

<b>Institution: Newcastle University</b>
<b>Unit of Assessment: UoA3 - Allied Health Professions, Dentistry, Nursing and Pharmacy</b>
<p><b>1. Unit context and structure, research and impact strategy</b></p> <p><b>1.1 Overview</b></p> <p>Work at Newcastle University (NU) shapes policy and practice in three related areas: Allied Health, Dentistry and Pharmacy. Our research seeks to: enhance health and wellbeing across the lifecourse; address and ameliorate the impacts of inequalities; and develop and deliver novel interventions to improve health and care. Based in the Faculty of Medical Sciences (FMS), our research has strong links across NU and with key strategic NHS partners: Newcastle upon Tyne Hospitals NHS Foundation Trust (NuTH) and Cumbria, Northumberland and Tyne and Wear NHS Foundation Trust (CNTW) and with policy and industrial partners. The strength of these relationships is evidenced by our status as an Academic Health Science Centre: Newcastle Health Innovation Partners (NHIP), which is core to our future strategic development.</p> <p><b>1.2 Context and Structure</b></p> <p>Since REF2014, our strategic goal has been to develop and expand research in <b>Allied Health, Dental Sciences</b>, and <b>Pharmacy and Pharmaceutical Sciences</b> and this UoA3 return has increased by 137% to <b>45</b> researchers (45 FTE), the culmination of strategic expansion and purposeful consolidation. For example, we have: consolidated our multi-professional allied health expertise; grown our successful School of Dental Sciences; consolidated our Nutrition research within FMS by moving colleagues from our Science Agriculture and Engineering Faculty; expanded our School of Biomedical Sciences to include Nutritional and Sport Sciences and launched a new Masters in Dietetics programme; and, in 2017, transferred the School of Pharmacy from Durham University to NU.</p> <p>Researchers in UoA3 are based in three Schools (Dental Sciences, Pharmacy, and Biomedical, Nutritional and Sport Sciences) and the NU Population Health Sciences Institute (NUPHSI). NUPHSI was formed in November 2019, following a faculty restructure which moved from six, largely independently operating research institutes to three strategically interconnected ones: Biosciences, Translational and Clinical Research, and NUPHSI. Our institutes support colleagues with state-of-the-art research facilities, training and career development. Prior to the restructure, Allied Health researchers were in different institutes, but now are based within NUPHSI, giving increased visibility and critical mass to this area of research. The restructure maintained and strengthened our five successful schools. Core to the reorganisation was the establishment of cross-cutting multidisciplinary faculty research themes which ensure institute- and school-based researchers benefit from shared facilities and collaborations across the full translational pathway. At University level, we have established NU Centres of Research Excellence (NUCoREs) (REF5a 2.2.1) supporting cross-faculty collaborations and enabling our research to have global visibility and impact. UoA3 researchers play an active role in our NUCoREs particularly: "<a href="#">Healthier Lives</a>" (<i>Director: Mathers</i>); "<a href="#">Ageing and Inequalities</a>"; and "<a href="#">Cancer</a>".</p>

Our headline achievements during this REF period include:

- Building on the findings of earlier work, an award of \$2M from the Bill and Melinda Gates Foundation to develop and validate biomarkers of effects of excess vitamin A ([JNutr2019 Leitz](#)), involving international institutions from the Philippines, Bangladesh, Guatemala and USA Publication of the largest dental NIHR HTA-funded study to date (FiCTION) on caries management in children's teeth ([HTA2020 Maguire](#))
- Combining smoking cessation research in pharmacy ([BMJOpen2016](#)) and dentistry ([EurJDentEduc2018](#)) has culminated in a new HTA award for work in periodontology and smoking cessation (*Holliday, McColl (UoA2), Todd, Holmes, Kist, Preshaw*)
- Identifying the positive pharmacy care law, which demonstrated that pharmacies are the most accessible healthcare provider in areas of highest deprivation ([BMJOpen2014 Todd, Husband, Bambra \(UoA2\)](#)) and appropriate for direct referral from NHS 111 ([ResSocialAdmPharm2018 Nazar, Slight](#)) (Impact Case Study (ICS): "Increasing the use of local community pharmacies for minor illnesses reduces the burden on hospitals and GPs")
- Developing small injectable particles that can package genetic drugs and navigate their way through the blood capillaries in the brain and reach the nerve cells, potentially opening a simple way to treat neurodegenerative disorders such as Alzheimer's and Parkinson's disease (Patents [US9981047B2](#); [US10201622B2 Moghimi](#))
- Showing that a very low calorie diet can reverse Type 2 diabetes ([Lancet2017 Mathers, Taylor ICS UoA1](#))
- Changing current practice in speech and language therapies for children with motor speech disorders ([IntJLangCommunDisord2015 Pennington ICS UoA4](#))

UoA3 researchers work collaboratively with colleagues across FMS, NU, NHIP and other external partners. Examples of interdisciplinary links include:

- UoA1 regenerative medicine ([HTA2016 Exley](#)); cancer ([CancerRes2016 Robinson](#)); genetics ([JPathol2018 Kist](#))
- UoA2 Newcastle 85+ study ([JAmGeriatrSoc2019 Hill, Siervo, Mathers](#)); frailty ([JAmGeriatrSoc2018 Moynihan](#)); dementia care ([PGFAR2020 Exley](#));
- UoA4 interventions in complex neurological conditions such as gait analysis to predict Parkinson's disease ([AnnNeurol2019 Galna](#)); dementia risk models ([Stroke2020 Exley](#)); stroke care ([JAMANeurol2020 Exley](#))
- UoA5 mitochondrial mutations ([NatCancer2020 Mathers](#))
- UoA12 dental materials and engineering ([MaterSciEngCI2019 German](#))
- UoA20 mobilising resources for wellbeing ([Gerontologist2016 Mathers](#)); living with implantable technologies ([SocSciMed2017 Exley](#))

### 1.3 Research strategy

In REF2014, our strategy centred on increasing our focus on the major public health challenges in nutrition and dentistry of obesity, ageing and oral health through understanding mechanisms; developing and testing new interventions; and developing evaluation methodologies. We achieved this and expanded our strategy within UoA3 to include wider aspects of allied health, particularly in interventions for long-term conditions and pharmacy, with strong collaborations across our three areas of research. This has been supported by investment and the restructure described above, combined with the development of investigator critical mass, through strategic appointments and, importantly, by nurturing and developing our own staff. For example, the

formation of NUPHSI has increased our focus on the health and social care needs of people with long-term conditions and has co-located occupational therapy and speech and language therapy. In addition, NUCoREs have facilitated new collaborations that address translational gaps - such as non-malignant chronic pain - spanning pharmacy, neuroscience and dentistry; and broadening health inequalities research to encompass dentistry and pharmacy.

### 1.3.1 Allied Health

Our Allied Health research has broadened since 2014 from nutrition, and now encompasses other allied health professionals – including dietetics, occupational therapy, physiotherapy, and speech and language therapy – to address complex health issues. We deliver research to enhance health and wellbeing from beginning to end of life and inform and shape multidisciplinary clinical practice, policy development and implementation, with collaborations across NU and external partners.

We undertake a dynamic and diverse programme of research to improve the health and care of children, young people and families. Research funded through a NIHR Clinical Senior Lectureship (*Kolehmainen*) promotes health and function in children with physical limitations through participation in physical activities, and NIHR HTA-funded work assesses early powered mobility interventions for very young children ([HTA2020](#)). We developed and trialled interventions to increase the intelligibility of children and young people with motor disorders ([BMJOpen2018](#)) that changed guidelines and practice in speech and language therapy (*Pennington ICS UoA4*). We have developed novel methods for assessing body vitamin A stores in children and are applying them globally ([JNutr2020 Lietz](#)). Our research has directly led to the introduction of free school meals for infants and simplified food standards (*ICS: Improving school food standards and introducing nutritious free school meals for infants*). How we can support health care professionals deliver enhanced care is exemplified by our work to improve healthcare practice for parents of twins following the loss of one child (*ICS: Best practice for healthcare professionals in supporting parents who have experienced a bereavement from a multiple pregnancy*).

Tackling obesity is a lifelong and global challenge and our Human Nutrition Research Centre ([HNRC](#)) continues to address this major public health issue ([BMJ2016 Mathers](#)). Since 2014, we have increased focus on measuring dietary intake and nutritional status including [Intake24](#), our web-based dietary assessment platform that has been adopted into the National Diet and Nutrition Survey (*ICS UoA2*). We have pioneered use of urine-based metabolomics approaches to identify and validate novel biomarkers of food intake ([Metabolomics2019](#) with Aberystwyth and Imperial College *Mathers*) and this is being extended to assess dietary patterns and whole diets ([LancetDiabetesEndocrinol2017 Mathers](#)). Our vitamin D research (in particular public acceptance of vitamin D food fortification, [NutritFoodSci2019 Hill](#)) has led to industrial collaboration with Noble Foods resulting in the UK-wide availability of eggs enriched with vitamin D (*ICS UoA6*).

Our research focusing on later life seeks to maximise healthier lives and has provided evidence for the House of Lords Science and Technology Committee Inquiry into [Healthy Ageing](#) (*Mathers*). We have made extensive use of the [Newcastle 85+ Study](#) and other large cohorts to investigate how diet can enhance cognitive function ([JGerontolA2018 Hill](#), [AmJClinNutr2019 Siervo](#)). We have pioneered development of scalable web-delivered personalised nutrition interventions for adults across seven countries (EU-FP7-funded [Food4Me Study](#)) and

implemented this approach in multidisciplinary interventions to enhance healthy ageing (MRC-funded LiveWell Programme) and for dementia prevention (Alzheimer's Research UK-funded MedEx-UK Study; [BMJOpen2020 Mathers](#)). Our multidisciplinary research focusing on preventing and managing long-term conditions in adulthood has attracted prestigious research funding including NIHR HTA funding: [National Trial](#) of Tonsillectomy in Adults; Nasal Airway Obstruction [Study](#) (*Wilson*) and [PGfAR](#) Promoting Effective and Rapid Stroke Care (*Exley*). Bringing together physiotherapy and exercise expertise we have pioneered the use of gait to understand disease progression ([JGerontolA2017 Galna](#)) and lead the EU-funded (IMIJ2) [Mobilise-D](#) (*Galna*) consortium of 34 academic and industrial partners, including the [National Innovation Centre for Ageing](#).

### 1.3.2 Dental Sciences

Following REF2014 strategy, our oral health-related research has continued to focus on two areas of strength: Translational Oral Biosciences, and Oral Health Care and Epidemiology. Both work globally across the full translational pathway. Our strong policy links (e.g. with DHSC, NHSE, WHO) and commercial work (e.g. with GSK, Septodont, 3M-ESPE) ensure our research has international reach and impact.

In Translational Oral Biosciences, we have grown our oral microbiology research identifying novel enzymes and agents for biofilm control ([MolMicrobiol2015 Jakubovics](#)) leading to a patent ([WO2015048146A1](#)) and further funding for its translation to develop new prebiotic approaches to control periodontal disease. Our immunological research has identified novel salivary diagnostics for periodontal disease ([SciRep2019 Preshaw](#)), stemming from industrial partnerships and [EPSRC/Innovate UK](#) funding (*Taylor, Preshaw*). Our biomaterials research has expanded to include applications beyond oral health ([MaterSciEngC2019 German](#)), leading to further funding, including involvement with the [GIOTTO project](#) (EU H2020 E5.6m *German*). Our research on oral cancer and in oro-mucosal diseases ([CancerRes2016 Robinson](#)), continues to have strong international collaborations, particularly in human papillomavirus and head and neck cancer. We have invested in neurobiology to expand orofacial pain research into understanding mechanisms and work with pharmacy to understand novel management ([StemCellsInt2017 Telezhkin](#)).

Research in Oral Health Care and Epidemiology flourishes in strength and depth. We continue to play a leading role in the decennial [Adult and Child Dental Health Surveys](#) and now undertake secondary analysis of a variety of national datasets ([JDentRes2015 Steele](#)). Orofacial pain research now encompasses a wider range of conditions beyond temporomandibular disorders ([JDentRes2016 Durham, Steele, Exley](#)) and has garnered commercial interest (e.g. Septodont) in new management techniques for orofacial pain. Oral health economics is now well established and unique in its breadth and depth, recognised by the award of an [NIHR Clinician Scientist Award](#) (*Vernazza*). Our work on pathways of dental care, includes fillings for children ([HTA2020 Maguire](#)), adults ([IntEndodJ2014 Vernazza, Steele](#)), emergency dental attendance ([JOralRehabil2017 Durham](#)) and dental care for dependent older people ([JOralRehabil2018 Wassall](#)). This research has grown further through the award of six NIHR doctoral research fellowships in this area. Collaborating with colleagues in pharmacy and across FMS we have secured [NIHR HTA](#) funding for a new area of research to reduce periodontal diseases by addressing risk factors, such as smoking.

### 1.3.3 Pharmacy and Pharmaceutical Sciences

NU pharmacy research involves collaborative working with NU, NHS and pharmaceutical partners. Our work focuses around two areas: Disease Selective Medicines and Rational Medicines Use.

In Disease Selective Medicines we have led patented research into drug targets for the treatment of chronic non-malignant neuropathic pain with dentistry, and commercial partnership with Akari Therapeutics, ([Pain2016](#) Patent:[PCT/EP2018/084036](#) *Obara*). We have developed therapeutic strategies for improved tumour selectivity of cancer medicines and mitigation of adverse effects ([Molecules2019](#) *Gill*), leading to US and EU patents (e.g. [US10556014B2](#)) and further clinical evaluation *via* [Incanthera PLC](#). Our research has developed and optimised drug delivery systems, including developing personalised nanotherapies ([TissueEngPartA2018](#) *Harburn*), focused on the effectiveness and safety of nanopharmaceuticals ([NatCommun2019](#) *Moghimi*), and the management of immunological responses to nanotherapies ([NatNanotechnol2017](#) *Moghimi*). We have produced new tracer materials and patent-protected delivery systems for experimental treatment of cancer, cardiovascular diseases, immune disorders and diseases of the central nervous system (Patents [US9981047B2](#); [US10201622B2](#) *Moghimi*). Our strengths in transdermal drug delivery have led to preclinical development of a microneedle biosensor platform for minimally invasive skin disease detection, and exploration of the use of lasers as a means of drug delivery ([CritCareMed2015](#) *Ng*).

Our Rational Medicines Use research focuses on use of, and access to, medicines and pharmaceutical services ([BMJOpen2014](#) *Todd, Husband*) and the role of community pharmacy in minor ailment management, public health and screening ([PLoSOne2020](#) *Nazar, Todd*), long-term disease management and immunisation (ICS: *"Increasing the use of local community pharmacies for minor illnesses reduces the burden on hospitals and GPs"*). Our work on the use of electronic systems to support medicines focuses on safety and the reduction of prescribing errors, whilst also defining the characteristics of safer system design ([LancetDigitHealth2019](#), *Slight*), and the use of digital technologies to support overall health and fitness, particularly in the context of preparation for and recovery from surgery. Our expertise in deprescribing and inappropriate prescribing of medicines has created collaboration with the NHS and globally (Karolinska Institute, Sydney, Washington and Texas Universities [BrJClinPharmacol2018](#), *Todd*). A particular focus is the outcomes associated with deprescribing in those with multimorbidity and frailty and how inappropriate prescribing may differ from that to the non-frail population.

### 1.4 Future Strategy for Research and Impact

In October 2018, the launch of our University research strategy promoted a one-university vision, with which the 2019 FMS restructure aligns. By enabling researchers to work together in cross-disciplinary networks across the faculties, we are better configured to meet the demands of the contemporary funding landscape (larger grants funding multidisciplinary working to address major complex societal, economic and health challenges) and to achieve collective research excellence and impact.

Our future UoA3 strategy will continue to focus on interdisciplinary translational and applied research across major societal challenges in our three areas of Allied Health, Dentistry and Pharmacy and Pharmaceutical Sciences. We will continue to grow our research through further

appointments and development of our own staff (sections 2.2, 2.3). We will strengthen further collaborations through FMS research themes and NUCoREs and with external partners in key areas such as clinical trials, big data and community interventions. We will continue to develop emerging areas of strength in personalised complex health interventions, clinical education research and rational medicine use, linking these with established research areas. To maximise impact, we will exploit opportunities for translational research and impact facilitated by NHIP and our extensive NIHR Infrastructure (see below), particularly the [NIHR Applied Research Collaboration](#) North East and North Cumbria.

The aim over the next five years is to maximise cross-disciplinary input into our research endeavours, whilst retaining and developing our disciplinary remits:

In **Allied Health** we will develop and evaluate novel personalised interventions ([HealthExpect2020 Kolehmainen](#)) to promote child and family health and wellbeing and develop practical, digitised measures. We will collaborate closely with scientists and clinicians to generate new theoretically underpinned interventions and evaluate their effectiveness and implementation at scale. We will exploit the opportunities afforded by our “[Healthier Lives](#)” NUCoRE to address the integrated and interdependent nature of behaviour and the social, cultural and political environments. To achieve these advances and impact, we will leverage biological and behavioural sciences and digital technologies including artificial intelligence, big data and other leading-edge approaches. We will engage with industry, policy makers and civil society to co-produce more effective interventions to promote and facilitate behaviour change. We will continue to exploit large publicly available datasets (e.g. UK Biobank) to address contemporary population health challenges. We will extend the interaction between our allied health researchers with the new sports and exercise research group (UoA1) to enable new opportunities to maximise elite performance.

In **Dental Sciences**, we will build on our two areas and strengthen cohesion between them by, for example, combining microbiology, genetic and immunology expertise and by using our health economics expertise to support diagnostic immunology work. We will optimise working through the faculty research themes and NUCoREs, to continue to develop our work in the areas of water fluoridation and oral care of children and older adults. Two new senior lecturer appointments due in 2021 will strengthen capacity in translation with a focus on dental clinical trial expertise. We will invest in our emerging research strength of Dental Education, aided by a recent [NIHR Incubator for Clinical Education](#) co-led and hosted by the Schools of Medical Education and Dental Sciences.

In **Pharmacy and Pharmaceutical Sciences**, we will strengthen Disease Selective Medicines research through expanded collaboration with industry, particularly in the area of tumour-activated prodrugs to support management after tumour removal. Translating our laboratory research in chronic non-malignant pain to clinical settings will allow development of new patient treatment options. To improve the effectiveness and safety of nanotherapies and nanopharmaceuticals, we will continue to work with industrial partners. The role of community pharmacies within ever-changing national and international health services will be the focus of the Rational Medicines Use group. Specifically, we will examine their provision of new services and better integration with primary care to address health inequalities. We will explore how technology can effectively support deprescribing and appropriate prescribing, including the use of AI to aid screening and medication review.

## 1.5 Open Access and Research Integrity

Across NU we encourage the wide dissemination of both research outputs and data. Colleagues are supported by our Research Data Manager (Dr Chris Emmerson) in the development of data management plans to ensure they think ahead about data sharing, including making use of the University [Research Data Repository](#). For example, data from the decennial adult and children's dental health surveys, released via the ESRC UK Data Service, and used globally by policy makers and academics. The University's [e-Prints repository](#) ensures research outputs are Green Open Access, and we make best use of UKRI and COA funding together with internal funds to increase the proportion of Gold Open Access.

The University is a signatory of the Concordat for Research Integrity and, as outlined in REF5a, has identified *Woods* (UoA21) as its expert convenor on research integrity, while *Rowe* (UoA4) has recently been appointed Dean for Research Culture and Strategy with oversight of integrity. We have joined the UK Reproducibility Network; maintain policies and procedures compliant with the Concordat to Support Research Integrity; subscribe to UKRIO; and are members of the Russell Group's Research Integrity Forum. NUPHSI methodological expertise, together with the NIHR Research Design Service (*Exley*), provide critical input into study design and statistical rigour which significantly contribute to overall research reproducibility and integrity. UoA3 has also contributed more widely through service to the NHS Research Ethics Committee with two committee chairs (*Heasman, Preshaw*).

## 2. People

### 2.1 Overview

Our submission includes 45 staff (33% Female) of whom 10 are practicing clinicians. In addition, nine NIHR Academic Clinical Fellows, six NIHR Clinical Lecturers and a broad community of 13 honorary clinical academics contribute to our research. Of those returned, 56% are professors, 24% mid-career and 20% Early Career Researchers (ECRs). Women represent 27% of chairs, 44% mid-career and 33% early career stage; and ethnic diversity is low (9% are BAME), reflecting a sector-wide problem as is self-declared disability (no returned staff). Improving diversity is a key future target.

We are building capacity by mentoring and supervising at pre-doctoral/foundation, doctoral and ECR levels (~40) through internships, fellowships and related research project funding including from NIHR, AMRC and Newcastle BRC. We host the only paediatric NIHR Academic Training Advocate (*Kolehmainen*), and the NIHR Associate Dean for Dental Integrated Academic Training (*Durham*). Through successful applications for the full range of NIHR awards (from pre-doctoral to Senior Clinical Lecturer), and other UKRI and charity-funded awards, we have supported 25 AHPs, 27 dentists/dental care professionals and five pharmacists to advance academically. Our allied child health research team is recognised as a national trailblazer in developing clinical capacity, for example providing paediatric clinical academic support for three other centres in England.

We are recognised nationally as a sector leader for supporting and developing clinical academics and provide national leadership for training initiatives and award panels (section 4).

We encourage all colleagues, but particularly ECRs, to participate in University programmes such as our Academies (Policy, Global, Skills and Enterprise - REF5a 2.2.5).

## 2.2 Staffing strategy

Our strategy is to have a strong career development pathway underpinning our capacity building and succession planning. We target recruitment to enhance our international leadership, invest in our fellowship programmes, support ECRs to obtain external fellowships and recruit at lecturer level in our schools to strengthen priority areas and build new areas of focus. Consequently, we have grown considerably.

Over the assessment period we have made strategic appointments to replace losses and intend to grow further. Across all three areas of our research, we will continue to build capacity with strategic appointments, particularly at junior and mid-career stages, and invest in developing researchers through the NUAcT scheme (REF5a 3.2.4).

We will continue to exploit external fellowships and work with NHIP to develop clear research pathways for AHPs and pharmacists. This investment, coupled with our collaborative research culture, will deliver our vision whilst also responding to short-term needs, such as COVID-19. We have recently made two new appointments in Nutrition and four in Sports and Exercise Science. In 2020, we launched a new Masters in Dietetics degree programme. The new staff associated with, and the graduates from, this degree programme will strengthen our capacity for Allied Health research in both clinical and public health settings. Future recruitment will aim to expand areas of strength in neurophysiology, physical activity and nutrition and health. In Dental Sciences, we strengthened capacity with three appointments in Translational Oral Bioscience (two lecturers and one senior lecturer) and a new clinical psychologist lecturer within Oral Health Care and Epidemiology. We are in the process of appointing a clinical lecturer and two senior lecturer posts focused on joining our two research areas, and plans for further research appointments including research-active Dental Care Professionals (Hygienists/Therapists). Following the transition of Pharmacy in 2017, we invested in seven new academic appointments and in the coming two years will recruit to strengthen research on drug delivery systems and nanoscience.

Equality of opportunity and diversity are promoted and championed by the respective heads of unit and equality, diversity and inclusion leads in Institutes, Schools and Themes. Early in this REF period we increased the proportion of female ECRs, resulting in more women at mid-career stages. This will, with appropriate mentoring, balance the profile of our senior academics. As part of our commitment to minimise casualisation in our workforce, most new academic appointments are open-ended contracts. Only 2% of returned staff are on fixed term contracts, restricted to those in fellowship positions. All of whom join our academic track community (section 2.5) and, subject to satisfactory progress, move to open-ended appointments. All research staff funded on grants are offered open-ended contracts after four years. Staff movement between projects is facilitated by a process that starts six months prior to the end of funding/contract with all new positions placed in the redeployment pool, together with bridging funding, a core element of the delivery of the Concordat (section 2.3 below).



### 2.3 Staff development

All colleagues are encouraged to develop research and leadership skills throughout their careers. Personal objectives are identified and prioritised in annual review meetings (PDR) with a senior academic, with dedicated training for appraiser and appraisee. The PDR provides strategic advice, identifies areas of support and training needs and highlights concerns. Each PDR is submitted to the Head of School or Institute enabling high level oversight and identifying common needs across disciplines. All academic staff contribute to undergraduate and postgraduate teaching and supervision with teaching skills training provided by our Learning and Teaching Development Service. In 2021, we move to a year-long engage and aspire programme with mentoring at all levels, rather than an annual one-off review.

We are committed to the Concordat to Support the Career Development of Researchers. NU was one of the first awarded a HR Excellence in Research Award by Vitae in 2010 (renewed twice). UoA3 researchers have undertaken training with NU's Global, Policy, Enterprise, and Skills Academies (*Vernazza, O'Connor, Bissett*) as well as performing key leadership roles (*Lietz*), (REF5a 2.2.5). Staff are also encouraged to access complementary external programmes e.g. Aurora Scheme (*Mentor: Exley*; 6 attendees); NIHR national leadership training (*Vernazza*); and the Academy of Medical Sciences FLIER Programme (*Kolehmainen*).

Working with our globally recognised citizen panel, Valuing Our Intellectual Capital and Experience ([VOICE](#)), we support and train colleagues to work and engage with patients and the public to inform research questions. Colleagues can apply for internal Faculty and University funds to strengthen funding applications to promote partnership working and impact activity.

### 2.4 Effective Integration of Clinical Academics and NHS-employed Active Researchers

Close collaborations of our researchers with the NHS, public health and social care organisations is vital to achieve our aim of influencing clinical practice and promoting health and well-being. Since the launch of NHIP, we have further strengthened the integration of clinical academics and NHS-employed Active Researchers by establishing three standing committees in Research and Innovation, Education and Training, and People and Culture. These committees improve integration across NHIP to ensure NU and the two largest NHS regional organisations deliver impactful innovations for maximum patient benefit.

Ten (22%) submitted staff hold honorary contracts with NuTH, and our Research Themes host many clinicians with honorary academic appointments. We facilitate the training needs of our clinical academics and allied health professionals, via support from our Clinical Academic Office which manages the NIHR Integrated Academic Training and Integrated Clinical Academic (ICA) pathways, and by involving senior clinical academics in PDR, mentorship, and peer review of applications for external awards. NU has a strong track record of achieving NIHR Academic Clinical Fellows (ACF) and Clinical Lecturer (CL) posts in dentistry, which have supported nine ACF and six CL since 2014. Colleagues have secured personal awards across the NIHR clinical academic pathways: two In-Practice fellowships; 14 doctoral training awards (including seven NIHR Doctoral Research Fellowships in dentistry, the highest number in the UK and the first award to a Dental Hygienist); one Development and Skills Enhancement Award, two Translational Research Fellowships; three BRC fellowships; two ICA Clinical Senior Lectureships and one Clinician Scientist award.

## 2.5 Early Career Researchers

Our ECR development programme enables junior researchers to realise their ambitions and progress to careers as independent academics, researchers in industry or non-research careers. NU's Career Advisor and Organisational Development Specialist works with our Career Development Working Group - including Director of Non-Clinical Fellowships (*Higgins-UoA5*), Clinical Academic Office (*Sayer-UoA1*, *Pennington*, *Kolehmainen*, *Vernazza*, *Mathers*) and Head of Faculty Research - to ensure that our Career Pathways Framework and training reflects the needs of the whole Faculty.

All ECRs are encouraged to develop advanced research and translational skills through bespoke training programmes. These comprise FMS ECR programmes and opportunities through our Academies including PI Development Programme (11 attendees) and Policy Academy Fellowship Scheme (four attendees); in-house topic-specific programmes, e.g. Development and modelling of AHP complex interventions group; and external courses e.g. [European Nutrition Leadership Platform](#).

ECRs have access to mentoring by senior academics, within and beyond NU, and ECR peer-support groups. All colleagues are encouraged to develop collaborations and exchange with other research institutions, and are supported to do so through our Broadening our Horizons Scheme, and through secondments and internships. We encourage colleagues to engage with users of research through: 'Bitesize' impact sessions; delivering training; and community outreach for undergraduate students. We have also developed specialised training for ECRs outside of NU. For example, our Personalised Nutrition (sponsored by [NuGO](#) and Carotenoid Bioavailability (sponsored by COST initiative Eurocaroten) training courses attract attendees from across Europe.

ECRs are supported to develop research funding applications as PIs or to apply for personal fellowships. They are guided and mentored throughout the process by senior academic staff, their peers and our Research Funding Development Managers; from the initial development of ideas, through the writing, application, and interview processes and, after success, to deliver their research. Internal funding, like our Small Grant Scheme, enables researchers to acquire preliminary data to support applications, and they can also develop their research expertise as co-applicants on externally-funded awards. Whilst we are successful in external fellowships, in 2014 we introduced a new FMS fellowship initiative to recruit the next generation of talented researchers which provided salary, start-up costs, a studentship and dedicated personal mentoring. Initially aimed at biomedical scientists, it expanded to population health sciences (*Byun*). In 2019, this programme was replaced at a university level by the NUAct scheme (REF5a 3.2.4). Each of these positions equates to £450,000 investment per person, demonstrating our commitment to nurturing our talent.

NU fellows, and externally funded clinical and non-clinical fellows, are expected to progress to open-ended contracts with support from internal programmes and the Clinical Academic Office. In Year 3, fellows take part in a mid-term panel review comprising internal and external academic members. Based on transparent written criteria, this panel can recommend the Fellow is offered an open-ended academic position. Successful fellows are well placed to apply for promotion to Principal Research Associate or other academic positions.

## 2.6 Research students

We have a vibrant and diverse postgraduate research student (PGR) community. During the REF period, 164 PhDs have been awarded, with 118 continuing students. Our PGR population is diverse (63% women; 47% BAME backgrounds). We have a steady presence of international students (38.7%) from a range of countries including Saudi Arabia, Libya, and Malaysia. The majority of our international students are sponsored and funded by their government (66%), and most home/EU students are funded by personal awards from fellowships from NIHR and BRC; and BBSRC, ESRC and MRC Doctoral Training Programmes and AMRC. PGR are authors on 19% of our return. In the 2019 Postgraduate Research Experience Survey, 90.5% of NU Institute of Health and Society PGRs (where most of ours were based prior to restructure) agreed that "Overall, I am satisfied with the experience of my research degree programme".

Our research training strategy extends from undergraduate to post-doctoral, with our research-led teaching exposing students at all stages to NU research. Undergraduate students are encouraged to gain paid experience of working with our research teams through vacation scholarships, internships, and placement years. These are funded by NU, Faculty, and external awards such as the Wellcome-funded INSPIRE scheme, with specific placements in dietetics and dental. Undergraduate dental and medical students can intercalate for our Masters programmes, with many going on to pursue further degrees. We also host students from other national and international institutions for short periods of research experience and training e.g. undergraduate placements, ERASMUS-funded internships, and vacation studentships. For example, we host undergraduate research placements from nutrition degree programmes at both Newcastle and University College Dublin.

Over the next five years we will identify and mentor the next generation of applied health researchers. Through NHIP we will develop career pathways for all AHPs and pharmacists from Masters level to Doctorate, specifically seeking to maximise opportunities afforded through the NIHR/HEE funding schemes. In Dental Sciences, we have established a novel academic foundation scheme for dentists/therapists (with Health Education England North East) and a novel scheme to train general dental practitioners in research (with NIHR Local CRN) to develop potential doctoral applicants. We will also seek to increase the number of non-clinical applied health researchers across UoA3 through national schemes, our BRC and Doctoral Training Programmes.

The FMS Graduate School provides rigorous research training and personal development opportunities to equip all students with the skills and confidence to excel in careers in research, academia, industry and the third sector. This is supplemented by subject-specific training e.g. writing groups, methodology discussion forums, and individual DTPs training. Students agree their training and development needs with supervisors at the outset of their studies, and record these in a personal development plan which is reviewed annually. Academic Performance Reviews (APRs), conducted by two independent academics, take place at three and eight months and then annually until submission. APRs reflect on research study progress as well as the development of transferable skills. We have clear expectations of PGRs and supervisors and pay careful attention to the expertise and experience of supervisory teams. New supervisors must undertake faculty training before joining a supervisory team led by a more experienced supervisor.

We provide a supportive and inclusive learning environment. PGRs are integrated into our academic community and embedded in at least one FMS Research Theme through which they can attend, and present, at seminars and Faculty research events. FMS operates a student buddy system and there is an active PGR peer-support group which receives funding for speakers' travel expenses and pump-primes social events. There is an annual FMS PGR conference run by and for students at which PGRs present their work and develop transferable research skills. Our students are also heavily involved with organising and participating in the North East Postgraduate Conference (one of the largest in the UK with >600 registrants each year). This is supported by UKRI DTP sponsorship to allow free participation to all PGRs in the North of England, including a full-time crèche facility (financed by Newcastle University EDI funds). Our PGRs are also encouraged to present their research nationally and internationally with funding available via our Broadening our Horizons Scheme (section 2.5).

## 2.7 Equality, Diversity and Inclusion

Our research and impact strategy are underpinned by a collective commitment to values and practices that cultivate a supportive, inclusive and fair research environment, and provide freedom and opportunity to pursue and succeed in diverse career pathways. We have held Athena Swan Silver status for nine years. The former Institute for Health and Society (now part of NUPHSI) was the first in NU in 2011 to be awarded Silver status, renewed in 2014, and consolidated into a Faculty Silver Award in 2019. From the outset of the Athena Swan scheme, we have committed to a process that goes beyond gender to all protected characteristics and to an ongoing cultural change in all aspects of our practices. We strive to ensure that, regardless of job role, grade and career pathway, individual contributions to research by technical and professional services staff are acknowledged, celebrated and rewarded.

Since 2014, 35% (6/17) of promotions have been to women, including 66% (5/9) promoted to personal readerships or chairs, two of whom had taken at least one period of maternity leave. Our 2019 Faculty Athena Swan Silver award highlighted improvements that can be made and we are aware of the discriminatory impact of COVID-19 (described in section 2.9). Within the REF period, women in UoA3 have taken on key leadership roles; *Exley* (Dean of NUPHSI) and *Valentine* (Dean of Taught Programmes). Both *Pennington* and *Kolehmainen* hold Clinical Academic Office leadership roles and *Kolehmainen* is a Research Theme Lead.

Individual unit's EDI committees meet regularly and are supported by a core FMS EDI team. UoA3 researchers are active in University EDI Initiatives and have received funding from the Equality, Diversity and Inclusion Fund (*Exley*) for projects investigating barriers and facilitators to women pursuing clinical academic careers. Across FMS we have robust policies to support staff and PGR students to return to work following any extended leave with personalised support (University Returners Support Programme, which since 2018 has supported five colleagues) and we also led the drive to reintroduce NU's Parents' Network. The "You said, we did" initiative was developed to give everyone a voice for change. Issues identified and resolved included the provision of EDI training, divergence of policy for unpaid paternal versus maternal/adoption leave, and disseminating EDI knowledge (roadshows and an [EDI blog](#)). We value NU's commitment to EDI detailed in REF5A 3.4, with its membership of the Advance HE's Race Equality Charter, and the Business Disability Forum and a Global Stonewall Diversity Champion. This provides a framework within which our approach is secured, alongside important policy initiatives with practical utility. We are committed to the Concordat to Support the Career

Development of Researchers, and NU was one of the first awarded an HR Excellence in Research Award by Vitae in 2010 (renewed twice since).

Our submission was constructed with an understanding of disciplinary balance. Outputs were self-nominated and evaluated anonymously by at least two senior academics (with both an indicative score and reasons), the REF lead moderated the scores. Selection of the return was by paper, not author, in line with our code of practice.

## 2.8 Recognition and Reward

Formal recognition for excellent performance happens via our annual promotions round, a fully transparent process, which allows academics to submit cases for promotion. NU signed the [Declaration on Research Assessment](#) in 2018 and does not use journal impact factors for promotion or evaluation of research staff; promotions are based on quality evaluations. Promotion processes are overseen by Heads of Academic Units, in close conversation with relevant line managers. Individuals who wish to be considered for promotion, or have been recommended by their line managers, submit draft applications to specially convened unit panels, which offer advice on how to strengthen the application. This individualised programme of support, written into job plans, has shown success in internal promotions. During the REF period 17 colleagues were promoted (six to their first academic position). Promotions include: Lectureships (*Kolehmainen*); Senior Lectureships (*Holmes, Kolehmainen, Siervo, Vernazza*); Readerships (*Pennington, Kolehmainen, Valentine*); personal chairs (*Araujo-Soares, Durham, Exley, Hill, McCracken*).

In 2019, the HNRC celebrated its 25<sup>th</sup> Anniversary with a special symposium and evolution into the Healthier Lives NuCoRE. Celebrations of the Dental School's 125<sup>th</sup> birthday also showcased research activity. More informally, our Vice-Chancellor holds Celebrating Success Ceremonies three times per year to celebrate staff and student achievements. Our Dean of Research and Innovation hosts a Celebratory Lecture twice a year spotlighting the Faculty's research and impact achievements and each event features an ECR keynote speaker. Post-doctoral research success is celebrated at the FMS annual post-doc symposium, organised by our Post-doctoral Committee. The NUPHSI and Schools each hold their own research celebrations and events, all of which continued on-line during the pandemic.

## 2.9 Responding to COVID-19 impacts on colleagues (REF5a Annex)

Since March 2020, we have sought to mitigate the impact of the pandemic on colleagues and their research by making use of University initiatives. For example, four RAs and two research administrators were granted three-month extensions to their employment contracts that were due to expire before the end of July. UoA3 researchers who saw their research significantly impacted also benefitted from UKRI funds, managed through the University.

We immediately introduced measures to enable safe home working including the collection of office equipment and furniture. Wellbeing and work-life balance have been our priority with managers encouraging colleagues, particularly those with caring responsibilities, to reflect this in their workload. We have supported research to continue within the limitations of government restrictions, moving research studies online, where possible, and pausing those that could not.

Meetings and seminars all moved online, and we received positive feedback that this facilitated inclusion. 'Quiet Fridays' were introduced in recognition of the impact of increased screen time, and colleagues were encouraged to have time away from online meetings. Formal communications were increased with at least weekly staff updates from the Vice-Chancellor and Executive Board. Informal 'keep in touch' arrangements were put in place at academic unit and research group level. NUPHSI held its "research day" over the period of a week with sessions at different times of the day, all of them recorded, to allow as many colleagues as possible to take part.

PGR students affected by COVID-19 were provided with fee-free extensions. In addition, suspension of studies was made available for students called to NHS front-line duties, with increased caring responsibilities or those personally experiencing or impacted by COVID-19. The NU COVID-Impact Scholarship scheme also supports additional stipend where funding has not been secured from their normal sponsor. Virtual drop-in sessions and regular mailings and newsletters provide information and support to our PGRs. In addition, one-to-one support was given by supervisors to students whose research plans were disrupted and those with caring responsibilities or difficulties with working from home.

### **2.10 Future EDI Priorities**

Whilst we will continue our efforts to support women to succeed, we are extending our EDI aspirations beyond gender. The low proportion (9%) of colleagues returned in this REF from BAME backgrounds (none chairs) and none with declared disabilities is an important focus for us going forward. Although we are a Global Stonewall Diversity Champion, we do not currently collect data concerning LGBTQ+ inclusion and this is a priority for the future. We will review and develop our recruitment processes, documentation and networks to engage and support a more inclusive research environment. For example, the NUAcT scheme recruitment process includes a first phase short listing that is anonymised to avoid explicit and unconscious bias. We will encourage applications with greater diversity and monitor whether this assists with redressing our imbalance. We will continue to work on the University initiatives outlined in REF5a, supported by the FMS leads on diversity and the University Dean of Equality, Diversity and Inclusion to create research cultures, activities and environments where people from varied backgrounds can thrive.

## **3. Income, infrastructure and facilities**

### **3.1 Income**

In this REF period UoA3 research income has been £17.8M (£2.5M average annually). Of this, 30% is from charitable sources; 26% UKRI and 22% NIHR. We have been increasingly successful in leading large-scale, multi-centre and multi-national bids to UKRI, NIHR, AMRC, with industry and in international consortia. These awards and other interdisciplinary project grants and personal awards complement the opportunities afforded by the NIHR infrastructure awards hosted by NU, or in which we are partners. For example, Oral and Skin is a key theme of the £16M NIHR BRC; the £9M NIHR Applied Research Collaborative North East North Cumbria themes map directly to our research; and pharmacy and dental both have an important presence in the £2.3M NIHR School for Primary Care.

### 3.2 Infrastructure and Facilities

UoA3 researchers and research facilities are housed on our main campus and on the Campus for Ageing and Vitality (CAV). We share facilities on both sites with NuTH providing excellent opportunities for patient-focussed research. Our strategy to grow research in UoA3 has necessitated and been facilitated by significant investment in new and existing infrastructure and facilities.

Expansion of research in Allied Health was enabled by investment in the Sir James Spence Institute by our partner trust. This provided research space and specialist labs for research with children and young people, equipped with one-way mirrors, high specification video and audio facilities for behavioural and neurophysiological assessment and intervention research. These are adjacent to the Great North Children's Hospital, for easy access by families participating in our studies. Our patient-facing ageing research facilities are concentrated on the CAV site which we have recently purchased from NuTH (£8M). CAV is home to our BRC; the Clinical Ageing Research Unit focusing on investigations in older people and equipped with specialist gait assessment facilities; our innovative Clinics for Research and Service in Themed Assessments one-stop, multidisciplinary research-integrated clinics centred on the needs of older patients with complex multiple disorders; and a new [NIHR Patient Recruitment Centre \(PRC\)](#).

To enhance critical mass and to facilitate collaboration, we co-located nutrition researchers in the William Leech Building with Public Health colleagues. This is adjacent to the recently-opened Dame Margaret Barbour Building, a £30M investment providing: state-of-the-art sport and exercise science laboratories for teaching and research; facilities for food and nutrition research; high specification, technology-enabled teaching spaces; and clinical consultation facilities used by medical, dental and pharmacy students and researchers.

Our School of Dental Sciences is located within the NuTH Dental Hospital, and researchers have access to the Dental Clinical Research Facility (CRF), the only dental facility in the country hosted as part of a main NIHR CRF. This provides research-dedicated dental surgeries and hosts research nurses, hygienists and therapists. The facility has enabled NU to undertake commercial research with Philips and Colgate-Palmolive and now hosts national trials in oral medicine and paediatric dentistry. Our expansion of Translational Oral Bioscience research has led to re-purposing teaching space as a laboratory for neuroscience equipment and we are refurbishing laboratories to strengthen neuroscience research and provide space for PGR expansion.

Whilst our partnership with NuTH brings important benefits for clinical research, much UoA3 activity is especially relevant to primary health care. Building on our successful work with general dental practices across the region through [FiCTION](#) and [iQUAD](#), we have established a [Northern Dental Practice Based Research Network](#) of research-active practices. This is cited as an exemplar for other regions by the national oral and dental NIHR CRN group (*Vernazza* leads the national CRN Primary Dental Care Champions Group) and gives our researchers easy access to primary care-based dental teams and patients.

We invested £4M in state-of-the-art laboratories and resources for teaching and research in the King George VI Building for the new School of Pharmacy. Two largescale teaching laboratories are linked to working laboratory spaces to enable the involvement of undergraduate students in

research. These are equipped to support drug design and delivery research as well as projects with industry. Pharmacy research is also carried out within our Institutes and SAgE Faculty facilities which enables multidisciplinary research, for example in cancer and drug development. The Newcastle Helix site is an innovative partnership between NU, the city council and Legal and General. It houses the flagship Catalyst Building, a £44M bespoke headquarters for our National Innovation Centres for Ageing (NIC-A) and Data (NIC-D). Helix also hosts the only NIHR Innovation Observatory (NIHRIO) in the UK which horizon scans for medical technologies that are up to 10 years from becoming publicly available, and then tracks progress as they evolve. The observatory has three core activities: technology briefings, advanced horizon scanning tools and patient involvement. UoA3 will continue to exploit these facilities with new collaborations across all three innovation areas, where industry and the public join together with the researcher and the NHS to speed up the development pathway. This is integral to our future plans to develop practical, digitised measures for shaping health and wellbeing, and to use data and technology to develop interventions that promote and facilitate behaviour change. We will also maximise the PRC to recruit patients from a diverse range of backgrounds, an important aspect of our commitment to equality and diversity in research.

The following Infrastructure and Facilities have specific UoA3 input and relevance:

<b>Centres and Units</b>
NIHR School for Public Health Research (SPHR) - Fuse (2012-2022)
NIHR School for Primary Care Research (SPCR) (2015-2020)
NIHR Policy Research Unit (PRU) Behavioural Sciences (2019-2023)
NIHR Policy Research Unit (PRU) Older People and Frailty (2019-2023)
MRC Lifelong Health and Wellbeing Centre in Ageing and Vitality (2014-2019)
NIHR Biomedical Research Centre (BRC3) in Ageing and Long-Term Conditions (2007-2022), <b>renewed</b> in 2017
CRUK Newcastle Cancer Research Centre (2014-17) <b>renewed</b> (2018-2024)
MRC/ARUK Centre for Integrated Musculoskeletal Ageing (2012-2017), <b>renewed</b> (2017-2022)
Versus Arthritis Experimental Arthritis Treatment Centre (2012-2018)
Versus Arthritis Centres of Excellence in Tissue Engineering (2016-2021)
Northern Alliance Advanced Therapies Treatment Centre for Cell, Gene and Tissue Therapies (2016)
CRUK Newcastle Experimental Cancer Medicine Centre(2017-2022)
Wellcome Trust Centre for Mitochondrial Research, <b>renewed</b> (2020-2024)
<b>Infrastructure Awards</b>
NIHR Innovation Observatory (2017-2024)
NIHR Applied Research Collaboration (ARC) North East and North Cumbria (2019-2024)
NIHR Research Design Service North East and North Cumbria (2008-2023)
BEIS/MRC National Innovation Centre for Ageing (2018- )
MRC/EP SRC Molecular Pathology Node (2015-2019)
MRC Newcastle University Single Cell Functional Genomics Unit (2015-2018)
MRC/Wellcome Human Developmental Biology Resource (2018-2023)
NIHR Newcastle In Vitro Diagnostics Co-operative IVDC (Newcastle MIC) (2018-2022)
NIHR Clinical Ageing Research Unit / Clinical Research Facility (2008-2022)
NIHR Health Protection Research Unit (2014-2020)



**Training/Doctoral Training Partnerships**

ESRC Doctoral Training Partnership (NINE DTP) (2017-2024)

EPSRC Centre for Doctoral Training in Digital Civics (2014-2022)

MRC Doctoral Training Partnership - Discovery Medicine North (DiMeN) (2016-2021)

BBSRC Doctoral Training Partnership (2010, renewed 2015, 2020)

Wellcome Trust 4ward North Clinical PhD Academy (2016-2022)

**3.3 Methodology and governance infrastructure**

One of the Research Themes created with the FMS restructure is '**Innovation, Methodology and Application**' (IMA), which includes colleagues whose research delivers new underpinning methodological and technical expertise. For UoA3, IMA provides expertise in biostatistics, health economics, qualitative methods and evidence synthesis. It works closely with the Newcastle Clinical Trials Unit (NCTU), a UKCRC-Registered CTU to design, conduct and deliver clinical trials. NCTU has a cross-discipline trial portfolio and currently manages 33 active international trials including three UoA3-led studies in allied health and dentistry.

In addition, the NU-hosted regional £5.1M **NIHR Research Design Service** provides expert advice to researchers internally and externally, particularly less experienced colleagues and ECRs. Our **Newcastle Joint Research Office (JRO)** supports researchers in the development, implementation and delivery of experimental, translational and clinical research, including funding development, governance, regulatory compliance, and intellectual property. A Quality Assurance team oversees regulatory requirements. An Informatics team supports data access, storage and reporting working alongside a NU Research Data Management Team working across NU. The JRO also delivers bespoke training, ensuring that clinical research is safe, value for money, of the highest quality and translates to improved patient outcomes.

**3.4 Contribution of technical and professional services staff**

We are committed to a Team Science approach to ensure that our technical, technologists, methodologists and professional service colleagues are properly acknowledged for their contribution to our research and have a stable and rewarding career structure. In 2016, NU launched our technician network, TechNet, to enable technicians to share resources and information and to support career development and exchange of skills. In 2017 we were a founding signatory of the Technician Commitment. We strongly encourage the contribution of each research team member to be reflected in authorship, with 11% of authors on submitted outputs being technical or professional services staff.

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

UoA3 researchers have a strong track record of collaborating across the university and with external academic, industry, health care and policy partners. Our researchers play an active role in shaping the research landscape, nationally and internationally. Their expertise and leadership are recognised by their appointment to strategic advisory roles, funding councils and policy forums, and honoured by prestigious national awards. We have also contributed to Research England actions to shape and deliver the REF process (*Mathers, Hackett* REF2021). Staff at all levels are encouraged to undertake academic citizenship activities and receive support, mentoring and training to do so, such as through our Academies. This involvement is equitable,

improves our research culture and is key to enabling our research to be heard by policy makers and to maximise impact.

#### 4.1 Academic collaborations and impact

Many of our major studies involve multi-centre research teams with collaborators across the UK, Europe and globally including the FiCTION HTA investigating caries management in children's teeth (co-led from NU, Leeds and Dundee with another 7 UK universities and dental practices across the UK involved); the DiRECT Study (co-led by NU and Glasgow with GP practices across the UK) that is changing guidelines about the management of people with type 2 diabetes (*UoA1 ICS "Remission of type 2 diabetes using a low-calorie diet"*); MOBILISE-D, a NU-led consortium comprising 34 partners from academia and industry funded through the EU (IMIJ2); the TULIP consortium of longitudinal cohort studies of advanced age (80+) Newcastle 85+ Study, Leiden 85-Plus Study, TOOTH Study, Japan and LiLACS New Zealand. In addition, several colleagues have visiting appointments with other higher education institutions, to enhance collaborations and to disseminate research e.g. Universities of British Columbia, Minnesota, Monash and Osaka.

#### 4.2 Industry collaborations and impact

Industrial collaborations are central to our strategy. We have attracted joint funding with industry through various mechanisms including: Innovate UK ISCF funding for future food production systems and EPSRC Innovate-UK funding for novel salivary diagnostics for periodontal disease. In addition, we have attracted direct industry funding working with companies such as Philips, Colgate-Palmolive, Saluda Medical, Akari Therapeutics and 3M. We held an Industrial Case Studentship with Philips for dental biofilms work. The 3M funding included funding towards a PhD, helping to build our future capacity for industry collaboration. In addition, we filed 15 Pharmacy Patents, of which 12 have been granted to date. Work to enrich hens' eggs with vitamin D (*Innovate UK Hill*) has led to the reformulation of the UK's leading free range egg brand 'Happy Egg' with higher vitamin D than standard eggs (*UoA6 ICS*). Capitalising on HEIF, NIC-A and NIC-D we will build further collaborations with industry over the next five years to accelerate the implementation of our healthcare products and innovations.

#### 4.3 Policy collaborations and impact

We work with a wide range of organisations to ensure that research informs national and international policymaking on research, the provision of care, and clinical training. *Mathers* gave oral evidence to the House of Lords Science and Technology Select Committee Inquiry into Ageing Science. Many of our funded projects include policy makers as partners – e.g. RAINDROP (*Vernazza*). The WHO commissioned NU to undertake research to inform guidance on intake of free sugars (ICS "*Informing the WHO Guideline on sugars contributed to the global introduction of limits on sugar intake*"). We collaborated with the Department for Education to introduce free school meals for infants and new school food standards to help combat childhood obesity (ICS "*Improving school food standards and introducing nutritious free school meals for infants*").

Our expertise is recognised by invitations to contribute to policy making and consultancy work for policy makers. For example, we led the development of [dental commissioning standards](#) for NHS England, directly influencing the dental care offered to millions across England and to a major Health Education England review of the dental workforce. We have also provided

evidence to enquiries and commissioned reviews of evidence for Temporomandibular Disorders in the USA, the Food and Drugs Administration and the US [National Academies of Sciences, Engineering, and Medicine](#) (*Durham*). We are members of international research networks that prioritise and promote research in individual topic areas. NU has several major roles in the International Association for Dental Research which promotes and advocates for dental research, including board members and former president. *Durham* leads the Royal College of Surgeons of England and NHS England ('Getting it Right First Time') national review of Care pathways and Management of Temporomandibular Disorders in Primary Care.

We work with a wide range of organisations to ensure that research informs national and international policy making on research, the provision of care, and clinical training. Nationally these include: Department for Health and Social Care (*Steele*), National Health Service England (*Steele, Holmes, Vernazza, Wassall*), Health Education England (*Holmes*), General Dentistry Council (*Ellis, McCracken, Holmes*), Public Health England (*Holmes*); Advisory Committee on Novel Foods and Processes (*Mathers*); NC3Rs; MHRA Human Tissue for Safety Assessment Working Group, Scientific Sub-committee of the British Toxicology Society (*Gill*); General Pharmaceutical Council Accreditation (*Todd, Husband*); Royal Pharmaceutical Society Education and Standards committee (*Husband*); British Association for Study of Community Dentistry (*Holmes*); Royal College of Speech and Language Therapists research priority setting (*Pennington*); British Academy of Childhood Disability Research Steering Group (*Pennington, Kolehmainen*).

Internationally these include: WHO Collaborating Centre in Nutrition and Oral Health (*Moynihan*); Advisory Board Research Center for Nutrition and Food Sciences, Munich; Chair NUGO-European Nutrigenomics Organisation - (*Mathers*); Surveillance of Cerebral Palsy in Europe (*Pennington*); International Association of Dental Research Roles (President: *Moynihan*; Board Member: *Jakubovics*); Swedish Research Council for Sustainable Development (*Brandt*); American Academy of Cerebral Palsy and Developmental Medicine Sialorrhea Care pathway (*Pennington*); International network for Orofacial Pain and related disorders (President: *Durham*, European Society of Endodontology (President: *Whitworth*); European Association of Oral Medicine (President: *Carrozzo*), Global Alliance for Vitamin A (*Lietz*).

#### 4.4 Engagement with public and patients

Our research benefits from close collaborations with patients, their families and the public, and these have grown over the REF period. [VOICE](#) is our public engagement network and associated online digital platform. Established in 2007, VOICE has grown significantly with national and international reach and now sustains a network of engaged "research active citizens" supporting thousands of research projects. VOICE is embedded as a University coordinating mechanism for public engagement with research and the PPE/I mechanism for a range of our NIHR infrastructure across the North East, NIC-A and NIHRIO. VOICE now connects other NU engagement activities, and since 2014 has expanded from a local organisation to a global entity. Our Engagement Co-ordinator provides encouragement and training in engagement for our ECRs and we host an annual "Tilly Hale Award", in memory of a champion of patient involvement in research, for innovative ECR projects that strengthen public engagement and patient involvement.

We work closely with the Young Person's Advisory Group YPAGNE that plays a key role in advising and participating in Allied Health and Dental Sciences projects relating to children and

young people. Work between YPAGNE and one of our dental NHIR DRF holders received a British Society of Paediatric Dentistry Research Prize. AHP researchers also have close collaborations with PenCRU Family Faculty (Exeter), who advise on research in childhood disability. We host a specific Oral and Dental PPI group which has influenced studies and provides lay members for our large projects. Internationally, we have a collaborative relationship with the international patient advocacy group the Temporomandibular Joint Association in Wisconsin, USA.

We also train and employ experts-by-experience - patients and family members - on research grants as co-applicants and as co-researchers. We have developed expertise in working with groups who are less commonly engaged in PPI networks. This includes young people and children with disabilities including communication disorders (e.g., [ActiveCHILD](#); [Fidelity](#)). We have PPI groups who advise on individual projects e.g. quality of life of those on home parenteral nutrition. Sensitive, careful engagement with parents who have undergone a bereavement from a multiple pregnancy was central to developing guidance for healthcare professionals to best support them during this time. The resulting changes in practice have been very well received by parents (ICS "*Best practice for healthcare professionals in supporting parents who have experienced a bereavement from a multiple pregnancy*").

We have given public lectures across the UK and beyond including invitations to science festivals, bespoke events, NU Insight (public) lectures and schools. Research also informs our extensive undergraduate outreach programmes including the student-led BrushUp scheme, delivering oral health promotion activity across the region in non-dental settings and our Pharmacy school partners with Newcastle City Council to host an outreach pharmacy centre at the city's Grainger Market.

#### **4.5 Responsiveness to national and international priorities**

The COVID-19 pandemic created many urgent challenges for UoA3 relevant areas. NU responded to these challenges at pace and scale. Within UoA3, we quickly established a new research area around dental aerosols, rapidly generating high quality results (*Jakubovics*). These were incorporated into evolving national guidelines (e.g. the NICE-sponsored Scottish Dental Clinical Effectiveness Programme (SDCEP), UK & Irish Dental Schools' Council policy documents) and enabled the re-opening of Dental School-based clinical activity (c. 400k patient episodes per annum) across the UK.

#### **4.6 Contributions to, and recognition by, the research base**

Colleagues returned to UoA3 make substantial contributions to the wider research community in the UK and internationally as members of research funding panels, editors of research journals and editorial boards.

**Funding bodies:** We have representation across UKRI funding schemes, for example: MRC Industrial CASE Studentship Panel (*Mathers*); ESRC "Understanding Society" programme Governing Board (*Mathers*); Royal Society Newton Advanced Fellowship Panel (*Mathers*); UKRI Future Leaders Fellowships Panel (*Mathers*) and NIHR funding schemes including: Programme Grant for Applied Research (*Exley*); Health Technology Assessment (*Kolehmainen, Slight*); RfPB Yorkshire and North East (*Durham [Chair], Todd*); In-practice fellowships (*Holmes*);

Development and Skills Enhancement Awards (*Durham*), Doctoral Research Fellowships (*Exley, Husband*).

Internationally, we are members of the World Cancer Research Fund International Regular Grant Programme (*Mathers*). We also contribute through roles as Trustees of AMRCs: British Nutrition Foundation (Vice Chair), Rank Prize Funds (Chair), Oral and Dental Research Trust.

**Editorial positions:** Our editorial duties are extensive including hosting Editors in Chief of the British Journal of Nutrition (*Mathers*), Journal of Dental Research (*Jakubovics*), International Journal of Language and Communication (*Pennington*). Colleagues at all career stages hold Associate Editors positions at 11 journals and are editorial board members of a further 20. For example: International Journal Paediatric Dentistry (*Vernazza*), Journal of Oral Microbiology (*Taylor*); Scientific Reports (*Kist*) Journal of Patient Safety (*Slight*); Pilot and Feasibility Studies (*Husband*); PLOS ONE (*Todd*); Journal of Pharmacological and Toxicological Methods (*Gill*); BiolImpacts, Molecular Therapy, Precision Nanomedicine (*Moghimi*); Developmental Medicine and Child Neurology (*Pennington*); Agronomy (*Brandt*); British Journal of Nutrition (Hill); Journal of Oral and Maxillofacial Surgery (*Carozzo*); Journal of Oral Rehabilitation (*Durham*); Frontiers in Microbiology (*Chang*); International Endodontic Journal (*Whitworth*); and International Journal of Stem Cell Research and Therapeutics (*Telezhkin*).

**Invited presentations:** Over the REF period, UoA3 researchers made 150 invited presentations, including 45 keynote international conference addresses.

**Honours:** Honorary Fellow of the Nutrition Society (*Mathers*, 2020); Molecular Epidemiology Group Silver Medal (*Mathers*, 2015); Neonatal Society "Widdowson Lecture" (*Mathers*, 2015); IADR E.W. Borrow Memorial Award (*Maguire*); British Empire Medal (*Heasman*, 2017); BDA John Tomes Medal (*Steele*, 2016); IADR Innovation in Oral Care Award (*Jakubovics*, 2016); King James IV Professorship Royal College of Surgeons of Edinburgh (*Durham*, 2017).