Institution: De Montfort University

Unit of assessment: 3

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

1.1 UNIT CONTEXT AND STRUCTURE

Research in UOA 3 at DMU spans activities in the Schools of Allied Health Sciences, Nursing and Midwifery, and Pharmacy in the Faculty of Health and Life Sciences. It is focused on the unifying theme of health and well-being with the aim of being responsive to challenging opportunities within areas that utilise our interdisciplinary research expertise to support regional, national and international health and social-care needs. The research is conducted within three research units:

- the Institute for Health, Health Policy and Social Care (HHPSC; 10.5 FTE staff returned)
- the Institute of Allied Health Sciences Research (AHSR; 19.8 FTE staff returned)
- the Leicester Institute for Pharmaceutical Innovation (LIPI; 29.8 FTE staff returned).

The institutes were created in the current census period in recognition of the need to move beyond small research groupings and develop an environment that promotes collaborations and interdisciplinarity. They provide the organisational structure and support mechanisms required to deliver research in prioritised areas of strength that extend from Nursing and Midwifery through to Pharmaceutical Technologies, and to laboratory-based cellular and molecular research and Biochemical Health. Research-active staff, while members of an institute representing their main research focus, are encouraged to work flexibly across institutes and beyond the boundaries of School and Faculty, in order to develop interdisciplinary research.

1.2 RESEARCH AND IMPACT STRATEGY

1.2.1 Research Strategy

Our research strategy as projected in our submission in 2014 is to (1) further develop a culture that encourages our staff to undertake innovative and rigorous research; (2) develop new collaborations with strong partners at home and abroad; (3) progress commercialisation and maximise impact; and (4) grow our postgraduate research (PGR) student numbers within the Unit and enhance their experience. The strategy builds on the Unit's vision to focus its expertise and continue to develop original and distinctive research that provides benefit to people's health and well-being globally. Our progress against the research strategy is as follows:

1 We have significantly increased our pool of research-active staff and we are returning 60.1 FTE Category A staff which reflects a 91.4% increase from the 31.4 FTE returned in 2014. The current submission comprises 27 professors and associate professors, 20 lecturers and senior lecturers, and 16 Vice-Chancellor 2020 (VC2020) lecturers and Early Career Academic Fellows (ECAFs) (see REF5a), reflecting a strong senior research leadership base with a critical mass of potential future research leaders in the pipeline. The VC2020 lectureships are an additional career pathway introduced in 2013, specifically targeting the recruitment of academics with potential to develop into our future research leaders. The ECAF scheme, introduced in 2017, targeted those at a much earlier stage in their careers and are appointed to the Unit to support research development around the theme of health and well-being, but with the opportunity to subsequently progress to tenured lectureships upon successful completion of a one-year probationary period (REF5a).

We have enhanced our research culture and engagement with research through promotions and have bolstered our mentoring programme, monitored through the Faculty Research and Innovation Committee, to ensure support for staff at all stages of their careers (see 2.1). In addition, a number of honorary appointments have been made, allowing esteemed individuals from other institutions and clinical practice from home and abroad to mentor and work with researchers within the Unit on joint research

activities of mutual benefit. For example, in Health, Health Policy and Social Care, Karen **Harrison-Dening**, a nurse specialist in dementia, and Head of Research and Publications for the charity Dementia UK, joined DMU as Honorary Professor in Dementia Research, supporting one international and six national research studies within the Institute. In the pharmaceutical sciences, there have been several honorary research positions including 7 research fellows and 2 visiting professors (Marc **Brown**, former Chief Scientific Officer, MedPharm and Gordon **Muirhead**, President, GMPharma Ltd) from within the UK and abroad that have contributed to the mentoring of staff and to the development of research projects and outputs. In the basic sciences, Professors Ken **Farrington**, Consultant Nephrologist, Lister Hospital, and Jeremy **Pearson**, Associate Medical Director (Research) at the British Heart Foundation support research within the cardiovascular and cell-signalling research groups, with **Farrington** offering guidance and support around NHS ethics and research governance more widely to the Faculty.

2 We have achieved the objective of developing new collaborations with strong links at home and abroad through collaborations with European and other international partners by joining EU NETWORKS such as COST 15203 and COST 16227 with over 33 participating countries in each, including some from outside the EU. These networks have resulted in internationally co-authored publications with over 400 authors. The MITOEAGLE (Mitochondrial mapping: Evolution - Age - Gender - Lifestyle - Environment) network (COST 15203) has reviewed and published the 'Mitochondrial Physiology' concepts and definitions, and submitted its vision on specific protocols and nomenclature to *Nature Metabolism*.

We have used our Global Challenges Research Fund (GCRF: £97,205 allocated) to establish wider collaborations with developing countries through engagement with universities and other institutions as well as health services and departments (see 4.1) on projects that include enabling hybrid autonomous non-conventional energy integrated water/wastewater treatment system for remote African communities (Katherine **Huddersman**), co-creating handwashing education to improve personal hygiene, particularly in children in underprivileged areas (Katie **Laird**), developing strategies for addressing childhood malnutrition in Tanzania (Bertha **Ochieng**), developing patient-centric approaches to drug development for neglected tropical diseases (Mingzhong **Li**), and developing evidence based approaches to improving health through identifying non-adherence to cardiovascular medications in Iraq and Kenya (Sangeeta **Tanna**).

We have specifically targeted strategic partnerships with local and national NHS Trusts in primary, secondary and tertiary care; voluntary, private and charitable sectors; local councils; universities and other groups and organisations nationally and globally on projects of direct translational significance (see 4.1). These have enabled staff to successfully engage either as principal investigators or as co-investigators on prestigious projects that utilise their expertise and interdisciplinarity in health-related research to contribute to societal impact at the regional, national and international level (see 4.1). Of note is the collaboration initiated in 2019 between the University and Arts Council England on the jointly funded £2,800,000 groundbreaking Talent25 longitudinal intervention study to investigate the influence of arts and culture on the health and well-being of infants and children throughout their development into adulthood (see 4.1).

3 Commercialisation and maximising impact of our research has seen some significant developments achieved by entering into strategic partnerships with external organisations to create exploitable solutions (see 4.1). For instance, we have contributed to the production and marketing of safer culinary oils (Martin **Grootveld**) which has received in excess of £100,000 in commercial income from various sources, including the International Trade Centre, Weston A. Price Foundation, Green Pastures Products Inc., and HEIF Networking Award. We have developed a novel non-invasive multiplexed process analytical technology (multi-PAT) to assist biopharmaceutical businesses develop freeze-dried drugs and vaccines (Geoff **Smith**). The technology, which has generated £401,642 from three collaborative R&D Innovate UK grants (Biostart, AtalsBio and FastLyo), has been trialled at the Centre for Process Innovation (Darlington) and

now installed in a freeze-dryer at the National Institute for Biological Standards and Control (South Mimms), facilitating and accelerating the development of more robust and energy efficient production methods. We have also developed processes for producing a catalyst in several formats (**Huddersman**) with HEIF funding for development (£25,022), as well as funding from the US military ($150,000), DSTL (£70,000), and Schlumberger Foundation (£60,000) among others. The project, which has been scaled up to meet industrial needs, has generated an exclusive licence in the ophthalmic area to the US company Better Vision Solutions for use with the one-step hydrogen peroxide contact lens cleaning solutions. A worldwide patent (WO2017151604A1) has been taken out by the licensee in Japan, USA, EU, China, Canada, Brazil and Australia.

4 Overall PGR student recruitment during the census period increased by 66.7% since 2014 (93 in 2013/14 compared to 155 in 2019/20) and completions have more than doubled (40 in 2014 compared to 81 in 2020), meeting our objective of growing PGR student numbers. The increase in completions is evidence of the support and supervision provided for our students, which is further demonstrated by our PRES results in 2020 that showed our supervision and research training for students was particularly strong, with 88.5% (sector 86.7%; benchmark 87.6%) reporting to be happy with their supervision and 93.1% (sector 91.4%; benchmark 91.6%) reporting that their supervisors have the skills and subject knowledge to support their research while 90.3% (sector 85.8%; benchmark 86.8%) expressed overall satisfaction with their research skills, and 94.4% (sector 89.5%; benchmark 89.9%) claiming their skills in applying appropriate research methodologies, tools and techniques have developed during their programme. Recognition of the appreciation of the supervision provided is further demonstrated with **Grootveld** (School of Pharmacy) being one of the five finalists from over 100 nominations for the national award of PhD Supervisor of the Year (2020) run by FindAUniversity.com for his dedication and determination, with his work being described as outstanding and of an extremely high standard.

To expand the diversity and scope of our student base, the Unit has successfully implemented its innovative collaborative PhD scholarships with University Hospital Leicester NHS Trust and the Leicester Partnership Trust to enable full-time NHS staff to enrol with fee-waiver part-time PhDs while also teaching our undergraduate and postgraduate taught students. This has brought the three institutions closer together and facilitated working on high-quality research that is meaningful to patients while building upon clinical academic capacity and providing practical experience for the students.

1.2.2 Impact strategy

Our impact strategy is fivefold, with aims to:

- enable impact generation to inform our recruitment policy, with appointments targeted at areas of existing strengths;
- develop staff through workshops on impact and knowledge exchange;
- include impact generation in the mentoring of staff, particularly those at the early stages of their research careers;
- create partnerships across the world, including Europe, the USA, Asia, Africa, and Brazil to ensure our impact is not restricted by national borders (see 4.1); and
- adopt a participatory approach with stakeholder involvement to co-design and co-produce research as well as support delivery and facilitate the influence of our research on education, policy and product development, the healthcare services, practitioners, service users and the public.

These approaches ensure that pathways to impact are incorporated into research proposals right at the early stages of planning. Moreover, impact informs our internal funding policy for seed-funded projects and we support staff during our annual rounds of research and innovation time allocation to enhance their engagement with change-making research that generates

impact. This feeds into the annual appraisal process where performance against deliverables identified for research time allocation are reviewed.

Progress against impact strategy

The results of the strategy are demonstrated by our impact case studies, which we will continue to develop beyond the census period. These include influencing change in regulation and policy for maternity care (Tina **Harris**), improving the experience of people living with dementia (Andy **Northcott**), informing the production and marketing of safer culinary oils (**Grootveld**), developing DNA barcoding methodology to enable stronger regulation of the herbal medicines industry (Tiziana **Sgamma**), and developing a novel minimally invasive assay for better management of adherence to cardiovascular medications (**Tanna**).

To enhance wider reach and engagement with our research, we organise promotional events, including a Pharmacy Innovation Showcase focused on exhibiting innovative research across the discipline; an Antibiotic Awareness Day to raise understanding on antibiotic resistance; workshops in collaboration with the International Society for Pharmaceutical Engineering (ISPE) UK Affiliate on the practical application of Quality by Design, including hands-on practical work and classroom training sessions. Stakeholder involvement, public consultation and user engagement with our research are promoted through events such as: Dementia Research Café Conversations with medical practitioners, carers and patients with neurodegenerative disease; Alzheimer's Society Studentship Showcases with carers of patients with neurodegenerative disease; DMUlocal volunteering activities with Diabetes UK to raise awareness and reach out to diverse communities at risk; and Children's Cancer and Leukaemia fundraising, increasing public awareness of cancer in children. We also take a proactive approach in engaging with a dedicated University Media and Communications team to ensure timely dissemination to the public, and screen media coverage of our most impactful findings, enabling us to monitor and evaluate the difference our research is making in the real world. Workshops on dissemination and public engagement are part of our annual calendar of events to support staff increase their external media profile.

1.3 OPEN ACCESS AND RESEARCH INTEGRITY

Researchers adopt a policy of adherence to the University's Ethics and Research Integrity guidelines with specific commitments to open research and culture. This is promoted by making research outputs accessible through the Green Open Access route on the DMU open research archive (DORA) within three months of acceptance. They also ensure that data is deposited on Figshare, our data repository system, to demonstrate transparency and share with the wider community in order to generate greater potential benefit. Some outputs are supported for publication through the Gold Open Access route using central funds when available.

Outside of the formal institutional facilities, individuals are encouraged to promote their outputs through media platforms. In other cases, staff take opportunities to write opinion or discussion pieces for open access publishers such as The Conversation as well as blogs.

Going forward, we will be promoting publications through the University's own press (DMU Press) in support of its mission to make journals and books free at the point of access in digital format, enhancing free global access and the widest possible dissemination.

1.4 SUMMARY OF PROGRESS AGAINST 2014 OBJECTIVES

Research within our UOA at DMU has undergone substantial transformation since 2014 both structurally and in scale. We have moved to structured thematic interdisciplinary institutes which have provided the catalyst for growth and success. We have been able to consolidate our research and expertise, resulting in a significant expansion in our partnership and networks, which extend across the globe (see 4.1). Our research environment has been enhanced and the research culture strengthened through our far-reaching collaborations, underpinned by strategic staffing policies, which included new recruitment of leading senior researchers, appointment of renowned external academics and clinicians to honorary positions within targeted disciplines, creation of a pipeline of future research leaders through the VC2020 and ECAF schemes,

supporting the promotion of our staff, and their participation in the Future Research Leaders programme specifically developed by the University for staff deemed as 'highflyers' (see 2.1).

The impact of our transformation is reflected in (1) a significant increase in our staffing research capacity and return to REF 2021; (2) a striking proliferation in outputs with a 104% rise in publications of various forms, including journal articles, books, book chapters and conference proceedings; (3) a significant growth in PGR student recruitment and percentage completions; and (4) a notable increase in the number of high-profile national and international multimillion-pound projects involving our staff (see 4.1). These achievements show promise and give confidence to our aim to strengthen our research leadership in the core areas of excellence, enabling further growth and success.

1.5 FUTURE STRATEGIC AIMS AND GOALS FOR RESEARCH AND IMPACT

We aim to continue to build on our research progress, expanding our strategic priorities to ensure that we are responsive to changes in the funding and political landscape so as to maintain our influence, not just within national boundaries but globally. Our research strategy going forward will therefore be underpinned by the principles of (1) improving competitive external-income generation, (2) generating high-quality outputs, (3) maintaining sustainability through a pipeline of research-active staff, (4) increasing research visibility and impact, and (5) supporting continued recruitment of high-calibre PGR students. The delivery of these principles is outlined below (1.5.1 to 1.5.5):

1.5.1 External-income generation

Income from external sources is increasingly focused on generating excellence recognised nationally and internationally. We will therefore ensure that we continue to consolidate our research in areas of excellence in health and social care and in the lab-based sciences to be competitive in income generation. In parallel, we will select future programmes in response to national and international demands, prioritising interdisciplinary research that provides potential for future growth with demonstrable impact. For instance, we will exploit emergent opportunities for health care created by Covid-19 which will include building on **Laird**'s research on laundry and the coronavirus (see 4.1) with the aim of developing textile antimicrobial laundry supplements and establishing a test standard to determine the efficacy of laundry to be used globally. We will also maximise on other opportunities such as Daniel **Sillence** working alongside the University of Oxford to repurpose existing licensed medicines including select inhibitors of glycolipid metabolism for treating Covid-19, Maitreyi **Shivkumar** developing broad-spectrum antivirals for rapid deployment against corona and other future new viruses, and Kathryn **Hinsliff-Smith** along with Jayne **Brown** leading a UK-wide Covid study exploring the experiences of families, carers and residents in care homes during the pandemic to improve care services.

Within Health and Social Care, we will continue to support the multimillion-pound Talent25 and 'Crying Babies' projects (see 4.1). We will also be growing our research on dementia through a multi-institutional study looking at the everyday use of restraint on people living with dementia in hospital; and will build on our research into mental health by exploring access to perinatal mental health services for first-generation migrant through the ADRIFT study.

There are two further major initiatives we aim to develop as part of our focus on health outcomes and quality of life across the life course. The first will develop a partnership with Willows Health, the largest GP practice in Leicestershire, which will lead to the creation of a Willows-DMU Centre for Primary Care Research. This will combine our expertise together with those of primary-care clinicians to carry out transformational research, including collaborating with DMU's Digital Health Technology Unit to identify and develop technologies that will have a positive impact on improving the care provided to patients. Furthermore, the research activities will be extended to exploring mental health provision in Leicestershire (particularly in the wake of Covid-19), asthma care, diabetes management and the link between Covid-19 and other complications. Opportunities for generation of quality outputs and external-income to drive wider adoption of care solutions will be central to our engagement within the Centre.

The second initiative aims to expand our research into Applied Global Health following the offer of an appointment to Tine **Van Bortel** as Professor of Global Health in Allied Health Sciences in July 2020. **Van Bortel**'s expertise in Global Mental Health and Well-Being, and Determinants of Health and Well-Being provides new opportunities to extend our research in these areas together with local and global partners and networks already developed. **Van Bortel** will broaden the scope of our research in several areas including the development, application and evaluation of enabling technologies, creative solutions, and social innovations to overcome barriers to health and wellbeing, and to address inequalities. This will complement planned engagement with the Willows-DMU Centre for Primary Care Research and build synergies not just within our three institutes but with others across the Faculty, such as the Mary Seacole Research Centre which focuses on Mental Health and Resilience in migrant communities. The research conducted in this Centre is largely policy-based at this stage and its members are therefore being returned into UOA 20.

Further initiatives to enhance our income streams will focus on our industrial interface which will be advanced principally through our Pharmaceutical Technologies and Nanomedicine, the Chemistry for Health and Environment, and the Bioanalytical Sciences research groups. We will build on the established work of **Smith**, **Grootveld** and **Huddersman** (see 1.2.1) by developing new avenues of high-profile research, specifically in neurodegenerative disease, led by Nicoleta **Moisoi**. This will be a major programme of research within the Unit for which some funding has already been secured from Alzheimer's Research UK (ARUK; £212,624) and commercial partners (confidential information) funding the project via the Dementia Consortium (part of ARUK). The programme of research will focus on two aspects, the first on validation of novel targets and drugs for Parkinson's disease using both murine and induced pluripotent stem cell derived models of the disease. This research aims to identify viable therapeutic approaches for Parkinson's that will be taken forward for further validation and/or commercialisation with the consortium. The second focus will be on neuroimmune interactions in Parkinson's and this aspect is being developed in collaboration with the University of Verona and the National Institute for Physics and Nuclear Engineering in Romania. An application has been submitted (May 2020) to the Michael J Fox Foundation totalling over US$4,000,000.

Li's research on neglected tropical diseases is another priority area for growth and will be developing a patient-centric approach for the treatment of malaria. Another project funded by the EPSRC (£906,253) within **Li**'s group will also aim to develop a patient-centric supramolecular formulation of new anti-leishmanial drugs for Indian communities.

In January 2020, DMU joined a £26,000,000 BBSRC- and Innovate UK-funded consortium, established to catalyse collaboration between academics and industry partners working on biofilms through the National Biofilm Innovation Centre. We will utilise this initiative to provide a stimulus for researchers in UOA 3 to identify industry partners for the development and commercialisation of innovative products and approaches for biofilms, including developing molecular imprinted polymer coated central venous catheter (collaboration with Kimal PLC), and developing new disinfectant surface wipes (collaboration with PAL International).

1.5.2 High-quality outputs

We aim to increase the quantity of high-quality outputs through refinement of our publication and dissemination policies. In line with this, we will support all research-active staff through mentoring where needed, and with adequate time allocation and funding to produce, on average, one high-quality (3*/4*) peer-reviewed manuscript annually. We will aim to target at least 70% of publications to the top 25% of journals within our respective disciplines while ensuring a minimum of 40% are with international collaborating partners. Our policy of ensuring outputs are on DORA within three months of acceptance will be carefully monitored and we will continue to support open access publication of high-quality outputs to maximise the visibility and reach of our research.

1.5.3 Staffing sustainability and succession planning

Developing our own future research leaders is central to our culture for sustainability and succession planning and we anticipate changes in our staffing due to the retirement of several

senior members of the Unit. We are mindful of the impact this will have on our research and the risk this will pose in weakening our research excellence in the areas led by our senior researchers. We will therefore continue to build on the strengths of our pipeline future leads, ensuring appointments continue in areas at risk of maintaining the sustainability of their research activities, and support the progression through promotions of staff deemed excellent.

We will further develop talented staff by facilitating opportunities to advance through national and international fellowship schemes. We have had some success in the Faculty in supporting staff to apply for fellowships, such as Esmee **Hanna**'s (submitted into UOA 20) NIHR Advanced Fellowship. We will now build on this by creating a Faculty Research Fellowships Mentoring Group that will provide a network of experts who will assist researchers to develop skills for competitive fellowship applications. Through this, we aim to increase success in the number of fellowships awarded to our staff from the early career researcher (ECR) stage through to senior levels with at least one in every institute within the UOA over the next REF cycle. To further strengthen our commitment to developing our ECRs going forward, we will apply to gain admittance to the Academy of Medical Sciences Springboard Scheme so that staff within the first five years of their academic post in our Unit will have the opportunity to apply for up to £100,000 over two years to support their research on health-related themes. These staff will have access to the Academy's acclaimed mentoring and career development programme.

1.5.4 Enhance research visibility and impact

The co-production of research and generation of impact will continue to be central to our funding policy and we will monitor our strategy for impact in line with funding applications both internally and externally. We will strategically prioritise internal funds, annually ring-fencing one third of our research development budget to accelerate projects that include impact and engagement activities. We will ensure researchers build and strengthen mutually beneficial relationships with external partners who will contribute to the planning for potential impact, facilitate evidence-gathering as well as delivering the benefits of our research to a range of beneficiaries.

Maintaining stronger links with clinicians, applied health researchers and industry will be a focused objective to facilitate the translational elements of our research and we will continue to review and prioritise areas for development, and strengthen interdisciplinary working. We will also include alignment of our research with the key priorities of the United Nations' Sustainable Development Goals (SDGs) relevant to the UOA. This will be in fulfilment of the University's commitment to the 17 SDGs for which it was awarded Global Hub status for SDG 16 on a three-year tenure that started in 2019 (REF5a). We embrace the commitment to the SDGs, with particular focus on 3 (good health and well-being), 4 (inclusive and equitable quality education), 6 (clean water and sanitation), 9 (industry, innovation and infrastructure), 10 (reduced inequalities) and 17 (partnership for sustainable development).

To further raise the visibility of our research and generate impact, we will continue to promote our findings to a wider global audience through online events and commemorating international and national awareness days, including World Hospice and Palliative Care Day and National Handwashing Day.

1.5.5 PGR student recruitment

We have made good progress in enhancing our PGR student cohort, increasing numbers by almost 67% during this census period with 107 currently registered on various degree programmes. It is now our ambition to build on this critical mass and increase our cohort by a further 50% over the next REF cycle in line with supervisor capacity, and we will work with our Associate Dean, International, and with the International Office to specifically target the international market with potential for research growth. This will be in line with our recruitment strategy which includes improved web presence with a virtual tour of our research facilities, including laboratories, library resources and PGR study rooms. For prospective candidates who fall short of our PhD entry criteria, we will offer opportunities to enrol onto Masters programmes to develop their research and writing skills before embarking on a PhD. We will also continue developing our PhD programme with the NHS Trusts and will introduce 'taster' sessions for academics, clinical staff and others wishing to study for a higher research degree.

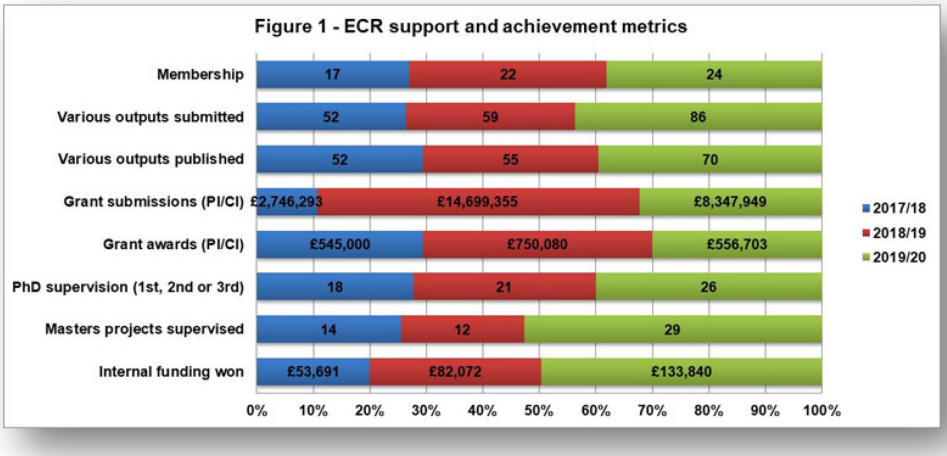
Section 2. People

2.1 STAFFING STRATEGY AND STAFF DEVELOPMENT

Our commitment to supporting the next generation of researchers and to developing a diverse group of high-quality research-active staff has driven our recruitment strategy. We prioritise attracting, developing and retaining staff with research potential and excellence. We have used new appointments to expand our research so that we can contribute to emerging global challenges and have further utilised new appointments and promotions as strategic levers to increase critical mass in order to strengthen our priority areas, enhance interdisciplinarity and increase our international networks. This has meant a number of strategic new recruits and promotions including the appointment of Anwar **Baydoun** as Professor of Cardiovascular Pharmacology and Associate Dean Research and Innovation (ADRI; 2018), advancing research leadership in the Faculty across institutes and centres as well as strengthening research in the cardiovascular areas. The recruitment of Kay **de Vries** as Professor of Older People's Health (2017) and **Ochieng** as Professor of Integrated Health (2017) to the School of Nursing and Midwifery increases the School's professorial appointments to four and has enabled a programme of outstanding-quality health research through the establishment of major collaborative partnerships on a series of high-profile projects locally, nationally and internationally (see 4.1). Graham **Sewell**'s appointment (2019) in the School of Pharmacy as Professor of Pharmacy Practice brings established expertise in the areas of cancer chemotherapy, occupational exposure of healthcare staff to hazardous medicines, and the environmental impact of drugs and their metabolites excreted by patients receiving chemotherapy.

Apart from targeted new recruitments, the Unit's staffing policy has enabled it to prioritise recognition of research excellence from within, and support a new generation of research leaders with exceptional talent and promise with rapid promotions to professors and associate professors. These include the promotion of **Smith** from Reader to Professor in Pharmaceutical Process Analytical Technology (2015); Zeeshan **Ahmad** from Reader to Professor in Pharmaceutics and Drug Delivery (2016); **Li** from Reader to Professor in Crystal Engineering and Drug Delivery (2019); **Tanna** from Reader to Professor of Pharmaceutical Analysis (2018); and Randolph **Arroo** from Reader to Professor of Phytochemistry (2019). Among the associate professorial promotions, **Laird** was promoted from Senior Lecturer to Associate Professor in Microbiology (2018), **Moisoi** from VC2020 Lecturer to Associate Professor in Pharmacology (2019), Nick **Turner** from VC2020 Lecturer to Associate Professor in Bioanalytical Chemistry (2019), and **Sillence** from Senior Lecturer to Reader (2015) and subsequently changing title to Associate Professor of Cell Biology in 2018. In Allied Health Sciences, Louise **Dunford** was promoted from Senior Lecturer to Associate Professor of Nutrition (2019), Avninder **Bhambra** from Senior Lecturer to Associate Professor in Biomedical Sciences (2019), Harprit **Singh** from VC2020 Lecturer to Associate Professor of Cell Signalling (2019), and Umakhanth Venkatraman **Girija** from VC2020 Lecturer to Associate Professor of Immunology (2019). In Nursing and Midwifery, Andrew **Clifton** was promoted from Senior Lecturer to Associate Professor in Nursing (2017), Jane **Rutty** (2018) and **Harris** (2017) from Principal Lecturers to Associate Professors in Research and Innovation and Deputies to the ADRI within the Faculty. These promotions are a result of succession planning to build a sustainable critical mass in our targeted priority areas going forward.

Our succession planning strategy has also prioritised the next generation of researchers by recruiting through the VC2020 and ECAF schemes. Both schemes provide successful candidates with bespoke mentoring and an opportunity to establish a solid research career through dedicated research time (50%) and funding of up to £5,000 in their first year of appointment (REF5a). These targeted investments are enabling our future research leaders to establish strong foundations and develop their careers independently and through collaborations internally and externally with the outcomes illustrated in Figure 1.



We are particularly conscious of ensuring our pipeline talent have an influential voice within the Unit. We are therefore pleased that 77% of the VC2020 staff have been promoted to senior lecturers or associate professors and the ECAFs have been given tenure following successful completion of their probationary year. Both groups of staff are part of various decision-making processes, such as being included on faculty panels for reviewing and agreeing Research and Innovation Allowance (RIA) allocations to other staff. They also have representation on the Faculty Research and Innovation Committee, providing valuable opportunities, not only to contribute to decision-making at a senior level, but to also gain essential leadership skills and network with the Faculty's senior research management team.

Our Future Research Leaders programme, which provides mentoring together with a stipend of £1,500 for developmental activities, gives our rising research stars an opportunity to develop their research leadership skills, thereby setting out a path to senior positions. The programme seeks both to place this group as leading researchers in DMU and to equip them with the skills and the sense of responsibility to act as champions and inspire research in their own research groups, institutes, schools and faculties. Participation in the programme is an accolade and the size of the cohort is limited to 12 people per annum across the University but our Unit has been successful in supporting 6 staff through the programme since 2017.

For all researchers, there is a University Professional Development Unit that provides dedicated specialist and transferrable skills aligned to the Research Development Framework and we ensure staff are supported in various forms throughout the different stages of their careers. The RIA (REF5a) is also open to all researchers and is on top of a 10% scholarship time awarded to all staff. Researchers can apply for RIA ranging from 320 to 640 hours per year, which equates to 1 to 2 days per week. Allocations are made on a transparent basis with each application considered on its own merits. Notification of outcomes is through the ADRI and, where RIAs are not allocated, developmental considerations form part of the feedback given with appropriate support identified, including effective mentoring, particularly for less-experienced researchers going through this process for the first time.

We adopt both an informal and traditional approach to mentoring through the Faculty Research Mentorship Scheme which is facilitated by the Faculty Professoriate, other experienced researchers and external mentors brought in to give a broader perspective. The mentoring provides bespoke support that includes navigating through the career progression pathways, income and impact generation, and guidance around producing high-quality publications. These activities are also supported centrally through various events and workshops organised by the Researcher Development Team within Research Services. Institutes additionally organise their own activities, such as annual conferences, which are inclusive and offer opportunities for networking. Some of these events are facilitated from the research development budget administered by the ADRI to enhance cross-fertilisation of research ideas and to develop joint bids. We also support staff to develop their research and networks through the University Research Leave Scheme which is funded centrally on an annual basis (REF5a).

2.2 TRAINING AND SUPERVISION OF PGR STUDENTS

The Unit has a large and vibrant PGR student population from home and abroad, adding to our diverse culture within the Faculty. They are supported through various funding streams including DMU bursaries. In the census period, the University has provided 23 full bursaries and 25 fee-waivers to PGR students in the Unit. Others are recruited through externally secured research grants and through additional sources, such as EPSRC, Newton Fund or government-funded studentships including from the Egyptian Ministry of Higher Education and Scientific Research. As noted previously, we also recruit students from within the local NHS Trusts in order to help develop their professional needs and advance their clinical competence.

All our students are fully integrated into our research institutes to ensure that they are part of a research-rich environment and we provide opportunities for peer-mentoring from within the PGR student cohort. To minimise disruption and facilitate easy access to supervisors when on campus, we have created designated research student offices with dedicated computer stations, a kitchen, seating area and lockers which are additional to the central library facilities. All students are supported through the Doctoral College which oversees the administrative aspects of their studies and monitors their progress from recruitment to completion. To assist with this process, DMU uses an online platform that allows research students, supervisors and the Doctoral College to track and record progression throughout the student's lifecycle from registration, through regular periodic reviews, to viva and final award to ensure milestones are met on time. The Faculty Head of Research Students (FHRS) works with the Doctoral College to oversee student academic progression and is assisted by the Institute Heads of Research Students (IHRSs) to ensure students are supported by their supervisory team, consisting of at least 2 supervisors with completion experience and subject expertise among the team. All supervisors must complete DMU's Certificate in Research Supervision in order to be eligible to supervise PGR students.

Students within the Unit are provided with generic training through the Doctoral College. The Faculty additionally offers two Doctoral Training Programmes (DTPs), one in the applied social and applied sciences and the other in bioanalysis, pharmaceuticals and health. Both DTPs are designed to provide specialised training opportunities and support for students while undertaking their PhD to ensure a high-quality experience. In addition to supporting their academic development, we are also mindful of their well-being. We are therefore dedicated to creating an environment that focuses on students' health and well-being by providing advice on finance, career and employability as well as mental health which, since March 2020, has included Doctoral College or Faculty virtual drop-in sessions with the FHRS/IHRS, PGR café for all students to catch up and talk about mental health, regular updates via the Faculty PGR Community Shell as well as central communications from the Associate Pro Vice-Chancellor and/or Pro Vice-Chancellor, Research and Enterprise. Where disruptions are inevitable due to the pandemic, we have provided a no-cost formal interruption to their studies.

To assist with their career development, we make funds available on a competitive basis to support conference attendance, specific training relevant to their studies and provide a £2,000 annual supplement for consumables for each laboratory-based project. Students are encouraged to be proactive in promoting their research and are provided with funds and administrative support through the Faculty Research and Innovation Office (RIO) to organise a student-focused annual Post-Graduate Research Conference, giving them an opportunity to acquire organisational skills as well as developing their presentation competencies. The conference is additional to several other events organised by the Institutes and/or Doctoral College, including the PGR lecture series, the three-minute-thesis and poster competitions. Furthermore, we recognise and incentivise our students through a number of prizes that are awarded yearly at the Faculty Research Awards and include an award for Excellence in PhD Student Contribution to the Research Community.

2.3 SUPPORTING AND PROMOTING EQUALITY AND DIVERSITY

Our UOA is committed to delivering the principles of equality, diversity and inclusion (EDI) and is, therefore, fully aligned with the University EDI strategy, DMUfreedom. DMUfreedom is monitored and governed by the University EDI committee which reports to the Executive Board

which in turn reports to the Board of Governors. A core principle of DMUfreedom is equal and fair access of opportunity and outcome for all staff regardless of their employment status and protected characteristics. This principle, along with all others, is monitored and reported on at the University EDI committee.

In addition, the Faculty monitors and reports on EDI opportunities and outcomes at the Faculty EDI committee which is chaired by the Deputy Dean and reports to the University EDI committee. The Faculty committee has representation from all schools and addresses issues that relate to EDI and, together with the Faculty Research and Innovation Committee and the institutional committee, monitors the current demographic profile of research academics in our Unit to support it in moving towards a well-balanced gender and ethnicity demographic.

We are particularly pleased to have been able to narrow the gap between white and Black, Asian and Minority Ethnic (BAME) researchers in the current submission when compared to 2014 (Figure 2) and have, overall, a fair gender balance for all the different categories of appointment within the UOA (Figure 3) with particular reference made to the increase in female professors (40% compared to 25% in 2014) brought about by targeted recruitment during the current census period. The high proportion of female associate professors currently (Figure 3) will ensure we bridge the professorial gender gap even further as we move forward.

Figure 2 - Gender and ethnicity - 2014 to 2020

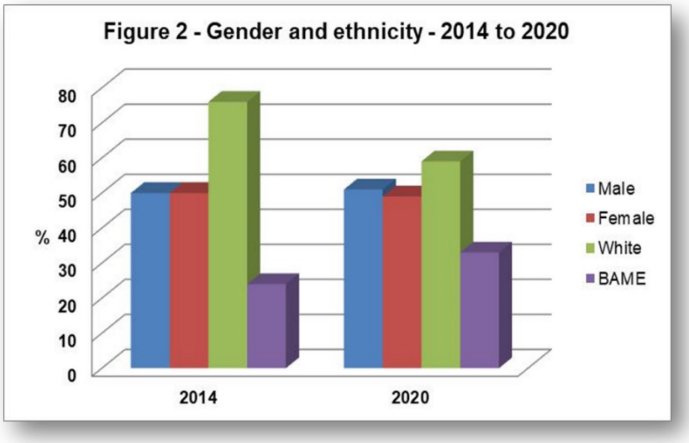
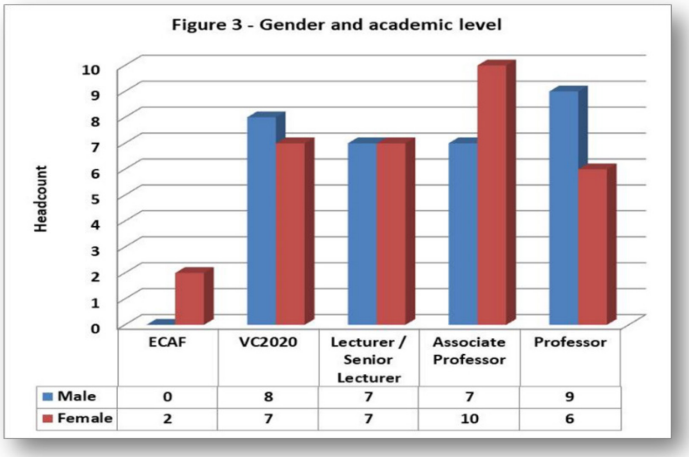


Figure 3 - Gender and academic level



Through DMUfreedom, we seek to further advance our EDI objectives to ensure our UOA is a diverse and friendly Unit to study and work within. We encourage all staff and students to feel the freedom to inspire and to succeed through the provision of training and operational frameworks that ensure active engagement beyond compliance with equalities legislation and University processes.

Our further commitment in supporting EDI and ensuring fairness to all is demonstrated by our pledge to the Athena SWAN charter (REF5a). We have set up a Faculty-wide Athena SWAN Equality, Diversity and Inclusivity Team, chaired by **Rutty**. This group is driving the principles of the charter and organises annual Athena SWAN conferences to promote equality and diversity across the Faculty. The School of Pharmacy secured a bronze award in 2019 and is now preparing to submit for a Silver award with the other two schools that form part of our submission also working towards achieving this goal.

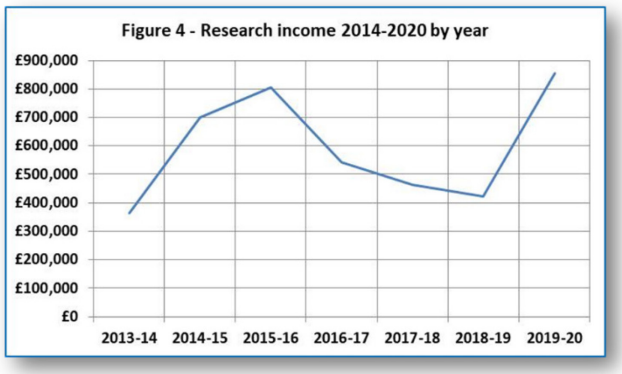
We have ensured that all staff within the Unit are supported with flexible working arrangements in line with DMU guidelines and policies. Family-friendly policies such as parental leave have also been supported throughout the census period, ensuring arrangements are put in place to cover tasks of staff on leave schemes. This includes making provisions not just for their teaching but also supporting PhD students under their supervision, and do so fairly without any bias.

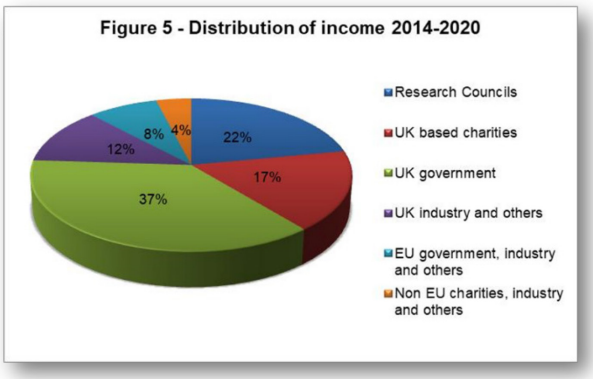
Section 3. Income, infrastructure and facilities

3.1 RESEARCH INCOME

Income generation over the current census period shows a marginal fall to values submitted in 2014 (£4,149,898 in 2019/20 compared to £4,406,671 in 2013/14). There was a declining trend, particularly between 2016/17 and 2018/19, which may be due to the drive to recruit VC2020 Lecturers / ECAFs as part of the succession planning strategy. We have, however seen a reversal of this trend in the last year with our income streams rising from £422,277 in 2018/19 to £853,965 in 2019/20 (Figure 4) and expected to exceed £1,000,000 in 2020/21. Grants have been secured from a wide range of funding bodies, including Research Councils (BBSRC, EPSRC, ESRC), charities (CRUK, ARUK, NC3R, Wellcome Trust), UK government (NIHR, DASA), EU2020, other sources (Table 1, Figure 5), and excludes examples of commercial income given in section 1.2.1.

Table 1: Income 2014–2020	
BEIS Research Councils, The Royal Society, British Academy and the Royal Society of Edinburgh	£901,870
UK based charities (open competitive process)	£402,248
UK based charities (other)	£290,010
UK central government bodies/local authorities, health and hospital authorities	£1,084,297
Health research funding bodies	£464,500
UK central government tax credits for research and development expenditure	£0
UK industry, commerce and public corporations	£267,799
UK other sources	£257,968
EU government bodies	£305,461
EU based charities (open competitive process)	£0
EU industry, commerce and public corporations	£11,031
EU (excluding UK) other	£9,662
Non-EU-based charities (open competitive process)	£16,758
Non-EU industry commerce and public corporations	£1,131
Non-EU other	£137,163
TOTAL	**£4,149,898**





It is pleasing that the larger share of our income is from esteemed competitive sources and it is encouraging that our conversion ratio of success has doubled from 9% in 2014 to 18% in 2020. We will maintain this upward trajectory and aim to realise a conversion rate of at least 20% going forward. To achieve this, we have introduced regular grant horizon scanning workshops

with institutes asked to identify specific funding opportunities as part of their annual research objectives mapped against their five-year strategic plans. Staff less experienced are paired with experienced researchers, including members of our professoriate, and supported through seminars and workshops aimed at writing good-quality grant applications. They are also provided with seed-funding from the research development budget for pilot studies that will lead to grant applications.

Examples of key awards that reflect the success of the strategic approach now implemented include:

- **J. Brown** (NIHR HTA; £2,000,000 with £797,819 to DMU): cluster randomised controlled trial of a service to support the mental health and coping of parents with excessively crying infants;
- **J. Brown** (Lottery Fund and European Union Social Fund; £2,400,000 with £250,000 to DMU): evaluation of National Lottery application by Vista, Building Better Opportunities;
- **Grootveld** The Quantum Leapers (£100,000): optically detected magnetic resonance (ODMR) for early cancer detection;
- **Hinsliff-Smith** (Dunhill Medical Trust; £133,000): uncertainty in healthcare: a qualitative study of patients' and clinicians' experiences and co-design of professional development and patient information materials;
- **Hinsliff-Smith** (National Lottery / Leicester Ageing Together, £52,000): Leicester Ageing Together evaluation report;
- **Laird** (Textile Services Association; £104,500): development of a standard test to determine efficacy of laundry;
- **Li** (EPSRC GCRF; £906,253, with £243,792 to DMU): patient-centric supramolecular formulations of new anti-leishmanial drugs for Indian communities;
- **Moisoi** (Alzheimer's Research UK; £212,624): validating CLPP-dependent activation of mitochondria quality control signalling as a neuroprotective strategy in neurodegenerative diseases;
- **Turner** (EPSRC; £296,003): Exploration of Linking Chemistry in the Design of Aptamer-Molecularly Imprinted Polymer Hybrids (aptaMIPs);
- **Turner** (Cancer Research UK; £100,000): Analysis of Extracellular Vesicles using Impact Electrochemistry;
- **Turner** (Partnership for Clean Competition; £132,000): Comprehensive Steroid Detection in Urine Via Targeted Clean-Up and Fully Automated GCxGC-MS Analysis.

3.2 RESEARCH INFRASTRUCTURE/FACILITIES

Our research institutes are led by Research Directors who are senior academics with internationally recognised track records within their respective research fields. Directors have oversight and day-to-day management responsibilities of the activities within their units and are supported by an Institute Steering Group with responsibility for evolving the institute's research strategy, monitoring its performance and ensuring effective implementation of the strategic plan. Membership of the steering group includes the director as chair, research theme leads, representative of the Faculty Professoriate, ECRs and IHRS.

Each institute is further supported by the Faculty Research and Innovation Committee which approves targets and monitors performance against agreed objectives and deliverables, including grant applications, awards, income and postgraduate student registrations and completions. Membership of the Faculty Research and Innovation Committee includes the Associate Dean, Research and Innovation (ADRI), Institute Directors, the institutional Head of Research Services, the Faculty Research and Innovation Office Manager, Mentor Lead, ECR and ECR Champion, REF UOA Coordinators, and Faculty Head of Research Students. The

Dean and the Pro Vice-Chancellor for Research and Enterprise, together with his deputy, are ex-officio members.

Connections between institutes, Faculty and University are maintained through the ADRI who sits on the Faculty Executive Committee, University Research Management Group, and University Research and Innovation Committee. This ensures activities within institutes align with the key strategic objectives of the Faculty and University.

The Faculty Research and Innovation Office, with its own dedicated staff headed by a RIO manager, provides wider support for the institutes and researchers, including managing, under the direction of the ADRI, the budget allocated to bench fees. They also provide administrative support and assist with organising various workshops, conferences and the Faculty Research Awards. Additionally, they produce a research newsletter highlighting the latest development and achievement in our research and support the ADRI in managing and processing various applications including those for RIAs as well as internal grant funding calls. The RIO manager sits on the Faculty Research and Innovation Committee and members of the team service the committee.

Our research also draws on expertise from within the East Midlands Research Design Services for grant-application writing and other support, including patient involvement in proposed studies. Within the University, we get assistance centrally from Research Services who provide support for grant applications through a dedicated Faculty Research Development Officer (RDO). The RDO assists with identifying funding opportunities, provides guidance on requirements of different funding bodies as well as policy and governance. Research Services also assist with costings and with post-award management of successful grants. Our researchers additionally benefit from extensive resources in the University's Kimberlin Library, with the Library and Learning Service providing guidance on open access and copyright.

There has been significant investment in the University's estates during the census period with a £136,000,000 Campus Transformation Project (REF5a) which has benefited our Faculty with £12,000,000 invested in refurbishing its buildings and upgrading its facilities for both teaching and research. The Faculty took the opportunity to integrate its laboratory facilities for research and teaching while maintaining bespoke specialist units dedicated to research alone. In this regard, we have modernised laboratories in the basic sciences, including upgrading our cell culture, HPLC, cell signalling and molecular biology suites. We have also acquired a high-resolution Jeol JNM-ECZR 600 MHz spectrometer for state-of-the-art solution-state research programmes, predominantly those involving multicomponent biomedical science investigations. This instrument has much improved signal resolution (specificity) and sensitivity with access to a large number of two-dimensional (2D) NMR techniques for solution-state structural elucidations (both uni- and multinuclear), including those for proteins. The investment has strengthened our very high level of expertise and experience in the areas of NMR-based experimental design, biometrics, chemometrics, metabolomics and data-mining, along with drug design, synthesis, characterisation and testing (both organic and metallodrugs).

We have created a world-class industry-standard Laboratory for Rapid and Adaptive Medicine Development and Manufacture which has positioned our researchers as leaders in continuous secondary manufacturing using Quality by Design principles. The use of novel in-line Process Analytical Technologies (PAT), as an integral part of the facility, has accelerated the pace of manufacturing innovation through a better understanding of materials properties and process design. The Unit, led by Walkiria **Schlindwein**, will continue to scope opportunities with the pharmaceutical industry to translate early innovative development of medicines into actual scale-up production using efficient methodologies underpinned by an international regulatory framework of Quality by Design guidance.

Our scanning electron microscopy (SEM) facility has also been upgraded by adding a sputter coater to enable the facility to apply a conductive layer of gold at a predetermined thickness, and have upgraded the EDX computer and hardware to the latest software platform (Aztec) which include Feature and Large Area Mapping to allow for samples to be analysed in automation and predetermined elements identified. These upgrades have provided

opportunities for wider external collaborations (see 4.1) and given researchers the advantage of the latest developments in SEM analysis.

We have acquired a Reichert Surface Plasmon Resonance (SPR) system with electrochemical capabilities and have additionally invested in several mass spectrometry instruments to add to our existing Qualitative Tandem Liquid Chromatography Quadrupole Time of Flight Mass Spectrometry (LC-QTOF-MS/MS). The new instruments include an Agilent 6120 liquid chromatography mass spectrometry (LC-MS) and a 7900 inductively couple plasma mass spectrometry (ICPMS) as well as an Agilent 700D GCMS QQQ MS gas chromatography mass spectrometry (GC-MS). The facility is part of the Covid-19 Mass Spectrometry coalition and the Midlands Mass Spectrometry group with key research in the field of small molecule analysis, particularly in metabolomics, environmental forensics and biomarkers in health.

We have invested in additional mid-range equipment including: 5 new HPLCs, X-ray powder diffraction (XRD), Ion Chromatograph, Oxygraph, Polar Bear Plus Crystal and Crystal 16, LI-COR Odyssey imaging system, Bench Top Bruker ESR, Cryostat, Vibratome, Critical point dryer SEM, Lyostat5 Freeze Drying Microscope, Pharma Test Dissolution Apparatus, VirTis AdVantage Plus XL, 2 shelf freeze-dryer. These are further to multiple smaller piece of equipment, which all together amounted to an additional investment of £1,124,000.

Apart from the internal investment made, we have developed strategic partnerships with other institutions nationally and internationally that facilitate sharing of research infrastructure which have provided access to: the Los Alamos National Laboratory in New Mexico, USA, looking at catalyst structures (**Huddersman**); a 60L reactor pilot unit at SENAI, Brazil and a 80L reactor pilot unit at Scottish Water Municipal wastewater treatment site at Bo'ness in Scotland as test sites for the destruction of simulated produced water and pesticides (**Huddersman**); animal testing and microbiological facilities at the London School of Hygiene and Tropical Medicine (**Li**); Docking software and expertise with colleagues in Hacettepe University, Ankara, Turkey (**Arroo**); the EPSRC mass spec facility at the University of Swansea (Joan **Taylor**); proposal-based Beamtime (in-kind value of £65265) with the ISIS Neutron and Muon Source at the Rutherford Appleton Laboratory of the Science and Technology Facilities Council (Omar **Mansour**); the loan of a $40,000 Vacuum Metal Deposition (VMD)-360 from West Technology to research into the use of precious metals in the detection of fingerprints on biodegradable and compostable plastic bags (Kevin **Farrugia**); Living Lab for care-home resident health and well-being in Holland (Landelijke Prevalentiemeting Zorgkwaliteit; **Hinsliff-Smith**).

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

4.1 COLLABORATIONS, NETWORKS AND PARTNERSHIPS

Researchers within the Unit collaborate extensively across all its disciplines and do so regionally, nationally and internationally. Our choice of collaborations, networks and partners is determined by our vision of developing impactful and innovative research which provides benefit to health and well-being. We have focused specifically on engaging with industries, government departments and policymakers, health- and social-care professionals, service users and carers. We have utilised various funding streams, including the faculty research development funds and the QR GCRF to pump-prime research that will develop collaborations widely. In establishing these links, we have ensured real use of our expertise to address the health, well-being and social-care needs of the local, national and global population, with examples of effective collaborations within the census period including:

- The DMU-Arts Council England Talent25 project, led by **Ochieng** in partnership with Leicester City Council, NHS England, The Mighty Creatives, The Spark, Mammas and Willows Health, to examining the impact of engagement in creative activities from birth to the age of 25 on the socio-economic status of the participants, including their well-being and abilities in later life; and identify interventions needed to increase beneficial cultural opportunities at the earliest possible stage in the development of infants and children. The project, with a 25-year timeline, will enable interdisciplinarity and impact on a global scale.
- **Ochieng** collaborating with Leicester City Council and Health Education England on the high numbers of underweight and overweight children in BAME communities to develop and

implement a training tool for healthy weight maintenance to bring about change and better health to black minority groups. This research has been extended to Tanzania with **Ochieng** collaborating with Muhimbili University of Health and Allied Sciences (Tanzania), the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDEC, Tanzania) on developing culturally sensitive strategies for reducing malnutrition in children.

- **J. Brown** establishing a wide network of regional and national partnerships on 'The Surviving Crying' feasibility study which involves University Hospital of Leicester (UHL) NHS Trust, Leicester Clinical Trials Unit, Leicestershire Partnership NHS Trust, University College London, Leicester and Middlesex Universities and the charities National Childbirth Trust and Cry-Sis. The study was initially funded from the NIHR HTA Programme (£528,632) to design and deliver a first step towards developing and evaluating an intervention to be incorporated into routine NHS services to support parents of babies who cry excessively. A further £2,000,000 NIHR grant has been awarded and has developed further links with the universities of Cambridge and Warwick to extend the research and evaluate the effectiveness of the intervention package in a large-scale cluster randomised controlled trial.
- **J. Brown** collaborating on the 'Work Live Leicester' Programme with Vista (lead partner), Voluntary Action Leicester (VAL), The Workers Educational Association, The Rural Community Council, Access Generation, Access all Areas, Be Inspired (a young people's charity), Leicestershire County Council, The Princess Trust, Go Travel and CASE Social Enterprise. The project, funded by the European Union Social Fund and the National Lottery Community Fund (DMU: £154,000), aimed to help economically inactive or unemployed people in Leicestershire into work or learning by improving their health and well-being and their social engagement, skills and work experience.
- **De Vries** collaborating with Queens University Belfast as part of an extensive international consortium conducting research on the 'Scaling up the Family Carer Decision Support' with partnerships across Canada (two universities – McGill and McMaster), Italy, Netherlands, Czech Republic, Republic of Ireland, and UK universities (Lancaster, Leicester and University College London). The project, aimed at increasing knowledge and understanding of end-of-life care issues for family members of people with dementia in care homes, is a large research initiative on tackling the challenge of neurodegenerative diseases and has received significant funding from the EU Joint Programme of Neurodegenerative Disease Research (€1,071,904) and the Alzheimer's Society Implementation Grant UK (£281,164). The Alzheimer's Society has agreed an extension of this study due to Covid-19 and the impact of this on the care-home sector. The value of the extended funding is being negotiated.
- **De Vries** collaborating on a Burdett Trust funded project (£99,900) with the University of Brighton, Birmingham City University in co-designing person-centred frailty interventions in partnership with older people and health professions across three healthcare sectors: Primary Care, Community Trusts, and Acute Trusts.
- **Harris**, contributing as the Senior Clinical Lead to the National Maternity and Perinatal Audit, funded by the Healthcare Quality Improvement Partnership (£4,000,000) to conduct the first comparative analysis of maternity care across England, Scotland and Wales. This project carried out with the Royal College of Obstetricians and Gynaecologists, the Royal College of Midwives, the Royal College of Paediatrics and Child Health, and London School of Hygiene and Tropical Medicine has increased awareness of geographical variations and introduced changes to regulatory and policy processes for maternity care. It has also integrated research-informed clinical measures into data strategies of the NHS, enabling better care outcomes for women and babies;
- **Hinsliff-Smith** leading the LOTUS (long-term care institutions) project in Brazil in collaboration with the University of Nottingham and UNESP and UPS (São Paulo, Brazil), together with an extended network across Europe and the USA, including the University of Graz (Austria), Liden and Maastricht Universities (Netherlands) and Duke University (USA).

- **Huddersman** collaborating extensively in the UK and across the world to maximise the use and commercialisation of her novel catalyst technology. These include collaborations with:
    - Federal University of Agriculture (Nigeria), University of Lomé (Togo), Energie Stable Togo (Togo), WaterAid (Togo), SNV Africa (Cameroon), PPI Industriel (Burkina Faso) on the Enabling Hybrid Autonomous Non-Conventional Energy Integrated Water/Wastewater Treatment System for Remote African Communities project;
    - KEE Process Ltd (Aylesbury), TMD Technologies Ltd (Middlesex), Hammond Produce Ltd (Redhill), the Allerton Project, Game and Wildlife Conservation Trust (Leicester), and Loughborough University (Loughborough) to develop a microwave-assisted oxidation catalysis system;
    - KEE Process Ltd (Aylesbury, UK), Tecen Commercial LTDA (Rio de Janeiro, Brazil), SENAI Biosynthetic Innovation Institute, SENAI CETIQT and SENAI Innovation Institute for Green Chemistry (Brazil) on UV assisted catalysis of Brazil wastewater and reuse.
- **Laird** developing strong collaborations with local NHS Trusts, Industrial laundries (Elis (formerly Berenden, UK), Chemical Manufactures (Micro-fresh International; Leicester, UK), Trade Bodies such as Textile Services Association (TSA; London)), the European Textile Services Association (ETSA; Brussels, Belgium)) and the Textile Rental Services Association (TSA; Virginia, USA)) to raise awareness of the risks to healthcare workers concerning spread of infectious bacteria and viruses and the correct methods for washing textiles to avoid spread of pathogen in the home and clinical setting. This research has challenged industrial laundries protocols for the decontamination of spores and Public Health England's guidance on washing healthcare uniforms domestically, which Laird's extensive research has shown to be inadequate. More importantly, global trade bodies have funded (£104,500) research into developing a standardised test protocol to determine the decontamination efficacy of industrial laundering to be used internationally. Laird has also secured additional funding from the Higher Education Innovation Fund (£34,452) to conduct further research looking specifically at the survival of coronavirus on textiles. The research has been presented to a number of international conferences (American Society of Microbiology, Society of Applied Microbiology, Textile Institute World Conference & ECCMID (May 2015 - June 2020)), and to global textile/laundry associations including, the UK, US, European, Finish, German, Swiss and Belgian associations, all of which are going to disseminate the main messages so they can be implemented in healthcare laundering within their countries to prevent further transmission of coronavirus.
- **Li** collaborating with industries (Almac Group (UK), Certara Ltd (UK), Charnwood Molecular Ltd (UK), GMPharma Ltd (UK), and Structure Vision Ltd (UK)), a medical research charity (LifeArc, UK), the London School of Hygiene and Tropical Medicine, other national universities (University of Durham, University of Keele), and international universities and institutes (Federal University of Rio de Janeiro (Brazil), University of Hyderabad (India), Banaras Hindu University (India), CSIR (Indian Institute of Chemical Biology)), on mechanistic multiscale co-crystal dissolution modelling, and on patient-centric treatments for malaria and for leishmaniasis.
- **Smith** collaborating with GEA Lyophil GmbH (Germany), Sciospec Scientific Instruments GmbH (Germany), Biopharma Process Systems Ltd (UK), the National Institute for Biological Standards and Control (UK), Centre for Process Innovation (UK), BlueFrog Design (UK), Sanofi-Ireland, and OncoLytika (UK) on the development of technologies for freeze-dried drugs (see 1.2.1).
- **Schlindwein** collaborating with GlaxoSmithKline (UK), ColvisTec AG (Germany), BASF (Germany) and Reckitt Benckiser (UK) on rapid and adaptive medicine development and manufacture using Quality by Design. This initiative is supported by an Industry Advisory Group which includes representatives from GlaxoSmithKline, Pfizer, AstraZeneca, Bristol-Myers Squibb and senior assessors from the Medicines and Healthcare Products Regulatory Agency.

- Wide collaborations by members of the Unit to provide SEM service support for other universities (London South Bank, Portsmouth, Anglia Ruskin), police forces (Bedfordshire, Dorset, Hampshire, Thames Valley) and forensic service providers (CellMark Forensics) across the UK as part of our initiative to grow research in the forensic sciences which is new to DMU and to the UOA.

The above is in addition to other individual collaborations with over 40 national and 30 international partners around the world, including:

- Africa: Ibn-Sina University (Sudan), University of Makeni (Sierra Leone), Kenyatta National Hospital (Kenya) and Aga Khan University Hospital (Kenya);
- Europe: Arcadis (Netherlands), Forschungszentrum Jülich (Germany), University of Geneva (Switzerland), International School of Advanced Studies (Trieste, Italy), Maastricht University (Netherlands), Facultad de Farmacia (Spain), Universidad Miguel Hernández de Elche, Department of Parasitology (Spain), IMIDRA, Departamento de Investigación Agroambiental (Spain);
- India: Environmental Sanitation Institute, Manav Sadhna (NGO), and Together In Development and Education (NGO)
- Russia: Institute of Applied Physics, Koltsov Institute of Developmental Biology, Sechenov Institute of Evolutionary Physiology and Biochemistry, Institute of Cell Biophysics, Pushchino, St Petersburg State University and Pavlov Institute of Physiology.

4.2 WIDER ACTIVITIES AND CONTRIBUTIONS TO THE RESEARCH BASE, ECONOMY AND SOCIETY

Our diverse portfolio of research, led by established and internationally recognised academics, has created a position of influence with a particular focus on providing research-led expertise which has advanced knowledge and made economic and societal contributions. Through their achievements, many of our researchers have been recognised nationally and internationally and have made significant contributions in all disciplines submitted in this UOA. These contributions, in addition to reviewing extensively for national and international journals, include:

4.2.1 Grant reviewing

- **Li** and **Turner** serving as full members of the EPSRC Peer Review College
- Antonio **Pena-Fernandez** serving as Global Assessor for the Royal Society of Tropical Medicine and Hygiene
- Other staff across the Unit reviewing extensively for national funding bodies such as MRC, BBSRC, EPSRC, Cancer Research UK, Blood Cancer UK, Wellcome Trust, Royal Academy of Engineering, The Royal Society, Abbeyfield and Dunhill Medical Trust; and for international funders including the Czech Science Foundation and Israel Science Foundation.

4.2.2 Membership of professional bodies and learned societies

- **Baydoun**, Fellow of the British Pharmacological Society
- **Laird**, Fellow of the Royal Society of Biology
- **Li**, Membership Secretary of the British Association for Crystal Growth
- **Sewell**, Life member of International Society of Oncology Pharmacy Practitioners (ISOPP)

Other staff are ordinary members of various scientific societies and focused groups, including: The British Pharmacological Society, Biochemical Society, Microbiology Society, Royal Society of Biology, Royal Society of Chemistry, British Toxicology Societies, Spanish Toxicology Societies, Association for the Study of Medical Education, Particle Technology Focus Group (Institution of Chemical Engineers (IChemE)), Biopharmaceutics Focus Group (Academy of

Pharmaceutical Sciences of Great Britain), Age-Related Medicines Development and Use Focus Group (Academy of Pharmaceutical Sciences of Great Britain).

4.2.3 Membership of committees and advisory boards

- **Arroo**, Executive Committee member of the Phytochemical Society of Europe
- **Baydoun**, Programme Committee Member for the Pan-Asian International Conference on Science and Technology
- **Dunford**, Research Committee for the Royal College of Emergency Medicine
- Mohamed **Elsawy**, Master of Drug Discovery and Development Program Advisory Board (Gulf Medical University)
- **Harris**, the Insights Group (a subgroup of the Maternity Transformation Programme run by NHS E&I), and Clinical Reference Group of the National Maternity and Perinatal Audit
- **Laird**, Chair of the Medilink (East Midlands) Infectious Disease Special Interest group, and UK Management Committee member for the COST Action CA16227
- Naomi **Martin**, Midlands Innovation Flow Cytometry Committee
- **Moisoi**, Midlands Steering Group Alzheimer's Research UK, COST 15203 - MITOEAGLE Network, and member of the Management Committee and Leader of Working Group 4
- Wendy **Norton**, Steering Committee Member of the Royal College of Nursing Women's Health Forum
- **Schlindwein**, EPSRC Future Manufacturing Research Hub for Continuous Manufacturing and Advanced Crystallisation Advisory Board
- **Singh**, European Society of Cardiology Working Group Atherosclerosis and Vascular Biology
- **Tanna**, Executive Working Committee of the Midlands Mass Spectrometry Group
- **Turner**, Secretary to the Macro Group UK, affiliated to both the Royal Society of Chemistry and the Society for Chemistry and Industry
- **Shivkumar**, **Laird** and **Farrugia** listed on the Government Covid-19 Expert Database.

4.2.4 Editorial duties

- **Arroo**, Editorial Board of *Phytochemical Analysis*, *Phytotherapy Research*, *Phytochemistry Letters* and *eFood*
- **Baydoun**, Topic Editorial Board of the *International Journal of Molecular Science*
- **Elsawy**, Editor-in-Chief for the review book: *Peptide Bionanomaterials: From Design to Application*
- Mark **Evans**, Special Topics Editor for the *International Journal of Molecular Sciences*
- **Hinsliff-Smith**, Editor for the journal *Nurse Education in Practice*
- **Laird**, Editor for the *International Journal of Food Science Technology*
- **Moisoi**, Associate Editor for *Bioenergetics Communications*, and Editorial Board member *MitoPedia Preprint Archives*
- **Pena-Fernandez**, Associate Editor for *Bioenergetics Communications Public Health*, Topic Editor for *Toxics*
- **Sewell**, Associate Editor of the *Journal of Oncology Pharmacy Practice,* and Editorial Board Member for *European Journal of Parenteral and Pharmaceutical Science*
- **Sgamma**, Guest Editor for *Plants*

- **Sillence**, Editorial Board of *Frontiers*, *Membranes MDPI*, *Journal of Medical and Clinical Research*, *Science Research* and *Open Journal of Pharmacology*

4.2.5 Keynote and plenary lectures

- **Arroo**, International Symposium on Phytochemicals in Medicine and Food (Shanghai, China, 2015); 23rd Conference on Isoprenoids (Minsk, Belarus, 2016); 2nd International Symposium on Phytochemicals in Medicine and Food (Fuzhou, China, 2017); Symposium on Natural products in Drug Discovery (Bangkok, Thailand, 2018); Conference on Biological Activities of Essential Oils (Orleans, France, May 2019)
- **Baydoun**, Pan-Asian International Conference on Science and Technology (Bangkok, Thailand, 2015)
- Federico **Brucoli**, World Congress on Antibiotics (Rome, 2018)
- Larry **Goodier**, Italian Society of Travel and Migration Medicine, Venice (2020)
- **Harris**, Midlands Maternity and Midwifery Festival (Edgbaston, 2018); RCM Midwifery Leaders Forum (London, 2019),
- **Martin**, COINS (Lithuania, 2018)
- **Moisoi**, National Conference of the National Neuroscience Society (Bucharest, Romania 2016); Conference on Mitochondrial Physiology (Hradec-Kralove, Czech Republic, 2017)
- **Rutty**, Annual National Medico Legal Conference, Singapore (2015)
- **Schlindwein**, 9th Crystal Forms Conference (Bologna, 2017); Leistritz Pharma Extrusion Conference (Nuremberg, 2018); Royal Society of Chemistry seminar (London, 2019)
- **Sillence**, Biochemical Society: 'Drug repurposing' (IET Birmingham, 2019)
- **Turner** Royal Society Symposium on Molecular Recognition (Nagpur, India, 2015)
- **Tanna**, 5th International Conference and Exhibition on Analytical & Bioanalytical Techniques (Beijing, China, 2014); APS 7th International PharmSci Conference (Glasgow, 2016); World Conference on Analytical and Bioanalytical Chemistry (Barcelona, 2018)

4.2.6 Awards and recognitions

- **Norton** made Fellow of the Royal College of Nursing (2020) in recognition of her outstanding contribution to improving health care and shaping policy, practice standards and services to the profession. Her groundbreaking work on surrogacy has expanded understanding of the changing nature of human reproduction in the 21st century
- **Ochieng** received The Mary Seacole Leadership Award (2017) in recognition of her contribution to improving the health of BAME communities
- **Pena-Fernandez** received the Ebola Medal for Service in West Africa (2015) for his humanitarian crisis response. This medal is the first to be awarded by the UK Government for a humanitarian crisis response
- **Rutty** received the Forensic Nursing Excellence Award from the International Association of Forensic Nursing (2016) in recognition of an individual who has contributed significantly to the advancement, growth and success of forensic nursing
- **Tanna** received the APS PharmSci Geoffrey Phillips Analytical Science Commendation Prize (2016) regarding counterfeit medicines

4.2.7 Patents and licences

- The Unit has developed two patents over the census period. The first is an international patent for the invention of arsenobetaine and arsenosugar analogues and derivatives and their use in therapy, particularly for the prevention and/or treatment of cancer. The compounds of the invention may also inhibit angiogenesis, thereby preventing metastasis of cancer cells, particularly of breast cancer cells (the organoarsenic compounds as

therapeutic agents for prevention and/or treatment of cancer - WO2016059198 A1; April 2016). The second, a patent in Great Britain, relates to the use of low-level ammonium chloride to enhance human endurance. Furthermore, an additional benefit is observed when ammonium chloride is administered in combination of green tea extract or epigallocatechin-3-gallate (the enhance of physical endurance - GB1700400.3; January 2017). A licence and consultancy agreement have also been generated with Better Vision Solutions (USA) from Huddersman's research (see 1.2.1).