Institution: University of Lincoln

Unit of Assessment: A3 Allied Health

a. Overview

Health Research at the University of Lincoln

The **Lincoln Institute of Health (LIH)** is a cross-university interdisciplinary research collaboration focusing primarily on three areas of research: fundamental science, personalised therapy and translational research – spanning the spectrum from bench to bedside. It was founded as a result of the University of Lincoln's continuing investment in health as a research priority since RAE2008, as well as the well-recognised need for a more integrated approach to healthcare. The **LIH** was formed to study key health and social care problems using a multidisciplinary and multiprofessional 'bench-to-bedside' approach. The **LIH** operates in partnership with health, social care and third sector services nationally and regionally, as well as with academic and commercial partners and policy groups in the UK and internationally. Research within the **LIH** is designed to understand and translate the fundamental molecular and cellular mechanisms that underpin disease, to develop and deliver diagnostic tools and therapeutic treatments to improve human health, and to improve the practical delivery of health and social care to make positive changes to people's lives.

The University has made and continues to make major strategic investments in health and health-related research, enabling Allied Health (UoA3) to expand returning 19 staff (including 17 new staff) compared to 9 staff in RAE2008. This has built on the University's initial focus on health policy- and practice-related research in the Lincoln School of Health and Social Care within the College of Social Science, and more recently through the establishment within the College of Science of new Schools of Life Sciences (established in 2012) and of Pharmacy (formed in 2013), as part of its wider expansion in STEM research across the university.

The **LIH** has 33 academic staff overseen by a management group, including representatives from the three Research Groups/Units detailed below, which is responsible for developing and implementing the **LIH** research strategy and action plan. A wider steering group, which supports and guides our activities, includes members from other interdisciplinary groups undertaking health research (e.g. Lincoln Social Computing Research Centre, Health Advancement Research Team in Sport and Exercise Science, the Perception Action and Cognition Group in Psychology) as well as external stakeholders including Lincolnshire Community Health Services NHS Trust, East Midlands Ambulance Service NHS Trust, United Lincolnshire Hospitals NHS Trust, Lincolnshire Commissioning Groups, Public Health and international links including with the European Forum for Primary Care and Emergency Medical Services 999 Forum.

Research Groups and Units

Work is conducted within and across two research groups in the College of Science: the "Molecular Basis of Disease (**MBoD**)" and "Drug Design and Delivery (**DDaD**)" groups, and within the "Community and Health Research Unit (**CaHRU**)" in the College of Social Sciences with overlaps between the groups.

- ***MBoD*** comprises research on four themes: *Infection and Immunity* (Biswas, Dixon, Flint, Lancaster, Taylor, Williams); *Clinical Pathology* (Bates, Rea, Reyers, Rose, Slee); *Medical and Molecular Genetics* (Gutierrez, Machado, Williams); *Molecular Oncology* (Bachrati, Bates, Graham, Hussain, Rinaldi, Singh).
- ***DDaD*** comprises two themes: *Drug Design and Molecular Pharmaceutics* (Blagden, Ferrari, Flint, Goddard, Lancaster, Lappin, Sharma, Singh, Taylor and Vllasaliu); *Analytics of Biological Systems* (Baron, Croxton, Miller).
- ***CaHRU***, established in 2010 by Siriwardena includes Windle, Asghar, Davy and Middlemass and four research assistants. Three programmes of work have been developed: Quality and Outcomes in Primary Health Care (QOPH), Pre-Hospital and Emergency Quality and Outcomes (PEQO), and Older People and Well-Being (OPWB).

b. Research strategy

Since RAE 2008 Allied Health's key approach has been to build on our strategy of multidisciplinary research, engaging with the health services to address issues of local and national importance so as to bring about improvements in care. The strategy aligns with the University's strategic research

aims: to continuously improve the research environment; to invest in building key research capabilities and resources; to underpin the continuing professional development of researchers; to raise the impact of research; and to strengthen the postgraduate environment. Our activities and achievements in relation to these are summarised below.

Responding to priorities

Fundamental to the strategy and culture in the **LIH** are its underpinning principles that research: responds to key priorities in health (e.g. cancer, cardiovascular disease, infection, long term illness, prescribing, organisation of health systems); is co-created and conducted in partnership with key stakeholders (service users, health practitioners, health organisations, industry and policy makers) in a way that is responsive to their needs; and, in doing so, increases the likelihood of research being implemented and leading to uptake and impact. This approach ensures we conduct timely high quality studies and design, implement and evaluate innovative health technologies in national and international priority areas. Our 'pipeline' of research ranges from molecules and cells ("bench"), to personalised medicine ("bedside" or "consultation" through to development of "personalised-genomic-led diagnosis and treatment") and "community" interventions. We test our findings at local and regional level before progressing to larger national or multinational research studies. This is exemplified by research on insomnia and hypnotic drugs where we worked with service users and practitioners to develop novel ways of treating insomnia, more responsive to the needs of patients and health services, beginning locally but then achieving international impact (see *insomnia impact case study*). A further example is our research with English ambulance services (see *prehospital emergency care case study***)** that led to improvements in emergency care for heart attack and stroke – an example of "dissemination by design" – and led to significant changes in paramedic practice.

Investment in infrastructure

The University of Lincoln has made a major investment in facilities for health and health-related research during the census period (£20m 2008-13) and this process has continued with the formation of the LIH in April 2013 and will continue with a further £14m scheduled for investment in the next three years. This has created an environment that is attracting outstanding researchers and research students/assistants which is critical to the University's future research capacity. For example, the continuing multi-million pound investment in the Lincoln Science and Innovation Park (LSIP) will provide state-of-the-art research facilities and infrastructure for future world-class research (see below).

Investment in people

Implementation of the University's vision for health research has led to the appointment of 23 new academic staff in UoA A3 since RAE2008 across all three schools, including 12 Early Career Researchers (ECRs): Asghar, Biswas, Davy, Ferrari, Graham, Goddard, Gutierrez, Lancaster, Middlemass, Sharma, Singh, and Vllasaliu. Specific mechanisms for supporting research are University-funded doctoral studentships (over 20 in number), appropriate reduction of teaching and administrative duties, and mentorship for ECRs and support for academic networking (e.g. support for conference attendance and relevant training). An innovative partnership, funded by *East Midlands Health Innovation and Educational Cluster*, between *East Midlands Ambulance Service* and **CaHRU** has supported paramedics to embark on research degrees.

Aims and objectives: co-creating health research to maximise impact

Our groups support five objectives which stem from our overarching aim of co-created research that maximises impact:

a. To involve individual, organisational and corporate stakeholders (e.g. patients, the public, practitioners, managers, commissioners, policymakers or industry representatives) in each stage of the research process;
b. To conduct national and international multidisciplinary research to develop innovative health and social care technologies, treatments and systems;
c. To examine the performance and functioning of health and social care practice, organisation and delivery, with a particular emphasis on promoting quality, efficiency and equity;
d. To ensure outcomes are appropriately and widely disseminated using the concept of 'dissemination by design' and using a variety of media;
e. To develop a sustainable research infrastructure and environment.

In delivering these objectives the **LIH** has increased competitive external funding (e.g. EU FP7, UK-RC, National Institute for Health Research), published more papers in high impact journals (e.g. BMJ, Annals of Internal Medicine, Nature Neuroscience) and resulted in greater impacts on national and international policy and practice compared with RAE2008 (see impact template and case studies).

Involvement of health and social practitioners, managers, commissioners and policy makers
Our research involves clinicians and health professionals, not just as research participants but also as co-applicants on bids, collaborators on studies and expert advisors supporting and guiding our research. This degree of involvement enables project outcomes to be more easily adopted into practice. For example, in the **PEQO** programme, we involved pre-hospital regulators, ambulance staff and managers to ensure change across a number of treatment areas (e.g. for heart disease, stroke, cannulation and pain management) which would otherwise have occurred far more slowly, if at all. Successful bids involve working closely with policy makers to ensure our research is responsive to national priorities. For example, in the **OPWB** programme we worked closely with the Social Care Institute for Excellence (SCIE) to take forward research into preventive care for older people. Dr Machado works with Professor Nicholas Morrell at Cambridge University Hospitals NHS Foundation Trust on the genetics of pulmonary arterial hypertension.

Public engagement and involvement of service users and carers
The public, patients and service users have been central in guiding our research activity. We have developed a number of strategies to ensure our research is linked to user priorities, outcomes that can be influenced and implemented by users, and findings that can be understood within the public domain. Where possible, users, from a broad range of organisations (e.g. existing patient groups, third sector organisations, pensioner groups), are co-applicants in our bids, members of steering groups or involved in the research through data collection, analysis, contributing to reports, papers and dissemination through conference presentations or by cascading information through peer organisations. For example, service users were involved in the Pre-hospital Outcomes for Evidence Based Evaluation (PhOEBE: http://www.cahru.org.uk/research/peqo/phoebe/) bid as well as contributing to the management of the programme. A number of service users also reviewed information sheets and interview schedules, thus ensuring that our approach was meaningful to participants.

Involvement of industry
Examples include: Taylor has conducted two product development projects with Novozymes. Biswas and AiCuris (http://www.aicuris.com/18) have a successful collaboration on helicase-primase inhibitors (HPI) for treating resistant *Herpes simplex*, which is now entering Phase-3 clinical trials. Lancaster has collaborated with Novartis and Sanofi (previously Acambis) to develop a vaccine for hospital acquired *C. difficile* infection currently in Class-1 clinical trials. Siriwardena is working with Ultrasis (UK) to develop novel online platforms for delivery of psychological therapies and TESAN (Italy) to develop telecare for people with multiple long-term conditions. These partnerships with industry will be further developed to identify and deliver further research outcomes.

Multidisciplinary research to develop innovative health and social care technologies
Research on prehospital clinical quality indicators for ambulance services (in **CaHRU**) led to the adoption of these indicators into NHS national regulatory frameworks (*Care Quality Commission* 2010). Research exploring prevention and personalisation for older people has underpinned central and local government actions around prevention of disability and promotion of well-being (*Department of Health* 2010). We influenced the *European Innovation Partnership in Active and Healthy Ageing*, who used our work to advance their research strategy for the co-production of care (*EIPA* 2011). Our research has affected UK vaccination policy through research findings being included in the Chief Medical Officer's annual letter on influenza vaccination (*Annex B GP practice checklist*, 2012-14). Our studies on insomnia (e.g. Resources for Effective Sleep Treatment, REST) have helped adults to sleep better and reduced inappropriate hypnotic prescribing. Our e-learning package for clinicians about treatment for insomnia has had over 3,000 unique visitors (including clinicians and service users) from 90 countries across five continents.

Building new collaborations through seed-funding grants
A University-wide Research Investment Fund (£500k pa) and smaller internal college grants have

been made available to build capacity and research experience. These fund multidisciplinary studies across the three Colleges involving industry or statutory bodies (e.g. clinical and operational staff). Five projects have been awarded to **CaHRU** since 2010 and have led to further external bids and key publications (e.g. *Huedo-Medina T et al.* BMJ 2012; 345: e8343).

Promoting shared learning
In addition to dissemination through publication and at international and national conferences, a core programme of quarterly **LIH** seminars ensures future joint research opportunities can be identified and implemented. In addition, staff attend monthly college-wide seminar programmes. **CaHRU** also runs bimonthly 'Improvement Science and Research Methods' seminars and quarterly seminars in partnership with the local NHS. **MBoD** and **DDaD** seminar programmes include eminent speakers, for example, Professor Steve Jones, University College, London. **LIH** staff have successfully won external awards for seminars, e.g. Davy secured funding from the *Foundation for the Sociology of Health* and Illness for an international seminar series "Intersectionality: Theory and practice for Quality Improvement in Healthcare".

c. People, including:
i. Staffing strategy and staff development

Staffing strategy
The **LIH** is supported by the University's *People Strategy*, a comprehensive range of policies around employment, equal opportunities, research management and ethics, each with an element designed to facilitate and support research activity among staff and students. The University has signed up to principles of the *Concordat to Support the Career Development of Researchers*. It has introduced minimum academic standards regarding research productivity within its annual appraisal system for those seeking career advancement. Research success is rewarded directly through financial incentives and indirectly through the research leave scheme. This is open to all categories of contracted staff on an annual basis. In addition, every researcher has a nominated research mentor as part of the research element of the *Continuing Professional and Personal Development (CPPD) Framework*, as well as access to a *Further Study Fund*, which can be applied to cover all or part of expenses for further study.

Recruitment
The **LIH** has ensured the appointment of core research staff to develop its research strategy by selecting, recruiting, and retaining researchers with the highest potential to achieve research excellence. **MBoD** and **DDaD** appointed 15 new researchers as lecturers, senior lecturers, readers or professors. **CaHRU** has recruited 8 new research staff following the appointment of Siriwardena (in 2010): a reader, two senior lecturers, a research fellow and four research assistants. **CaHRU** (as part of a wider consortia) has received research funding from the NIHR, EPSRC, EU (FP7 programme) and Health Foundation. Longer term funding, including a 5-year NIHR Programme Grant for Applied Health Research (PGfAHR), has allowed us to build a critical mass of research activity, capacity, outputs and outcomes.

Integration of clinical and NHS-employed academics
Clinical academic leaders are part of the **LIH**. Siriwardena works as a part-time General Practitioner and is also Associate Clinical Director at *East Midlands Ambulance Service* (EMAS), which facilitates cross-organisational collaboration. Several research programmes (e.g. PhOEBE, ASCQI) and individual studies have been conducted with NHS Category C staff. Two PhD students have been appointed from EMAS along with PhD students from secondary care nursing. Research infrastructure (RAE2008 and NIHR research capacity development) funding has been used to fund ECRs (Asghar**,** Davy) and research studentships.

Supporting and developing careers for research excellence
The **LIH** provides a planned induction process, mentorship and appraisal. All staff are supported in using the CPPD Framework, an on-line tool that enables researchers to review and critically reflect on their skills, knowledge and expertise in relevant areas. This is used in annual appraisal (and quarterly or six-monthly reviews) to ensure individual research goals and development needs are achieved. Tailored training in methods and skills is provided (e.g. health economics, producing peer reviewed publications). Investment in research activity has ensured that, where possible, staff transfer from short-term research contracts to permanent positions (Asghar, Davy). Competitive

doctoral studentships were introduced in 2009 with a total of 19 in **MBoD** and **DDaD** and 2 in **CAHRU**.

ii. Research students

We have markedly increased numbers of postgraduate research (PGR) students since RAE2008 with 27 PhD students registered (compared with 17 in RAE2008) and 10 completions over the census period (compared with none in RAE 2008). A *Masters in Clinical Research* programme has successfully recruited students who normally progress to PhD studentships. **LIH** plans to further increase this investment in PGR students particularly through university-funded collaborative studentships across cognate areas of **LIH** research, e.g. cancer, vaccinations, prescribing, social computing and health. Senior members of the **LIH** all have responsibility for supervising Masters by Research and PhD students and our effective staff recruitment strategy has ensured that our supervisory capacity has increased. Every research student is a member of the University's Graduate School which fosters the development of postgraduate research and champions the interests of research students at the University. The Graduate School offers research education and career development programmes and a support network for all research students. Research students are supported to present their work at seminars and at an annual Postgraduate Student Conference, to get work published, identify potential research funding and to learn skills transferrable to the workplace.

d. Income, infrastructure and facilities

Members of the **LIH** work closely with Business Development Managers in each College to help identify opportunities for funding and collaborations to develop grant applications. This ensures a coordinated approach. In addition, each College has a Director of Research, with dedicated administrative support, to lead and encourage a strong research culture. This model, established during the census period, has seen grant income awarded rise across our three units from £2.5m (2000-07) to almost £17m (2008-13).

Income

The total spend on research projects was over £1.6m and the value of active grants in the period, which includes funding shared with other institutions, is almost £17m. Such success is of greater note since **CaHRU** has only been in existence since 2010, whilst **MBoD** and **DDaD** only reached full capacity in 2013. In particular, Siriwardena is chief investigator for a 5-year NIHR Programme Grant for Applied Health Research (£2m), and is collaborator on a EU-FP7 project (€2.5m) and Research Council study (EPSRC £500k). He has also been chief investigator for two Health Foundation grants (£400k and £450k), two NIHR studies (Research for Patient Benefit: £55k, £103k) and is collaborator on several other grants. Blagden holds a grant from the EPSRC (£500k) and Bachrati from BBSRC (£386k). The reach and breadth of our funders reflects the types and extent of our research; ranging from individual fellowships awarded by the *Royal Society* (Taylor) and *British Heart Foundation* (Machado); from a *Royal Society Research Grant* (awarded to Singh in 2013) to a complex NIHR and Health Foundation funded multisite studies (Siriwardena).

Infrastructure and facilities

Working in partnership with the *Lincolnshire Co-operative Society*, £14m has been invested to develop the Lincoln Science and Innovation Park (**LSIP**), a 10-acre facility in the heart of the city. Providing state-of-the-art laboratories, for disciplines such as biology, biomedical science and the new School of Pharmacy. The partnerships within **LSIP** will ensure staff conduct cutting edge research shaping future approaches and outcomes in health and social care. The Joseph Banks Laboratory, comprising research laboratories, offices and dedicated research equipment, serves as the hub for **LSIP**. The potential to attract international pharmaceutical and biotechnology companies, linking academia, industry and technology, will further strengthen our research infrastructure and environment. This will support the existing excellent track-record of achievement, lead to greater critical mass in world-class research and increase our impact.

LIH benefits from support provided by the University Research Office (**URO**), *Enterprise@Lincoln*, and School Research Administrators. **URO** provides access to expert consultant advice on bids, collaborative partners and proposal development; applies cross-University peer review processes on tenders, and; works alongside our researchers to ensure that proposals are costed to deliver value for money. A centralised on-line database (Awards Management System) supports bid

management. Monthly meetings enable cross-college networks and programmes. **LIH** is a collaborative partner in the *NIHR East Midlands Research Design Service*, which supports applied health research bids. *Enterprise@Lincoln* supports effective project management early in the research process, providing non-disclosure agreements with potential partners, itemised consortium contracts and intellectual property agreements. Through managing consultancy arrangements, they support collaboration with governmental departments or non-governmental organisations, e.g. *Social Care Institute for Excellence (SCIE).*

We subscribe to core research databases (e.g., UKRO, NIHR) and information on funding sources is collated and disseminated weekly by the School Research Administrators. The Colleges coordinate cross-college meetings around specific programme areas to identify those tenders to be progressed, collaborators, competitors and user involvement for bids.

The Graduate School provides research education, career development programmes and a support network for all research students. All are supported to present their work at seminars, to publish and identify research funding. In addition, there are extensive online and physical library facilities and IT support.

Research governance
The University Ethics Policy is central to our research governance. Each School has a Research Ethics Committee which reports to College and University Ethics Committees. The College Ethics Committees include lay-members and meet requirements of external funders. Induction processes include ethics training and Good Clinical Practice training for clinical trials. We have agreed a Memorandum of Understanding with primary care through the Lincoln Health and Social Care Steering Group to ensure we follow the NHS Research Governance Framework. A proportion of our sponsored research projects are audited.

e. Collaboration or contribution to the discipline or research base

Scope of activity
Through innovative methods and practice, our researchers are: identifying disease aetiology (e.g. proteome-wide chemical and molecular profiling), epigenetics; developing individualised drug treatment (e.g. pharmacogenetics); designing better delivery of pharmaceutical drugs (e.g. biological therapeutics), solid state pharmaceutics, and crystal engineering; designing and evaluating the impact of vaccinations (e.g. development and early testing of *E. coli* vaccination and the mitigating impact of influenza vaccination on acute myocardial infarction and stroke); identifying barriers and facilitators to reducing inappropriate prescribing practices (e.g. inappropriate hypnotic drug use); determining the effectiveness and cost–effectiveness of treatments or services (e.g. change in older peoples' quality of life and service use following the implementation of preventative services); using improvement science methods to increase service quality and evaluate the effect on efficiency and equity across health and social care organisations (e.g. timely and appropriate treatment delivered by ambulance-based clinicians, increasing vaccination rates and ensuring outcomes are reported and implemented in national policy and guidelines).

Research publications and dissemination
All our units have delivered high quality international peer-reviewed publications focussed towards a range of audiences, notably: *Nature Structural and Molecular Biology* (Bachrati), *Gut* (Biswas), *Nature Neuroscience* (Guttierez), *Circulation* (Machado), *Annals of Internal Medicine* (Middlemass), *Nano Letters* (Goddard), *Journal of Controlled Release* (Blagden, Vllasaliu), *Journal of the American Chemical Society* (Singh, Sharma), *Angewandte Chemie* (Taylor), *British Medical Journal, Canadian Medical Association Journal, Stroke, Vaccine and Sleep* (Siriwardena).
An example of different media to promote findings includes the use of e-learning to help clinicians to better manage patients with insomnia (see impact case studies). We make full use of social media (e.g. blogs and Twitter) to disseminate our work (e.g. @LIH_UoL, CaHRU_UoL, and www.CaHRU.org.uk). We link our findings to research partner websites: for example, a phage protein crystal taken by Taylor was featured as 'research image of the month' on the *Royal Society's 'Inside Science'* blog.

Selected invited talks and presentations
Invited talks and keynote presentations have included the following: researchers from **DDaD** have

presented at 'Nanotechnology meets Clinical Medicine' at the *European Research Council* conference, Aviano and Udine, Italy (2011) and 'Advanced diagnostics and drug-delivery at the nanoscale', Trieste, Italy, 2010 (Ferrari); Lappin spoke at *the American Association of Pharmaceutical Science* (2011) to discuss 'Microdosing and the Pharmaceutical Industry'; Singh spoke on 'Synthesis of C-2´-Deoxynucleosides Containing Bulky Base Surrogates as Structural Probes for DNA Protein Interactions' at the *Indo-Italian Seminar on Green Chemistry and Natural Products* at New Delhi, (2008), 'Sequence-Selective Detection of Double- Stranded DNA using DNA-Binding Polyamides Functionalized Gold Nanoparticles and Microarrays' at the *3rd Royal Society of Chemistry, Bio-Organic Group Forum* (2012), and 'Sequence-selective detection of double-stranded DNA using DNA-binding polyamides microarrays' at University of Ghent, Belgium (2013); Goddard spoke on 'Interdependence of two NaK domains in a fused nitrate/nitrite transporter' at the University of East Anglia Department of Biological Sciences (2009), 'Functional expression of the GPCR NTS1' at Oxford Science Park (2010) and 'Recent advances in GPCR structures and function', at the Department of Biochemistry, University of Oxford in (2013);. Invited lectures on molecular mechanisms include talks on 'Protein structures and phage' at the *Edinburgh International Phage Conference* (2008) and Phage 2013 at St Hilda's College, Oxford (Taylor), and on 'Drug resistant mutations in HSV helicase-primase complex' at a symposium on viruses and antiviral therapy, Queens' College, Cambridge in 2012 (Biswas). Machado co-chaired the *4th World Symposium on Pulmonary Hypertension* in 2008 and was an invited task force member for the 5th iteration in 2013. He was also an invited speaker at the 'Basic science of pulmonary hypertension' at the University of Cambridge in 2010; Keynote lectures in the area of community and health include: on the *Quality and Outcomes Framework at the Primary Care Transparency Conference*, Netherlands (2011); on chronic disease at the *XII Primary Care Congress*, Empoli, Italy (2012); and influenza vaccination and cardiovascular disease at the EU Geriatric Medicine Congress, Venice (2013) (Siriwardena). Windle was invited to speak at the *International Expert Seminar on Ageing and Long-Term Needs*, London School of Economics (2011) and alongside the Chair of the Health Committee, Centre for Public Policy Studies at 'Adult Social Care After the White Paper' (2012).

National and international academic research collaborations

We have had active grant-funded research collaborations and research publications with more than 20 international and national academic units since 2008 as well as collaborative partnerships with academic experts across the university including social computing, psychology, nursing, sport and exercise science, and social policy. Our work in **CaHRU** (Siriwardena) on insomnia involves collaborations with the Program in Placebo Studies (PIPS) at Harvard University, Allied Health Services at University of Connecticut and General Practice and Primary Health Care, University of Ghent as well as the Sleep and Circadian Neuroscience Institute at the University of Oxford, Universities of Glasgow, Loughborough and Sussex. **CaHRU** currently works with NIVEL (Netherlands Institute for Health Services Research) on a EU FP7 study (QUALICOPC) involving 27 countries and with the University of Milan on another EU FP7 study (CHROMED) involving six countries. In prehospital research, **CaHRU** collaborates with the School of Health and Related Research (ScHARR) at the University of Sheffield and also the Universities of Swansea and Surrey. Members of **MBoD** collaborate with the Molecular Virology group, University of Cambridge (Biswas) and the biomimetic Research Group at Amity University, India (Sharma). Joint work with the Amity Institute of Biotechnology, India, has led to a collaborative PhD studentship on 'Efficacy of Rivastigmine and Quercetin conjugate form for Alzheimer's disease and its modelling and docking studies' (Sharma). There are also collaborations with the Departments of Organic Chemistry at the Universities of Ghent (Belgium), Glasgow, Strathclyde and Leicester (Singh).

Members of **DDaD** collaborate with Pharmaceutical Engineering at Bradford University (Blagden); the Microdosing Research Group at Duke University, USA, Regenerative Map at the Project Karolinska Institute, Sweden and University of Maryland, USA on Effects of PGJ2 in rodent optic nerve stroke (Lappin), School of Pharmacy, University of Nottingham (Vllasaliu**).**

We have strong research links with international and national industry, health and social care organisations. We work with international companies developing specific drug development and delivery mechanisms, including crystallisation, e.g., biotechnical work with Novozymes, Critical Pharmaceuticals, GSK, Pfizer, AstraZeneca (Blagden). Lappin works as a consultant member of the Scientific Advisory Board for Xceleron Inc., USA. Siriwardena works with TESAN (Italy) to evaluate innovative telehealth (CHROMED: EU FP7) and with Ultrasis (UK) in an EPSRC study to

develop online delivery of psychological therapies. We have active funded collaborations with health, social care and the third sector organisations including Lincolnshire Community Health Services NHS Trust, East Midlands Ambulance Service NHS Trust, National Ambulance Research Steering Group, Social Care Institute for Excellence and Department of Health. We are also represented on the Trent Comprehensive Local Research Network since 2009 and the East Midlands Academic Health Science Network and Local Education Training Board.

Multi-disciplinary research partnerships

Successful consortia have been formed and awarded competitive funding with international and national colleagues based in academia, industry, statutory and non-governmental organisations. These include (amongst others) specialists from nanotechnology, synthetic organic chemistry, stem-cell research, pharmaceutical engineering, psychiatry and behavioural science, emergency medicine, elderly care, statistics and health economics. We have highlighted academic organisations from which our experts are drawn above. Our researchers lead and feed into a wide range of international and national policy groups. For example, Siriwardena is a board member of the *European Forum for Primary Care* and *the Emergency Medical Services 999 Research Forum*, both international groups of academics and policy experts. He chairs the *National Ambulance Research Steering Group* and is a board member of the *National Ambulance Clinical Quality Group in England*. Windle was a member of the national *Social Care Institute for Excellence Health and Well-Being Advisory Group* (2010–11) and as lead author delivered: 'Preventing social isolation: interventions and outcomes' (*Research Briefing 39*).

Participation in editorial and peer review processes

Siriwardena is editor of the international journal *Quality in Primary Care* and an editorial board member of the *British Journal of General Practice*. Our researchers review for over 50 journals ranging from fundamental science to community and primary health, e.g. *Brain, Journal of Cerebral Blood Flow and Metabolism, British Journal of Pharmacology, Journal of Neurochemistry* (Bates); *Hepatology, Journal of Antimicrobial Chemotherapy, Expert Review of Anti-Infective Therapy, Antiviral Research* (Biswas); *Journal of Optics, IEEE, Electron Device Letters* (Ferrari); *FEBS (Federation of European Biochemical Societies*) journal (Goddard); *Expert Opinion in Drug Metabolism and Toxicology Bioanalysis, British Journal of Clinical Pharmacology* (Lappin); *Nanomedicine, European Heart Journal* and *European Respiratory Journal* (Machado); BMJ, Lancet, Vaccine, Heart, Thorax (Siriwardena); Acta Crystallographica Section F, *Glycobiology, Carbohydrate Research, Applied Microbiology* (Taylor), *Nanotechnology Biology and Medicine, Pharmaceutical Research Molecule*s (Vllasaliu). Our researchers have reviewed grant applications for the European Commission, Italian and Portuguese governments (Bates); MRC, the BBSRC, EPSRC (Ferrari, Bates); and the NIHR, MRC, ESRC, National Institute for Social Care and Health Research Wales, Diabetes UK and Health Foundation (Siriwardena).

Fellowships and awards

Our researchers have been successful in being awarded several prestigious fellowships. For example, Machado was recipient of an independent *British Heart Foundation* fellowship in the Division of Genetics and Molecular Medicine, King's College London. In the third year of his PhD at the University of Leicester he discovered the major gene that causes Pulmonary Arterial Hypertension. He is taking forward this work at Lincoln. Taylor is recipient of a long-*term Royal Society University Research Fellowship* with renewal (2008-14). Through his work on phage, he is developing new ways of combating infections.

Other awards include a *MRC Laboratory of Molecular Biology* Career Development Fellowship 2009-12, British Council – Italy partnership program 2008-2009 (Ferrari); *Marie Curie Individual Fellowship and Leverhulme Trust Fellowship* (Bachrati), *Wellcome Trust Vacation Scholarship* 2013 (Vllasaliu) and Senior Academic Fellowship within the EU MEDBIOLIN project (Bates). Davy received the *British Sociological Association Philip Abrams Memorial Prize* 2012 for the best sole-authored first book in Sociology in the UK.