subdivided into three research Themes: Cell Signalling and Membrane Biology; Disease Prevention, Therapeutics & Diagnostics; Bioscience & Biotechnology Engineering. These Themes have been developed since REF2014 to address key research challenges and priority research areas of major funders. Each Theme brings together researchers with related interests and facilitates effective communication, collaboration and sharing of instrumentation and resource. Themes have been structured with deliberate overlap to prevent research activity being 'silo-ed' and to encourage cross-Theme collaborations (e.g. *Reynolds/Wheatley*; *Maddock/Sandhu/Wheatley*; *James/Maddock*; *Renshaw/Farnaud*; *Reynolds/Greaves*; *Dodd/Greaves/Bennett*) resulting in cross-Theme papers, grant applications and collaborative research with industry. The Bioscience & Biotechnology Engineering Theme in particular is inherently multi-disciplinary. The research centres are linked through the Professor of Healthcare Technology, a post held jointly between CSELS/CIH plus jointly-held dedicated support from a Research Development Executive from Research Services.

**CIH:** is building to become a globally-recognised research centre for pioneering and opinion-setting research in the area of digital healthcare and its contribution to monitoring healthcare and enriching and prolonging individual lives and improving communities. Research goals are delivered by three research Themes: Behaviour and Implementation Science (BIS); Healthcare Technology and Innovation (HTI); Epidemiology and Evidence Based Healthcare (EEBH).

### Research objectives

Within our REF2014 Environment statement we identified five objectives for the current REF assessment period:

1. Develop further research in health behaviour change techniques;
2. Build further capacity for original research;
3. Improve patient and public participation in research;
4. Build on and develop existing and new international collaborations for research;
5. Address international and national priorities for research.

The strategy for achieving the UoA3 research objectives has made a step-change since 2014, prompted, in part, by an increase in the drive to integrate technology, artificial intelligence modelling and the provision of wireless networks into healthcare and translational medicine. Recognising the changing nature of real-world problems and technological advances, we took the strategic decision to develop and open CIH which launched in 2018 to function alongside CSELS, formally Centre for Applied Biological and Exercise Sciences. Such an investment was based on the close linkage between the University and the University Hospital Coventry and Warwickshire (UHCW) and strong links established with Public Health Warwickshire and the Biotechnology and Pharmaceutical Industries. These partners and collaborators have seen changes in their approach to healthcare with an emphasis on the need for the inclusion of a more technological approach to disease treatment, prevention and management. The response from the University was to assist in this development by providing a research base (CIH/CSELS) to enable the generation and development of new tools and techniques to monitor, diagnose and treat health and to foster linkages with local healthcare bodies and industry.

#### *2014 Objective 1: Develop further research in health behaviour change techniques (BCTs)*

The creation of the Behavioural and Implementation Science (BIS) Theme within CIH was a strategic response to achieving this objective, creating a critical mass of researchers (*Lycett, Johnson, Martin, Turner, Whelan* and three researchers returned in UoA4). BCTs form the foundation of the BIS Theme. All our interventions are built on BCTs and we have expanded the work on BCTs and developed a sister taxonomy for alternative health techniques (*Lycett*), such that many interventions integrate both. We work in partnership with Public Health Warwickshire, where we are commissioned to integrate and evaluate public health interventions in accordance with BCTs. Our BCT-based research focus has been expanded by the appointment of new staff to BIS (*Johnson, Martin, Whelan*) and encompasses online interventions to improve mental health of a broad range of population groups, including: eating behaviour in obesity (*Lycett*); autism (*Martin*); diabetes (*Whelan*); plus living with cancer (*Turner*). This expansion in BCT is reflected in papers, grant capture and PhD studentships. The development of the face-to-face and digital Help to Overcome Problems Effectively (HOPE) programme in the last REF period, has led to the formation of a spin-out company in this REF period to license its use by MacMillan Cancer Support, the NHS and Carers Trust UK, to support individuals living with and beyond cancer

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(Turner), people living with long-term conditions (Turner) and parents of children with autism (Martin). This research is captured in the UoA3 Impact Case Study “*Hope 4 The Community CIC: Improving the lives of people living with a long-term health condition by providing self-management tools*”.

### 2014 Objective 2: Build further capacity for original research

There has been a vigorous and sustained programme of investment over several years to grow research capacity within UoA3. This has focused on three synergistic aspects of the research environment;

- **space** - in 2018, UoA3 moved into purpose-built brand-new dedicated research laboratories and office space located in the new £59M Alison Gingell Building (details in Section 3);
- **staff** – 14 new strategic recruitments were made within UoA3 (six Professors, four Associate Professors, two Assistant Professors, one Lecturer, one Independent Research Fellow) plus dedicated research time increased for three Early Career Researchers (ECR) (details in Section 2);
- **equipment** - £2.3M was invested in new capital equipment (details in Section 3).

Outputs from UoA3 subsequently increased from 318 papers in REF2014 to 731 papers in REF2021.

### 2014 Objective 3. Improve Patient and Public participation in research

Concomitant with the delivery of our research strategy over this REF period, which included establishing CSELS and CIH Research Centres, has been increased Public Patient Involvement and Engagement (PPIE). Service-users are consulted in co-creation, for example, of self-management interventions and furthermore, co-deliver interventions provided by Macmillan, the NHS and Carers UK. Indeed one of the UoA3 spin-out companies established since 2014, “*Hope for the Community*” (Turner) was co-founded by four service-users. Likewise, Allen engaged with patients and other volunteers on the PPIE panel to develop a medical device related to peripheral arterial disease for primary care. In addition, an Innovate UK-funded project developing an Open Source electronic observations software solution for bedside monitoring of patients includes as partners: OpusVL (an Open Source software specialist); South London and Maudsley NHS Trust plus Cheshire and Wirral Partnership NHS Trust; Apperta Foundation (a clinician-led, not-for-profit company, supported by NHS England); NHS Digital and Coventry University (Wark).

### 2014 Objective 4. Build on and develop existing and new international collaborations for research

We have developed a wide range of collaborations across 27 countries (Sections 3 and 4). In REF2014, 56 of the 318 papers published (17.6%) had international co-authors (based on the authors' affiliation at the time of publication in Scopus). This increased to 445 of 731 outputs (60.9%) for the current REF period with 94% of UoA3 staff publishing an international co-authored paper in the period.

### 2014 Objective 5. Address international and national priorities for research

This has been facilitated by the creation of CSELS and CIH and the strategic development of new research themes within UoA3 since 2014. Our research (details below and in Section 4) has addressed nationally-defined research priorities including: the Life Sciences Industrial Strategy (<https://www.gov.uk/government/publications/life-sciences-industrial-strategy>) Science in healthcare: Delivering the NHS Long Term Plan (<https://www.england.nhs.uk/publication/chief-scientific-officers-strategy/>); the Biotechnology and Biological Sciences Research Council (BBSRC)

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priorities of Bioscience for Health; World-class Underpinning Bioscience; Healthy Ageing Across the Life-Course; Food Nutrition and Health; Integrative Microbiome Research plus disease priorities of major biomedical charities (Cancer Research UK, British Heart Foundation). Promoting physical health in older age (Medical Research Council (MRC)), *in silico* trials and technology for developing, testing and accessing biomedical and pharmaceutical relevant products (EU Societal Challenges Horizon 2020 Personalised Health and Care; EIT Digital Health) plus obesity, mental health, multi-morbidity, health behaviours (National Institute for Health Research (NIHR)); maternal health monitoring (Bill and Melinda Gates Foundation) and religion & spirituality in health (John Templeton Foundation). Maximise the commercial impact of world-class knowledge developed in UK industries and its research base (Innovate UK; Horizon2020). A growing role for technology in the NHS and digitally-enabled care (NHS Long-Term Plan).

### Summary of our research strategy since REF2014:

Our Allied Health research strategy since REF2014 has been to develop impact from the laboratory to the clinic and community and has focused activities on two major areas, each at different stages of the translational pathway:

#### *i. Disease-orientated research in the discovery phase*

Achievements include identification of molecular mechanism providing insight into normal and pathological states (*Aspinall, Burke, Greaves, Maddock, Morozov, Renshaw, Reiman, Sandhu*); the role of cell processes in disease development (*Bennett, Burke, Dodd, Farnaud, James, Maddock, Tapp*); the allied molecular mechanisms of drug action (*Deganutti, Reynolds, Wheatley*); studies on drug toxicity (*James, Maddock, Sandhu*); the development of diagnostic and mathematical and computational tools to support drug development and clinical decisions (*Blundell, Deganutti, Gould, He, Maddock, Mukandavire, Reynolds, Wheatley*). Aligned to this, the award-winning spin-out company, InoCardia Ltd, (*Maddock*, details in Section 3) assesses cardiovascular drug safety for the Pharmaceutical Industry.

#### *ii. Translation and Assessment of research and its applicability*

Our aim for this phase of work was to move projects from the feasibility/discovery phase to assessment of their viability, with the ultimate aim of bringing them into practice. Achievements here include development and evaluation of interventions (*Dong, Jakovljevic, Johnson, Lycett, Martin, Szczepura, Turner, Whelan*) and interventions for chronic health conditions (*Horton, Lycett, Martin, Morozov, Wark, Williams*); innovative methods of measuring physiological and clinical parameters (*Allen, Kurmi, Maddock, Sandhu, Shah, Zheng*). In part, these viability assessments have been achieved through the links forged with external partners such as UHCW (*Coad, Maddock, Morozov, Renshaw*), Public Health Warwickshire (*Lycett*), Moor Instruments, Newcastle Hospitals, Microsoft Research (US), National Physical Laboratory, Photometrix (*Allen*) plus TherapyAudit, Cheekmate, OkDok (*Zheng*), UCB a global BioPharma company (*Maddock, Wheatley*), Sosei Heptares (*Deganutti, Reynolds*) and Cresset-Group (*Maddock*).

### Research Objectives over the next 5 years

Our mission is to improve human health, professional practice, patient outcomes and cost-effective care through synergistic research undertaken across UoA3 with a focus on “*Molecules/cells to public/community health*”.

We will continue to focus on excellent fundamental research with a translational pipeline delivering health and wellbeing improvements, coupled with cutting-edge technology development and implementation. We will:

**Unit-level environment template (REF5b)****i. Build on Research Centres' synergies - Fundamental and Translational Research**

Our research mainly focuses on major public health concerns related to ageing and chronic diseases including cardiovascular and vascular disease, cancer, immunological and metabolic disorders. Our primary strategic aim is to focus on these issues, and the underpinning molecular and cellular mechanisms, to develop and expand basic, clinical and healthcare science research and increase our award-winning innovative research pipeline, to expand translation of outputs to clinical utility and commercial venture and so improve health outcomes worldwide.

We will play to our strengths in translational and healthcare science research to extend understanding of mechanisms and further develop and assess pharmacological, physiological, physical activity, nutrition, exercise and behavioural interventions to improve public health in collaboration with colleagues submitted to UoA24.

**ii. Grow and Support Allied Health Professional and Healthcare Scientist Research Capacity**

Building on current REF period achievements, a new Centre for Healthcare Research (CHR) will be created to integrate enhanced patient care and academic excellence through research, practice development and innovation, while fully embedded within the NHS healthcare structure.

Furthermore, a new Institute for Health & Wellbeing (IHW) will form an umbrella over the CIH, CSELS and CHR research centres. IHW will build on current evidence-based research projects and innovative activities to inform and enhance clinical practice aimed at influencing clinical improvements and national/international patient outcomes.

**iii. Innovation**

IHW will enable research focussed on innovation excellence from molecules to public/community health, lifestyle, nutrition, exercise and behavioural sciences in order to improve health across the life-course. We will build on our existing award-winning multidisciplinary approach to novel physiological measurements, computational modelling, data science and medical technology research both across our research centres and in partnership between the Institute for Complex Systems, the Health Trusts, global biopharma and med-tech industries and regulatory stakeholders. By working closely with industry and healthcare partners we will aim to accelerate the adoption of new innovations into the NHS. To support this approach a Clinical Community Diagnostic Centre initiative will be established (£25-30M; preliminary planning stage) in partnership with UHCW and Coventry City Council). This will be a dedicated facility to deliver routine diagnostics, education and training, research and innovation (Precision diagnostics/Personalised care, Digital pathology, Novel biomarkers, Translational medicine, Cutting-edge technology with industry and SMEs) and establish a landmark facility that will provide access to high-quality diagnostic healthcare. We seek to become a major rallying institute linking pharma, diagnostics, robust interventions and healthcare systems worldwide, and enable businesses to test and embed their technologies aimed at improving patient outcomes and cost-effective care.

**iv. Grow Funding to underpin research**

Staff submitted within UoA3 have already attracted funding from BBSRC, InnovateUK, British Heart Foundation (BHF), Royal Society, NIHR, Horizon2020 and from many national and international industrial collaborations (Section 3). Globally, governments are concerned about the rise in non-communicable diseases because these have a considerable impact on healthcare costs



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and many are looking towards technology to reduce this financial burden. The international response to this challenge, of moving towards integrating technology into healthcare, was mirrored nationally in the UK drive to involve innovation and technology in all aspects of patient management and to assist with the Sustainability and Transformation Partnerships currently operating within many regions. Over the next five years we aim to grow high quality funding streams and consolidate emerging work in med-tech, healthcare science technologies with industrial partners, particularly building on synergy across the health themes and alignment with translational technological innovation.

The objectives above align to the national “Science in healthcare strategy” (<https://www.england.nhs.uk/publication/chief-scientific-officers-strategy/>) and “Life sciences: industrial strategy” (<https://www.gov.uk/government/publications/life-sciences-industrial-strategy>) focusing on a strong healthcare and life science research agenda to give allied health professionals and healthcare science workforce greater opportunity to lead scientific research, making best use of their unique combination of skills in creative product development, strong analytical skills, as well as the clinical expertise to contextualise how innovation will fit into the wider health system.

### Impact

Within UoA3, impactful research has been facilitated by the appointment of an Advisory Committee comprising Executive-level members from NHS, SMEs and third-sector organisations, as a proactive approach to generating impact by targeting research with unmet needs. A Professor of Healthcare Technology (*Farnaud*) was appointed as a CSELS/CIH joint-position, whose role in part is to link researchers with SMEs to facilitate end-user impact. Research Services assist in exploiting our research, identifying intellectual property, linking with stakeholders and collecting impact evidence.

Arising from our ethos of ‘research excellence with impact’ (Coventry University Corporate Strategy) and supported by Research Services plus the Enterprise and Innovation Office (EIO), our strategic research decisions have resulted in the creation of three spin-out companies; InoCardia – Safety Pharmacology ([www.inocardia.co.uk](http://www.inocardia.co.uk); Maddock), Hope for the Community (H4C) Community Interest Company ([www.h4c.org.uk](http://www.h4c.org.uk); Turner) and OVO Biomanufacturing – Optimising vaccine manufacturing ([www.ovobiomanufacturing.com](http://www.ovobiomanufacturing.com); Gould, see below), of which both InoCardia and H4C provided impact case studies for UoA3 (“Safer Heart Therapies: Improving Drug Development and Patient Outcomes with InoCardia Ltd” and “Improving the lives of people living with a long-term health condition by providing self-management tools”, respectively). InoCardia (Maddock) benefited from assistance from Coventry University in spinning-out the company, identifying potential funders and providing expertise in company management. Members of EIO provided H4C (Turner) advice on start-up, selecting best-suited company structure, intellectual property and licence negotiation. Research Services plus EIO also facilitated the stakeholder involvement which led to our final impact case study (‘Improving Care for Young People with Long-Term Illnesses and Complex Health Needs’, Coad), in which the local hospital (UHCW) was heavily involved supporting the research and providing access to patients and resources.

### Interdisciplinary Research

UoA3 has fully encouraged and developed cross-collaboration with other research disciplines. This is evident in how our research Themes, which have significant differences in their research

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methods and data analysis, have been brought together to respond to the whole life-cycle of providing healthcare interventions; from big data analysis through assessing patient needs to behavioural change, healthcare science technology, biomechanical engineering, health economics, health services commissioning, medicine and surgery, and prototype design. This interdisciplinary environment is developing an exciting new culture where all of our research community is looking beyond its own focus to the expertise of researchers across the University, nationally and internationally, to increase the reach of research outputs, strengthen funding applications and increase the diversity of PhD supervisory teams. The interdisciplinary environment within UoA3 has been enriched by mathematicians in CDS (*He, Mukandavire*) addressing biological problems and electrical engineering expertise (*Blundell, IFTC*) applied to health problems. *Farnaud* (UoA3) collaborating with *Graves* (UoA12) has exploited microbes to recover metals from waste electronic components, resulting in an Impact Case Study for UoA12 in this REF submission plus a presentation to the UK Parliament, Industry and Parliament Trust. Other examples include *Wheatley*, PI on a project combining protein expression, molecular pharmacology, biophysics and immunology (BBSRC-Industrial Partner Award; 3 universities plus the Pharma UCB). *Jakovljevic, Maddock* are part of multi-national consortia (EU Horizon2020-funded SILICOFCM; EIT Digital Health) comprising experts in cardiovascular clinical medicine, molecular biology and physical biochemistry, bioengineering, and computer scientists to develop a computational platform for *in silico* clinical trials and drug development respectively.

## Open Research

Our commitment towards an open research environment goes beyond the REF open access policy, as shown by the involvement of service-users in the co-creation of the self-management interventions and by our approach to public and patient involvement and engagement with appropriate research projects within UoA3.

Reproducibility is a core tenet in every aspect of our research and is the foundation on which our research outputs are built. In support of this, statistical methods training including the use of software packages such as SPSS, is offered to staff and post-graduate researchers (PGR). This enables researchers to determine the correct sample size for a specific trial or the number of times a laboratory experiment has to be replicated to provide surety for the results. The training also provides both resources and understanding about how to analyse data-sets. Combined with training in ethics plus our governance structure, this provides assurance to researchers that others can replicate their results.

## Research Integrity

The research unit follows the five principles of Universities UK's Concordat on Research Integrity, ensuring that we embed the highest levels of research integrity through; mentoring, peer-review, staff training and development, and through the governance of our highly-experienced Research Ethics Committee. Ethics applications are mandatory for all research projects, using an online portal which includes access to the Integrated Research Application System (IRAS) for those requiring NHS approvals. Research involving the use of chemical or biological materials, requires hazard and risk assessments to be completed, which are approved and held centrally.

Ethics training is recognised as a key objective for all our researchers, including Post-Doctoral and PGRs, and this is evidenced through our unique programme of training researchers to become ethics reviewers. All researchers are encouraged to attend this programme and become reviewers for applications submitted across the Faculty of Health and Life Sciences, an approach

underpinned by our Unit's values of encouraging development, supporting colleagues and being collaborative.

## 2. People

This UoA3 submission comprises 35 independent researchers (34 FTE).

### Research Staff Development

Staff development within UoA3 aligns to the institutional policies and processes, in addition to national strategic priorities such as the NHS (2019) Interim NHS People Plan (<https://www.longtermplan.nhs.uk/publication/interim-nhs-people-plan/>). Academic development and progression are assisted by mentoring, internal seed-corn funding schemes, funded PhD studentships, identification of research funding support, training in the preparation and submission of grants and papers, research seminars and funds for conference attendance. We were pro-active in keeping the detrimental effects of COVID on the research of our staff to a minimum and encouraged regular informal on-line interactions to promote well-being.

There is a commitment to professional development with support and engagement for clinical academics and allied health professionals including a dedicated formal Clinical Academic Research Excellence (CARE) programme. The CARE programme was established in partnership with UHCW during this REF period to support allied health professionals working in the NHS to undertake translational research and become research leaders of the future. The CARE programme encourages capacity and capability, with an emphasis on helping drive the delivery of the highest quality research and aligned clinical care. NHS-employed researchers at UHCW and neighbouring NHS Trusts are also encouraged through Comprehensive Local Research Networks (CLRN), funded mentorship schemes and integration via Honorary Research Fellowships (*Coad, Turner, Maddock, Renshaw* have mentored 10 such researchers). This enables health professionals to benefit from expertise of the unit's staff and *vice versa* and has resulted in clinical academics such as *Johnson* and health professionals (*Gordon* submitted to UoA24) to be employed and integrated within a research centre that offers full research support and accommodation. In 2015 an HEE/NIHR MRes programme was awarded (£1.5 million; *Coad*) supporting 32 allied health professionals/healthcare scientists. Since being awarded the HEE/NIHR, additional grants and accolades have been awarded (i.e. Best CLRN researcher in West Midlands 2019; *Gordon* submitted to UoA24). Resulting research outcomes have been used by NICE, NHS, and sector charities internationally to develop specialist training, enhance resource allocation, and influence policies and guidelines to improve care services, which is further demonstrated in UoA3 ICS "*Improving Care for Young People with Long-Term Illnesses and Complex Health Needs*" (*Coad*). Going forward, four jointly-appointed Professors will be employed to work across Coventry University and UHCW to further drive our future aims, supported by a collaborative Board and set of governance processes.

### Unit's staffing and recruitment policy and evidence of its effectiveness

The number of research-active staff in UoA3 has increased from 17.6FTE in REF2014 to 34FTE in the current REF submission. Our strategy is to develop, recruit and retain world-class researchers. This has included strategic recruitment of specific expertise to enhance research in the Themes and to build on the areas of research strength identified since REF2014. Professorial appointments in the current REF period included a blend of internal development and promotion (*Farnaud, Lycett, Maddock*) plus external appointments (*Allen, Jakovljevic, Renshaw, Reynolds, Wheatley,*



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*Zheng*). In addition, a total of four Associate Professors – *Kurmi, Martin, Shah, Tapp*; two Assistant Professors – *Johnson, Whelan*; one Lecturer - *Burke* and one Independent Research Fellow - *Deganutti*) have been recruited. Recruitment was not uniform throughout the REF period, as recruitment increased markedly with the opening of CIH and following the opening of the new Alison Gingell Building in 2018, as would be expected. By deliberately making appointments at early career, mid-career and Professor levels we have maintained a balanced staffing structure. Furthermore, this recruitment at all levels enhances the sustainability of the Unit going forward as it provides a vibrant research community possessing an effective balance of potential and experience. Our future research activity and succession planning is also supported by our favourable demographic profile which shows that 65% of UoA3 staff are in the 31-50 years age group.

### Support for Early Career Researchers (ECRs)

Institutionally-funded research investment schemes are available to support ECRs. Schemes have clear eligibility criteria to ensure a sustainable and targeted approach to support and to verify that applicants have sufficient experience. Those on fixed-term contracts can apply where their contract is longer than the proposed duration of the project. Such schemes include access to internal pump-priming funds to undertake transformative, cross-disciplinary, cross-national, and cross-sector research. These schemes support researchers at different career stages to develop their research practice, to work together as teams, and to enhance the wider research environment at Coventry University. The schemes have included an ECR and doctoral studentship scheme, ECR networking and skills development scheme, funds for purchasing research equipment, international and interdisciplinary pilot projects, and for public engagement with research. In addition, each Research Theme receives annual funding enabling academics to travel to national or international conferences.

The Academic Support *Programme* in Research Excellence (*ASPiRE*) supports ECR academics, with strong research promise, to access the *University's* rich research environment and work towards becoming independent researchers by providing combined mentorship and training over a two-year period. There are two *ASPiRE* Fellows linked to UoA3, with *Aspinall* and *Renshaw* as their mentors. We are committed to our ECRs and are prepared to invest in them to provide career development opportunities for talented ECRs in UoA3. In addition to *ASPiRE*, we also have an Associate Membership of Research Centre Scheme. Fundamentally, the scheme provides teaching staff with dedicated time and resources for research and embeds them within a Research Centre's environment. The individual's research profile and aspirations are taken into consideration at application. Within UoA3, we utilise and adapt University-level schemes to maximise the potential of our researchers and have the potential to review workloads so opportunities can be fully realised. For example, in recognition of their research potential, three ECR Research Centre Associates (Assistant Professors – *Bennett, Dodd, Greaves*), who have produced high-quality outputs, had the proportion of their time dedicated to research (rather than teaching) increased from 0.4FTE to 0.6FTE to support their research career development at this critical stage.

Further support is available via our 'Trailblazer' scheme, which is restricted to applications from ECRs, and provides fully-funded PhD studentships, giving talented ECRs the opportunity to lead a PhD supervisory team. They are supported in this role by the University's comprehensive Supervisor Development Framework and Programme. Currently, three ECRs (*Bennett, Dodd, He*) in UoA3 have been awarded Trailblazer PhD studentships.

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These schemes provide a raft of mechanisms that helps us to encourage and nurture the important and growing contribution of ECRs to our research outputs and to secure their contribution to the future reputation of our Unit. In this regard, it is noteworthy that one of our ECRs (*Dodd*) sits on the Early Career Advisory Panel for the Biochemical Society plus the Education, Training and Public Engagement Committee (as the ECR member).

Post-Doctoral Researchers are integral to the day-to-day activities of UoA3. As full members of the Research Themes, they are consulted on strategic matters such as developing new research initiatives within Themes and multi-disciplinary projects across Themes and with external collaborators. Post-Doctoral Researchers are actively encouraged to present their research in our regular seminar programmes and to invite external speakers. In addition to assisting with the training of PGRs, Post-Doctoral Researchers are offered opportunities to improve their education skills through involvement in teaching and supervisory activity, which ranges from project student supervision to research-led lecturing. Moreover, to expand their experience and develop their careers, Post-Doctoral Researchers are often included on the supervisory teams of PGRs in UoA3.

### Procedures to stimulate and facilitate exchanges with non-academic bodies

The Unit has developed partnerships with SMEs through the activity of its members in conjunction with the Enterprise and Innovation group. This group is responsible for running the UK and European government-funded knowledge transfer programmes (such as Innovate UK) and also for a substantial percentage of the SME engagement activities under the Higher Education Innovation Fund activity undertaken by the University. The University's EIO is frequently the first point of contact and engagement for SMEs and larger companies, and also supports University Group spin-outs in the exploitation of our IP. Partnerships during this period include: Life Science Group (*Farnaud, Renshaw*); Therapy Audit (*Zheng*); Abcam (*Renshaw*); InoCardia (*Sandhu*); Agrifesh (*Morozov*); Cell Therapy Sciences (*Gould*); NovoNordisk (*Dodd*). In addition, as cited above, part of the role of the Professor of Healthcare Technology is to work with the Advisory Board to assist UoA3 researchers develop links with SMEs and public and third sector bodies to establish joint programmes of work.

Supported by Research Services, capturing funding through the BBSRC-Industrial Partnership Award scheme provided another route to facilitate exchanges with industry (*Wheatley* collaborating with UCB the multi-national bio-therapeutics company). In addition, *Reynolds* was awarded a Royal Society Industry Fellowship (2017-2021), linked to the pharmaceutical company Sosei Heptares (Cambridge) which involved spending time regularly on-site. The Unit has also forged links with local public bodies including UHCW (*Maddock*) and Public Health Warwickshire (*Lycett*).

### Research students

PGR students are at the centre of research in UoA3; our students are embedded in all of our research, co-author most of our papers, run seminars with us, are physically co-located with staff, and considered as research staff. Staff in this submission currently supervise 44 PGR students registered for PhD, and there have been 57 successful PhD completions since 2014, an increase on the 17 PhD completions in the previous REF period. Coventry University match-funded 10 of the MRes NIHR studentships (detailed above) to convert them to PhD studentships further supporting embedded clinical research and health improvements within the NHS setting. The Unit has increased the number of fully-funded PhD studentships each year and currently funds 32 students. A significant development since REF2014 is the co-funding model, where 50% of the studentship is funded by an external partner. This adds an applied/translational element to the

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research, enriches the PGR training experience and increases external funding. External partners co-funding PGRs in UoA3 since 2014 include: Network2Supplies; InoCardia; Cell Therapy; Agrifresh; Abcam; UHCW (x2); Singapore A\*STAR.

Within the current REF period, the University has developed a centralised Doctoral College to coordinate all aspects of recruitment, training and progression of PGRs across the University which involves an annual Progression Review Panel comprising an independent Chair and a subject expert. This activity is complemented by a Doctoral Training Centre (DTC) for UoA3 activity, which provides practical laboratory skills training and development. We have successfully adopted a 'hub and spoke' model of PGR training, with the central Doctoral College coordinating transferable skills training and the DTC providing practical laboratory skills training and support. Each PGR has a supervisory team (maximum of four people) who meet with the student regularly. Within UoA3 we exploit this wider team to broaden the in-put of research experience support to the PGR. In addition to membership of PGR supervisory teams within our unit, UoA3 staff are on the supervisory team of 20 PGRs hosted outside of UoA3 providing multi-disciplinary support.

The effectiveness of our approach to Doctoral training was formally recognised by the Royal Society of Biology (RSB) in January 2018 when CSELS became the first RSB Accredited Doctoral Training Programme in the UK.

**Equality and Diversity**

The research centres contributing to the UoA3 submission are committed to promoting equality and supporting diversity in all its forms. We are proud of providing and promoting an inclusive environment in our research community. Our work and practices follow Coventry University's policy on Equality, Diversity and Inclusion. There have been increases in the proportion of females and individuals from BAME backgrounds working in grade 9 and 10 posts in the institution since 2016, the Director of CSELS within UoA3 is female (*Maddock*) and another female (*Lycett*) was a Theme Lead before subsequently becoming Director of CIH. Support for equality is provided by the University's Gender Leadership and Development Working Group and the Aurora programme, a woman-only leadership development programme. Of the 35 staff (34FTE) comprising the UoA3 submission: 20% are of BAME background (a greater proportion than the overall sector average of 8% for Nursing and Allied Health Professionals); the gender balance is 40%:60% (female/male) which is more equitable than the 74%:26% (female/male) for the Nursing and Allied Health Professionals sector; and age distribution for UoA3 staff is more evenly spread than for the sector overall, with 65% of UoA3 staff in the 31-50 years age group compared to the sector average of 49%.

<b>3. Income, infrastructure and facilities</b>
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Staff in UoA3 have captured funding from a rich variety of sources totalling over £11.8M for this REF period. This represents a growth in research funding of 45% since 2014, increasing from £8.15M in the previous assessment period. Researchers within UoA3 have acted as PIs and Co-Is on numerous projects, supported by a range of funding agencies and funding schemes - from Research Networks, Responsive Mode grants, Follow-on Funding for impact and engagement plus strategic programmes from a number of prestigious grant awarding bodies including the MRC (*Jakovljevic, Lycett, Wark*), NIHR (*Allen, Coad, Szczepura*), BBSRC (*Wheatley*), Innovate UK (*Farnaud, James, Maddock, Renshaw, Wark, Zheng*), Cancer Research UK (CRUK) (*Szczepura*),

## Unit-level environment template (REF5b)

Royal Society (*Reynolds*), Royal Academy of Engineering (*Zheng*), National Environment Research Council (NERC) (*Morozov*), Academy of Medical Sciences (*Greaves*) and the Technology Strategy Board (*Maddock*, *Szczepura*). In addition, staff within UoA3 have actively secured funding from a number of charities and third sector bodies (including Bill & Melinda Gates Foundation (*Zheng*), Arthritis Research UK (*Allen*) plus John Templeton Foundation, Acorn Children's Hospital Trust, The Bailey Thomas Charitable Fund, Teenage Cancer Trust, Linking Lives UK, The British Academy. Funding was secured from Warwickshire Public Health (*Lycett*) plus a series of NHS Trusts (*Coad*). Additional funding has been secured from the European Commission from a number of collaborative projects funded through the Horizon 2020 programmes (*Jakovljevic*, *Maddock*) and the NIHR Newcastle Biomedical Research Centre (*Allen*).

With respect to cross-HEI research infrastructure, *Wheatley* and *Reynolds* are co-members of a multi-centre research consortium of nine British Universities, awarded BBSRC funding (£368,680) via the 19ALERT scheme, for an Electron Paramagnetic Resonance (EPR) spectrometer (housed at Essex University in 2020) to study protein dynamics. Access to this specialised equipment and being part of a large consortium will be a springboard for future new projects for grant applications, collaborations and publications.

We have secured funded international collaborative projects with a range of countries including Australia (Monash; *Johnson*), Canada (Hamilton Health Sciences Corporation; *Turner*), Belgium (UCB; *Maddock*, *Wheatley*; EIT Digital Health, *Maddock*); China (Southern University of Science and Technology, YiTing Health and Technology Limited; both Innovate-UK, *Zheng* plus Beijing University of Technology; Bill & Melinda Gates Foundation, *Zheng*), Jordan (German Jordanian University and Atlas-Medical; Newton Fund, *Zheng*); Serbia, Austria, Belgium, Greece (Kragujavac University, Vienna University of Technology, Katholieke Universiteit Leuven, Ioannina University; EU Horizon 2020, *Jakovljevic*); South Africa (Stellenbosch University [with University of Birmingham as PI]); BBSRC, *Wheatley*). In addition, the Indonesian Government funds five PhD studentships (*Farnaud*, *Fei*, *Lycett*, *Martin*, *Turner*) and the Singapore agency A\*STAR jointly funds one PhD (*He*).

Overall, these cited research funds from a raft of agencies have been central for generating and supporting highly innovative research, including high-quality papers and conference presentations. Examples include multiple papers in *Nature*, *Cell*, *Nature Cell Biology*, *Nature Communications*, invitations to speak at conferences, to collaborate with industry plus a Technical Innovation Award by the Safety Pharmacology Society for research undertaken within UoA3 by InoCardia and CSELS (ICS; "Safer Heart Therapies: Improving Drug Development and Patient Outcomes with InoCardia Ltd").

## Organisational infrastructure supporting research and impact

The unit has been supported by high levels of investment over the REF period in order to extend the research and its subsequent impact. Coventry University has supported and encouraged the development of research activity in UoA3 through the provision of purpose-built dedicated research laboratory space in a brand-new building, the Alison Gingell Building, opened in 2018. This is a £59M building containing approximately 2000 m<sup>2</sup> of research laboratory space to the value of £2.4M along with specialist research equipment totalling £2.3M, together with teaching laboratories and simulation facilities. In addition, there are office and meeting spaces plus kitchen areas and break-out space, designed to encourage interaction and discussion across Research Themes and disciplines and between all staff, irrespective of experience, job role or grade. Consequently, the

## Unit-level environment template (REF5b)

physical space has contributed to a sense of cohesion, built research momentum and encouraged support and collaboration. The new space has provided, in part, the expanded physical space required to accommodate the increase in UoA3 staff since REF2014. Furthermore, the working environment within the new building has facilitated the strategic recruitment of new staff and provided space to house associated specialist research equipment. The organisational infrastructure of UoA3 was also re-configured to better develop our established research strengths and in recognition of the rapidly changing nature of technological advances in the Allied Healthcare Professions, clinical settings and in society. Our strategic response was to develop and open a new Centre for Intelligent Healthcare to support research at the forefront of digital healthcare and healthcare technology.

### Infrastructure and facilities

£2.3M has been invested in capital equipment during the current REF period. One example of this is University investment and research expansion in Healthcare Technology which includes the intersection between engineering, healthcare and information technology, to enable the continued development of translational and applied health-related research and including a state-of-the-art clinical physiological measurement room, with microvascular imaging capability, and nano-sensor fabrication facilities, including clean-room capability and a Prototyping Development lab. Similarly, in recognition of our growing work examining health benefits of exercise in different populations, the University has invested in a specialist body composition laboratory housing an iDEXA (£116k) to increase capacity for research and engagement activity related to bone and muscle health. In addition, significant investment to enhance the Cell Signalling and Membrane Biology; Disease Prevention, Therapeutics & Diagnostics areas includes: bespoke high-performance computing capability dedicated to computational molecular dynamics and modelling (>£110K); Nikon confocal microscope with live-cell chamber with hypoxia and Z-stacking functions plus total internal reflection fluorescence (TIRF) microscopy (>£272K); FACSMelody Cell Sorter; ÄKTA PURE protein purification system; ClarioStar high performance plate-reader; next-generation sequencer; Agilent Seahorse for mitochondria analysis; ICP-mass spectrometry system with single cell analysis function; inverted fluorescence microscope; real-time PCR analysis; bioreactors.

### Operational and scholarly infrastructure supporting research excellence with impact

The Unit has benefitted from the approach taken by the University in assisting in the development of research impact through the provision of expertise, facilities and technical support. For example, the award-winning spin-out company InoCardia ('Technological Innovation Award' from the global Safety Pharmacology Society in 2020, followed by a 'Women in Innovation' award from Innovate UK to *Maddock*), has laboratory space within the new Alison Gingell Building and the close association between the company and the University has facilitated its access to funding, its further interaction with local hospitals and the benefit of close association with other academics and biotechnology industry. A second example, Hope for the Community (H4C), an award-winning social enterprise (Top 25 of the NatWest SE100 'Trailblazing Newcomers' and named 'One to Watch' by 2020 Medilink West Midlands Medical & Healthcare Business Awards) provides digital products and services to empower people to manage their wellbeing. In addition to providing funds and facilities, the University provides the servers for the digital platform at the centre of this enterprise. Both of these spin-outs have contributed UoA3 Impact Case Studies (InoCardia (*Maddock*), "*Safer Heart Therapies: Improving Drug Development and Patient Outcomes with InoCardia Ltd*"; H4C (*Turner*), "*Hope 4 The Community CIC: Improving the lives of people living with a long-term health condition by providing self-management tools*".



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

A significant feature of research in the unit is the emphasis on collaboration to foster multi-disciplinary approaches and to extend the reach and impact of our research.

**Effectiveness of research collaborations, networks and partnerships**

Robust links have been forged with both the national and international academic, clinical and industrial communities, through collaborative research projects, or through supervision of PhD students funded by co-tutelle schemes (Stellenbosch University; South Africa) where PhD students are supervised by academics from both Universities in the co-tutelle. Furthermore, a novel format of PhD studentships has been developed in 2020 within UoA3 (*Wheatley*) in collaboration with Stellenbosch University (Chemistry Department) in which two 'reciprocal PhD students' (one based at each institution) spend three to six months at the partner institution funded/supported in a reciprocal arrangement. The synergy in this case, between the bioscience and chemistry expertise respectively, will be mutually enriching for the research environment of both host laboratories.

**Academic:** Our international partnerships have made major contributions in the Allied Healthcare research arena. For example, *Zheng* collaborated with German Jordanian University to develop an innovative wearable sensor to monitor respiration rate in newborn babies, which was short-listed for the Newton Prize 2020 (final 4 out of 180+), and with Southern University of Science and Technology China to develop a big-data centric hearing impairment rehabilitation solution (funded by InnovateUK-Guangdong urban innovation challenge; 2017). *Zheng* also collaborates with Sichuan University (China) to use machine learning to teach computers to 'listen' to stethoscope sounds and is developing a PhD co-tutelle with Sichuan University in healthcare technology. In Australia we have collaborative links with the University of Sydney (*James*) and Monash University (*Deganutti, Reynolds*), the latter of which generated a series of high-impact papers (*Nature, Cell, Nature Comms* included in UoA3 Outputs) describing drug action at the molecular level.

**Clinical:** Nationally we have established links with hospitals (including UHCW, *Coad, Maddock, Morozov, Renshaw*; Newcastle Hospitals NHS Foundation Trust, *Allen, Jakovljevic*; Salford Royal NHS Foundation Trust, *Allen*; Oxford University Hospitals NHS Foundation Trust, *Maddock, Sandhu*; University College London, *Maddock, Sandhu*) and with Public Health Authorities (Warwickshire Public Health Authority; *Lycett*) which have resulted in the joint projects. These partnerships have resulted in publications in top journals including *Journals of the American College of Cardiology, Circulation: Cardiac Imaging* and *EMBO Molecular Medicine*.

**Industrial:** We have forged collaborative partnerships and projects with the industrial sector, from the large multi-national Bio-therapeutics company UCB (*Maddock, Wheatley*) to a range of SMEs including TherapyAudit, Cheekmate, OkDok (*Zheng*), Cresset-Group (*Maddock*), Cardinale Health (*Jakovljevic*); LSG (*Renshaw, Farnaud*) and Network 2 Supplies Ltd (*Farnaud*) and have developed overseas links with Atomwise (*Reynolds and Wheatley*) a drug discovery company in the US exploiting Artificial Intelligence. *Reynolds* was awarded a Royal Society Industrial Fellowship to translate his computational molecular modelling into an applied drug-discovery context at the Pharma Sosei Heptares (Cambridge), with potential impact on several 'in-house' research projects, UK economy and society.

## Unit-level environment template (REF5b)

### Relationships with key research users/beneficiaries

Our approach for developing best-practice for reproducible research is detailed in 'Open Research' in Section 1. Research across the unit has benefitted academics, the Pharmaceutical and Biotechnology Industry, patients, their families and policy makers, as demonstrated by the three impact case studies (*Coad, Maddock, Turner*). Researchers have had close interaction with local public health bodies, including Public Health Warwickshire, and with the local Council to translate their research findings into practice. These studies have included work around influenza vaccination, smoking cessation and breastfeeding.

We are actively involved in generating interest in our research and engaging the public in our work through a number of efficient avenues. Engagement with diverse communities and public is inherent in the research this unit undertakes. This is particularly apparent in the multiple projects focusing on health behaviour change technique (BCT) detailed in Section 1 (REF2014 Objectives 1 and 3) plus the research captured in two UoA3 ICSs viz. "*Hope 4 The Community CIC: Improving the lives of people living with a long-term health condition by providing self-management tools*" and '*Improving care for young people with long-term illnesses and complex health needs*'.

Coventry University has an active press office, which disseminates scientific-based research to a wider audience. In addition, several colleagues deliver interactive lectures to the general public in an attempt to promulgate an awareness of basic and clinical science research. Staff also participate in radio and television broadcasts (*Coad; Gould; Maddock*) about translational research.

In addition, through numerous collaborations within the NHS, industry and academia, our research has had a broad impact on people, on scientific investigations, tools and techniques, on new drug/compounds testing with improved reliability towards humans, on predictivity and on throughput leading to national economic benefits in terms of improved patient compliance, patient quality of life and clinical outcomes (wide-ranging evidence provided via testimonials in all three UoA3 ICSs). Interactive websites have been commissioned to publicise our work and also to raise public awareness.

### Engagement

To promote our scientific findings in the public arena, research staff have engaged with the community through outreach work including 'Pint of Science' (*Maddock*) and 'Café Scientific' (*Maddock; Morozov; Aspinall*). Staff have actively participated in the Science Festival held at Jimmy Doherty's farm, famous for the television show "Jimmy's Farm" (c. 4,000 attendees), promoting research. This event involves children's activities and interactive scientific sessions to promote science aligned to allied health research. We have not only engaged with school pupils but also their teachers. In 2019, *Wheatley* was invited speaker at the Association for Science Education Annual Conference. This is the biggest international science education conference in the UK attended by ~3,000 science teachers to give a talk on his molecular pharmacology research - how drugs work.

We have inspired children to enjoy and study relevant scientific subject areas by holding a conference every year during the summer for schools across the city, in partnership with Coventry Local Education Authority, to show pupils how science influences our lives (*Maddock, James, Renshaw*). Staff also attend school careers events to promote biomedical and pharmacology-related research. We host several post-GCSE level work experience students from local schools, who are given a thorough introduction into the research interests of the unit and who undertake

## Unit-level environment template (REF5b)

small experiments in areas directly related to ongoing biomedical research. In addition, the unit has run the Coventry Young Researcher event for families with children aged 6-12 years old providing community opportunities to learn about science and research through experiments and art/crafts demonstrations. Feedback from these events has been very positive.

### Responsiveness to national and international priorities and initiatives

Implicit in our fundamental objective of 'research excellence with impact' is engaging in research that matters. To fulfil this aim, and maintain sustainability, our research addresses national/international priorities and we respond to changes in research priorities, whether driven by funding agencies or society.

Changing lifestyle behaviours to improve health is an international public health priority and we are contributing significantly to the evidence base. Our strategy is to develop interventions which are stratified (appropriate for the individual or group), scalable (suitable for use at community, region or national levels) and sustainable (sustainable long-term by the provider and delivering sustained behaviour change). Our research includes development and testing of behavioural interventions to support the treatment and rehabilitation of patient populations such as metabolic disorders (*Renshaw, Reynolds, Williams*); cardiovascular disease such as heart failure (*Jakovljevic, Maddock, Tapp, Zheng*), vascular disease (*Allen, Tapp, Sandhu*); Cancer (*Turner, Lycett, Maddock, Sandhu*) and maintaining weight loss (*Williams*). For example four newly revised weight management services were delivered across Coventry area by Coventry City Council as a result of the 'Be Active Be Healthy' behaviour change support project; One Body One Life (OBOL) family, OBOL 2-4, Buggy Workout Extra and Lifestyle Advisors (*Williams*).

Our work also includes validation, evaluation and assessment of diet, lifestyle, wellbeing and health status using traditional and new digital technologies (*Dong, Jakovljevic, Johnson, Lycett, Martin, Szczepura, Turner, Whelan*) and interventions applicable to chronic health conditions (*Horton, Lycett, Martin, Morozov, Wark, Williams*)

Another example was provided when Coventry University and InoCardia showcased the use of human tissue in safety assessment and demonstrated the ability of technology to reduce and replace the use of animals in research. To gauge the current use of human tissue models in safety pharmacology and the barriers to greater uptake, in May 2017 a Safety Pharmacology Society European regional meeting was organised entitled 'The Use of Human Tissue in Safety Assessment', which *Maddock* organised with the NC3Rs and Safety Pharmacology Society. This Stakeholder meeting influenced a wider community of end-users (e.g. Pharmaceutical, Biotechnology, Agrochemical, Nutraceutical and Cosmetic industries, relevant government related bodies & departments with health and tissue donation responsibilities, the British CardioOncology Society and regulatory bodies namely the Medicines and Healthcare products Regulatory Agency (MHRA) and the Food and Drug Administration (FDA), to develop approaches to optimise the use of human tissue. InoCardia's Work-loop Platform and Contractome-AI reduces animal tissue use and helps position the UK as a leader in the development of new technologies to replace the use of animals in research. The adoption of the InoCardia's technology by the Pharmaceutical industry has led to reduced animal usage and is detailed in the UoA3 ICS "*Safer Heart Therapies: Improving Drug Development and Patient Outcomes with InoCardia Ltd.*".

Both the University and UoA3 responded with agility to the recent COVID-19 pandemic caused by the SARS-COV-2 virus, due in part to our breadth of expertise and multi-disciplinary capabilities.

## Unit-level environment template (REF5b)

The University provided funding for 50 full-time PhD studentships to research all aspects of the pandemic. Following internal review of the proposals, researchers in UoA3 were awarded 24 of these studentships. Aligned to this, spin-out company OVO Biomanufacturing, co-founded by a UoA3 researcher (*Gould*), aims to improve the efficiency of vaccines for example the Oxford COVID-19 vaccine (ChAdOx1 nCov-2019) by the identification and removal of defective interfering viral particles from the vaccine stocks. Previous research with influenza vaccine suggested these viral particles had an adverse effect on the vaccine efficacy. In addition, InoCardia was awarded funding by the UK Government to reduce the risk of new COVID-19 drugs causing life-threatening effects on the heart (*Maddock*).

### Wider influence

We are widely engaged in the peer-review process for both academic publications and funding.

**Publishing:** In recognition of their research contribution and reputation in their respective disciplines, many of our staff have been invited to serve on editorial boards of journals or to act as guest editors. Over the current REF period, editorial roles have included: Physiological Measurement (*Allen, Zheng*); Experimental Gerontology, Immunology of Aging (*Aspinall*); Frontiers in Physiology, Frontiers in Computational Physiology and Medicine (*Allen*); Applied Sciences (*Farnaud*); Microorganisms (*Gould*); Frontiers in Cardiovascular Medicine (*Maddock*); Acta Diabetologica (*Dodd*); BMC Public Health, Journal of Mathematics (*Mukandavire*); Future Medicinal Chemistry (*Reynolds*); Frontiers of Endocrinology (*Wheatley*); Computational and Mathematical Methods in Medicine, Biomedical Physics & Engineering Express, Frontiers of Digital Health, Frontiers of Physiology, Scientific Reports (*Zheng*); Sensors (*Allen*).

In addition to these editorial roles, our research staff routinely review manuscripts for a wide range of journals reflecting the breadth of the unit's research expertise in the Allied Health Professions including: Nature, New England Journal of Medicine, Lancet, British Journal of Pharmacology, Proceedings of the Royal Society B, Journal of Endocrinology, PLoS One, Biophysical Journal, Biochemistry, Bioinformatics, Journal of Medical Internet Research, American Journal of Physiology-Heart and Circulatory Physiology; Medical Engineering and Physics; IEEE Transactions on Biomedical Engineering, Age and Ageing, Mayo Clinic Proceedings, Scientific Reports to name but a few.

**Funding:** The expertise of staff has been valued by major Government Research Council funding agencies: *Maddock* serves on the BBSRC Follow-On Fund Committee and *Tapp* was a Member of the Australian National Health and Medical Research Council (NHMRC) grant review panel (2014-2019). *Zheng* is a member of the Biological and Medical Sciences Review Panel of the Newton Fund coordinated by the British Council.

In addition to reviewing grant applications on behalf of UK funding agencies including: NIHR, BBSRC, MRC, EPSRC, Wellcome Trust, British Heart Foundation, NC3Rs, British Council, Leverhulme Trust, Leukaemia & Lymphoma, RoseTrees Trust; staff have fulfilled the role of expert reviewer on behalf of overseas funding agencies, commensurate with their international research reputations, including: South African Medical Research Council (*Farnaud, Maddock Renshaw*); European Research Council, Fonds National de la Recherche Luxemburg (*Tapp*); VLAIO - Agentschap Innoveren & Ondernemen, Flanders (*Allen*); Israel Science Foundation (*Maddock*); Royal Society of New Zealand (*Maddock, Wheatley*); National Research Foundation of South Africa (*Mukandavire, Wheatley*); Austrian Science Fund, Fund for Scientific Research, Brussels,



**Unit-level environment template (REF5b)**

Belgium, Research Grants Council of Hong Kong (*Jakovljevic*); Agence Nationale de la Recherche, France (*Reynolds*); European Commission (*Sandhu*); National Heart Foundation of New Zealand (*Wheatley*); Science Foundation Ireland, The Health Research Board Ireland, The Broad Medical Research Foundation USA (*Burke*); National Science Foundation USA (*James*).

**Potential to influence policy:** In addition to serving on Research Council Committees, our staff have used their expertise to contribute to other influential committees that have the potential to influence policy in the Allied Health Professions arena. *Aspinall* is a Member of the UoA3 UK REF Panel and has been a Trustee for the British Society for Research on Ageing. *Farnaud* is a member of the All-Party Parliamentary Group for Micronutrients and Health. *Maddock* is a member of the Human Tissue Working Party, part of the joint initiative of the National Centre for the Replacement, Refinement & Reduction of Animals in Research (NC3Rs) and the Medicines and Healthcare products Regulatory Agency (MHRA) working to reduce the use of animals in pharmaceutical development. Staff also make a range of contributions in the clinical area, including: Panel Member for the West Midlands NIHR Research for Patient Benefit (*Turner*); Mid Essex, Southend and Basildon (MSB) Innovation Advisory Board member, Steering Community member of Healthy Birth, Growth and Development (*Zheng*); Chair of the Quality Standards Committee of the British Dietetic Association (*Lycett*).

**Awards and honours:** The success and esteem of our staff has been recognised in a number of awards and honours since 2014. These include award of the Lord Cohen Medal to *Aspinall* in 2015 for pioneering research in the field of age-associated immune deficiencies and issues concerning vaccination in older people. In 2015, *Maddock* was recipient of the Safety Pharmacological Society Investigator Award which was followed by the Safety Pharmacological Society Technological Innovation Award (2020). *Maddock* also received the Innovate UK 'Women in Innovation Award' in 2020. *Allen*'s research has received international recognition; he was Team Leader for two entries shortlisted for the 2017 Institution of Engineering and Technology Innovations Awards: Healthcare Technologies and Emerging Technology Design categories, both awarded 'highly commended'. In 2019, *Allen* was recipient of a Research Achievement award by the Editor-in-Chief of the Institute of Physics Publishing, Physiological Measurement journal for obtaining 1000+ citations, the largest number for any article in this journal. *Wheatley* is an Honorary Professor in Biosciences at the University of Birmingham and *Reynolds* is Honorary Professor in Life Sciences at the University of Essex.

**Fellowships:** A series of Fellowships have been awarded to staff in recognition of their contributions to their respective fields of research: *Aspinall* is Fellow of the Royal College of Physicians (Edin), and Fellow of the Royal College of Pathologists; *Farnaud* is Fellow of Institute of Biomedical Science; *Wheatley* was elected to Fellow of the British Pharmacological Society in 'recognition of distinguished service to pharmacology'. *Farnaud*, *James*, *Maddock*, *Renshaw* are Fellows of Royal Society of Biology. *Allen* is a Fellow of the Royal Photographic Society and Accredited Senior Imaging Scientist. *Reynolds* is a Fellow of the Royal Society of Chemistry (FRSC) and was awarded a Royal Society Fellowship.

**Contributions to learned societies:** Colleagues make a significant contribution to the scientific community through their roles in learned societies including: Biochemical Society (Early Career Advisory Panel, *Dodd*; Education, Training and Public Engagement Committee, *Dodd*); British Pharmacological Society (Finance & Risk Committee, *Maddock*); Safety Pharmacology Society (Academic Outreach and Abstract Committee, *Maddock*). Royal Photographic Society (Imaging



**Unit-level environment template (REF5b)**

Science Group Committee, corresponding member, *Allen*). Institute of Physics and Engineering in Medicine (Member of the Physiological Measurement special interest group, *Allen*). Royal Society of Biology (Heads of University Biosciences, *Gould*); Royal Society of Chemistry (Theoretical Chemistry Group Committee, *Reynolds*); British Dietetic Association (Chair of the Quality Standards Committee, Education Board member, *Lycett*); Society for Endocrinology (Science Committee, *Renshaw*); Society of Experimental Biology (Animal Biology Committee, *James*).

As a consequence of their research reputation, our staff have organised conferences, including: Conference Co-Organiser, 2015, "GCPRs: Beyond structure towards therapy". Prato, Italy (*Wheatley*); Organiser British Society for Cardiovascular Research meeting, Oxford 2017 (*Dodd*); Organiser of symposia at Society for Experimental Biology Annual Conference, 2017, 2018, 2019 (*James*); Lead Organiser of mini-symposium on Photoplethysmography, Engineering in Medicine & Biology Society Conference, Berlin 2019 (*Allen*); Invited Scientific Committee Member for European Conference on Religion, Spirituality and Health (*Lycett*); Steering Committee 11th Conference on Advances in Diabetes and Insulin Therapy, 2019, (*Tapp*).

As a consequence of their research outputs and profile, our staff have been invited speakers and Chairs at conferences. Examples include: speaker at World Cardiology Congress, Hypertension Symposium, 2014 (*Tapp*); Co-Chair at Sino-UK Symposium on Physiological Measurement, Beijing 2017 (*Zheng*), speaker at International Consensus and Guidelines in Medical Thermography. Brazil 2015 (*Allen*); Dynamic Systems in Biology, Institute of Mathematical Sciences, Kenya, 2016 (*Mukandavire*); speaker at Joint Canadian and Japanese Safety Pharmacology Conference, Vancouver, 2016 (*Sandhu*); speaker at Engineers as Healthcare Practitioners, Ho Chi Minh City, Vietnam; Healthcare Technology Innovation Centre, IIT Madras, India 2018 (*Zheng*); speaker at Drug Discovery Chemistry, San Diego, 2019 (*Reynolds*); speaker at 4th Membrane Proteins Workshop, Taiwan. 2017 (*Wheatley*).