


Institution: Queen's University Belfast
Unit of Assessment: 3
<p>1. Unit context and structure, research and impact strategy</p> <p>Overview</p> <p>Research carried out in Queen's UoA3 lies within the Faculty of Medicine, Health and Life Sciences (the 'Faculty'). Since the last REF period, there has been substantial reorganisation in both the University and Faculty. This has provided this Unit with opportunities for enhanced discipline-specific and interdisciplinary research in delivering health innovation, a marked growth in quality research funding, increased staffing and significant investment in infrastructure.</p> <p>Unit highlights since REF 2014 are:</p> <ul style="list-style-type: none"> • £198.9M in research grants awarded in the assessment period leading to £175.1M in spend • An increase in Unit staffing from 125.63 FTE in REF 2014 to 149.36 FTE in REF 2021 • A significant growth in the number of doctoral degrees awarded from 141 in REF 2014 to 428 in REF 2021 • Notable investment in estate and infrastructure, including £32M for the new Wellcome-Wolfson Institute for Experimental Medicine • The establishment of two Pioneer Research Programmes to drive and enhance interdisciplinary research • The launch of a Postdoctoral Development Centre to support and offer career development opportunities for early-career researchers • Success in Athena SWAN awards including a new Gold award and renewal of two Silver Awards <p>Overall structure: Faculty reorganisation has led to the replacement of the Faculty Dean with a Faculty Pro-Vice Chancellor, supported by four Deans with distinct portfolios (Research, Education, Innovation and Impact, and Internationalisation) and associated budgetary responsibility devolved from central University to aid agility and more localised decision-making. This restructuring has seen more strategic integration and development of the research portfolio across the Faculty and this UoA3 return now comprises researchers from the School of Pharmacy, School of Nursing & Midwifery and two dedicated research centres from the School of Medicine, Dentistry and Biomedical Sciences (SMDBS): the Wellcome-Wolfson Institute for Experimental Medicine (WWIEM) and the Patrick G. Johnston Centre for Cancer Research (PGJCCR, previously CCRCB). The WWIEM is a new Centre, created in 2016, merging the previous Centre for Infection and Immunity and the Centre for Vision and Vascular Science.</p> <p>Research Focus: While each of the UoA3 Schools and Centres have distinct research themes, research is interdisciplinary with an overarching focus on innovation for health and healthcare. As illustrated in Figure 1, we are motivated to deliver innovative discovery and translational science research, alongside insightful health services research, leading to real-world improvements in health and healthcare. Our research integrates the full translational and innovation spectrum, spanning from fundamental discovery science, leveraging molecular/cellular/human models, to co-design and evaluation of health and healthcare solutions with end-users and developing innovative solutions and therapeutics to benefit industry and healthcare</p> <div style="text-align: center;">  </div>
Figure 1: Research focus in UoA3 Schools and Centres

Research Plans/Objectives following REF2014 and Unit's Research Strategy to deliver the plans: The distinct strategies/plans for UoA3 Schools/Centres over the assessment period are summarised below. Health innovation and generating impact have been central to all strategies.

School of Pharmacy: Research has focused on meeting global health challenges, notably HIV/AIDS, antimicrobial resistance, applying pharmaceutical sciences to intractable diseases (notably cancer and infection), and improving health and wellbeing in vulnerable and ageing populations. Specific research themes in the School are: Nanomedicine and Biotherapeutics, Pharmaceutical Materials Science and Formulation, Drug Delivery and Biomaterials, Infection and Antimicrobial Resistance, and Healthcare Delivery and Medicines Optimisation.

School of Nursing and Midwifery: The research focus is on enhancing health across the lifespan, through co-design and evaluation of health and healthcare solutions with patients and carers. Maternal and Child Health concentrates on early interventions in sexual and reproductive health, improving maternity care and the quality of life for children with complex needs. The Chronic Illness and Palliative Care group delivers innovative solutions to manage conditions including cancer, renal, and cardio-vascular conditions. There is a strong overarching focus on enhancing supportive decision-making for all at the beginning and end of life.

WWIEM: With a focus on dissecting the molecular basis of disease integrating different biological scales (from cells to tissue to human body) to develop new therapeutics, research spans three areas: (1) Immunobiology and Microbes focusing on molecular and cellular interactions underpinning the interactions between antibiotic resistant bacteria and the immune system, and inflammatory immune disease (multiple sclerosis); (2) Vision and Vascular Medicine targeting diabetic retinopathy and age-related macular degeneration (AMD); (3) Respiratory Medicine focusing on asthma, chronic obstructive pulmonary disease (COPD), cystic fibrosis (CF), and acute respiratory distress syndrome, with programmes in investigator-led pre-clinical development and clinical trials (Phases I-III). WWIEM programmes are supported by a set of technical units devoted to single cell analysis, and a portfolio of translational research models (human ex vivo lung, iPSC cells, 3D organoids, ex vivo blood vessels).

PGJCCR: The strategy has focused on translational cancer research, using clinical data to inform research hypotheses that can be interrogated using appropriate model systems, and developing new advances that can positively impact patient outcomes. Tumour site specialisms include prostate, breast/ovarian, colorectal and blood cancers, underpinned by disciplinary strengths in three core research areas: (1) therapy resistance, (2) tumour microenvironment biology and (3) DNA damage signalling. This research is supported by technology strengths in molecular and digital pathology, radiation biology and advanced bioinformatics.

While each of the Schools/Centres implemented these individual plans since REF2014, common overarching goals supported by the Faculty also drove development and progress across the Unit's research portfolio:

1. Greater excellence in research and research translation to improve health and society, through interdisciplinary and intersectoral working. Specifically, we planned to increase:

- UKRI, NIHR, Wellcome Trust and other high-quality funding
- Research partnerships with Industry and Health and Social Care Trusts leading to increased translation of research into practice
- Interdisciplinary research, and
- International collaborations.

2. Developing people and environment. Specifically, we planned to:

- Develop the career opportunities of our post-doctoral community and the large cohort of early career researchers
- Recruit outstanding academic staff at all levels to integrate with existing groups and lead on new areas of investigation
- Invest in research facilities and investigator support mechanisms.

The approach to achieving these goals was through an overarching University strategy, **Vision 2020**, driving the development of globally competitive interdisciplinary research. Highlights of how Vision 2020 was realised in the context of this UoA and relating to our targets set from REF2014 are summarised below.

Greater excellence in research

UKRI, NIHR and other high-quality funding- Specifically, there has been an increase in:

- New research grants of **£198.9M** awarded since REF 2014 compared to **£75.8M** in the previous assessment period, leading to income (spend) of **£175.1M**

Notable achievements include:

- A marked increase in research awards from UKRI: £12.6M in REF 2014 to £35.7M in this period
- A significant increase in NIHR funding from £1.4M to £13.4M
- UK charity funding has increased from £32.1M to £58.6M
- Success with all EU funding sources: £5.0M in REF 2014 compared to £29.2M in this period
- Industry funding has trebled from £3.8M to £9.9M.

Research partnerships with Industry and Health and Social Care Trusts leading to increased translation of research into practice

- Thirteen Knowledge Transfer Partnerships worth £2.8m established nationally and locally with pharma and healthcare companies (£1.6M grant funding from Innovate UK and £1.2M company contributions)
- Sixty new research studies in partnership with healthcare trusts (nine awards funded by Trusts and 51 with Trusts as a partner)
- Research has led to 245 disclosures, 93 patents granted, 72 licences (69 non-software and 3 software related) and nine spin-out/in companies: ProAxis, Re-Vana Therapeutics, Continga, pHion Therapeutics, CV6 Therapeutics (NI), VascVersa, Univ8 Genomics, ReproGo, and GenoMe Diagnostics.

Interdisciplinary research

As part of Vision 2020, and after a competitive review process, the University established Pioneer Research Programmes (PRPs) to enhance interdisciplinary research. This Unit successfully competed for support to establish two interdisciplinary PRPs in areas of major societal challenge with a strong impact focus: **The Centre for Evidence and Social Innovation Research and Impact (CESI)**, formed in 2016, co-led by the School of Nursing and Midwifery with the School of Social Sciences, Education and Social Work collaborating with the School of Psychology, the Centre for Public Health, the School of Natural and Built Environment, and Queen's Management School; **The Materials and Advanced Technologies for Healthcare (MATCH) PRP**, led by the School of Pharmacy, collaborating with the Schools of Chemistry and Chemical Engineering, Mechanical and Aerospace Engineering, Biological Sciences, WWIEM, and Nursing and Midwifery. Since their formation, these PRPs have been particularly successful in forging new successful interdisciplinary partnerships, attracting research funding and supporting ECRs as described under **The Unit's Approach to Interdisciplinary Research**.

International collaborations

Internationalisation of our research is evidenced by sources of our grant income from international funding agencies and charities such as NIH, Horizon 2020, with significant contribution from international co-investigators on grants and co-authors on outputs. These collaborations are described in Section 4. Since REF 2014, PGJCCR began two international doctoral training programmes (DTP) in conjunction with international partner institutions, the US National Cancer Institute (NCI), and Princess Margaret Cancer Centre (PMCC) in Toronto. WWIEM led one international training programme for early-career scientists supported by the EU Commission

(INBIONET, £3M; Marie Skłodowska-Curie Actions), and has been a partner in another two (BactiVax and OcuTher). The University, in conjunction with China Medical University in Shenyang, China, has established the China Medical University–Queen’s University Belfast Joint College (CQC) which provides undergraduate programmes in Pharmaceutical Sciences and Pharmaceutical Biotechnology, degrees developed by the School of Pharmacy. This initiative has led to a steady pipeline of CQC graduates to undertake Queen’s postgraduate programmes, primarily doctoral degrees. A more recent collaboration with the Mohammed bin Rashid University of Medicine in Dubai is now leading to promising research links in data science, child health and infectious diseases.

Developing people and environment

Developing career opportunities for post-doctoral staff and ECRs: An institutional £4M investment in a Queen’s Fellowship Academy has been established to provide professional and career development for research fellows recruited through a number of University Fellowship initiatives or staff holding specified externally funded Fellowships. Applicants will be in the early-stage of their careers with research interests that align with current research strengths at Queen’s, and given comprehensive support over the course of the fellowship as described in Section 2.

A £263K investment has been made in a dedicated Faculty Postdoctoral Development Centre (pioneered by WWIEM) to support training and development of all post-doctoral fellows. This has been largely driven by an increase in post-doctoral researchers from ~**100 in REF 2014 to 170 by REF 2021**, and recognising the need to provide more support and guidance to this cadre of researchers.

Recruit outstanding academic staff: There has been growth in Category A academic staff from **125.63 FTE** in REF 2014, to **149.16 FTE** for the current census period. In Pharmacy, one Professor, two Readers and one Senior Lecturer were appointed in this time period, together with six Lecturers. In Nursing and Midwifery, four Professors, one Reader and two Lecturers were appointed. In PGJCCR there have been three University Fellows, one CRUK Career Development Fellow, and 18 academic appointments including one Professor, two Readers and three Senior Lecturers recruited externally. In WWIEM, one Reader, two Senior Lecturers and eight Lecturers were recruited over the period, as well as four University Fellows, three Wellcome Trust Fellows, one Marie Curie Research Fellow, and one RD Lawrence Diabetes UK fellow. Further details are provided in Section 2.

Invest in research facilities and investigator support mechanisms: Infrastructure development has included £32M investment to develop and equip the WWIEM building, and ca. £3.5M, in the development of strategic interdisciplinary research initiatives such as the **CESI** (Nursing and Midwifery) and **MATCH** (Pharmacy) PRPs. The School of Pharmacy underwent a major internal refurbishment in laboratories, along with equipment investment, costing £3.6M. Other significant developments over the assessment period have been the investment (£4M) in the new Wellcome Trust-Wolfson Foundation Northern Ireland Clinical Research Facility (NICRF), the £2.7M QUB Cellular Therapy Facility and The Precision Medicine Centre (£10M). These are described further in Section 3.

Investigators are supported through the availability of postgraduate studentships and the provision of a bench fee initiative to attract high quality international research students. Schools/Centres support conference travel, alongside institutional support to develop new collaborations for major grant initiatives e.g. UKRI, Horizon 2020. There is a Faculty Peer Review College for research applications, and the Vice-Chancellor’s Research Prize with seven categories, each aiming to recognise and reward individuals or groupings of researchers, and research support staff, at various stages of career, who demonstrate exceptional leadership in the areas of research, engagement and impact. Nine members of this Unit have been awarded such prizes. Our commitment to the Athena SWAN Charter is translated into support for researchers, with an

emphasis on equality and diversity; this commitment has been recognised through SWAN awards across the Unit's Schools/Centres (see Section 2).

The Unit's Approach to Impact

Inextricably linked to the Unit's research is its approach to impact. The latter has been embedded in our strategies and the Unit provides a range of support mechanisms:

Institutional support investment in the University's Research and Enterprise Directorate, has provided a new dedicated research engagement hub to support public involvement and the values of partnership and collaboration in Queen's research <https://www.qub.ac.uk/Research/Our-research/Engaged-Research/>. There has been increased investment in business, Intellectual Property and contractual expertise to support entrepreneurial activity, out-licensing and the formation of global research consortia. The Unit has also received investment from an Institutional ESRC Impact Acceleration Award of £1.05m, which has been used to develop impact locally and globally, and is not limited to ESRC funded studies.

Involving Patient and Service User-Groups as part of our Unit's research and education committees has ensured our research is grounded in the reality of clinical conditions and their debilitating effects on individual patients. The Unit has pioneered the interaction with patient groups as an integral part of the research design. These collaborations comprise annual events and Patient and Public Involvement (PPI) meetings for specific projects and new research programmes. The Unit benefits from a close partnership with Northern Ireland Health and Social Care services. For example, the impact case study (ICS) ***Transforming supportive cancer care for patients and families*** (ICS 219628916) grew from a process of engagement with stakeholders, including all five Health and Social Care Trusts (HSCT) in Northern Ireland, Macmillan Cancer Care, Northern Ireland Cancer Network (NICAN), and the Northern Ireland Cancer Consumer Forum resulting in service development solutions in relation to identified needs for cancer care. This led to a redesign of follow-up care for cancer patients in Northern Ireland, and the co-design with a carers' advisory group of *Cancer Caring Coping*, an online intervention to support carers which is integrated into the health services of all five healthcare trusts in Northern Ireland. Other examples include the *Night with the researchers*, co-sponsored by the British Heart Foundation to raise awareness of cardiovascular disease in Northern Ireland, and the annual All-Ireland Ophthalmology day co-led by patient groups with diabetic retinopathy.

Entrepreneurial and Industrial partnerships. Impact through commercialisation has been at the forefront of activities within this UoA, representing one of the most important areas for QUB in attaining recognition as the top spin-out institution in the UK in 2020 (<https://www.thetimes.co.uk/article/queen-s-reigns-supreme-in-universities-league-table-8fnm19b2m>). Well-established spin-out companies such as Fusion Antibodies Plc. have now been listed on the London AIM stockmarket and PathXL was acquired by Phillips NV (and subsequently Cirdan in 2020). Several new spinout companies have been formed, including pHion Therapeutics, Re-Vana Therapeutics, VascVersa, ReproGo and Sonrai Analytics, as well as spin-in company CV6 Therapeutics which has relocated from the USA. In addition to entrepreneurial activity, strong collaborations with various researchers are in place with large companies such as Teva, Randox and the Almac Group. Indeed, Almac Discovery occupies space in the PGJCCR facilities with two joint appointments (Harrison and Kennedy) to facilitate and develop new strategic projects in drug discovery and precision medicine. The School of Nursing and Midwifery has developed collaborative research with NI companies Leckey and Neurovalens in rehabilitation innovations for children with disabilities. Ongoing collaboration with Randox and WWIEM is delivering diagnostics at the point of care funded by Innovate UK's Precision Medicine Technologies project (£1.6M), in addition to Randox-supported projects on near-patient testing in Pharmacy.

Future Strategy

The future strategic plan for the Unit is to increase research capacity, research excellence and research relevance to improve health and healthcare. As highlighted in the University's

Institutional Environment statement (Section 2c), QUB is a key partner in the **Belfast Region City Deal**, (<https://www.brcd-innovation.co.uk/>), a £1 billion investment bringing regional government, industry and universities together to develop Northern Ireland's economy and society. Included within this investment are the Research Innovation projects, including the Global Innovation Institute (GII; data security, informatics, analytics), the Institute for Research Excellence in Advanced Clinical Healthcare (iREACH) and the Advanced Manufacturing Innovation Centre (AMIC), all of which will present significant opportunities for this Unit. In addition, we will continue to build on the core research domains as articulated in the individual Schools/Centres strategies below, while strengthening our interdisciplinarity and collaborative links within and outwith the Unit:

School of Pharmacy: The future Research Strategy of the School of Pharmacy will be driven by our current research strengths and dynamic responsiveness to developing global health challenges and will map to the ongoing priorities of major national and international funders. The School will further develop its focus on pharmaceutical global health and healthcare delivery, patient care and translational medicine, healthcare technologies and biomedical engineering, with a focus on drug delivery and biomaterials, nanotherapeutics, infection and antimicrobial resistance and vulnerable populations, and consolidation of the **MATCH PRP**. These activities will be driven by opportunities provided by the Belfast Region City Deal, particularly within AMIC and iREACH, which will enable a step change in activities leading to optimal use of medicines.

School of Nursing and Midwifery: The future Research Strategy will advance its central focus on driving transformational improvements in health and healthcare both nationally and internationally. We will build upon research strengths in Maternal and Child Health and Chronic Illness and Palliative Care focussing on under-served populations and the inclusion of carers within communities of care. Building on the intentionally interdisciplinary staff base within our School and Unit, we will have an increased focus on leading transdisciplinary health innovations. Our research will continue to deliver evidence-informed innovations and clinical guidelines with international policy partners, notably the World Health Organization and European Society of Cardiology as well as with local practice partners, such as the Health Trusts and charities such as Marie Curie Hospice Care.

WWIEM: We will continue our focus to find new ways to treat vascular complications of diabetes (retinopathy), lung inflammatory diseases, and to tackle the threat of antimicrobial-resistant infections. The key pillars of our new research strategy are to focus on grand challenges common across the diseases of interest, using an experimental medicine approach. These are the molecular forces governing tissue homeostasis and regeneration, how resilience to disease develops and breaks down, and the molecular basis of natural protection. Therefore, humans, and where appropriate, translational models of research, will become the ultimate experimental subject in all our research programmes. We envision that this approach will dramatically accelerate the translation of discoveries into health delivery by overcoming current limitations due to the use of models far removed from humans.

PGJCCR: The PGJCCR will continue to use its unique strengths in digital health, molecular pathology and advanced radiotherapy to underpin the development of clinically-informed research hypotheses that will define our discovery programmes in the areas of therapy resistance, DNA damage signalling, tumour microenvironment and early detection, feeding back to the clinical setting to enhance outcomes for cancer patients. This will build on our partnerships with regional and international pharma, while extending our track record in spinout creation to drive the development of impact from our research. A critical and potentially transformative development will be integration of our clinical trials and discovery pipelines within the new iREACH facility planned to become operational in 2025.

The Unit's Approach to Interdisciplinary Research

The focus of our research on developing **innovation for health and healthcare** and the intentional interdisciplinary staffing of each School and Centre means that the research which happens within as well as between our Schools/Centres is naturally interdisciplinary.

There are multiple examples of such research projects which progressively grew across our Unit, driven by the synergy of our staff's expertise including:

- The EU IMI-funded inhaled antibiotics in bronchiectasis and cystic fibrosis (iABC) programme, involving WWIEM, Pharmacy, the Belfast and Health and Social Care Trust and 17 other academic and industrial partners from across Europe, is developing new inhaled antibiotic treatments for patients with these conditions and investigating novel methods to improve clinical trials of treatment.
- The FASTMAN Movember Centre of Excellence (together with University of Manchester, funded in 2014 and renewed in 2019) is one of two national Movember centres and brings together physicists, molecular biologists, geneticists and clinicians to rapidly translate precision medicine approaches for prostate cancer.
- The EU-funded BREATH (Border & Regions Airways Training Hub) Project which involves Pharmacy, WWIEM, academic and industry partners is increasing our understanding of chronic obstructive pulmonary disease (COPD) across the themes of epithelial, neuronal and smooth muscle cell biology and physiology, as well as inflammation to identify new targets for intervention and novel biomarkers to enable earlier diagnosis and management of the disease.
- 'The Passion HF' study (led by Nursing and Midwifery and involving WWIEM and Belfast and Health and Social Care Trust and funded by an EU Interreg project) is developing personalised digital technologies for patients living with chronic heart failure to self-manage their day-to-day care
- Development of new enhanced therapeutic delivery approaches for cytotoxics and antibiotics to cancer and infectious diseases respectively funded through NIH, MRC, EPSRC
- An EPSRC-funded programme between Pharmacy, WWIEM and Chemical Engineering to bridge the gap between the Engineering and Physical Sciences and Biomedical disciplines to tackle antimicrobial resistance. The programme has focused on developing new materials to prevent bacterial colonization, design new systems for antibiotic delivery systems, and establish new therapeutics based on boosting the immune system.

The **CESI** and **MATCH PRPs** led from this Unit have reinforced the approach to interdisciplinary research. MATCH members from across the Unit and beyond the Faculty have been awarded high quality research funding to support work in antibiotic resistance, 3D bioprinting (Wellcome grants), and the use of microneedle arrays in plasmonic photothermal therapy of basal cell carcinoma (EPSRC). CESI has over 100 fellows from all University Faculties and has been awarded significant funding on early child development (NIHR, Nuffield Trust; MRC GCRF) and hosts the national (UK and Ireland) centre of the international Campbell Collaboration for Evidence Synthesis.

The Unit's Approach to Open Research Environment/Culture of research integrity

This Unit embraces QUB's general commitment to supporting open access (OA) and we are committed to ensuring timely and accurate OA to publicly funded research and supporting public funder mandates for OA to research.

From November 2015, QUB has used Pure to ensure that we adhere to open access policies of HEFCE and funding agencies in accordance with policy highlighted in this link: <https://libguides.qub.ac.uk/openaccess>). The University also supports payment of OA fees for a number of journals, including those from the BioMed Centre suite of publications. To complement the University OA system for pre-published versions of publications, Unit Schools/Centres have paid for open access fees for selected publications.

We are committed to ensuring that our researchers adhere to the University's Code of Conduct and Integrity in Research (<https://www.qub.ac.uk/home/media/Media,598962,en.pdf>). Since August 2019 the University's Research Governance, Ethics and Integrity Committee has been a formal part of the University's governance structures. It is responsible for the development and

implementation of policies, procedures and training to support researchers and provides oversight through regular audits and review of reports. We fully adhere to the Concordat to Support Research Integrity as developed by Universities UK (UUK) since 2012, in collaboration with the Higher Funding Council for England (HEFCE), UK Research and Innovation (UKRI) and the Wellcome Trust. The University endorses the Russell Group's Statement of Cooperation in respect of cross-institutional research misconduct allegations.

As part of the University's Research and Enterprise Directorate, the Research Governance, Ethics and Integrity unit provides advice and support on all aspects of research governance and ethical approval. It has developed its Policy and Principles on the Ethical Approval of Research focussing on the protection of the rights, dignity, health, safety, well-being and privacy of research participants, the welfare of animals and the protection of the environment. All staff and research students working within or on behalf of the University are expected to adhere to the Policy. For research not requiring NHS Research Ethics approval, the Faculty Research Ethics Committee will review all relevant applications and provide Full or Proportionate review, and a number of Unit staff are members of this Committee.

2. People

Staffing strategy and staff development

As part of Vision 2020, the University has supported a sustained recruitment drive across all categories of staff. Recruitment was guided by a Faculty goal of securing high calibre research and education appointments to support collaborative innovations in health and healthcare.

Overall, there has been a 19% increase in staff numbers across the Unit over the assessment period. Table 1 summarises the growth within each School and Centre over the assessment period, based on FTE figures, with recruitment figures pertaining to the range of academic staff in terms of seniority reported in Section 1.

Table 1: Growth in Academic Staff since REF 2014

	N&M*	Pharmacy	WWIEM	PJCCR	Total
<u>REF 2014</u> Staff numbers (FTE)	19.03	33	44.6	29	125.63
<u>REF 2021</u> Staff numbers (FTE)	23.21	39	47.75	39.20	149.16
Growth in Staff numbers (FTE) over assessment period	4.18	6	13.35		23.53

*Nursing and Midwifery

Particular focus was placed on generating a vibrant supportive structure to promote future success for ECR staff. Since the last REF, Queen's invested £4M in a major early career fellowship programme (The Illuminate Vice-Chancellor and Patrick Johnston fellowships) establishing the **Queen's Fellowship Academy**. Our Unit has been awarded six fellowships. Each successful appointee was provided with a minimum of £20,000 in start-up funding, a PhD studentship, protected research time and mentorship to a permanent academic position. The programme has attracted successful candidates such as Hopley, Plouffe, Jafarnejad, Beli, Atlasi and Malinova from leading research institutes such as McGill University (Canada), Indiana University (USA) and The Francis Crick Institute as well as enhanced career pathways for research fellows already at Queen's. These fellows, alongside equivalent externally-funded fellows (Cancer Research UK, the Academy of Medical Sciences and Wellcome Trust Institutional Strategic Support Fund), are mentored through the Academy. It provides a comprehensive and bespoke development scheme, including access to a Fellows' Network, Mentorship Programme and a range of professional

training and development opportunities, underpinned by central university funding (totalling £130,000). These supportive structures enabled two early career fellows to be awarded UKRI **Future Leaders Fellowships** and enabled all early-career fellows to be part of our Unit's REF return. Our coaching has also helped secure seven Academy of Medical Sciences Springboard awards for Queen's ECRs over this REF period.

The current staff cohort, supported by some 170 postdoctoral researchers, provides for long-term stability and succession planning, with staff well-distributed across all grades of academic staff.

Career Development of all Staff

Driven by the goal of listening to and supporting our staff, two staff surveys undertaken in 2016 and 2019 have led to the development of three main pillars of support in this Unit: (1) Personal Development Review; (2) Training and development opportunities and (3) Mentorship.

Personal Development Review (PDR) is a continuous process over the academic year, offered to all staff to facilitate critical self-reflection on performance and to plan for academic progression/promotion. PDR offers greater agency and flexibility to staff to outline their own ambitions for education, research and citizenship (contribution to university and wider society).

Training and development opportunities are wide and varied, ranging from School-based (e.g. core skills training, seminar programmes) through to a selection of courses appropriate to development of multidisciplinary research skills offered by the University Learning and Development team. Since 2014, Queen's has also invested in developing high-level leadership skills, with **10 staff** from across the Unit completing a 10-day *Leadership and Management Excellence Programme*; all of these staff have taken on higher leadership roles in research or education. In April 2019, also in response to the staff survey, the University launched a *Connected Leaders Programme*, a re-invigorated leadership programme provided by Queen's Clinton Leadership Institute. **Four staff** in the Unit are currently enrolled on this programme.

Mentorship opportunities were expanded during this REF period, offered to all ECRs on appointment and in agreement with the mentee for a period of three years to optimise opportunities for development. An Athena SWAN-inspired mentoring scheme was launched in September 2018 to extend voluntary mentoring opportunities to all staff categories (academic and academic-related), regardless of length in post. Senior staff across the key constituencies act as mentors. The scheme has significantly increased staff engagement and enhanced progression readiness. Further bespoke mentorship opportunities aimed at enhancing equality of opportunity in academia are central to our Equality and Diversity policies as outlined later in this section.

Developing early career researchers (ECRs): Across our Unit, ECRs are assigned lower initial teaching loads and minimal administrative duties to allow them to develop independent research programmes. In addition, newly appointed lecturers are provided with a minimum of £10k 'start-up' career development award. An individually agreed, three-year structured development programme forms an integral part of the academic probation process, monitored by a support group of senior staff and informal mentor. Schools and Centres within the Unit also have a 'pump-priming' policy of funding a studentship for each new staff member and provide enhanced funds for conference attendance. A key aspect of support for new staff on their first academic appointment is the **Faculty Collaboration Seed Fund** (based on a scheme initially established in the School of Pharmacy) designed to help ECRs establish new research links with world-leading programmes related to their research discipline. Funding, up to a maximum of £5K, is available for research visits of 1-3 months in duration. Within the current REF period, **28 ECRs** have been supported to work in leading institutions abroad (e.g USA, Australia, Singapore) to establish productive new research collaborations. This policy has been highly successful, with maturing research collaborations, reciprocal visits and joint outputs published.

Post-doctoral research fellows (PDRFs): This group of staff is also allocated protected time (10 days per annum) to enhance their career development. Our colleagues are encouraged to use

Unit-level environment template (REF5b)

this time to attend training externally or internally or engage in activities not part of their normal work, e.g. committee involvement, or publishing from other studies.

PDRF staff also benefit from support from the Faculty's **Post-Doctoral Development Centre (PDC)** (<https://www.qub.ac.uk/about/Leadership-and-structure/Faculties-and-Schools/Medicine-Health-and-Life-Sciences/PDC/>). This model, begun in 2016 as an individual Institute initiative at the WWIEM focusing on supporting their large postdoctoral cohort, was adopted and expanded to the Faculty in 2018. The aims, as highlighted in Figure 2, flow from the key words of *Welcoming, Training, Supporting, Informing* and *Recognising*.

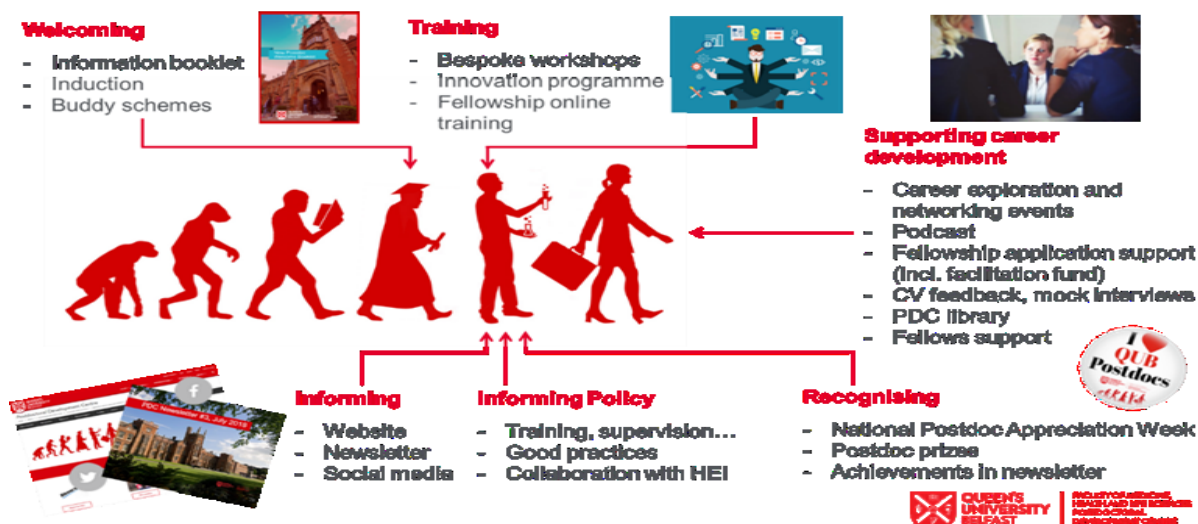


Figure 2: An overview of the activities of the Post-Doctoral Development Centre

PDC activities are part of a concerted effort by Queen's to offer outstanding support to its researchers through a **Concordat** to support the career development of researchers' action plans, resulting in the University's HR Excellence in Research award being renewed in 2020. It has led to tangible improvements for PDRFs such as enhanced training opportunities, formal recognition of contribution to PhD students' supervision; guidelines to improve access to teaching opportunities for PDRFs; and inspiring best practices in the sector. For example, in 2018, Queen's was the only UK university celebrating National Postdoc Appreciation Week, but the PDC's communications around this inspired other universities in London, Oxford, Manchester, Sheffield, and Dublin to organise events in 2019. The approaches to staff development and support have also led to **staff promotions for one third of our Unit's staff** since REF 2014 as summarised in Table 2, and almost equally so for female and male colleagues (46% female, 54% male).

Table 2: Promotions by Grade 2014-2020

Promotions to:	Senior Lecturer	Reader	Professor	Total
School of Pharmacy	11	5	6	22
School of N&M	12	2	2	16
PGJCCR	3	6	2	11
WWEIM	5	4	7	16
Total	31	17	17	65

Finally, our Unit also contributes to the leadership of the University across a range of portfolios, again appointing an equal number of male and female colleagues to these positions. The School of Pharmacy currently provides the Pro-Vice-Chancellor for Education and Students (Jones), the Vice-Dean, China Queen's College (Andrews) and the Associate Dean, Graduate School (McCarthy). The current Head of the School of Pharmacy was the former Dean of

Internationalisation for the Faculty of Medicine, Health and Life Sciences (McCoy). The School of Nursing and Midwifery provides representation on University Senate (Fitzsimons). The WWIEM currently provides the Faculty Pro-Vice Chancellor (Elborn) and the Dean of Innovation and Impact (Stitt) in the Faculty of Medicine, Health and Life Sciences. The PGJCCR provides the Director of the Queen's Gender Initiative and Academic Lead for Athena SWAN (McCloskey) and Faculty Associate Pro Vice Chancellor (Lawler).

Research students

Studentship provision for postgraduate research is a critical driver in research development. Since 2014, the Unit has graduated **428 doctoral researchers** (compared to 141 in REF 2014), **a rate of 61 per annum**, a clear indication of the vitality of the Unit and its research activities. We currently have 425 registered doctoral students across the Unit. In addition to PhD programmes, we have developed MSc and MRes programmes in areas such as Industrial Pharmaceuticals, Pharmaceutical Analysis, and Experimental Medicine. These programmes provide research training and a pathway into PhD programmes for many students and are integral to our internationalisation and sustainability strategies of creating next generation thinkers and innovators with the transferable skillset to become future leaders. We recruit internationally and 32% of our current research students are non-EU (21% in REF 2014). Our students consistently highly rate their experience in the Unit Schools/Centres in the Postgraduate Research Experience Survey (PRES). In the most recent survey (2020), 92% of PGR respondents across the Unit strongly agreed/agreed (SA/A) that supervisors had the **skills and subject knowledge** to support their project; 92% SA/A that they received an appropriate level of **feedback** on their work. With respect to **environment and resources**: more than 80% SA/A on all categories (working space 86%; computing 81%; library facilities 89%; access to specialist equipment 86%). In relation to **professional development**: 92% SA/A that their **project management skills** had been enhanced; 86% had developed **better communication skills** and 86% had developed **research independence**; and 75% reported that their **professional network** had expanded.

Formal admissions and assessment procedures, allocation of supervisors and good supervisory practice are the responsibility of Postgraduate Research Committees (PGRC). They are chaired by the Director of Postgraduate Research in each School/Centre. PGRCs, responsible to the Head of School/Centre, operate within all quality assurance regulations. PGRCs are responsible for the annual review of student progress and the formal Continuous Action for Programme Enhancement (CAPE) Review of research degree programmes. Since REF 2014, a Faculty PGR group has been established which has ensured best practice across the Faculty. The creation of a new **Graduate School** (<https://www.qub.ac.uk/graduate-school/>) during the assessment period has enhanced the reputation of the University and is central to provision of postgraduate training and the development of a supportive and nurturing research culture for students across the University.

Funding and recruitment: PhD studentships in the Unit are funded from a range of sources including government (Department for the Economy NI Research Studentships and Co-operative Awards in Science and Technology [CAST] Studentships), Research Councils, Research Charities (e.g. Prostate Cancer UK, Breast Cancer Now, British Heart Foundation), European Union and Industry (Randox, TG Eakin Ltd). A number of students are also funded through fellowships such as the NI Health & Social Care Research & Development (HSC R&D) Doctoral Fellowship scheme. International students are supported through overseas government scholarships, with these increasing through international strategic partnerships. For example, the PGJCCR four-year DTP with the National Cancer Institute (US), established in 2016, provides a unique opportunity for PhD students from the UK and Ireland to perform their PhD studies with one of more than 300 potential mentors at NCI (1-year MSc QUB + 3-year PhD NCI model). With the PMCC in Toronto DTP, our clinical pathway PhD students can avail of its Drug Development Programme (2-year PMCC and 1-year QUB). The China Medical University-Queen's University Joint College (CQC), a long-standing partnership, has resulted in a number of graduates opting to come to Queen's to undertake postgraduate studies. In this REF cycle, the University has developed a strategic educational partnership with Mohammed bin Rashid University of Medicine and Health Sciences, with a key partner being the School of Nursing and Midwifery. The first cohort of PhD students from this collaboration is now enrolled at Queen's. WWIEM coordinated a

European training network –INBIONET- including seven academic institutions from Ireland, UK, Austria, France, Germany and Switzerland, an intensive research SME, Preclin Biosystems, a multinational pharmaceutical company, Sanofi-Aventis, and a technological park (ParcBit), This network is training the next generation of European scientists in the competitive field of “microbial anti-immunology” focusing on new preventatives and therapeutics. The success of the training and the excellent results were highlighted by the European Commission in a report translated to six languages (<https://tinyurl.com/y4aaxqqd>).

All funded PhD projects are advertised on the School/Centre websites, on the FindaPhD.com website and through social media channels. Our websites have been recently re-designed to thematically profile academics and their research areas and we have developed a search tool for prospective PGR students; web-pages link directly to the prospective supervisor, the Faculty Recruitment Hub, the Graduate School and the online application portal. We also recruit doctoral students from clinical professions, most of whom have been working in clinical practice since graduation. We provide bespoke supervision and training with joint clinical/non-clinical supervisory teams actively encouraged. Since 2014, we have hosted 61 such doctoral fellows. We have also developed flexible approaches to supervision to facilitate doctoral completion by members of academic staff, part-time clinically active students and students with caring responsibilities.

Internal University funding is used to support interdisciplinary capacity-building initiatives. For example, 14 PhD studentships were provided to support the **MATCH PRP**, with each studentship involving formal cross-School/Centre supervision. Other examples of PGR student supervision outside this Unit include: Physics (Cold plasma treatment of infection), Computer Science (Artificial intelligence algorithm development for predicting disease), Social Science (Suicide Reduction) and Architecture/Built Environment (Configuring the home to improve health in chronic diseases). The period has also seen a number of joint studentships (10 FTEs) in the area of ‘microbe/host interactions’ funded through a University DTP led by Pharmacy, WWIEM, and the School of Biological Sciences. This offers an opportunity for doctoral researchers to study within a multidisciplinary setting and undertake integrated training in the emerging field of microbiome-enabled machine learning analysis, and the well-established fields of microbe/host interactions, immunology and translational research involving cross-School supervision within and outwith the Faculty.

Supervision, support and training: The supervisory team normally comprises a principal supervisor, a secondary or co-supervisor, and when required, a third supervisor e.g to provide an interdisciplinary link or to facilitate international engagement. Where a lecturer on probation is appointed as a principal supervisor, the member of staff must have gained a doctoral degree and have at least three years’ experience since its award and should be employed on a contract that would cover the duration of the proposed research degree to be supervised. The second supervisor must be a senior academic with experience of successful doctoral supervision. Supervisors new to the role of supervision must attend a one-day training course, delivered by the Graduate School, which also provides updates and examples of best practice for existing supervisors. PDRAs who make a significant contribution to the training and development of the postgraduate student can be appointed to the role of Assistant Supervisor.

All research students must complete 30 days of skills training over the course of their 3-year research degree. High quality training programmes, compliant with UKRI recommendations, are provided centrally through the Graduate School which provides training designed to connect students across faculties to mentors, leaders and employers within the University and beyond. All Graduate School training events are bookable through the University’s MyFuture platform. Schools/Centres in the Unit also provide a number of specific compulsory courses for all postgraduates, including an Induction Session, Health and Safety Training, Laboratory Demonstrator Training and Library Orientation. PhD students can demonstrate in undergraduate laboratory classes, following appropriate training, and many have an opportunity to teach.

PhD students have formal monthly supervisory meetings to monitor progress against their agreed research plan and to discuss future research. Supervisors in the Unit operate an open-door policy

encouraging more frequent discussions. Minutes of formal meetings are recorded using the online Research Student Lifecycle (RSL). Progress is monitored formally at Annual Progress Review (APR). For each student, an APR Panel is appointed by the PGRC. First and second year students provide a written report on their progress to date, an updated research plan and details of postgraduate training undertaken. Second year students also deliver a presentation on their work, with third year students providing a sample thesis chapter. The Panel meets individually with all students to discuss their work and makes recommendations to the PGRC regarding progress, with supervisor input. On this basis, the PGRC decides if a student can proceed to the next level. There is an established Appeals process. Students receive written feedback from the Progress Review Panel once the progress recommendation has been approved by the School/Centre PGRC.

The Student Voice: Postgraduate Student-Staff Consultative Committees operate in each School/Centre. Meetings are organized once per semester and provide an opportunity for students to raise issues with staff in an open and supportive environment. PGR year group representatives are also encouraged to report any issues that arise to the Chair of the relevant PGRC on an ongoing basis. Students have an opportunity to provide feedback on their experience by completing the annual PRES. Results are analysed and reported to Schools/Centres and senior management committees, where they inform the development of new policies and the monitoring of existing ones. The Student Voice component of the annual CAPE review has highlighted areas to which Schools/Centres have responded in the assessment period. For example, 'scientific writing as an international student' was highlighted in 2018 as an area where further support was required. To address this, a teacher of English for Academic Purposes (EAP) was appointed in 2019 to run courses for students on scientific writing. As part of his role, he visits the Schools and Centres and provides drop-in sessions, for one-to-one meetings. WWIEM/PGJCCR have access to their own EAP teacher. Similarly, students highlighted in 2017 that additional career support and advice would be beneficial. The Unit recognised that medium-long term career planning is an important activity, introducing students to options outside conventional academic pathways. Therefore, a Careers' event has been run annually by Faculty for both PhD students and PDRAs.

Financial support for PhD research students: All postgraduate students funded by the Department for the Economy receive £800 per annum which may be used as a research resource. The Unit also supports students through School/Centre funding, for example, by providing each student with between £400 and £900 per annum to support conference attendance. International students, along with their supervisors, may competitively apply for 'bench fee support' for new-start PhD students.

Opportunities to present research: Students are actively encouraged to use their research stipends to travel and to present research at national/international conferences with additional support provided by supervisors, bequests and scholarships to support conference travel. There are a number of dedicated postgraduate conferences throughout the year, at University, Faculty and at School/Centre level. All Schools/Centres in the Unit facilitate and support the organisation of these events which take place annually. PGR students take responsibility for organising the programmes and meetings are well-supported by academic staff, facilitating engagement with presenters.

Enhancing Equality, Diversity and Inclusion

Queen's inclusive environment celebrates and values diversity. Our core values (Integrity, Connected, Ambition, Respect, Excellence) synergise quality and attainment. Queen's is a recognised leader in gender equality due to the Queen's Gender Initiative (QGI), founded in 2000 (Director, Prof Karen McCloskey, PGJCCR), an independent, female-focussed entity that champions women, and promotes participation and progression.

Our Unit's strength in gender equality is recognised through Athena SWAN awards (one Gold, two Silver); moreover, we lead Equality, Diversity and Inclusion (EDI) work across Queen's, including chair of Institutional Self-Assessment Team, co-leads for the QGI Academic and Professional

Services Mentoring Programmes, coordinators of the Women's Early Career Academic Network (WeCan) and QGI Executive Committee members.

Innovative strategies promoting gender equality across this Unit are:

1. **Sharing best practices and acting together** Through the establishment of a Faculty Athena SWAN group, comprising SWAN Champions, a co-ordinator and data analyst, this highly effective group shares best practice, delivers events/initiatives, challenges decision-making around allocation of research resources to be viewed through a gender lens and has prompted changes to promotion/probation criteria e.g. highlighting gender bias in teaching evaluations. The group stipulated prioritisation of gender/broader EDI principles for post-COVID lockdown return to laboratories (see Annex to the Institutional Environment Statement).
2. **Role models and promoting visibility of women** in our Unit over the last decade are combatting under-representation of senior female academics. The 'Women of the Faculty' portraits project, new public lectures named after former prominent women in the Unit, review/challenge of speaker lists, all identify role models. Importantly, there is significant new work around racial equity (see below).
3. **Family-friendly policies and flexible working** illustrate Queen's commitment to equal participation, recognising that our diverse community is composed of parents and carers, who need a healthy work/life balance. Our Unit actively encourages uptake of family-friendly policies including Flexible Working, Parental Leave, Dependant Leave and Career Breaks. Maternity, adoption, paternity and shared parental leave are significantly enhanced in Queen's compared to statutory provision. In alleviating family pressures during the COVID-19 pandemic, 10 additional days of dependant leave are available. Female academics returning from maternity/adoption leave have a teaching-free semester for re-establishing research. Core meeting hours (10am–4pm) apply across the Unit, enabling caring responsibilities. Staff avail of on-campus Childcare and the supplemented Summer Sports Scheme.
4. **Leadership and Mentorship Programmes** have actively addressed under-representation of female professors. The Schools of Nursing and Midwifery, and Pharmacy have been led by women; Prof. Carmel Hughes was the first female Head of School of Pharmacy. We consistently challenge barriers to progression and provide Academic Progression workshops. Our Unit participates in QGI's Academic Mentorship Programme where female academics are mentored by senior female academics from a different School; a Professional Services scheme supports academic-related women. Our Unit has enabled participation of ten early/mid-career women in the Aurora Leadership Programme. Participants are mentored via QGI Mentoring Programmes and peer-support groups. Further tailored career planning support in the Unit includes Workshadowing Programmes, offering individualized opportunities to gain insights and demystify career pathways, and bespoke events through WeCAN and Faculty SWAN group. The next generation of researchers is inspired through public Open Days, Summer Research Programmes and undergraduate taster Internships.
5. **Addressing the gender pay gap:** since REF 2014, our Unit and the University identified that the dominant gender pay gap was at professorial level. From 2014-2018, two actions halved the professorial gender pay gap from 14.5% to 8.6%: (1) review and recalibration of Academic Progression criteria to ensure the leadership domain fully recognised all responsibilities, including SWAN leadership; (2) refinement of the number of points in the professorial scale. Sustained improvements to Academic Progression further reduced the gap to 6.8% in 2020.

Queen's is a member of the Race Equality Charter (REC) and is establishing an institution-wide Racial Equity Working Group. Staff and students in our Unit have proactively challenged stereotypes and exclusion within curricula and we are challenging/addressing racism. The REC academic lead is from our Unit; moreover, our Unit is appointing six Racial Equity Champions to work in their Schools and across Queen's. Our Unit is diverse with local and international staff and students from many backgrounds; many are members of the University's staff group iRISE (Internationally focused, Racial diversity, Inclusivity for all, Social cohesion and Equality of opportunity) and several student societies. In Queen's, 12.3% of academics and researchers

identify as Black, Asian, Minority Ethnic, representing significantly higher diversity than the Northern Ireland population (2%, 2011 Census).

Our Unit promotes wellbeing, recognising that productivity and creativity align with balanced home-work life. Self-care and good mental health are supported through a suite of wellbeing and social events. The QGI COVID-19 lockdown survey (developed by a Steering Group has two academics from the Unit) identified reduced wellbeing due to the pandemic, and has delivered recommendations to the University Executive Board.

We monitor compliance of the Unit's staff in taking mandatory online EDI training programmes that address gender, race, ethnicity, sexuality, gender identity, religion and disability. Staff from our Unit co-delivered Unconscious/Implicit Bias Awareness training and are currently leading the introduction of 'Active Bystander' training to Queen's. Our Unit is supported by the University Diversity & Inclusion unit that has responsibility for developing policies, monitoring EDI issues, staff training and statutory compliance with Section 75 Northern Ireland Act 1998. In preparation of this Unit's submission, EDI was paramount, and we adhered to the University's Code of Practice, including the output selection process.

3. Income, infrastructure and facilities

As outlined in Section 1, there has been a significant increase in research awards to the Schools/Centres in the Unit, together with substantial development and investment in infrastructure and facilities to support our research and impact strategies over the assessment period. The sections below describe the income (awards) for the Schools/Centres in the submitting Unit, followed by a description of infrastructure and facilities.

Income for the Unit

Since REF 2014, our awards have increased markedly (160%) from a range of prestigious funders such as UKRI, Charities and EU sources and Industry, supporting a diverse portfolio of research, leading to important impact. Our awards reflect the breadth of research undertaken in the Unit, spanning discovery science to intervention implementation, leading to innovation in health through impact. This reflects the success of our strategies to increase awards from these funders and provides an excellent foundation for our future research plans.

Across the Unit, **awards** from funders during REF 2021 compared to those obtained in REF 2014 are summarised in Table 3, confirming the significant uplift in awards from all major funding sources.

Table 3: Total Awards to Schools/Centres in UoA3 in REF 2014 compared to REF 2021

Funder	Amount (£M) 2014	Amount (£M) 2021
RCUK/UKRI	12.6	35.7
UK Charity	32.1	58.6
UK Government and Health Authority (including NIHR)	18.6	50.0
UK Industry	3.8	9.9
EU sources	5.0	29.2
Other overseas	3.6	15.4
UK Others	0.09	0.1
TOTAL (£M)	75.8	198.9

School of Pharmacy

Over the assessment period, research awards for Pharmacy have increased significantly from £12.4M in REF 2014 to £37.4M. There has been a marked increase in funding from UKRI sources (notably EPSRC and BBSRC; overall UKRI total £5.7M), NIHR and other central government bodies (£6.2M), EU government bodies (£10.3M) and industrial support (£4.1M). The charity sector continues to be a fruitful source for research grants notably the Wellcome Trust, Prostate Cancer UK, Cancer Research UK (CRUK), Breast Cancer Now, Dunhill Medical Trust and the Cystic Fibrosis Foundation (£3.3M).

Selected grants of significance supporting our key research themes, which endorses the strategic approach as described in Section 1, are highlighted below:

As part of the **Nanomedicine and Biotherapeutics** theme, grants have been awarded to support the development of unique genetic therapies and delivery systems with applications in the field of cancer (McCarthy: Touchlight Genetics £541K; McCarthy, Coulter and Kett: CRUK £141K, Al-Jamal: Prostate Cancer UK £301K), the development of novel strategies for the detection, characterisation and inhibition of proteases implicated in chronic diseases (Martin and Tikhonova, with colleagues from WWIEM: Interreg £2M), and the isolation and characterisation of bioactive peptides for potential therapeutic use and computational biology for drug design and molecular modelling (Tikhonova: BBSRC £310K; NI DAERA £235K; EU £163K).

Pharmaceutical Materials Science and Formulation has focused on the development of formulations to address major global issues including HIV prevention and multipurpose prevention technologies (including contraception) (Malcolm, Boyd, Kett: Wellcome Trust £467K; Malcolm and Boyd: International Partnership for Microbicides £340K, £337K and £566K); this research has contributed to ICS 219629101. The work on hot melt granulation and polymer extrusion/injection moulding technologies to produce unique formulations has important applications for industry (Andrews, Jones, McCoy: Department for the Economy £535K and £285K). Further formulation work has focused on veterinary products (Jones: Provita Eurotech Ltd £650K), which has also contributed to impact (ICS 219628894). The use of microneedles for transdermal drug delivery, patient monitoring and vaccine delivery, implantable delivery systems and ocular therapeutics has received extensive funding, highlighting the importance of these technologies to health care and urgent global challenges (Donnelly: Radox Laboratories £959K; EPSRC £821K; Wellcome Trust £506K; Thakur: EU £504K; Re-Vana Therapeutics £431K)

Drug Delivery and Biomaterials research engages closely with the two preceding themes and antimicrobial work outlined below. Research has attracted significant funding in photoactive biomaterials, polymeric medical devices, and sensor development (McCoy, Irwin, Carson, Jones: EPSRC £446K; Invest NI £142K; Irwin: Academy of Medical Sciences £99K). A recent award from EPSRC on peptide-mimetic hydrogels as a long-acting multipurpose drug delivery platform for combined contraception and HIV prevention complements work ongoing in material science and formulation as previously described (Lavery £766K).

Infection and Antimicrobial Resistance is a major global challenge and a long-standing strength of the School, with our research spanning the translational spectrum. Areas of activity include the management of infection in respiratory conditions such as CF and bronchiectasis (Tunney and Gilpin, with colleagues from WWIEM: EU-IMI £12.8M; also noted below), post-surgical infection (Gilmore: HSC R and D £549K), antimicrobial stewardship (Hughes and Tunney: NIHR £393K; Tunney and Gilpin: Radox Laboratories £535K) and novel antimicrobials and anti-infective biomaterials (Gilmore: BBSRC £649K and £94K).

Healthcare Delivery and Medicines Optimisation has focused on the appropriateness of prescribing in chronic disease and in care home residents. Funding has supported testing interventions to improve adherence to medicines in those living in the community (Hughes; Dunhill Medical Trust £157K), polypharmacy in older people and prescribing in dementia and care homes (Hughes and Barry: Special EU Programmes £613K; HSC Research and Development £278K;

Hughes: NIHR £233K) and the management of pain in those with dementia (Parsons: HSC Research and Development £275K).

School of Nursing and Midwifery

Between REF 2014 and REF 2021, the research income (spend) of the School of Nursing and Midwifery more than doubled, increasing from £2.9 million to £6.2 million. Our staff numbers have not substantially changed over the time period [a return of 19 full time equivalent (FTE) staff in 2014 to the current return in 2021 composed of 23 FTE staff], meaning that the *research capacity* of our staff has substantially increased during this time.

In Maternal and Child Health, research focuses on *early interventions* and includes an innovative focus on *male engagement in maternal and child health*. We have led the first UK-wide cluster RCT of a schools-based relationship and sexuality education (RSE) programme targeted to boys ('the Jack Trial') with Cardiff, Glasgow, LSHTM and UCL (Lohan & Aventin: NIHR £1M). The team has been awarded grants to co-design RSE and develop sexual health services within prisons (Lohan: MRC, £150K; Kelly & Lohan: Burdett Trust, £50K) and for young people with intellectual disabilities (Brown & Linden: Burdett Trust, £90K). Underpinning the School's early intervention research is the development of two NI longitudinal population health registers, the Cerebral Palsy Register (Kerr and Perra: PHA NI £502K) and Neonatal Intensive Care: Outcomes Research and Evaluation (McNeil: PHA NI £412K). This population-based research has led to research awards to develop early interventions to address identified needs, for example, amongst very preterm infants (Perra: NI HSC R&D £34.5K) and interventions with industry to support child friendly activity diagnostics for children with cerebral palsy (Kerr: MRC, £85K).

A second key focus is on *maternity care*. This team has been at the forefront of ensuring a robust framework for maternity care in NI through its leadership of Birth NI, the national survey of women's preferences (Alderdice, McNeil & Lynn: PHA, £90K); interventions to support continuity of care (McNeil & Lynn, PHA, £80K) and interventions to support mothers with mental health difficulties 'family focused practice' (Grant: HSCB, NI, £83K). Our portfolio of *global maternal and child health research* has expanded during this period, funded by MRC GCRF (Aventin, Lohan & Tomlinson: £500K), UKAID (Aventin & Lohan: CEDIL programme, £199K) and WHO (Tomlinson, £74K; Lohan £79K). Together, the team's research on sexual and reproductive health, specifically in prison healthcare and globally with WHO has informed an ICS (219629201), as has the Cerebral Palsy population-based research and follow-on interventions (ICS 219628984).

The Chronic Illness and Palliative Care research theme is tackling some of the world's greatest challenges: from using Artificial Intelligence to provide 24-hour personalised support for patients with heart failure [Hill, Fitzsimons, Thompson, Ski, Watson (WWIEM) & international partners: INTERREG, £360K] to interventions designed to support carers as part of communities of care locally and with partners in the Global South (Fitzsimons: CH&S, £85K; Santin: HSCR&D, £94K; DFE,NI & MRC GCRF, £255K). Working together with PGJCCR, in the field of cancer care, our team has been awarded research grants to improve quality of life through exercise interventions (Prue, O'Sullivan, Jain & Turkington: CRUK, Movember & HSCR&D, £485K) and to support management of cachexia and nutrition for patients and carers (Reid: HSCR&D & Marie Curie £210K). Together, the team's work on cancer care services and the inclusion of carers' needs locally and globally has informed the ICS (219628916): Transforming cancer care services.

In palliative care, the team's research is leading innovations in *end-of-life supportive decision-making for underserved populations*, such as patients with dementia in care home settings and patients with kidney failure. Grants awarded include the 'EU Joint Programme' award to support care home staff to engage in decision-making with family carers of patients living with dementia across six countries (Brazil: EU JPND, £464K) (<https://mysupportstudy.eu/>). A further example is an exploratory study of patients and carers: 'Decisions not to dialyse in advanced chronic kidney disease' (Noble & O'Halloran: NIHR, £512K), followed by a phase II RCT of an intervention to support advance care planning with older patients who have end-stage kidney disease (O'Halloran, Noble & Brazil: Dunhill Trust £145K). Recognising the increased vulnerability of care-home patients and patients with renal failure during the pandemic, the team has prioritised

research on optimising supportive end-of-life care decision-making with patients and relatives impacted by COVID-19 (Brazil, Reid & Noble: ESRC, HSC R&D & NI & Kidney Research Fund, £280K).

WWIEM

Over the assessment period, WWIEM experienced a 90% growth in overall research income, from £27.4M in REF 2014 to £52.1M in this current assessment period. This has resulted from success in attracting support from diverse funders, including a 146% increase in funding from UKRI, equating to £11.7M. NIHR funding grew from £3.9M (REF 2014) to £9.9M, EU grants increased to £8.3M and industrial research funding grew by £4.8M. Charity sector funding amounted to £11.9M, with a £3.2 M contribution from Wellcome Trust including the first ever Wellcome Trust Investigator Award to the University. The award of the Wellcome-Trust Institutional Strategic Support Fund to the Institute, to the value of £600K (matched by the University) has supported, among others, the career development of six postdoctoral researchers in the areas of WWIEM expertise, and three 3-month clinical placements.

Currently, WWIEM hosts 55 research groups, encompassing the fields of immunology, molecular and cellular biology, microbiology, and clinical trials. The discovery science teams work closely with colleagues practising in the Belfast Health and Social Care Trust who have their laboratories at WWIEM. Selected grants reflecting the success of the strategy outline in Section 1 are highlighted below:

The **Immunobiology and Microbes** theme researchers have secured grants to dissect the cross-talk between respiratory pathogens and their hosts with a focus on the innate immune system. Teams working on uncovering the infection biology of antibiotic resistant pathogens (*Klebsiella*, *Burkholderia*, *Legionella*, *Pseudomonas*) have received significant support from UKRI (Bengoechea: BBSRC £2M in five consecutive projects; Valvano: BBSRC £900K in two projects, MRC £343K, Schroeder: MRC £372K), as well as those working on respiratory viruses (Mousnier: Medical Research Foundation £300K; Power: BBSRC £378K, Wellcome Trust £212K). This knowledge platform has advanced to the pre-clinical stage, exploring first-in-kind directed therapeutic approaches against antibiotic resistance (Bengoechea, Kissenpfennig: MRC £285K, with Astra Zeneca), a blocking antibody against RSV (Ablynx £147K), a point-of-care diagnostic kit for infections in critically-ill patients [McMullan: NIHR £1.5 M (STOP trial)], and trialling new therapeutics against bacterial infections found in cystic fibrosis and bronchiectasis patients (Elborn, Ingram and Pharmacy colleagues: EU-IMI £12.8M). This expertise has also been mobilized to tackle COVID-19, securing grants to understand the pathophysiology of the virus, and identify new therapeutics (Power and PGJCCR colleagues: MRC £296K, Bengoechea: BBSRC £486K). This theme has further secured grants to harness the power of the immune system to foster tissue regeneration of the central nervous system, and the lung following inflammation-induced injury (Fitzgerald: BBSRC £467K, Wellcome Trust Investigator Award £1.7M; Ingram GSK: £298M in two projects).

The **Vision and Vascular Medicine** theme includes teams of basic and clinical scientists focusing on two of the major causes of vision loss in developed countries, namely, diabetic retinopathy and age-related macular degeneration (AMD). Several teams are addressing how early molecular and cellular events contribute to the development of late-stage complications associated with these diseases with an emphasis on microvascular circulation [Margariti: BBSRC £383K, Stitt: EU £360K, USA (NIH)-Ireland (HSC Research and Development) £512K, Medina and Stitt: USA (NIH)-Ireland £339K, Grieve, McDonald, Stitt, Watson: British Heart Foundation £2.5M in 12 projects]. The innovation and translational potential of this work is reflected in the attraction of significant funding in partnership with industrial stakeholders (Medina and Stitt: Novo Nordisk £1M, Xu: Novaliq £243K, Lengyel: F.Hoffman-La Roche £483K in two projects). This basic research work has informed UK-wide clinical trials led by WWIEM researchers to define the effectiveness of multimodal imaging for the evaluation of retinal oedema (Lois: NIHR £677K; (EMERALD total trial £816K)], and whether micropulse laser treatment is a useful therapeutic alternative to the use of conventional laser therapy [Lois: NIHR £982K (NIHR DIAMONDS trial)].

The **Respiratory Medicine** theme includes clinical academics and basic scientists providing mechanistic insights into the molecular and cellular events underlying lung inflammation and tissue destruction in acute respiratory distress syndrome, and cystic fibrosis (Taggart, Weldon, McAuley: MRC £481K) (ICS 219629399). This research has informed the use of mesenchymal stem cells to mitigate lung injury and to aid in the clearance of bacterial infections (Krasnodembskaya: MRC £1.2M in three projects), and to assess the impact of the lung microbiome (Elborn, Ingram, Taggart, Weldon and Pharmacy colleagues: EU £844K). This discovery science is complemented by experimental medicine respiratory research exploring new therapeutics supported by the NIHR and the Wellcome Trust [Elborn, Bradley: NIHR £986K (CLEAR trial), McAuley: NIHR £2.08M (REST trial), Shyamsundar: HSC Research and Development £891K, O’Kane, McAuley: Wellcome Trust £1.8M (REALIST trial)]. This work aligns with research to define robust criteria of quality and assessment of care which can be used as outcomes in clinical trials (Blackwood: NIHR £1.8M SANDWICH trial; ICS 219629352). Researchers in this theme lead the only UK-wide project on asthma personalized medicine [Heaney and McGarvey: MRC £3.2M (RASP)] which has secured additional funding from industrial stakeholders (Heaney: Amgen £575K, GSK £450K, Boehringer Ingelheim £450K)

PGJCCR

The PGJCCR is a multi-disciplinary research environment that forms the hub of translational cancer research in QUB. Since the previous REF period, PGJCCR has more than doubled its research income from £33.6M to £74.9M. The development of patient impact for early-stage clinical trials is supported by our CRUK ECMC (CRUK £1.35M and HSCNI £373K) and the Trials Acceleration Programme (TAP, Bloodwise, £128K and Cure Leukaemia £147K). Since REF 2014, PGJCCR has expanded its operation to a second building (5000m²), the Health Sciences Building (HSB) as a translational hub to develop impact emanating from the PGJCCR. The HSB houses the Precision Medicine Centre of Excellence (PMCOE), spinout companies Sonrai Analytics and GenoMe Diagnostics, and California-started spin-in CV6 Therapeutics. Additionally, a strategic partnership with Almac Discovery and Almac Diagnostic Services has been established to drive innovation and development of research impact.

Research in the Centre focuses on themes of (i) therapy resistance, (ii) tumour microenvironment and (iii) DNA damage signalling; supported by cross-cutting technology specialisms. Funded programmes that support these areas include:

Therapy Resistance: Understanding molecular mechanisms of drug resistance is supported through a CRUK programme award (Longley, £856K) and BBSRC (McDade, £384K). Molecular insights from these programmes have pioneered the development of novel first-in-class small molecules towards a key resistance target FLIP (Longley, Harrison: Wellcome £5.8M; MRC £885K) and intrabodies towards key oncogenic proteins (Scott: BBSRC £346K). In blood cancers, Mills examines the interaction between molecular mutations, treatment strategies and therapy resistance (Children’s Cancer and Leukaemia Group: £174K). The molecular insight into treatment strategies underpins the development of clinical impact in the treatment of myeloproliferative diseases as described in ICS 219629334.

Tumour microenvironment: A major focus is the development and application of sophisticated *ex vivo* and *in vivo* genetic engineered murine models to more accurately reflect the complex milieu of tumours such as the CRUK ACRCelerator (Dunne: £101K to QUB, collaboration with Beatson Institute); development of new models to define metabolic mechanisms in colorectal cancer (Kerr: CRUK, £957K), hypoxic endothelial biology (Branco: Breast Cancer Now Fellowship, £165K to QUB) and antiprotease imbalances in lung cancer (Small: MRF £163K). LaBonte-Wilson is also using novel genetically engineered mouse models for the examination of extracellular signalling in prostate cancer (PCUK £482K).

DNA damage response and signalling: Research into the DNA damage response and signalling in tumour progression and therapy response has led to the development of marketed transcriptomic biomarkers (The DNA Damage Immune Response assay; Harkin, Kennedy, Savage, InvestNI and Almac, £2.8M total), which has been validated to predict benefit/response

to adjuvant chemotherapy in breast and oesophageal cancers (Kennedy, Savage, McIntosh, Turkington: CRUK £1.8M total) and colorectal cancer through the MRC S:CORT UK consortium (Kennedy, Dunne, Lawler: £1M to QUB).

Technology Specialisms: PMCOE: launched in 2019, PMCOE brings together high-throughput genomics, digital pathology, artificial intelligence and big data analytics in a new clinically accredited state-of-the-art facility (InvestNI £4.1M initial investment further supported by national network research programmes from CRUK £3.3M and InnovateUK £5.2M) and the NI Biobank. The PMCOE is also partnered with the Belfast HSCT to deliver NGS-based cancer diagnostics for the whole of NI. Digital Health: The PGJCCR is one of only six national Health Data Research UK sites (Lawler: MRC £716K in partnership with Swansea University); developing new paradigms in the interpretation of disease prognosis and treatment prediction. In addition, Lawler is leading the HDR DATA-CAN, a digital Innovation Hub Programme (MRC £915K to QUB). As evidence of the impact of this research, Sonrai Analytics was spun out of QUB in 2019 within the field of multi-omics data analytics and AI. Advanced Radiotherapy: This team brings together clinical oncology, radiation science and radiotherapy physics (PCUK FASTMAN, O'Sullivan, Jain, Prise, Mills, McArt, Kennedy, Wilson and Butterworth). The first 5 years of this programme were completed in 2019 (£2.7M) and subsequently renewed to at least 2022 (PCUK £850K). This programme is involved in the development of clinically applicable diagnostic/prognostic assays, delivery of three biologically-informed, biomarker guided clinical trials, and theoretical modelling of Radium-223 mechanism-of-action which had led to the adoption of new clinical practices as detailed in ICS 219629019. These translational programmes are complemented by fundamental research programmes (Prise: EC Framework 7, £620K, McMahon: UKRI FLF £1.1M).

Operational infrastructure, facilities and specialist equipment

To support the Unit's research activities, there has been a concerted approach to providing outstanding **operational support and a physical environment** in which all staff and students can undertake the highest quality work. Such an environment, along with the necessary equipment and other facilities have ensured that we were able to meet our goals as articulated in the Schools/Centres' research strategies.

A prime example of this is the new WWIEM £32M 9,000m² facility (completed in 2015) and associated laboratories in the Medical Biology Centre (MBC) (920 m²). The funding for the new facility and the research equipment was provided by a number of charities and individual donors, the Wellcome Trust, the Wolfson Foundation and UK capital investment. The WWIEM building is a state-of-the-art research facility containing a large suite of open-plan multipurpose research laboratories including numerous tissue culture, molecular biology, biochemistry and microbiology laboratories. Its award-winning design aims to facilitate interdisciplinary research and collaboration between groups. The building is an example of sustainable and carbon-limiting laboratory design through the application of the 3Rs "*Reduce, Recover, Renewable*". The WWIEM was officially opened on September 14th, 2018, by Prof Sir Paul Nurse. The capital raised was also used to purchase multimillion value state-of-the-art imaging equipment and genomics that crystalized in the creation of the Faculty Core Technology Units (CTUs) on advanced imaging and genomics. In addition, part of the equipment capital was used to improve the high computing capacity in the health campus.

The School of Pharmacy has undergone a three-phase major refurbishment and expansion of its facilities completed in 2019. The School now occupies 5800m² over five sites (compared to 4600 m² in 2014). This reflects growth in academic staff numbers, the post-doctoral research fellow cohort and research students. The £3.6M refurbishment resulted in improved laboratory and associated facilities (write-up space) and dedicated equipment areas. Each laboratory has appropriate technical staff support, who are trained in relevant techniques and oversee health and safety requirements, including training and induction for new staff and students. Technical staff are also responsible for equipment maintenance. Over the assessment period, there has been ~£4M investment in research equipment to support programmes across the research themes including state-of-art microscopy, next generation sequencing, 3D-printers, spray dryers, mass spectrometers and cell imaging readers. As noted above, central facilities such as CTUs are also

available and are extensively used by staff. As part of the **MATCH PRP**, the University has provided £515K for equipment, administrative and technical support to further enhance the interdisciplinary research within the University and to engage with research end users, notably industry and the health service.

The School of Nursing and Midwifery has received significant investment in infrastructure and research support through the creation of the **CESI PRP** interdisciplinary workspace bringing together staff from all faculties (£500K from QUB and Atlantic Philanthropies). The impact of the new investment in CESI has led to increased interdisciplinary university-wide research projects, including those led by early career researchers and enhanced training opportunities for PhD students and post-doctoral research staff. Additional investment through staffing and studentships have also contributed to overall infrastructure support.

A £4M investment in the new Wellcome Trust-Wolfson Foundation Northern Ireland Clinical Research Facility (NICRF) has supported clinical trials research. Based in Belfast City Hospital, the NICRF has the infrastructure to support clinical trials from conception to completion. With dedicated staff, the NICRF allows researchers to access a specialised area for clinical research, including equipment not available in the NHS. It contains ten clinical rooms, a blood processing facility and a diet kitchen for nutrition studies.

Funding (£2.7M) has been invested in the QUB Cellular Therapy Facility. Based in the Royal Victoria Hospital and maintained in conjunction with the Belfast Health and Social Care Trust, it was jointly funded by Medical Research Council (£1M), Health and Social Care Research and Development Division (£1.3M) and QUB (£0.4M).

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

Our approach to collaboration and contribution to the research base, economy and society is embedded in our research and impact strategies, reflecting the Unit's commitment to these activities. We have deliberately moved beyond conventional academic aspects of collaboration and contribution to encompass key stakeholders and end-users of research, recognising the core element of our mission- the centrality of patients and the public in our research. Below, we outline key examples of collaboration which reflect this broader mission, including public engagement and patient and public involvement in the development, conduct and implementation of research and subsequent findings, through to policy. Many of these activities have also contributed to impact generation, examples of which were described in Sections 1 and 3.

Academic and industrial collaboration: Through research dissemination and communication, staff have forged key collaborations across other institutions on the island of Ireland, the UK, the EU and across the world. Specific funding initiatives (Science Foundation Ireland, Interreg, All-Ireland Institute of Hospice and Palliative Care) have supported collaborations with colleagues in Irish institutions, while the Interreg North-West Europe Programme, Horizon 2020 and the IMI initiative have supported EU applications. A unique tripartite arrangement between funders in Northern Ireland (HSC Research and Development Division), the Republic of Ireland (Health Research Board) and the USA (National Institutes for Health) have facilitated world-leading research programmes to be supported in the areas of cystic fibrosis (CF), pancreatic cancer and post-surgical treatment of infection. Other examples (not exhaustive) of collaborating partners include: National Universities of Cambridge, Oxford, Manchester, Liverpool, UCL, London School of Hygiene and Tropical Medicine, Warwick, Newcastle, University of East Anglia, ICR. European Trinity College Dublin, Technical College Munich, Academisch Ziekenhuis Maastricht, University of Strasburg, Leiden University. International Purdue, Buffalo, Toronto, NCI, University of Massachusetts, University of Auckland, University of Melbourne, University of British Columbia, McMaster University, Université Catholique de Louvain, Leuven. Industrial: GSK, Roche, Astra Zeneca, Pfizer, Amgen, Randox, Astex Therapeutics, Celerion.

In addition to funded collaborations through research grants, we have formal agreements for collaboration and student transfers in place with organisations such as the National Cancer

Institute, Bethesda, and Princess Margaret Cancer Centre Toronto. Our approach to supporting collaboration such as the ECR Faculty Collaboration Seed Fund (see Section 2) helps to develop partnerships, particularly for those at the formative stage of their careers. The PRPs within this Unit (**CESI and MATCH**) have enhanced collaboration across Centre/School/Faculty and the University, while engaging with end users of research such as area-based communities 'innovation zones', patients, practitioners and industry, including health providers. These approaches are aimed at extending our international research reach to enhance the quality of our research and drive impact generation.

Patient and Public Engagement and Involvement: At an institutional level, the University Engaged Research Action Plan has established a Patient and Public Involvement (PPI) Network reflecting the NHS 'INVOLVE' principles as a key objective. It includes members from across the three faculties with Unit member, Professor Alan Stitt, as academic lead. An all-Ireland PPI Network being led by NUI Galway in collaboration with QUB, University of Limerick, University College Cork, University College Dublin, Trinity College Dublin, Royal College of Surgeons in Ireland, Dublin City University and a range of other partners, including charities and patient advocacy organisations, has recently been approved for funding support by the Health Research Board in the Republic of Ireland. These Networks reflect what is already common practice in the Unit as patient and public engagement and involvement has been central to much of our research over the assessment period. Many Unit staff use the resources provided by the HSC Research and Development Division and its **Public Involvement Enhancing Research Group (PIER NI)** [PIER NI \(Public Involvement Enhancing Research\) | Public Health Agency - Research & Development in Northern Ireland \(hscni.net\)](https://www.hscni.net/PIER-NI) Other key examples of how engagement and involvement have been implemented are described below:

PGJCCR works closely with clinical and trial staff in the **Northern Ireland Cancer Trials Network (NICTN)**, the **Northern Ireland Cancer Research Consumer Forum (NICRCF)** and the **Belfast Health and Social Care Trust**. These collaborations have led to-

- A regular PPI induction and training day
- The establishment of a Prostate Cancer Patient Advisory Group which feeds into studies
- A Public and Patient Involvement and Engagement group as part of the DATA-CAN initiative, which is the UK's Health Data Research Hub for Cancer.

Within WWIEM, PPI in cystic fibrosis studies has been progressed through the NICRF and the **European Cystic Fibrosis Clinical Trials Network (ECFS-CTN)**. People with CF or parents are part of the trial review process to ensure that the study design is acceptable to patients. Elborn founded ECFS-CTN, which Downey now co-directs. ECFS-CTN sites prioritise trials for which the protocol has been reviewed and approved by teams of CF patient/parents, doctors, research coordinators, and statisticians. This improves trial design, ensures an acceptable burden of participation and prioritises impactful trials (to best use the limited patient population). To date, 140 protocols have been reviewed. WWIEM is implementing a **cross-community post-primary schools' initiative** in which students will work together to investigate major microbial research problems using mobile laboratory demonstrations, research projects on grand challenges in health, documentary recording and open lectures. This initiative will introduce students to the centrality of science in society and the importance of teamwork in addressing important problems in health.

The Northern Ireland Cerebral Palsy Register (NICPR) at the School of Nursing and Midwifery (Kerr and Perra) is one of 10 'test-bed' projects that will test the **NIHR National Standards for Public Involvement in Research**. This will establish if the NIHR standards work in practice and to share what is learnt from using the standards. As a 'test-bed' the NICPR will (i) create a public involvement (PI) group (persons with CP and their family, carers and friends), (ii) collaboratively determine terms of reference, activities and training needs of this PI group, (iii) develop jargon-free communication methods to meet the needs of different audiences, and (iv) record, monitor and evaluate our PI activity. <https://www.qub.ac.uk/research-centres/NorthernIrelandCerebralPalsyRegister/GetInvolved/>

Policy activities: During this REF period, the School of Nursing and Midwifery has developed a sustained contribution to the work of the WHO in Geneva. Tomlinson, a Consultant to the WHO is one of the co-ordinating writers of the WHO document 'Nurturing Care for Early Childhood Development: A Framework for Helping Children Survive and Thrive to Transform Health and Human Potential'. He is co-author of the WHO-Lancet commission 'A Future for the World's Children?' and is currently a member of the WHO Strategic and Technical Advisory Group of Experts (STAGE) for Maternal, Newborn, Child, Adolescent Health & Nutrition. Lohan is the WHO Consultant leading on synthesising the global evidence on 'Engaging Men and boys in Sexual and Reproductive Health and Rights' This research is shaping WHO's global agenda for the improvement of sexual and reproductive healthcare by effective engagement with males. The School's appointment of Fran McConville, Lead Midwifery Advisor to the WHO as an Honorary Professor of Practice 2020-2023 will enhance this sustained partnership between our School and WHO.

Contributions: Unit staff play significant and meaningful roles in the wider research community which have been recognised through prestigious awards/prizes, membership of learned bodies, scientific advisory boards, funding panels, editorial roles including membership of editorial boards and regular reviewing activities for funding bodies and journals. Collectively, over the assessment period, Unit members have been awarded 104 prizes/honours, 43 fellowships of learned societies, delivered more than 300 keynote conference presentations and served on 51 UK and 22 non-UK funding panels. Below we have provided selected examples to illustrate these contributions.

Honours and Prizes (selected): **Hill**, Nursing and Allied Health Professional Award, European Society for Cardiology; **Linden**, Fellow of the British Psychological Society; **Thompson**, Academia Europaea; **Tomlinson**, Academy of Science of South Africa (ASSAF), **Fitzgerald**, MS Society (UK and Ireland) Researcher of the Year; **Krasnodembskaya**, Stem Cells Young Researcher of the Year; **Stitt**, Eva Kohner Prize Lecture European Association for Research in Vision and Ophthalmology, Royal Society-Wolfson Merit Award, 5th Fincham Medal, Member of Royal Irish Academy; **Al-Jamal**, GSK Emerging Scientist Award; **Donnelly**, Controlled Release Society Young Investigator Award; **Gilmore**, WH Pierce Prize, Society for Applied Microbiology; **Jones**, Academy of Pharmaceutical Sciences Innovative Science Award, Griffith Medal of the Institute of Materials, Minerals and Mining; **Lamprou**, Royal Pharmaceutical Society Science Award; **Allott**, Irish Cancer Society Research Fellow of the Year; **Blayney**, Women in Tech Award and the TechWomen100 Award; Butterworth, US Radiation Society Early Career Investigator Award, **Dunne**, Best paper, European Alliance for Personalised Medicine Congress; **Mullan** and **Beirne**, TP Gunton Award; **Prise**, Bacq and Alexander Award, European Radiation Research Society and the Douglas Lea Lecturer, Institute of Physics and Engineering Medicine (IPEM); **Evergren**, Ambassador for the American Society for Cell Biology; **Andrews**, Eminent Fellow Academy of Pharmaceutical Sciences; **Elborn**, Elected Fellow, Academy of Medical Sciences.

Professional Bodies and Roles (selected): **Bengochea**, Chair of the Sustainability and Development committee and Trustee of the Microbiology Society; **Buckley**, Council, Irish Association of Cancer Research; **Coulter**, Chair, Association of Radiation Research; **Gilmore**, Wellcome Trust/DoH Alternatives to Antibiotics Consortium, President of the Society for Applied Microbiology; **Hughes**, Former Chair of the Scientific Advisory Board, Pharmacy Research UK; REF Sub-Panel 3 member; **McNeil**, International Confederation of Midwives Research Standing Committee; **Hill**, European Society of Cardiology Heart Failure Association, **Fitzsimons**, Board member European Society of Cardiology and UK Council of Deans Executive Board member; **Reid**, Chair of the All-Ireland Palliative Care Research Network; **Elborn**, Member of SAGE; **Fitzgerald**, Wellcome Trust Neuroimmunology Scientific steering committee; Research Strategy Group, MS Society; Multiple Sclerosis Society Expert Clinical Trials Consortium; **McAuley**, American Thoracic Society Critical Care Assembly Nominating Committee; NIH PETAL Network International Advisory Committee; International ECMO Network, Chair; NIHR HTA General Board; **McMullan**, NICE Sepsis Guideline Development Group; **Power**, COVID-19 expert advisory group, British Society for Immunology and Academy of Medical Sciences; Chair, International Respiratory Syncytial Virus Society, extended to 2022; **Valvano**, Themes Panel, Biochemical Society, UK; **Xu**,

Trustee of Association for Ocular Pharmacology & Therapeutics; **Stitt**, Fighting Blindness Ireland, Scientific Advisory Board; Sir Jules Thorn Charitable Trust, 50th Anniversary Award 2014, Panel Chair, Moorfields Eye Hospital/Institute of Ophthalmology; **Branco**, Breast Cancer Now Scientific Advisory Board; **Coyle**, CR-UK ECMC Combinations Alliance Joint steering committee; **Gonzalez de Castro** Chair UK Molecular Pathology Scientific advisory group UKNEQAS; **Jain**, Chair of the Irish Radiation Society; **Kennedy**, member of MRC Stratified Medicine group; **McIntosh**, Chair, Early Disease Subgroup of NCRI Breast Research Group; Member, NCRI Strategic Advisory Group; **Mills**, Member of the Scientific Advisory Panel for Leuka; **Scott**, Trustee, British Society of Nanomedicine; **Lawler**, European Research Council Ethics Committee, Horizon 2020 Health, Ethics Committee; Vice President, European Cancer Concord; European Alliance for Personalised Medicine; **O'Sullivan**, Advanced Prostate Cancer Consensus Committee, Royal College of Radiologists Clinical Academic Committee, NCRI -Prostate CSG, Advanced Prostate Cancer Sub-group member

Research Funding Committees (selected): **Al-Jamal**, Prostate Cancer UK Research Advisory Committee; **Gilmore**, Hungarian National Research, Development and Innovation; **Hughes**, Member of selection panel for the NIHR School for Primary Care Research; NIHR Health Services and Delivery Research Review Panel; **Irwin**, Royal Academy of Engineering; **Tunney**, La Caixa Scientific Foundation, European Clinical Microbiology and Infectious Diseases; UKRI FLF peer review college; **Wagner**, EPSRC prioritisation panel, Science Foundation Ireland; **Bengoechea**, Co-chair ANR (France)-BMBF (Germany) on Antimicrobial resistance; UKRI FLF Deputy Chair sift and interview panels; BBSRC core member committee D; Chair Peer Review Panel, INFECT-ERA (EU FP7 Programme), MRC Infection and Immunity Board; core panel member Infection and immunity ANR (France); **Brazil**, NC3Rs panel member; **Fitzgerald**, Wellcome Trust Cellular and Molecular Neurosciences, BBSRC Research Committee E; Chair, Wellcome Trust/HHMI/Gates Foundation/Gulbenkian Foundation International Research Scholars; MS Society of Great Britain and Northern Ireland; **Lundy**, Newton Foundation; **McAuley**, Chair of NIHR/MRC 2019-nCoV Rapid Response Call 1; MRC/NIHR Efficacy and Mechanism Evaluation Programme Director; **Stitt**, Diabetes UK Research committee member (2017- present); National Eye Research Centre UK; Royal Society: Commonwealth Science Grants Committee; French Agence Nationale de la Recherche (ANR): International Scientific Review Panel for University Hospital Institutes; **Taggart**, European Respiratory Society College of Experts; **Heaney**, MRC Populations and Systems Biology Board; **Xu**, Fight for Sight UK; Bright Focus USA; **Brazil**, Deputy Chair, Policy Research Unit Commission of NIHR; Member of the Health Services and Delivery Research Programme, NIHR; **Fitzsimons**, Northern Ireland Chest Heart and Stroke Scientific Advisory Committee; **Lohan**, MRC Global Health Research Board; **Harrison**, MRC DPFS panel; **Jain**, Prostate Cancer UK Research Advisory Committee; **Scott**, UKRI FLF Peer-Review College, MRC DPFS panel, EuroNanoMed (ERA-Net CoFund); **Grieve**, Vice Chair, BHF Grants Committee, NC3Rs; **O'Sullivan** Irish Cancer Society: Career Fellowship Committee Chair; Expert member CRUK Fellowship committee. Chair of Fellowship Committee- Friends of the Cancer Centre; **Kennedy**, CRUK New Agents Committee, MRC Stratified Medicines Board.

Selected Editors/editorial board members: **Boyle**, Neonatal Nursing; **Brown** Learning Disability and Practice; **Thompson**, European Journal of Cardiovascular Nursing; **Santin**, Frontiers in Public Health; **Coulter**, Cancer Nanotechnology; **Gilmore**, Journal of Applied Microbiology and Letters in Applied Microbiology; **Jones**, Journal of Pharmacy and Pharmacology; **Fitzsimons**, Journal of Cardiovascular Nursing, European Heart Journal – Acute Cardiovascular Care & British Journal of Cardiac Nursing, **Ge**, Nanotechnology: Nanomedicine & Nanobiotechnology; **Tomlinson**, PLoS Medicine; **Hughes**, Pilot and Feasibility Studies, Cochrane Collaboration (Effective Practice and Organisation of Care); **Lamprou**, Pharmaceutics; **Tunney**, Journal of Cystic Fibrosis and Critical Reviews in Microbiology; **Bengoechea**, Infection and Immunity, Microbiology-UK, **Curtis**, Microcirculation; **Fitzgerald**, Journal of Cell Communication and Signalling, American Journal of Clinical and Experimental Immunology; **Krasnodembskaya**, Frontiers in Pharmacology; **Lundy**, Archives of Oral Biology; **Margariti**, Insights in Stem Cells; International Journal of Biochemistry and Molecular Biology; **McAuley**, BMJ Open, **Power**, Pathogens, **Stitt**, Current Eye Research, Diabetologia, Clinical Ophthalmology, Microcirculation; **Taggart**, Journal of Cystic Fibrosis, **Valvano**, The Journal of Biological Chemistry, Nature

Scientific Reports, Infection and Immunity; **Xu**, Experimental Eye Research, Frontiers in Immunology; **McArt**, PLoS Computational Biology; **McCloskey** British Journal of Pharmacology; **Mills**, Molecular Cancer; **Adrain**, The FEBS Journal, Scientific Reports; **Longley**, Clinical Cancer Research, Molecular Cancer Therapeutics, Journal of Chemotherapy, Nature Communications, Cell Death & Differentiation, Cell Death & Disease.