Institution: University College London

Unit of Assessment: 03B Allied Health Professions, Dentistry and Nursing (Pharmacy)

a. Overview

This submission presents the research environment at the UCL School of Pharmacy and outlines how it facilitates the activities of the academic staff. This institution has been a major contributor to education, research and professional development within the pharmaceutical arena since its foundation in 1842. Prior to January 2012, the School was an independent member of the federal structure of the University of London. The School is now a Division of UCL, rated as 4th in the world in the 2012/2013 and 2013/2014 QS University Rankings. The School is situated within the Faculty of Life Sciences that, together with the Faculties of Medical Sciences, Brain Sciences and Population Health Sciences, forms the School of Life and Medical Sciences (SLMS). This re-positioning has built on the existing strengths of the School to produce an environment of exceptional vitality and forward momentum, reflected by the number and quality of recent academic appointments (14 since the merger) as well as the range of ongoing collaborations with colleagues and Divisions across UCL, including the Divisions of Medicine, Biosciences, Chemistry and Mechanical Engineering as well as the Institutes of Child Health, Genetics and Neurology. Academic staff have produced 1856 publications over the census period, including 1679 research papers and 60 book chapters and books. The School has filed 13 new patents in the period, while 6 patent families have progressed to be granted. Average annual research grant income is £6.84m, with a total grant income of over £34m since 2008. The School is involved in two Centres for Doctoral Training (EPSRC and BBSRC), with a further EPSRC Centre with the University of Nottingham recently announced, and has founding involvement or ownership of six spin-out companies, with a current School share value of £3.1m.

Research strategy is developed through the Research Committee and implemented through Research Clusters; *Molecular Drug Delivery and Nanomedicine* (**Brocchini**), *Pharmaceutical Materials and Dosage Form Design* (**Gaisford**), *Drug Discovery* (**Fish**), *Biodiversity and Medicines* (**Heinrich**), *Neuroscience in Health and Disease* (**Stephenson**), *Disease Models and Clinical Pharmacology* (**R Harvey**), *Medication Use, Systems and Practice* (**Smith**), *Behavioural Medicine and Treatment Optimisation* (**Horne**) and *Pharmacy Education and Global Workforce Innovation* (**Bates**). Each Research Cluster has a Lead Academic (in bold), whose primary roles are to develop research strategy, identify opportunities, support grant applications and assist the Heads of Department in mentoring staff. Membership is flexible and staff are not limited to one cluster, thereby fostering interdisciplinary research. The Research Committee, comprising the cluster leads and Director, considers and formulates overarching research strategy, audits current research, allocates internal funding and examines the case for new academic staff. The activities of the School are considerably augmented by collaborations and relationships with external bodies including the Department of Health, numerous hospital trusts and UCL Partners, the pharmaceutical industry, the Royal Pharmaceutical Society, the Fédération Internationale Pharmaceutique and prestigious research groups at institutions and universities such as Cambridge, Oxford, Imperial College, CNRS Paris, Monash, Georgia State University, University of California San Diego, National Cancer Institute Bethesda and Yale University.

b. Research strategy

Main objectives, activities and drivers: The School is committed to the generation of outputs, grant income, stakeholder engagement and enterprise activity commensurate with the highest international standards in the areas of expertise defined by the clusters. The key strategic tools are: i) encouragement of cooperation, mentoring and opportunity identification via research clusters and staff development strategies; ii) support for the research infrastructure (for example CIF investment of £4.3m since 2008); iii) development of collaborations with colleagues in other divisions and faculties within UCL; iv) engagement with UCL research support infrastructure such as grant-writing advice services and a range of enterprise and technology transfer organisations such as UCL Business, UCL Consultants, UCL Partners and the UCL Translational Research Office, described in more detail below; v) encouragement of engagement with stakeholders such as industry (e.g. the EPSRC Centre for Doctoral Training with the University of Nottingham); vi) strategic appointments in existing and developing areas of strength (e.g. four appointments in

chemical biology to support drug discovery since 2012); vii) encouragement of translational research, enterprise and spin-out company generation; viii) encouragement of engagement-based research such as policy development in which the School has traditionally had a leadership role (for example see **Bates** and **Barber** Impact Case Studies on education and national health policy development); ix) strong external collaborations with national and international research partners.

Research environment and institutional support: The School has an annual turnover of ~£21m and currently employs 183 staff, 53 of whom are academics, and houses 163 postgraduate students and 48 postdoctoral researchers. There has been considerable recruitment activity in the last two years alone, including four new professorial appointments (**Craig**, **Della Pasqua**, **Fish**, **Kozielski**), two senior lecturers (**Barker, Wei**), three lecturers (**Chater, Orlu Gul**, **Williams**) and five Excellence Fellows (**Chapman**, **Haider**, **Healy, Pasparakis, Rahim**), these being well-supported, prestigious UCL positions for future research leaders. There has been a continuing programme of infrastructure improvement (see ***Internal facilities*** below), consolidation of existing projects such as the £5.1m Molecular Pharmaceutics Wing (opened by HRH The Princess Royal in 2009) and equipment purchase (~£4m since 2008).

In terms of scientific direction, the main theme areas of drug discovery, formulation sciences, neurosciences and medicines use and health outlined in RAE 2008 have been maintained and enhanced. However, the recent introduction of a cluster structure has allowed greater flexibility and encouraged collaboration across disciplines (see ***Future strategy*** below). In addition, the merger with UCL has opened up major research support opportunities for the School. For example, UCL provides specialist support for grant applications through a team of Research Facilitators, under the office of the Vice Provost (Research). Support includes notification of upcoming funding calls, grant writing workshops, facilitation of collaborative teams, assistance with impact statements and 'light touch' grant reviewing by academic champions. UCL also supports and part funds PhD studentships; these Impact Studentships have been secured (co-funded either by the School or by external bodies) by **Della Pasqua, Gaisford, K Harvey, R Harvey, Rahim, Shah** and **Williams** with collaborative partners in UCL Chemistry, Neuroscience, Physiology and Pharmacology and the Institute of Neurology. We are also able to interact with UCL Hospitals (comprising 6 hospitals) and UCL Partners, an Academic Health Science Partnership comprising a community of over 40 academic and NHS members, covering a patient population of over six million people. As an example of this integration, **Brocchini** has a joint appointment with the Biomedical Research Centre (BRC), run jointly by the UCL Institute of Ophthalmology and Moorfields Eye Hospital. This world-leading centre won the 2012 Queen's Anniversary prize for outstanding excellence. The collaboration with Prof Sir Peng Khaw has led to the development of novel solid formulations to treat ocular fibrosis and two patents have been submitted in this area.

Peer reviewed research funding: The School has a significant portfolio of competitive funding for basic and applied research. Examples include the following; **Ali**, **K Harvey**, **Jovanovic**, **Mercer**, **Pearce, R Harvey**, **Stephenson** and **Thomson** were awarded £1.4m by MRC to identify mechanisms underlying synapse-specific clustering of $GABA_A$ receptors; **Della Pasqua** secured €250k from the EU as part of a €2.6m project developing gabapentin for the treatment of paediatric chronic pain; **Gaisford** secured £388k in an EPSRC award (overall value £1.24m) with UCL Chemistry and Strathclyde School of Pharmacy to study the generation of polymorphs via inkjet printing; **Neidle** was awarded a £912k Cancer Research UK grant to develop his nucleic acid recognition studies; **Shah**, **Ruiz** and **Thomson** were awarded £1.5m by MRC to understand selective targeting of synapses to specific dendritic locations and their modulation by voltage-gated ion channels; **Schatzlein** and **Uchegbu** are part of the €1.8m EU TRANS-INT project, which aims to design oral nanomedicines and involves 16 academic and industrial partners (value to the School £524k); **Stephenson**, **R Harvey**, **Ruiz**, **Shah** and **Thomson** were awarded £379k by the Wellcome Trust to establish an advanced imaging facility for neuroscience; **Shah** secured €1,400,547 from the ERC to study the role of presynaptic HCN1 channels in regulating cortical synaptic transmission and plasticity; **Stephenson** and **Shah** have recently secured £645k from the BBSRC to study TRAK-mediated neuronal mitochondrial trafficking mechanisms; **P Taylor** was awarded £325k by BBSRC to investigate disruption of cytoplasmic membrane-associated function in *Staphylococcus aureus* and has had continuous MRC support for the last 13 years; **Williams** has secured €368k to develop tissue engineering of the right heart outflow tract using an electrospun bioresorbable polymeric tube as part of a €4.5m EU consortium grant. Other

successful funding areas over the reporting period include medicines use (**Barber** and **Smith** ~£2.7m), medication safety (**Franklin** ~£1.5m); phytochemistry (**Gibbons** ~£0.5m), behavioural science (**Horne**, ~£2.5m) and nanomedicine (**Kostarelos**, ~£3.3m).

Translation of basic research into medicines is one of our core missions and our research is well supported through both RCUK and industrial collaborations. **Basit** has attracted ~£1m of industry funding and has developed a number of advanced drug delivery technologies, including COLAL-PRED™, PHLORAL™, Prorelease™ and Duocoat™, all of which are at various stages of development with commercial partners. **Brocchini** has developed polyethylene glycol (PEG) conjugates in partnership with Polytherics; the company has developed treatments for haemophilia, cancer and multiple sclerosis and licensing income has exceeded £8m in 2013. **Neidle** has collaborated with Summit plc via a Wellcome Trust Seeding Drug Discovery Initiative grant to develop a novel drug against the major hospital infective agent *Clostridium difficile*; this drug will shortly enter Phase 2 trials. **Tuleu** is Chair of the Formulation subgroup of the NIHR Medicines for Children Research Network, a £5m initiative to facilitate paediatric clinical trials. **Tuleu** and **Orlu Gul** are part of a €5.84m FP7-Health-2013-Innovation consortium to develop clonidine formulations for paediatric patients (total value to UCL €593k). **Uchegbu** and **Schatzlein**'s company, Nanomerics, has a lead product METDoloran, a nano-enabled form of the endogenous opioid peptide leucine5-enkephalin, due to go into first-in-man studies in 2015. Therakind, founded by **Wong**, has produced Buccolam®, a treatment for prolonged acute convulsive seizures in children that is now being marketed across Europe by Viropharma Inc.

Enterprise activities: Since 2008, the School has had 19 new patents either filed (13) or granted (6). The School has entered into 14 licensing agreements with companies based on its IP. In addition, the School has instigated or been associated with several spin-out companies including Nanomerics Ltd (**Uchegbu** and **Schatzlein**) which attracted a £1.2m EPSRC Technology Strategy Board (TSB) award for Molecular Envelope Technology (MET). Polytherics (**Brocchini**) attracted £12.15m in venture capital funding, while Spirogen (in which **Thurston** played a significant role) has recently been sold for up to $460m to AstraZeneca. Estimated turnover for School spin-out companies is £10.5m per annum and the estimated share value stands at £3.1m. Similarly, the formulation consultancy company Pharmaterials, founded by **Buckton**, was sold to the US multinational Pharmaceutics International Inc. following eight years of growth, while **Gaisford** and **Basit** were founders of Kuecept Ltd, which currently provides formulation and first-into-man expertise to over 150 industrial clients.

Centres for doctoral training and industry interaction: The School has been involved in establishing successful Centres for Doctoral Training (CDTs) including the BBSRC London Interdisciplinary Biosciences PhD Consortium (comprising UCL, King's College London, Royal Veterinary College, London School of Hygiene and Tropical Medicine, Birkbeck College) and the CDT in Targeted Therapeutics and Formulation Science, a ~£2m scheme in partnership with Nottingham University and the EPSRC. A range of company partners including Alliance Boots, AstraZeneca, GlaxoSmithKline, Pfizer, Critical Pharmaceuticals, Molecular Profiles and Quotient Clinical supports the CDT. An award for a further CDT with Nottingham (total value circa £11m) has been announced and will support 60 PhD studentships. Additionally, industry collaboration has been supported via successful applications for Cooperative Awards in Science and Engineering (CASE) studentships (with EPSRC, BBSRC and MRC support). During the reporting period staff including **Ali, Barber, Basit, Brocchini, Buckton, Constanti, Craig, Hadgraft, K Harvey, R Harvey, Gaisford, Lane, Rahim, K Taylor, P Taylor, Tuleu** and **Wells** have developed productive collaborations with: AstraZeneca, CeGaT GmbH, ConvaTec Ltd, Dermal Laboratories, GE Healthcare, Genzyme, GSK, GW Pharmaceuticals, Kuecept Ltd, Marloes Technology, Novartis, Pfizer, Pharminox, Polyphenon, Polytherics Ltd, Proctor and Gamble and Rosemont. The combined worth of EPSRC DTP, CASE awards and part-funded industry studentships to the UCL School of Pharmacy in the reporting period is £1.98m.

Consultancy: The experience and reputation of the academic staff is reflected by the fact that ~70% engage in consultancy, act as Expert Witnesses or perform contract research. For example, **Basit**'s provision of consultancy to an established European Pharma company (Tillotts Pharma AG), led to >£500k of research funding over the last 5 years to develop the coating system PHLORAL™. The product, originally developed by him and to which the School has royalty rights, has entered phase III trials. Large projects have typical values of £50k to £200k and in total, 130

contracts with a combined value of £3.2m have been put in place during the reporting period. Such activities are supported by UCL Consultancy who identify partners, manage contracts, and provide indemnity. Staff are contractually allowed to perform up to 40 days consultancy per annum.

Publications: Research is published in high impact factor peer-reviewed journals, with a total of 1679 articles in the reporting period. Publication highlights include *JACS* (14), *J Biol Chem* (23), *Cell Rep* (1), *Chem Comm* (17), *J Med Chem* (19), *Nature* or *Nature branded* (16), *Neuron* (2), *PNAS* (8), *Science* (1). The staff have also published 60 books or book chapters over the reporting period. Each academic has a UCL Institutional Research Information System (IRIS) page, listing all publications along with biography, research themes and esteem items and which is publically accessible. All publications are stored in UCL's open access database, UCL Discovery, which allows any member of the public access to bibliographic information and, where copyright allows, full-text articles. Open access publication is actively encouraged and supported financially by UCL.

Strategic UCL-based groupings: The School is participating or leading in a number of UCL-based research initiatives which include the following: **Brocchini** is a partner in the EPSRC Centre for Innovative Manufacturing in Emergent Macromolecular Therapies, an initiative led by the UCL Division of Biochemical Engineering. The partnership is focused on enabling the manufacture of macromolecular therapies and hence aiding industry to bring such products to market. The consortium includes UCL, Imperial College and 30 UK companies and Knowledge Transfer Networks. **Brocchini** is a member of the Biomedical Research Centre for Ophthalmology, an NIHR-funded centre based at Moorfields Eye Hospital and partnered by the UCL Institute of Ophthalmology. **Horne** is the UCL representative for the Centre for the Advancement of Sustainable Medical Innovation (CASMI). This is a major partnership between Oxford University and UCL and aims to address the issues that have led to current failures in the translation of basic bioscience into affordable and widely adopted new treatments. **Neidle** and Miller (UCL Translational Research Office) are lead partners in the UCL Drug Discovery Initiative. This group is based in the School, employs two dedicated medicinal chemists and is run in conjunction with the Wolfson Institute for Biomedical Research and UCL Chemistry. The role of the initiative is to develop a pipeline of small-molecule drug discovery programmes and is funded by the Wellcome Trust Institutional Strategic Support Fund (£390k over three years). **Orlu Gul** is a member of the Executive Group for UCL's Grand Challenge of Human Wellbeing, a major cross-university initiative associated with promoting lifelong wellbeing for individuals and for society. She organised the 'Maximising Ageing Research at UCL' workshop at the School in November 2013 to promote research between senior UCL researchers with an interest in ageing including Professor Dame Linda Partridge (Director of the UCL Institute of Healthy Ageing) and Professor Sir Peng Khaw (Director of the NIHR Moorfields Biomedical Research Centre). This group is now actively developing a cross-UCL strategy for funding and research cooperation. **P Taylor** is a member of the steering committee of the *Bloomsbury Research Institute*, a joint initiative between the London School of Hygiene & Tropical Medicine (SHTM) and UCL to translate microbiological research into new modes of detection, treatment and control. With over 200 scientists involved in the partnership, the Institute is one of Europe's largest infection research groups, with other partners including the MRC Clinical Unit, the MRC Molecular Cell Biology Unit (UCL), the Malaria Centre, the TB Centre (SHTM) and the UCLH/UCL Biomedical Research Centre (UCL/UCLH).

Future strategy: The development of research clusters has resulted in enhanced opportunity identification (e.g. invitations to research-sponsoring organisations such as MRC Technology and Argenta, grant-writing workshops) and encouragement of collaboration within UCL (for example a 'speed dating' session with UCL Chemistry and a joint research symposium with the Institute of Child Health). This flexible research management structure has allowed the emergence of interdisciplinary themes that we intend to encourage and develop in the future. These include:

Underpinning chemical biology: the recruitment of **Fish**, **Kozielski**, **Healy** and **Haider** has complemented the strengths of both the *Drug Discovery* and *Biodiversity and Medicines* clusters by providing a core of biological chemistry, ranging from target identification through to epigenetics and molecular modelling. This knowledge base is also feeding into the activities of the *Disease Models and Clinical Pharmacology* and the *Neuroscience in Health and Disease* clusters. Cancer continues to be an area of major focus, and there are extensive links with the UCL Cancer Institute and the oncology community within UCH. There is also collaboration with the Biological Chemistry group in UCL Chemistry and the School is a partner in their recent EPSRC Doctoral Training

Centre bid. The chemical biology and modelling expertise also feeds into the opportunities afforded by the UCL Drug Discovery initiative, with which the School is ideally placed to position itself as a major facilitative centre for drug discovery within UCL.

Medicines for children: this has been a long-standing strength of the School and it is envisaged that that it will become greatly enhanced in future years, not least due to the excellent relationships with the Institute of Child Health, Great Ormond Street Hospital and the Institute of Genetics (which has a particular focus on childhood diseases and pharmacogenomics). Specific strengths include: the recruitment of **Della Pasqua** who is a clinical pharmacologist with specialisation in pharmacokinetics of children's medicines; the work of **R Harvey** on childhood genetic diseases; **Tuleu** who is an internationally renowned expert on formulation strategies for children; **Gaisford**, **Barker** and **Craig** with their interest in minitablet, thin film and other specialist formulation strategies; **Bates** and **Smith,** with their interests in global childcare and medicines provision. We will be seeking one professorial and two lectureship positions in this area.

Global healthcare and workforce planning: The School has strong links and leadership roles with a number of international organisations such as such as the Fédération Internationale Pharmaceutique (FIP; **Bates** was made a Fellow in 2013 and was instrumental in developing a formal partnership with UNESCO) as well as a long-standing interest in international pharmaceutical care provision (**Smith**). The *Pharmacy Education and Global Workforce Innovation* and *Medication Use, Systems and Practice* clusters are aligning to consider key issues of provision in developing countries. This maps onto the aforementioned interests in medicines for children and UCL's *Grand Challenge of Human Wellbeing* as well as mapping on to the interests of the Faculty of Population Health Sciences, which includes the Institute for Global Health. In addition, colleagues from the *Biodiversity and Medicines* cluster (**Heinrich**, **Prieto-Garcia**, **Gibbons**) are increasingly involved in global herbal medicines safety and substance abuse, given the continuing importance of traditional medicines as a front-line source of pharmaceutical provision.

Nanofabrication: There is a growing interest, particularly within the *Pharmaceutical Materials and Dosage Form Design and the Molecular Drug Delivery and Nanomedicine* cluster, in the development of novel techniques for the preparation of nanostructured materials, which includes electrospinning (**Williams**, **Craig**), nanofibre formation by pressure gyration (**Craig** and **Barker,** in collaboration with Mohan Edirisinghe in the UCL Department of Mechanical Engineering, who is also collaborating with **Orlu Gul** on microfluidic systems) and ink-jet and 3D printing (**Gaisford, Hilton**). Contacts are being strengthened in this area with the biomaterials and clinical groups within the Division of Medicine and the Division of Surgery and Interventional Science within the Faculty of Medical Sciences. The above examples of emerging areas of strength will be supported by new positions and infrastructure support, including judicious use of School reserves, access to infrastructure and estates funding from UCL, collaborative and administrative support from UCL and equipment provision via opportunities such as the SLMS Capital Equipment call, which annually invites bids for major equipment programmes, as well as anticipated CIF funding. We will continue to support entrepreneurial activity and envisage our portfolio of patents and spin-companies will continue to grow. The School also recognises its responsibilities in terms of professional and scientific citizenship and staff will continue to be encouraged to support their respective research communities. In addition, major initiatives within UCL provide multiple opportunities for growth and new research initiatives. These include the building of the Francis Crick Institute, the largest centre for biomedical research in Europe, due for completion in 2015.

c. People

Staff recruitment strategy: The School currently employs 183 staff, including 53 academics, along with 44 administrative, 20 technical and 8 maintenance staff. The School houses 163 postgraduate students and 48 postdoctoral researchers. This profile remains very largely consistent with the previous census period. The ratio of male to female staff is male 51.4%: female 48.6% and the average staff age is 42.6 years old. All staff have been on Equality and Diversity training and we are fully participating in the Athena Swan initiative, led by **Smith**. Staff appointments are determined with input from Heads of Department, Research Committee and the Divisional Executive Team (DET). All staff involved in recruitment must undergo the 'Recruitment and Selection in HR' briefing, organised by UCL Organisation and Staff Development (OSD).

The academic staff profile has changed over the assessment period, with new staff having been

recruited to grow the research portfolio; these include 21 academic appointments of which five are UCL Excellence Fellows. These fellowships are prestigious three-year positions for outstanding scientists, supported by generous start up packages and suitable mentoring with a clear view to their securing permanent positions on completion. This is part of a SLMS-wide scheme to develop the next generation of research leaders. Inevitably, academic staff have left during the reporting period. While some leavers retired, others have gone on to highly prestigious positions. For example, **Thurston** and **Wong** left to take up Head of School positions in the UK and Hong Kong, while **Kostarelos** joined the Nobel laureate-led graphene group in Manchester University but retains a visiting professorship at the School.

The development of the research cluster structure has allowed identification of key areas for recruitment and investment. For example (and for the sake of simplicity we only list professorial staff and new recruits) in the *Drug Discovery* cluster, the presence of **Neidle** and recruitment of **Fish**, **Haider**, **Healy, Hilton and Kozielski**, have led this group to now have considerable strength in underpinning biological chemistry, epigenetics, target identification and molecular modelling. *Molecular Drug Delivery and Nanomedicine* (**Brocchini, Uchegbu**) have expanded to include **Pasparakis**. *Pharmaceutical Materials and Dosage Form Design* (**K Taylor, Buckton**) has grown to include **Craig**, **Barker**, **Orlu Gul, Somavarapu** and **Williams**, while *Neuroscience in Health and Disease* (**Stephenson, Thomson**) has grown to include **Mercer**. The *Disease Models and Clinical Pharmacology* cluster (**R Harvey, K Harvey, P Taylor**) has grown to include clinical pharmacology (**Della Pasqua**) and *in utero* delivery of genetic material for treatment of inherited neurological disease (**Rahim**). *Medication Use, Systems and Practice* has internationally recognized expertize (**Barber, Smith, D Taylor**) and have now recruited **Wei** whose statistical expertise is feeding into numerous projects, while *Behavioural Medicine and Treatment Optimisation* (**Horne**) has recruited **Chapman** and **Chater.** The staffing strategy over the next five years includes plans to recruit in the areas of emerging strength listed earlier (age-related medicines, personalised medicines, therapeutic neuroscience and nanofabrication).

Staff development: UCL has a formal annual 'Appraisal, review and development' scheme for all staff, designed to provide support and guidance for staff and to ensure staff achieve their full potential. It is also used as a tool to obtain feedback, review job descriptions and content, examine workload, discuss forthcoming objectives and support development in current and future roles and promotion possibilities. Promotions take place via recommendations from the School being passed to a SLMS-based panel which considers all applications and on which the School has had direct representation. This panel makes recommendations to the UCL Academic Promotions Committee, chaired by the Provost. Over the reporting period there have been five internal promotions to lecturer (from Fellowships), eight promotions to senior lecturer, five promotions to reader and two promotions to professor.

The School has also introduced an induction scheme for new staff (over and above the central UCL induction and training scheme), while we have developed a sophisticated mentoring system for younger recruits where a senior academic acts as a guide and supportive colleague. New appointees with limited academic experience also follow a probation scheme. Probation, which typically lasts for three years, is a supportive mechanism designed to ensure that staff are competent to undertake academic duties. The requirements of the probation process are incorporated into the appraisal and mentoring schemes. UCL Academic Careers Office introduced the Future Fifty mentoring scheme for 2012 (in which 50 senior academic staff mentor 50 new recruits, who have potential to be future academic and clinical leaders, across UCL). **Basit, Brocchini, R Harvey** and **Stephenson** act as mentors on this scheme while **Chater, Hilton** and **Mercer** were selected as mentees. UCL also runs a Future Leaders Programme, where two staff (**Gaisford** and **R Harvey**) have been selected to receive bespoke leadership training.

The School has introduced a transparent workload model to ensure fair and open distribution of teaching and administrative tasks. Staff members appointed to Research Fellowships are not expected to contribute heavily to teaching or administration as they develop their research skills and seek to establish independent funding. Early-stage academics will have a reduced teaching and administrative load, the reduction being dependent on the nature of the role and the individual. All academic staff contribute to the School's taught programmes. UCL's sabbatical policy allows paid leave free from teaching and administrative duties and is designed to enable staff to maintain a high calibre of research, scholarship, teaching and innovation. For example, **Gaisford** spent one

term at Monash University establishing a network between Monash and the University of Sydney, **Heinrich** spent one year at Southern Cross University (Australia) establishing the Southern Cross Plant Science Institute. **Gibbons** and **Yang** have both been granted sabbatical leave for 2014 to work with Professor Yoshinori Asakawa (Tokushima Bunri University, Japan) and Professor Dame Carol Robinson (Dept. Chemistry, University of Oxford), respectively.

Other UCL staff support includes the SLMS Translational Research Office, which facilitates research between academia and industry. Funding is offered to encourage research addressing the UCL Grand Challenges (Sustainable Cities, Human Wellbeing, Global Health and Intercultural Interaction). Similarly, staff can avail themselves of UCL Impact studentships, access to Knowledge Transfer Champions or Enterprise Secondments, proof-of-concept funding through UCL Business and EPSRC Knowledge Transfer funding. Beacon Bursaries are available to support public engagement. A wide range of staff training courses, grant writing workshops and feedback mechanisms, interdisciplinary research meetings and meetings with funding council representatives occur on a regular basis. The School is represented on Faculty and SLMS-based committees whereby research strategy and opportunities are discussed. On this basis, communication of opportunities for both research and personal development, possibilities for feedback on both performance and applications, and assistance to staff seeking to achieve research excellence are all of outstanding quality.

Research students: *Recruitment and funding:* The School currently has 163 postgraduate research students, of which 84 are home and 79 are overseas. 135 doctorates were awarded within the reporting period, of which 25% of home/EU students were funded by RCUK sources. The development of the CDTs, successful applications for studentships (e.g. RCUK CASE, Commonwealth Foundation) and commitment of UCL to match-funded schemes creates a strong and sustainable portfolio of project sourcing. Recruitment to these studentships is competitive and is overseen by the Divisional Postgraduate Tutor (**K Harvey**), supported by Registry staff. Studentships are advertised in specialist journals and websites and the School holds a database of students who have applied for general admission. A panel of academic staff, including the Primary Supervisor, performs short-listing and interviewing. All members of the shortlisting and interview panel must have completed the Recruitment and Selection in HR briefing, organised by OSD. Development of students internally from MPharm or MSc to doctoral study is encouraged.

Supervision and personal development: The Divisional Postgraduate Tutor oversees all postgraduate programmes and students are provided with a copy of the Graduate Research Degrees Code of Practice and Student Handbook. All doctoral students have a supervisory team comprising a Principal supervisor, a Secondary or Joint supervisor and a Thesis Committee Chair. A Principal supervisor must have completed a period of probation, be an expert in the research area and have supervised at least one successful PhD student as part of a team. The PhD Chair must be a senior academic. PhD students are registered initially for MPhil and may be transferred to PhD following satisfactory performance at an upgrade *viva*. The upgrade *viva* is performed by two academics, one from another UCL Division, and is overseen by the Thesis Committee Chair, within 9-15 months of registration. Once experimental work has been completed (usually within 36 months) students may transfer to Completing Research Status (CRS). During CRS, which lasts for 1 calendar year, the student retains access to all UCL facilities and services, to allow preparation for *viva* examination.

A wide range of transferable skills courses is provided for all research students by the UCL Graduate School and students are expected to log 60 points (equivalent to 6 weeks) of course attendance. There are over 200 different courses across the full range of skill domains defined by the Researcher Development Framework. This is complemented by the School's long-established PhD training programme training programme (which was integrated into the UCL framework in Sept 2012), which organises training events including safety, basic research skills, presentation skills and paper writing, the use of animals, ethics in research and thesis preparation. Also timetabled in the programme are bi-annual Research Days, attended by all postgraduate students, and at which they present work as a poster (second year) and an oral presentation (third year), and careers events. Careers events are organised by MSc and postgraduate Programme Directors, supported by the UCL Careers Service. These events provide one-to-one access to representatives from industry and professional bodies (such as the RPS and APS), CV and cover letter writing tips and interview practice. In addition, the UCL Careers Service arranges regular

Sector Themed Career events in which all students can participate. School academics also participate in the ULLA Summer School programme, a pan-European collaboration between leading Schools of Pharmacy. The Summer School, which is held every two years, was held at the School in 2013 and offered an unparalleled opportunity for the School's postgraduate students to interact with their European peers, form networks, discuss best practice and arrange overseas exchange visits.

The UCL Graduate School requires all research students to maintain an online research student log (https://researchlog.grad.ucl.ac.uk/). The log outlines the contract between the student and the Primary and Secondary supervisors and their mutual responsibilities and provides a framework for recording details related to student's research. The log also acts as a record of project planning, personal development and progress monitoring. Staff members are expected to contribute between 5-10% of their time to each project and are limited to a maximum of six PhD students to ensure they can devote sufficient time to project management and progression. Students undertake a course in paper writing and are expected to prepare manuscripts of their work for publication. In addition, students are encouraged to prepare grant applications for further support, such as overseas exchange visits or post-doctoral placements (for instance, the Maplethorpe Fellowship scheme). Six current staff members, including the Director, are former PhD students of the School. As well as postdoctoral research associate posts and fellowships (e.g. Marie Curie, Rett Syndrome Foundation), PhD students at the School who graduated in the reporting period have been appointed to a number of key positions. Examples (with graduation year) include: Emma McConnell (2008) Medical writer at KnowledgePoint360 Heathcare Information Group; Dr Wafa Al-Jamal (2008) Lecturer in nanomedicine the UEA School of Pharmacy; Yogini Jani (2008) Lead Pharmacist, Medication Safety UCLH; Suzanne McCarthy (2009) Lecturer in the School of Pharmacy at University College Cork; Khondaker Miraz Rahman (2009) Lecturer in Medicinal Chemistry at Kings College London; Paula Thompson (2009) senior epidemiologist at Registrat-MAPI, a global CRO; Roy Turner (2009) Formulation Expert, Novartis Pharma AG; Claire De-May (2011) Grants Officer for the UK Alzheimer's Society; Victoria James (2012) Grants Adviser, Neuroscience and Mental Health, Wellcome Trust; Sarah Ramsden (2012) Producer: The Biomedical and Life Sciences Collection, Henry Stewart Talks Online; Rowena Hancock (2013) Pharmaceutical Assessor, MHRA; Andy Suter (2013) Head of Product Development and Medical Affairs, A Vogel Bioforce AG.

d. Income, infrastructure and facilities

Income: The provision of a stable research environment is underpinned by a sustainable financial infrastructure. The School has an annual income of ~£21m which may be broken down in a typical year (2012-2013) to 22% from research grants, 19% from HEFCE (research allocation), 15% from HEFCE (teaching), 36% from tuition fees (including research postgraduate and masters courses) and the rest from miscellaneous sources. The School has received £4.3m in CIF funding since 2008, of which £3m was spent on building infrastructure (e.g. library, computer unit) and £1.3m on equipment. Grant income has averaged at £6.84m per annum since 2008, with a total income in the reporting period of £34.2m, of which £10.8m were derived from UK research councils.

Internal facilities: The School comprises eight floors devoted to teaching and research. In addition we rent space in BMA house to allow extensive and well-appointed office facilities for practice and policy research. The School houses a significant amount of research equipment to support research, some of which is organised into core services accessible to all UCL staff. These include the **Biological Services Unit**: This facility comprises five animal rooms, four procedure rooms, a surgery, cage wash and autoclave area. The BSU has four highly experienced members of staff. The maximum capacity is 650 cages (to be expanded to 1000 cages by late 2013). The suite is used extensively by our neuroscience and drug delivery staff, with applications ranging from histochemical and patch-clamp sample preparation through to drug absorption and pharmacokinetics using novel delivery systems. A wide range of larger animal facilities are available within UCL to which staff also have access. **Microscopy suite**: The unit was established by **McCarthy**, who is the electron microscopy (EM) manager. The suite has scanning EM, transmission EM and optical microscopy and attracts external funding to maintain its state-of-the-art equipment. The suite is recognised nationally as one of the leading Microscopy centres and has won numerous image awards from the Wellcome Foundation, The Royal Microscopical Society and 'Visions of Science' as well as appearing on the BBC News and BBC One Show. A Wellcome

Trust bid led by **Stephenson, Thomson, R Harvey, Ruiz** and **Shah** raised £380k to support an advanced imaging facility for neuroscience. This facility comprises two laser scanning confocal microscopes (funded by ERC and MRC), both equipped to allow time-lapse, live cell imaging. **Integrated Structural Chemistry Service**: Comprising CHN elemental microanalysis, mass spectrometry (MS) and nuclear magnetic resonance (NMR) the service enables full structural characterisation of chemical and biochemical samples. The NMR facility comprises two high-field instruments (400 MHz and 500 MHz). The Mass Spectrometry labs have a range of instruments providing MALDI TOF, LC-MS, MS/MS and exact mass measurements. A nano-LC system used as a front end to the Q-ToF instrument enables separation of peptides for proteomics studies. A new triple quad mass spectrometer is shortly to be installed. Three members of the Faculty (**Kozielski**, **Neidle** and **Parkinson**) share a state-of-the-art macromolecular crystallographic facility, funded by CRUK and CIF. Other examples of equipment purchased in the reporting period include: Benchtop X-Ray Diffraction System (Rigaku) for qualitative and quantitative analysis of polycrystalline materials; Port-a-Patch Screening Station (Nanion) for high-throughput electrophysiology; Tandem Quadrupole Mass Spectrometry analyser (Waters) for identifying and quantifying unknown compounds in complex samples; PheraStar (BMG Labtech) high-throughput plate reader for drug discovery; Quanta FEG 200 - High Resolution Scanning Electron Microscope for nanometer imaging of biological samples and formulations.

The School houses a dedicated pharmacy **library**, of 383m^2 and refurbished in 2009 with an investment of £730k. Specialist librarians provide researchers with individual tailored support including free interlibrary loans, information skills training, mediated literature searching and citation data. As part of UCL, School researchers have access to one of the largest information services in the UK, including full access to sixteen UCL libraries, many of which are within walking distance. Between them the UCL Biomedical libraries subscribe to over 4,000 medical and health-care related journals and texts electronically as well as holding over 2,000 journal subscriptions in print. The School is also extremely close to the British Library. We also have a dedicated visual production suite for poster presentations, brochures and external publicity publications. The **computer unit**, also recently refurbished with an investment of £720k in computers and workspaces and £290k on fibre-optic cable installation, provides IT support, maintenance and consultation for both staff and students. In addition, researchers have access to UCL distributed memory computing clusters such as Legion, which are essential for molecular (**Haider**) and pharmacokinetic modelling (**Della Pasqua**).

In addition to School-based facilities, there is a wealth of equipment supporting each research area. For pharmaceutics research, the School is exceptionally well equipped in thermal analysis, surface analysis, imaging (atomic force and thermal probe methods), small-scale manufacture and dosage form design (hot melt extrusion, minitablet production, 3D printing, nanospray drying equipment), cell culture facilities and skin permeation facilities. There is an extensive range of HPLC, LC, gas chromatography and spectroscopic equipment as well as 81 fume hoods within the building, while the electrophysiology work is supported by state-of-the-art two-photon imaging and patch-clamping equipment. The School has introduced a Research Innovation Fund (currently circa £100k/annum) to support purchase of equipment and software and for travel and investment in new collaborations. This is managed by the Research Committee and is used to strategically invest funds in new cross-disciplinary research initiatives. This adds to the UCL-wide opportunities for School-based equipment purchase such as the aforementioned SLMS Capital Investment Fund and CIF funding.

UCL-based facilities: The facilities available at UCL are commensurate with expectations for a world-leading university. Some selected examples include the following. Within the Faculty of Life Sciences, the Division of Biosciences and the MRC Laboratory for Molecular Cell Biology has extensive state of the art imaging, zebrafish and biological NMR facilities, while the Gatsby Computation Science Unit has state-of-the-art facilities for neural computational work; all of these are highly relevant to our therapeutic neuroscience priorities. Within SLMS, the Faculty of Population Health Sciences has recently incorporated the MRC Clinical Trials unit and hence has access to 200 clinical trials scientists, while the Institute of Child Health and Great Ormond Street Hospital have a GMP facility for gene delivery systems, all relevant to the interests of, **Della Pasqua**, **Orlu Gul, Rahim**, **Tuleu** and others. The Department of Chemistry has state-of-the-art XRD and computational facilities for structure elucidation and modelling, relevant to the work of

Gaisford, Haider, Kozielski, **Neidle** and **Parkinson**. The Institute of Child Health hosts UCL Genomics, which offers genome, exome and RNA sequencing facilities and associated bioinformatics expertise is provided by the UCL Institute of Genetics; this ties in with our growing interests in personalised medicines and genetic diseases. The forthcoming Francis Crick Institute will be a world leading biomedical research centre with associated facilities; our biological chemistry, discovery and neuroscience interests are expected to benefit significantly from this major initiative.

e. Collaboration or contribution to the discipline or research base

Collaborations and their influence on research strategy: *External collaborations:* Staff have numerous international collaborators, which lead to student and/or staff exchanges, publications (numbered in parentheses) or grant applications. For instance, **Constanti**: University of Catanzaro (5). **Gaisford**: University of Sydney (2) and Strathclyde University (EPSRC grant). **Gibbons**: (36) with collaborators from Australia, Austria, China, Colombia, Greece, India, Italy, Malaysia, Mexico, Serbia, Thailand and USA and 9 international grants. **K Harvey** and **R Harvey**, joint PhD studentships with NIH-Bethesda. **R Harvey**: collaborations with National Institute of Genetics, Japan (3), Queensland Brain Institute, Australia (4) and University of California, San Diego (2) and 5 international grants. **Jovanovic**: Yale (1) and Université Méditerranée (1). **Neidle**: University of Cambridge (6), Georgia State University (4), Imperial College London (8), as well as with CNRS Paris, University of Lisbon, German Cancer Research Centre, National Cancer Institute USA, Harvard Medical School, University of Arizona. **Parkinson**: University of Milano (AICR funding) and University of Barcelona (commercialised a crystallisation screening process and 1 publication). **Prieto-Garcia**: Universities of Valencia and La Plata (3). **Shah**: Collaboration with Baylor College of Medicine, USA (1), Institute of Biophysics, Italy (2), Universidad de Castilla (ERC and BBSRC grants and 5 publications). **Stephenson**: Université Bordeaux (BBSRC grant and 1 publication). **Wells**: Singapore National Research Institute (2).

Internal (UCL) collaborations: these are very numerous so we list only those projects with shared postgraduates or research assistants. **Ahad** with Kurian (Institute of Child Health); **Basit** and **Gaisford** with Emmanuel (UCH); **Craig** and **Orlu Gul** with Edirisinghe (UCL Mechanical Engineering); **Gaisford** with Price (Chemistry), Day (Institute of Biomedical Engineering) and Standing (Institute of Child Health); **K Harvey** and Fisher (Institute of Neurology); **Gibbons** with Ruth Morgan, Director of the Centre for Forensic Sciences; **Neidle** with UCL Cancer Institute (collaborations with Ashcroft, Hartley, Pedley, Pereira and Strauss); **R Harvey** and Smart (Neuroscience, Physiology and Pharmacology); **Uchegbu** and **Schatzlein** with Nguyen (Physics and Astronomy); **Williams** and **Gaisford** with Salzmann (Chemistry).

Influence on research strategy: Clearly the collaborations enrich the research portfolio of the individual staff involved, but the School is also developing institutional collaborations with the University of Nottingham (via the continuing CDT programme), Monash University (Australia), Shenyang Pharmaceutical University (China), King Saud University (Saudi Arabia) and others. It should be emphasised that the merger with UCL has greatly facilitated internal collaborations and the encouragement of such relationships is a major priority for the School. This is exemplified by School financial support of six UCL Impact awards in 2012, specifically to fund shared postgraduate studentships with UCL colleagues. We also participate in events such as the Faculty Research Day and the Early Career Neuroscience forum (of which **Shah** is chair) and a range of subject-specific UCL forums, all of which promote and encourage collaboration.

Contribution to the discipline: Academic staff serve (currently or within the reporting period) on a wide range of *national and international committees*, including funding review boards. For example: **Bates**: Coordinator for the FIP-UNESCO Global UNITWIN Network for Education. **Buckton**: Committee Member of the Commission on Human Medicines (CHM). **Craig:** Honorary Professor, Shenyang Pharmaceutical University, China. Member of the Monash Institute of Pharmaceutical Sciences Advisory Board. **Franklin**: BNF Strategic Advisory Committee, Chair of the RPS Conference Research Panel. **Gaisford**: Chair and Hon. Treasurer, Thermal Methods Group (Interest Group of the RSC) and Committee Member Material Sciences Focus Group (APS). **Gibbons:** Chair of the Novel Psychoactive Substances (NSA) subgroup of the Advisory Council on the Misuse of Drugs (ACMD). **Heinrich**: Academy of Pharmaceutical Sciences (APS) Board Member and Member of the Herbal Medicines Advisory Committee of the MHRA. **Horne**: Member

of the MRC College of Experts. **Lane**: APS Board Member. **McCarthy**: Secretary of the Society of Electron Microscope Technology. **Neidle**: Sits on grant review boards for the French National Cancer Institute, Science Foundation Ireland, Royal Society Industrial Fellows and the Wellcome Trust Peer Review College. **Prieto-Garcia:** MHRA Advisory board for homeopathic products. **Shah:** Member of the working group for the National Centre for the Replacement, Reduction and Refinement of animals in Research (NC3Rs). **Stephenson:** Member of the BBSRC Review Panel and Wellcome Trust Molecular and Cellular Neurosciences Committee. **K Taylor**: Chair of the British Pharmacopoeia Commission, UK delegate to European Pharmacopoeia Commission, Committee member of Commission on Human Medicines (CHM), Chair of Chemistry, Pharmacy and Standards Expert Advisory Group of the MHRA. **P Taylor:** Member of the MRC Infection and Immunity Board, UK Space Agency Space Environments Working Group. **Uchegbu**: EPSRC Health Technologies Strategy Advisory Team and Scientific Secretary of the International Controlled Release Society.

Staff serve as *Editors* of numerous international journals. Examples include **Bates**: *Pharm Edu* **Buckton**: *Int J Pharm*: **Franklin**: *BMC Health Serv Res*, *BMJ Quality and Safety*; **Gibbons**: *Phytochem Lett*; **R Harvey**: *Frontiers in Mol Neurosci*; **Heinrich:** *Frontiers in Ethnopharmacol*, *J Ethnopharmacol*; **Neidle**: European editor, *Bioorg Med Chem Lett*; Chairman, Executive Board of *Tetrahedron Publications*; **Stephenson**: *J Biol Chem*; **Uchegbu**: *Pharm Nanotech*, *J Pharm Sci*. Staff also serve as *Editorial Board Members* of international journals. For instance, **Basit**: *Drug Dev Ind Pharm*, *Int J Pharm*; **Brocchini**: *J Biomat Applic*; **Craig:** *Thermochim Acta*; *J Pharm Sci*, *Int J Pharm*; **Gibbons**: *Nat Prod Rep*, *Phytotherapy Res*, *Planta Medica*, *Fitoterapia*, *Phytochem Anal*, *Phytochemistry Rev* and *Chinese J Nat Med*; **Heinrich**: *J Pharm Pharmacol*, *Chinese J Nat Med*, *BLACMA*, *Phytochem Lett*; **Jovanovic, Shah**: *J Biol Chem*; **Lever:** *British J Pharmacol, Pulm Pharmacol Ther*; **Neidle**: *Nucleic Acids Res*, *Mol Cancer Therapeutics*.

The majority of staff are Members, and many are Fellows, of at least one professional body. *Fellows* include **Bates**: Royal Statistical Society, Royal Society for Public Health, Fellow of International Pharmaceutical Federation (FIP). **Buckton**: American Association of Pharmaceutical Sciences, Academy of Pharmaceutical Sciences (APS), Royal Society of Chemistry (RSC). **Constanti**: British Pharmacological Society. **Craig**: Royal Pharmaceutical Society (RPS). **Fish**: RSC. **Gaisford**: RSC. **Gibbons**: RSC, Linnean Society. **R Harvey**: Zoological Society of London. **Horne**: RPS. **McCarthy**: Royal Microscopical Society. **Smith:** RPS**. K Taylor**: RPS. **Uchegbu**: Controlled Release Society, Eminent Fellow of the APS.

Distinguished lectures: The staff have given an extremely large number of invited and plenary lectures and some selected examples are given here. **Ali**: Janelia Farm Conference invited speaker, Washington DC (2012). **Craig**: American Association of Pharmaceutical Scientists (2009, 2010, session chair 2011). **Franklin**: Healthcare IT Standards Conference, Singapore (2011). **K Harvey**: Gordon Research Conference - Inhibition in the CNS, Colby College, Waterville, USA (2011); Society for Neuroscience 43rd Annual Meeting, San Diego, USA (2013). **R Harvey**: Society for Biochemistry and Molecular Biology Molecular Life Sciences, Frankfurt (2011); 6th European Congress of Pharmacology (EPHAR), Granada (2012). **Heinrich**: New York Botanic Garden: Invited Special Lecture (2012). **Horne**: Brian Gazzard Lectureship in HIV Medicine (2013); European League Against Rheumatism (EULAR), Madrid (2013). **Neidle**: The Pfizer Lecture, UK (2010); Distinguished Lecturer, Baptist University of Hong Kong (2011); Kelland Lecturer, European Organisation for the Research and Treatment of Cancer (2011).

Awards: The School is proud of the achievements of its staff and is pleased to report examples of external recognition for outstanding scientific and professional contributions. Awards include **Ali**: Muslim News Award in Excellence in Science and Engineering (2008). **Barber**: Gold Medal of Guild of Healthcare Pharmacists (2011); RPS Lifetime Achievement award (2013). **R Harvey**: Joint recipient of the Sertürner Award for research into pain pathways (2009). **Gibbons**: Pharmanex Prize, American Society of Pharmacognosy (2012). **Neidle**: Sosnovsky Prize, RSC (2008). **Shah**: GSK Prize Lecturer at the Int. Union of Physiological Soc. (2012). **Stephenson**: Gary Price Memorial Lecturer, BPS (2008). **D Taylor**: RPS Synergy Prize (2008). **Uchegbu**: RPS Pharmaceutical Scientist of the year award (2012).