Institution: De Montfort University

Unit of Assessment: 3 Allied Health Professions, Dentistry and Nursing

a. Overview

De Montfort University's submission to UoA3 encompasses research areas previously submitted to RAE2008 under three separate UoAs (Allied Health Professions and Studies; Nursing and Midwifery; and Pharmacy). Our philosophy since RAE2008 has been to develop a new interdisciplinary research structure that is responsive to challenging opportunities within areas of particular strengths. Based within the Faculty of Health and Life Sciences (HLS), our research Groups are: Biomedical and Environmental Health; Pharmacology; Pharmaceutical Technologies; and the Nursing and Midwifery Research Centre (NMRC). Academics are primarily associated with one research Group but may also be affiliated to one or more other Groups (within this UoA or the wider university).This strategy promotes an environment that develops strength in the underpinning sciences whilst facilitating a cross-disciplinary approach to identifying opportunities and addressing research challenges. Research within the present submission is inevitably diverse, often interdisciplinary, and takes a variety of forms, e.g. laboratory based, healthcare improvement, industrially collaborative. It is underpinned by focused investment in new staff and infrastructure, and a research environment that is supportive, responsive and forward-looking at all levels of organisation within the Institution. Since RAE 2008, researchers have produced more than 1000 research outputs within the scope of the submitting unit (data extracted from the De Montfort Open Research Archive (www.dora.dmu.ac.uk).

b. Research strategy

Significant changes to the research environment have been introduced over the assessment period. Since 2011, all staff within the UoA are physically located on the same campus following the relocation of nursing staff to new purpose-built facilities. Staff within the UoA have also benefited from greatly enhanced centralised support services for research within the census period, namely the University's Research, Business and Innovation Directorate (RBI) and Graduate School Offices (Est. 2009).

The key features of the research strategy outlined in RAE 2008 – and articulated across three UoAs – are embraced within our current strategy. Since 2008, the research strategy has been revitalised to achieve four major objectives: (a) to strengthen our external reputation for research excellence and innovation; (b) to enhance the sustainability of our research through diversification of research grant income generation; (c) to develop our research capability through strategic appointment of staff and investment in infrastructure; and (d) to ensure a vibrant and supportive environment for students and staff, that fosters collaborative and interdisciplinary research. Evidence across the census period that we are achieving our objectives is provided by: the strategic appointment of seven new staff over the census period to strengthen and expand existing areas of excellence (professorial and early stage researchers) (see section ci); significant investment in infrastructure (buildings, laboratories, capital equipment) (see section d); increasing postgraduate research recruitment throughout the census period (see section cii); greatly enhanced supportive mechanisms for our researchers (see section ci); increasing diversification of significant research grant successes from national and international funding bodies (see section d); an expanding portfolio of collaborative research with external institutions, both nationally and internationally (see section e); and the creation of innovative research degree programmes to meet the needs of key stakeholders, e.g. the NHS. Further evidence of our success is indicated by prestigious recognition for our highly innovative research: invitation (as one of only six) to display our artificial pancreas research (**Taylor**) at the 2013 British Business Embassy's Healthcare & Life Sciences event 'Britain is Great'; nomination of our blood spot analysis research for clinical applications (**Tanna/Lawson**) for Research Project of the Year at the 2012 Times Higher Education Awards; award of the Royal Society of Chemistry's Analytical Method prize in 2010 (**Tanna/Lawson**); and House of Commons award for research excellence in Hospital Acquired Infections in 2008 (**Laird**).

Continuing progress in relation to the major strategic objectives of the submitting Unit and research Group strategies (see below) is achieved by providing research infrastructure support, internal funding opportunities, support with writing bids, research career succession planning (future leaders programme) and press office support. Mechanisms for promoting and vitalising

research include Annual Research Planning (since 2009) at research Group and Faculty levels, which embraces challenging growth targets, seeks to diversify income sources, ensures quality of activity and promotes dissemination of research findings. The research planning is cognisant of the external funding environment and of shifting opportunities, and seeks to enable multi and inter-disciplinarity. Our Annual Faculty Research Audit for all academic staff provides intelligence on potential areas of synergy and helps identify staff and research areas that might benefit from additional support. Other mechanisms for promoting and vitalising research include the provision of a strong programme of staff development opportunities and core funding to support research (e.g. laboratory consumables, staff and student conference attendance, research leave, project pump priming).
Success in research is celebrated in a weekly Faculty Newsletter and a quarterly University magazine. Interdisciplinary collaboration is promoted through various mechanisms, including open seminars organised at the UoA and research Group levels where recent research developments are discussed between a mix of visiting speakers and DMU students/staff. Staff within the UoA also participate in wider initiatives within the University, such as the Professorial and Distinguished Lecture Series. Major events to promote and disseminate the Unit's research externally include our Health & Wellbeing 2011 Research Showcase, which attracted over 300 attendees from academia, industry and third-sector organisations.
As a result of these major initiatives, the submitting Unit has a more planned, cohesive and responsive research environment with greater opportunities for inter-disciplinary research, a vibrant and current web presence and a more extensive national and international profile.

Individual Research Group Strategies:
Biomedical and Environmental Health: A theme of this Group's strategy is to engage in interdisciplinary research on factors such as diet and environmental hazards influencing human health and development of new diagnostic tools, with particular focus on different ethnic Groups. Recent EU funded research, for example, has highlighted health risks associated with exposure to toxic elements (e.g. arsenic, lead and cadmium) from certain foods and non-food items, such as betel quid and baked clay, consumed within the Asian community. Application of advanced bioanalytical techniques to aid detection, diagnosis and therapy is a further theme of research within the Group: NIHR and industry funded research applies LC-MS/MS analysis of a drop of blood on paper to improve the effectiveness of drug therapy and treatment for paediatric and adult patients; internationally collaborative research focuses on the high sensitivity quantification of chemical warfare agents and their metabolic products in biomedical samples; multicomponent high-resolution NMR analysis of biofluids and tissues is applied for diagnostic and prognostic purposes in collaboration with UK hospitals. Expertise in bio and chemometrics, and metabolomics, including NMR-based exploratory data analysis and pattern recognition techniques, are also applied to biomedical investigations. A third theme of research, which has been enhanced through recent appointment of new staff with expertise in molecular diagnostics, is the control and diagnosis of infectious diseases: a novel catalysis-based antimicrobial system has recently been patented; in collaboration with UK hospitals, MALDI-TOF-MS and PCR techniques are being applied to discrimination of antibiotic resistant bacteria; and the mechanism of antimicrobial action of nano-metals in biofilms is being actively studied.
The Group often works collaboratively with members of other Groups within the unit, such as the NMRC and Pharmaceutical Technologies. This Group also has a strong network of UK, EU and international collaborators (see section e) and frequently hosts visiting scholars from European universities supported by Erasmus, Leonardo De Vinci and British Council (Commonwealth Staff Fellowship) programs. Furthermore, over the census period, the Group has hosted several international students on governmental scholarships and EU-funded Marie Curie Early Stage Researchers.
Pharmacology: This Group is engaged in three key areas of research – neuropharmacology, cell signalling and pharmaceutical biotechnology – and employs *in vitro* and *in vivo* models to investigate the effect of drugs on body systems. One of the strategic aims over the REF assessment period (which will be continued for the next five years) involves an enhanced focus in neuropharmacology, by applying our combined expertise in molecular, neurochemical and electrophysiological techniques to clarify unresolved research questions related to the mechanism of action by drugs used for the treatment of psychiatric disorders, including depression and

attention deficit hyperactivity disorder (ADHD). Recent research highlights in this area show that 5-HT receptor subtypes differently affect proteins mediating neuronal plasticity as well as experimental evidence of different responses to psychostimulants dependent on age. Future research aims to build on these key findings and will develop molecular and functional strategies focusing on the long-term mechanism of action by antidepressant drugs and the unknown therapeutic mechanism of action by psychostimulants in the treatment of ADHD. Other research, in collaboration with Oxford University, concentrates on neurodegenerative disorders, focusing on the role of calcium signalling in the cellular origin of serious diseases such as glycosphingolipid storage conditions. Another strategic aim is to utilize our combined expertise in chemistry, pharmacology and biotechnology. Recent research has, for example, highlighted how a healthy diet via CYP1-activation may prevent the onset of degenerative disorders. Further, a family of CYP1-activated pro-drugs has been patented and licensed with the lead compounds considered for phase I clinical trials. Our recently developed, patented and robust yeast-based expression systems will be pivotal for our future research strategy regarding high throughput screening of specific drug classes (e.g. specific Cytochrome P450 inhibitors). The Group benefits from national and international collaborations (see section e) and has, over the assessment period, hosted early career researchers from the EU including France, Sweden, Italy and Spain, funded by their host Universities and Erasmus.

Pharmaceutical Technologies: This Group's strategy is to build on a strong track record of innovative, collaborative research that collectively addresses a wide range of industrial challenges (through developments in manufacturing process control) and un-met clinical needs (through innovations in the bioavailability of active pharmaceutical ingredients, drug delivery and biomaterials). Novel methods for the manufacture and quality control drug products and medical devices (inc. materials for wound dressings and implants) are being actively researched by this Group. The Group has developed a Pharmaceutical Quality by Design initiative (HEIF and regional development funding) with the specific purpose of aligning its research activities to the development of new medicines and manufacturing processes in a way which is consistent and supportive of the pharmaceutical and associate industries. This initiative is delivering greater engagement with industry through specific events (e.g. DMU hosted Quality by Design conference in 2013).

The Group has developed an implantable closed-loop insulin delivery device that in pre-clinical trials has been shown to reduce blood glucose to normal levels in diabetic pigs. Further examples of externally funded research projects include EPSRC research projects in materials science (particle engineering and pharmaceutical co-crystals) and a TSB collaborative R&D project on industrial process control (freeze-drying). The TSB project has led to the development of a patented process analytical technology (LyoDEA), which is to be commercialised by GEA Pharma Systems. Building on these successes, and through recent recruitment of new staff, the Group has diversified its biomaterials and drug delivery expertise leading to the development of novel fabrication methods involving electro-hydrodynamic techniques to create micro and nano-structured drug products and wound dressings. The Group also makes advances in improved quality control testing of drug products, in which novel photokinetic methods have been established for accurate determination of quantum yields (**Maafi**). This photokinetic research will lead to the development of more accurate drug actinometers for characterising photo-degradation. The industrial interface for this Group's research is further described in section e.

Nursing and Midwifery Research Centre (NMRC): The NMRC strategy is to continue to develop our established research themes in patient safety, reproductive health, breast feeding, service user and carer involvement in mental health and doctor-patient communication by utilising infrastructure support provided within this UoA and centrally. This has resulted in our research into patient safety (surgical site infection, deep venous thrombosis and pressure ulcers), reproductive health and sickle cell disease contributing to policy in the UK and having international profiles. Two new research themes of palliative care and mental health are being supported with the appointment of two new professors. Our strategy of working collaboratively has led to the development of formal relationships with charitable palliative care organisations LOROS (Leicestershire and Rutland Hospice), Macmillan and Rainbows, and researchers work with many other healthcare organisations, user Groups, academic institutions and commercial companies (see section e). The Unit's vibrant and supportive environment for research has seen significant year-on-year increases in PhD and professional doctorate students linked to this Group, which, in conjunction with

intensive research sabbaticals, positive recruitment of staff with doctoral qualifications and reduction in teaching hours for four mid-career research staff has increased our research capacity. The Group's strategy of active dissemination and lobbying (for example with the Human Fertilisation and Embryology Authority, All Parliamentary Group for Infertility, All Parliamentary Group for Sickle Cell and NICE) is aimed at continued success in influencing policy and practice, e.g. national policy in infertility treatment, the management of sickle cell and interventions to reduce surgical site infections.

Unit Strategy Over The Next Five Years:

In line with the long-term continuation of strategy, over the next five years the Unit plans to:

(1) Further develop a research culture that encourages our staff to undertake innovative and rigorous research.

Assisted by adoption of the Researcher Development Framework, we plan to grow research capability by increasing the number of research-active academic staff in our focus areas, through a combination of new early stage researchers' appointments and support and development for existing staff who are able to initiate (or re-establish) a research career. Developing researchers will be fully integrated into existing research Groups, with access to mentoring opportunities. Our researchers will continue to access a range of competitive mechanisms (Faculty and central) to fund research-related activities, e.g. research scholarships, research leave and pump-priming research and innovation funding. We also plan to support and develop our research-active staff through introduction of Individual Research Plans with associated research allowances, to give researchers the time to undertake high quality research.

Pharmacy practice research is expected to have a more substantial role in our future profile; research in this area will focus upon the provision of an authoritative policy-related evidence base, aimed at enhancing the use, efficiency and effectiveness of medicines.

(2) Consolidate existing and develop new research collaborations with strong partners at home and abroad.

All our research Groups will undertake measures to increase engagement with EU funding including: representation at key seminars, pro-actively supporting researchers in EU networking and, through our EU funding specialists, identify calls and networks in the health area. EU and international collaborations will also be enhanced through research exchange at all levels and by further developing the Unit's facilities for visiting researchers. A strategy of long-term planning informed by the 'Grand Challenges' framework will continue to be adopted to facilitate generation of larger, more focused pre-emptive proposals.

Ongoing developments to strengthen research links with healthcare organisations will be pursued principally through our NMRC and Biomedical and Environmental Health Group. These include strategic interaction with various Groups/organisations, e.g. Leicestershire Partnership Trust (LTP); University Hospitals of Leicester (UHL) Trust; the CLARHC (NHS Institute Collaboration for Leadership in Applied Research in Health & Care); and Leicestershire and Rutland Hospice (LOROS), Leicestershire County Council, Sickle Cell Society, National Gamete Trust, European Society for Human Reproduction, and Epidemiology and The Patient Association. The Faculty also hosts four members of staff from the East Midlands Research Design Service, including the regional lead for public, patient participation in research. Bio-analytical techniques developed within the current census period have attracted considerable interest from Chinese research institutes (British Council funded invited visits for research dissemination) and strategic alignments will be made to explore this development further.

Our industrial interface will be advanced principally through our Pharmaceutical Technologies research Group, building on their QbD initiative and their strong record of success during the current census period (see above and section e).

Continuing investment in our physical resources will be complemented by a strategy to extend arrangements for sharing of research infrastructure with other institutions (e.g. regional HEIs and industry).

(3) Grow PGR student numbers within the Unit and enhance their experience.

New initiatives will include the development of multi-disciplinary Doctoral Training Programmes (DTPs) within the UoA to provide critical mass and opportunities to improve the overall experience and environment for our research students, including embedding training and employability skills. Two DTPs, each with specialist pathways, are planned to commence in 2013-14, that will address

the training needs of PGR within the research Groups outlined above.
(4) *Progress commercialisation and maximise impact of our research.*
Intellectual property previously developed by the Unit's researchers already provides a strong income stream into the institution. Furthermore, over the current census period we have published 11 patents and entered into partnerships with industry for future exploitation of our IP. The University has entered into a strategic partnership with an external organisation (Prospect IP) who will work with us to identify and develop our intellectual capital. From a recent University-wide survey of disclosures, seven new IP opportunities, assessed as having significant commercial potential, have been identified based on the research within this UoA. We will work with the external partner to create exploitable solutions, which in each case includes funding for completion of proof-of-concept research.
Within the Pharmacology Group, a focus will be the commercialisation of pro-drugs and screening assays that were developed and patented within the current census period; research which has attracted considerable interest from the pharmaceutical industry and for which licensing negotiations are ongoing. Other opportunities for commercialisation of our research exist in markedly increased sensitivity and accuracy of drug detection, which allows the development of less invasive sampling techniques in clinical research.
A focus of the Pharmaceutical Technology Group's activity will be to build on successful pre-clinical trials of an insulin delivery device, in collaboration with overseas partners. A purpose-built laboratory will be used for in-house clinical investigations of strategies to control diabetes. Funding has also been acquired from industry to develop new technologies for infection control and, in conjunction with the NHS, charitable funding obtained to explore the use of Terahertz technology as a diagnostic tool for melanoma.
During the next five years, we will build on developments arising from HEIF funded projects (£360k) awarded to staff within this Unit, to promote knowledge exchange with the pharmaceutical SME sector. The application of bio-analytical techniques in consultancy and quality assessment of drugs is expected to become a substantial contributor to external income generation for research development. Further, in a recent (2013) round of competitive HEIF-5 funding within the University, staff associated with the UoA secured funds in the sum of £212k for proof-of-principle and collaborative research studies.
The planned developments outlined above (1 -4) complement our strategy to enhance the impact and visibility of our research, as described in REF3a, building on the existing strong impact arising from our NMRC research, as well broadening the pathways for our other research Groups.

c. People, including:

i. Staffing strategy and staff development

The submitting Unit has sought to maintain an effective balance in staffing structure between established research leaders with strong international research profiles and a growing body of early and mid-career researchers. Notably, within the census period, we have strengthened our research capability within the nursing area through the appointment (2011) of a new chair in the field of palliative care. This appointment supports our strategic objectives and enhances opportunities for collaborative research with the NHS and with charitable healthcare organisations and complements existing staff expertise within the nursing area from NHS clinical research backgrounds, such as our chair of Clinical Nursing Research. A recently-appointed (2012) chair of bioanalytical chemistry enhances our capability for interdisciplinary research at the biomedical and medicinal chemistry interface. These new professorial posts complement strategic appointment of seven early stage researchers and significant investment in infrastructure for research, as detailed in section (d).
In line with the Concordat to Support the Career Development of Researchers, staff development is a priority within the UoA and is supported through: the provision of in-house research skills training; a policy of providing sufficient time and resources to enable staff to develop their research potential; funding and supervisory support for staff undertaking PhDs; programmes of in-house publications and seminars to encourage writing and dissemination; and practical support for tasks such as writing for publication, drafting bids and conference papers. A mentoring scheme, developed by and monitored through the Faculty's Research Committee, reinforces the education and training of researchers. A key principle of the scheme is that it is available throughout a research career and is adaptable to the mentee's experience/circumstances. ECRs and newly-

appointed academic staff have a reduced teaching commitment and research Group leads and research mentors play key roles in the integration and development of ECRs and new staff. Faculty funding is provided for staff development in research – including training, network-building and conference attendance – and to cover the running costs of postgraduate research student projects. The faculty has also recently introduced a small projects fund where researchers can apply for up to £5k of support, with priority given to pump-priming of new lines of research, or for integration of ECRs or other new staff into ongoing research projects. Furthermore, whenever possible, staff within the UoA benefit from intensive research periods of typically four - eight weeks, in which they are relieved of formal duties so that they can focus on the completion of research outputs.
Staff within the UoA have also benefited from additional support for researcher development provided through competitive, university-wide schemes and staff development opportunities, such as: an annual Revolving Investment Fund (RIF) for novel and innovative research-related activities; a Research Leave Scheme, which enables relief from teaching; and seminars/workshops on general subjects (e.g. New Researcher Inductions, REF, Impact, Applying for Research Funding, Research Project Management and Intellectual Property Training). During the census period, our staff have won 14 RIF and six research leave scheme projects.
Selected staff within UoA3 have also benefited from the Vice-Chancellor's 'Future Research Leaders' programme (launched 2012), which seeks to raise the strategic research competence of a cohort of selected researchers within the University. Succession and sustainability will also be promoted by a new internal funding initiative (launched summer 2013), which will appoint two ECR Fellowships per year. In 2013, the University gained the 'HR Excellence in Research Award' from the European Commission, demonstrating a commitment to improve the working conditions and career development for research staff. A further commitment by the University to supporting mid-career development of staff within the UoA is shown by conferment of four Readerships within the census period.

ii. Research students

Important developments in this area within the census period include expansion of our 'Professional Doctorate Programme', introduction of our 'Masters by Research', and a significant increase in both Faculty and University support for postgraduate study.
As part of its active research culture, the Faculty provides bespoke training for research students and opportunities for student oral presentations, as well as workshops for supervisors. Research students can also access Faculty funds to help finance researcher development, e.g. presentation of papers at conferences, attendance at specialist workshops etc. Research students have a voice in decision making through their representation on the Faculty Research Committee. From October 2013, our Doctoral Training Programmes (see section a, point (3)) will further enhance career and cohort development for research students associated with this UoA.
DMU's Graduate School Office provides further researcher training that aligns with the national Concordat and ensures that research students are subject to rigorous procedures of internal scrutiny and monitoring.
The submitting Unit has been successful in bidding for University funded, nationally advertised PhD studentships, acquiring 13 during the census period. Furthermore, >30 bursaries for research students have been secured from a wide range of foreign governments and universities, UK industry and charitable organisations, e.g. Hope Against Cancer Foundation, Burdett Trust, Rainbows. Recruitment of postgraduate research students onto MPhil/PhD degrees within the UoA has increased steadily over the assessment period, with total recruitment over the assessment period of 67 FT and 43 PT research students.

d. Income, infrastructure and facilities

Income. Over the census period, research grants have been secured from a range of sources, including the UK research councils, the NIHR, the EU Framework programme, UK governmental bodies and UK industry. Of particular note are projects studying caking resistance in particulate products (EPSRC, £224k), in-process particle sizing (EPSRC, £190k), freeze-drying process control (TSB, £169k), melanoma diagnosis (Hope Against Cancer, £75k), reproduction research (ESRC and NIHR, £400k), biochemical processes controlling uptake of arsenic in humans (EU-FP7 Marie Curie, £198k), DNA-based tests for commercial medicinal plant authentication (EU-FP7 Marie Curie, £170k), glucose-responsive insulin dosing device (NEAT, £215k), product formulation and control of freeze-drying (TSB, £169k), studies on health intervention (PEPSICO Foundation,

£398k), implantable insulin device for controlling diabetes (Edith Murphy Foundation, £200k), a project to explore why people undertake voluntary work (Macmillan Trust, £102k), hospital care (Burdett Trust, £160k). Such research grants illustrate funding source diversity across the Unit, as well as the recognition by major funding organisations of the importance of the research conducted.

Infrastructure. Research in UoA3 is aligned around the core Groups described in the previous sections and has access to state-of-the-art, dedicated facilities (as described in the next section). This infrastructure is further underpinned by a variety of Faculty and University-wide structures designed to facilitate research and promote excellence. The Faculty's Research and Commercial Office provides assistance with costing proposals and post award support. The Faculty Research Committee (at which each of the research Groups are represented) manages a research budget and co-ordinates research administration to the benefit of the UoA. Furthermore, where appropriate, research undertaken is subject to review by the Faculty's Research Ethics Committee and may also be subject to ethical review by external organisations, such as the NHS. Central support for researchers is provided by the Research and Business Innovation Office, established in 2009, which is responsible for overseeing and implementing the institutions overarching research strategy, ensuring that all our external applications for funding maintain quality standards through rigorous internal peer review, and building the profile and impact of our research through press/marketing. Support for intellectual property development is provided for staff and students through an institutional partnership arrangement with IP consultants. The De Montfort Open Research Archive (Est. 2009) forms the primary public and institutional record of research outputs. Staff have access to the 'ResearchProfessional' database of current research funding calls and news, with support for novice users provided through experienced staff within the UoA.

Facilities. De Montfort is undertaking an ambitious programme of upgrading the physical infrastructure of the University. Nursing and Midwifery research has benefited by relocation (2011) to a new purpose-built facility (£8M), which includes space to facilitate international collaborations and conferences. Since 2007, our research laboratories have been expanded or upgraded through major refurbishment (£0.8M); specialist research laboratories now include those for Cell Signalling, Human Tissue Culture, Clinical Microbiology and Drug Metabolism. Entirely new facilities have also been developed: a Pharmaceutical Product Development Suite and an Exercise Physiology Research Laboratory were opened in 2012. Furthermore, over the census period, significant capital expenditure has enhanced our laboratory equipment, including the purchase of a tandem mass spectrometer (£300k) and scanning electron microscope (£168k). External funding from the East Midlands Development Agency (£350k) has secured a new terahertz imaging and spectroscopy facility and a Novocontrol Broadband dielectric spectrometer. Other major analytical equipment includes: NMR (400MHz), EPR, LC-MS, MALDI-MS, confocal and atomic force microscopy, and FACS.
HEIF funding (£600K) has been used to develop our research infrastructure in the field of pharmaceutical product development. Access to national facilities within the census period includes: beam time at Diamond (Synchrotron Radiation Circular Dichroism, X-ray fluorescence spectroscopy); National Mass Spectrometry Facility (Swansea); Photoelectron Spectroscopy facility (Cardiff University); and Solid State NMR spectroscopy facility (Durham University).
Research students associated with this UoA are housed in a dedicated and recently refurbished and upgraded computer facility in close proximity to the research laboratories. Similarly, a dedicated computer facility and office environment is provided for visiting researchers.

e. Collaboration and contribution to the discipline or research base

Research within UoA3 submission is characterised by a high level of collaborative activity with external institutions, both nationally and internationally. The nature of these collaborations varies between research Groups (as detailed below), with strong examples of effective collaborations with the public sector, industry and academia within the census period.
The **Biomedical & Environmental Health** Group has a wide network of academic collaborators, both nationally and internationally, that facilitates an interdisciplinary research approach. Collaborations that have led to research outputs within the census period include: **UK** – University

of Leicester (Diabetes Research); the University Hospitals of Leicester NHS Trust (Centre for Therapeutic Evaluation of Drugs in Children); University of Manchester (School of Earth, Atmospheric and Environmental Sciences); University of Aberdeen (Institute for Biological and Environmental Sciences); University of Surrey (Centre for Clinical Science); Newcastle University (Medical Toxicology Centre);the British Geological Survey; Queen Mary (School of Biological and Chemical Sciences); St. Georges Hospital Medical School (University of London); University of Bristol (School of Chemistry); The Knowledge Centre for Materials Research; University of Bolton (Institute of Materials Research and Innovation); University of Warwick (Warwick Medical School).
EU – Karl Franzens Universität (Institute for Chemistry); University of Catania (Department of Neurisciences); Miguel Hernandez University; University of Minho (Department of Biological Engineering); University of Lisbon (centre of Chemistry and Biochemistry).
Internationally – Research Institute of Hygiene; Occupational Pathology and Human Ecology (Federal Medical Biological Agency, Russia); University of Chicago (Department of Health Science); Aichi Gakuin University, Japan (School of Dentistry); National Institute of Health (USA); Chennai Medical College Hospital and Research Centre (India). Invited keynote lectures and British Council sponsored visits to China enabled wider dissemination of our research, with proposals of collaboration in Nanjing, Wuxi and Chongqing in China.
The **Pharmacology** Group has established links with several other universities, research institutes and industry, which have led to high quality research outputs within the current census period. These include: University of Oxford (Departments of Psychiatry and Pharmacology); University of Leicester (School of Psychology); Newcastle University (Institute of Aging); Samsun Medical School, Turkey; Neurosearch, Sweden; AstraZeneca, UK and Eli Lilly Ltd, UK. The Group also collaborates on projects involving the extraction, chemical analysis and pharmacological testing of natural products from plants. The Group were partners in a DFID-LINK project for the development of *Artemisia annua* as a UK crop for the production of antimalarial medicine and have investigated the anti-cancer properties of a range of plant flavonoids. Recent work on the development of DNA-based tests for the authentication of commercial plant-based medicines has been cemented by the award of a Marie Curie IAPP grant to collaborate with the German phytopharmaceutical company, Schwabe Pharmaceuticals.
Effective mechanisms to promote industrially-collaborative research is epitomised by the **Pharmaceutical Technologies** Group's QbD initiative (see section b), which is delivering greater engagement with industry through specific events (e.g. DMU hosted QbD conference in 2013). The Group has established collaborations with: University of Leicester and University of Nottingham's Veterinary Science facility for its exercise physiology projects – a team of experts in sports medicine, interactive soft/hardware, diabetes, physiology and pharmacology; GEA Pharma Systems, AstraZeneca and Ametek for the development of LyoDEA, a new process analytical technology for freeze-drying of pharmaceuticals. Regional Development Funding (£350k) was secured to develop a terahertz imagining and spectroscopy centre, that led to engagement with over 30 regional businesses. The Group has organised several one-day events (workshops, seminars and demonstrations) within the census period to showcase their research and to promote collaborative research with industry. Partner universities include: Cranfield (Nanoscience), Loughborough University (Chemical Engineering), Massey University, NZ (Chemical Engineering), and Schools of Pharmacy in the Universities of Bradford, Reading, Nottingham and Aston.
The **NMRC** has a longstanding and fruitful relationship with NHS Trusts (University Hospitals of Leicester NHS Trust, Leicester Partnership Trust and the Birmingham Women's Hospital), East Midlands HealthCare Workforce Deanery and other health and social care organisations, such as Leicester City Council, which have resulted in improvements in patient safety, women's health, mental health provision and doctor-patient communication in cancer care. Collaboration with the Leicestershire and Rutland Hospice (LOROS) has resulted in the establishment (in 2012) of the Centre for the Promotion of Excellence in Palliative Care to support research into specialist palliative care practice. Researchers in reproductive health, sight loss, palliative care and breast feeding have well established working relationships with the Universities of Warwick, Leicester, Northampton, Sheffield, Swansea, Edinburgh, Huddersfield, Middlesex and Birmingham City, undertaking numerous funded projects together. Engagement with user Groups, professional organisations and third sector organisations are valued and encouraged. Researchers in reproductive health, patient safety, sight loss and service user and carer research have worked with key Groups and organisations, including: the Patients Association; Infertility Network UK;

British Infertility Counselling Association; National Gamete Donation Trust; the Royal National Institute for the Blind; and the Leicester Service User and Carers Research Audit Network.

Contribution to the discipline or research base:
During the census period staff have contributed to international journals: as members of editorial boards (e.g. *Journal of Clinical Nursing, Nurse Researcher, Molecular Membrane Biology, Bio-Medical Material & Engineering, Ethnicity & Health, Journal of Applied Microbiology, International Journal of Applied Chemistry, International Journal of Biomedical Sciences*); as associated editors (e.g. *Phytotherapy Research, Phytochemical Analysis, Journal of Research in Nursing, Diversity in Health & Care, Applied Organometallic Chemistry, Journal of Biological Education, Journal of Perioperative Practice*); and as editors-in-chief (e.g. *Biomedical Spectroscopy and Imaging, Diversity in Health & Care, International Journal of Medical and Clinical Research*) in addition to regularly serving as peer reviewers for a wide range of international journals.

Honours and awards received by staff over the period of assessment include the House of Commons award for research excellence in Hospital Acquired Infections (2008) and Royal Society for Chemistry Analytical Methods Prize (2010) and the British Pharmaceutical Conference Science Poster Prize (2009). Our staff have also been elected as Fellows to a range of national and international societies, including: Royal Society of Chemistry; Society of Biology; British Pharmacological Society; Institute of Biomedical Sciences; Royal College of Physicians and Surgeons of Glasgow; Royal Geographical Society; and the Linnaean Society.
During the census period, staff have regularly participated in peer-review of grant application to prestigious funding bodies, including: research councils (BBSRC, EPSRC, ESRC, MRC); the NIHR (RfPH, HTD, SDO, HSR programmes); major charitable organisations (e.g. Cancer Research UK, Wellcome Trust, Arthritis Research Campaign); EU-FP7 (as members/chairs of Expert Evaluation Panels); Scottish Health Research; British Council; and the Netherlands Organisation for Health Research and Development. Staff associated with this UoA also serve as **consultants** to international companies, such as GSK (Malaria Advisory Panel), Piramal Life Sciences Ltd (Scientific Advisory Board) and BTG Protherics UK Ltd. Our staff also serve as **advisors** for the Department of Health (e.g. Organ Donation Taskforce), the American College of Physicians (Surgical Site Infections), Human Fertilisation and Embryology Authority, National Gamete Donation Trust, Nuffield Foundation (bio-ethics working party) and Afiya trust (as trustee).

Memberships of **external committees/boards** include: the British Pharmacopeia and European Pharmacopeia committees on Herbal Medicines; NIHR RfPH Programme Grant Review Panel East Midlands; NIHR regional Comprehensive Local Research Network (CLRN); Advisory Committee of Malaria Chemoprophylaxis; Specialist Library for Ethnicity and Health Advisory Board; trustee for HOPE Charity (funder of research); Infection Prevention Society; National Institute for Clinical Excellence (NICE); Society for Applied Microbiology; and UK Particle Characterisation.

In addition to primary research outputs, staff are regularly **invited to submit journal review articles and book chapters** on their areas of expertise, e.g. Biomethylation of Arsenic, Antimony and Arsenic (Wiley, 2011); Infrared Spectroscopy of Protein Structure (Encyclopedia of Biophysics, Springer, 2013); Analysis of Organometallic Compounds in Environment and Biological Samples (Royal Society of Chemistry, 2010); Fluoroacetate (Elsevier, 2009); Surgical Site Infection Surveillance (Journal of Hospital Infection, 2013).