Institution: The University of Leeds

Unit of Assessment: UOA3 (Allied Health Professions, Dentistry, Nursing and Pharmacy)

a. Context

The University of Leeds (UoL) integrated the management of research with innovation in 2010, linking research activity with translational strategies to implement findings widely and effectively. Our chief aim is to improve the health of patients and carers through education, policy and commerce. The main beneficiaries of our research, therefore, are users of healthcare and caregivers, NHS/private health care providers, health policymakers and industrial partners. The research strategies and strengths of the Research Groupings (REF5) are reflected in their impact: **Dentistry & Allied Health Professions** (AHP; including Medical Physics and Podiatry) has particular strength in commercial impact and influencing guidelines and clinical practice. **Nursing** research in the School of Healthcare (SH) particularly shapes health policy and national/international guidelines, and informs and educates patients, carers and professionals.

1. Health policy and national/international guidelines. Our research has informed Department of Health policy including: Implementation guidelines for commissioning (Podiatry); sterilisation of dental instruments (Dentistry); and the Care Quality Commission (Nursing). Also Royal Colleges, National Health Forum, Health Foundation, RPS Scotland (Medicines Management), NHS Evidence (Wounds) and others. It has informed national, European, US and other international guidelines (pain and dental trauma research plus examples in Case studies 1, 3, 4 and 5).

2. Commercial. Longstanding key industrial partners in research undertaken by the School of Dentistry (SD) include GlaxoSmithKline (GSK), Johnson & Johnson, Smith & Nephew and Colgate Palmolive. The Biomineralisation and Biomaterials & Tissue Engineering themes have productive relationships with small and medium sized enterprises including Avacta, AedStem, GABA Int, Geitschlich Biomaterials and [text removed for publication]. Philips Healthcare and AstraZenica have funded Medical Physics research. Seven patents have resulted from research in biomineralisation, caries, tissue engineering and antimicrobial therapy. A spin-out company has been formed as a result of research in self-assembly peptides; Credentis ag (Case study 2). Two medical devices for restoration of early enamel caries (Curodont Repair™ and Curodont Protect™) have been developed and another for prevention of caries formation (via Densol). Leeds Test Objects was established to undertake the manufacture and selling of Leeds Test Systems, which arose from Medical Physics research and are used extensively in safety testing of new x-ray machines. Medicines Information research led to the formation of LUTO, a company whose 18 staff have provided readability advice and testing for Pharma and other international companies since 2007.

3. Patient/carer education. This includes service user videos (web and DVD): 'Understanding Neuropathic Pain', 'Pain relief in cancer care: What you need to know' and 'Understanding Angioplasty' from the SH resulting from pain research.

4 Professional/practitioner education. Our research findings underpin local, national and international Continuing Professional Development (CPD) and pre-registration programmes, targeting healthcare professionals and managers, e.g. 'How to assess and manage pain in care homes' national study day arising from pain and medicines management research; publications and education programmes for podiatrists and other arthritis practitioners in the UK and internationally (Case study 1).

b. Approach to impact

The Dentistry & AHP and Nursing Research Groupings have used parallel "bench to chairside/bedside'' and "planning to practice" approaches to inculcate impact across the entire research process. Four essential elements embed it firmly within the culture:

(1) Ensuring that staff are knowledgeable about types and methods of generating impact;

(**2)** Involvement of appropriate beneficiaries in all stages of research, from planning through to implementation, to maximise the significance of impacts;

(**3)** Ensuring that expert advice and support for generating impacts are rapidly available to staff at all stages of the research process;

(**4)** Active promotion, using internal and external resources to maximise the reach of our impact.

Professorial/Director-level research leads actively support staff and research students (PGRs) in understanding and generating research impact. Training is provided by the UoL Staff and Departmental Development Unit (SDDU), which runs an enterprise workshop programme for PGRs

and staff and provides media training. We work closely with the central UoL Research & Innovation Service (RIS), which supports Intellectual Property and Commercialisation, Impact and Innovation, Knowledge Transfer Partnerships (KTPs; four with the SH and one with the SD), Patents and Contracts, and Marketing. The UoL has established academically-led, HEIF-funded Sector Specific Innovation Hubs, which aim to match internal research capabilities with external opportunities via strong industry and NHS partnerships, attract further investment, maximise the impact of our research and foster research excellence with impact. We engage with four; Medical Technologies (comprising the Innovation & Knowledge Centre, IKC, and the WELMEC Centre of Excellence in Medical Engineering), Health Services Delivery, Social Care, and Stratified Medicine. Thus, staff have access to innovation opportunities, proof of concept funding (also via Wellcome Trust Institutional Strategic Support Funds) and strategic partnerships with commercial and NHS organisations. "Pepnet" is a campus wide network that aims to develop and share best practice in public engagement. To maximise dissemination and public engagement, we work closely with the Faculty Marketing & Communications Team and the Press Office supports publicity to the media. HEIF funding has supported networking events and promotional materials, and we run local and national public engagement events. Our research-based educational materials can be accessed worldwide via the UoL publicly available video repository LU-tube. Further to these shared approaches, the two research groupings have complementary strengths in generating impact.

Dentistry & AHP excels in translating excellent clinical research and world leading basic science into findings for direct patient benefit. We work with partners in a seamless continuum from the laboratory to the clinic and back to the laboratory. Our research is framed against a challenge-led agenda and aligned with our translational research strategy. Patient and clinician involvement is at the heart of our research activities and we have developed robust mechanisms for engaging and supporting patient involvement across the spectrum of research activities, including prioritisation, planning implementation and dissemination of research (e.g. http://lmbru.leeds.ac.uk/about/leeds-patient-and-public-advocacy-group/). Pavitt is a member of the Board of INVOLVE (Patient and Public Involvement in Research). We work closely with industry; e.g., since 2008 the SD has signed 12 non-disclosure agreements and 21 research contracts (including seven gifts in aid totalling £300,453) with 11 companies. All industrial partners are invited to the SD Annual Postgraduate Research Day. The CEO of AVACTA is an Honorary SD Professor; AVACTA is a collaborator in WELMEC and supports a PDRA and an EPSRC CASE PhD student in the SD. The Stratified Medicine Hub (with Buckley) ran an Imaging Industry Day in 2012 (58 delegates; 24 from industry); resulting in a GSK-EPSRC CASE award and a Technology Strategy Board call (£7.5m) for *in vivo* imaging partnerships with industry and a major publicity event to be held in Leeds.

Our approaches to impact and strategy are informed by our involvement in WELMEC (see REF5) and the IKC in Medical Technologies (£7.3M funding from EPSRC, BBSRC and Technology Strategy Board). Dentistry and AHP staff are co-investigators as well as collaborators in the IKC and WELMEC, and Kirkham is one of only six EPSRC translational Professors supported by the IKC across the UoL and LTHT. Medical Technologies strategy is to focus on key knowledge and capability areas that have huge potential to deliver clinical benefit (in this context, the development of innovative devices for skeletal tissue regeneration and repair, regenerative therapies and diagnostic methods), and on early validation of technical concept and commercial feasibility to reduce late failure and accelerate innovation. WELMEC and IKC are strategically aligned and provide a full translational pipeline for our musculoskeletal and imaging research: WELMEC takes basic science projects to Technology Readiness Level (TRL) 3-4 and the IKC then takes them to TRL5 and supports subsequent commercialisation through industrial partners. WELMEC has supported six PDRAs in the SD. The SD also received £1.3M from the Medical Technologies hub for the co-development (with Credentis) of second generation self-assembling peptides (SAPs) for use in dental applications; following lab-based screening, first in man studies are being carried out in our UoL/Wellcome Trust funded Dental Translational and Clinical Research Unit (DenTCRU), illustrating our bench-chairside strategy. Additionally, SD with the School of Engineering is building new enamel surfaces using laser technology (EPSRC funds).

IP, impact and commercialisation are embedded in the training programmes of PDRAs and PGRs, and in developmental plans for new and existing staff. The IKC recently introduced a PG Diploma in Innovation, undertaken to date by four SD PDRAs. We actively support staff in accessing funding to increase opportunities for interactions with industry and other end-users and promote translation of our research. Four SD staff were Yorkshire Forward Enterprise Fellows, receiving

financial support and industry mentorship. The White Rose Health & Innovation Partnership, Yorkshire Forward, Medipex, the White Rose University Consortium and Regener8 have provided proof-of-concept awards for early research with potential for commercial benefit. These have led to patent applications for photodynamic therapy research as well as patent applications and a licensing agreement for the IP to make viability assays for pancreatic islets cells.

Nursing excels in delivering research that underpins evidence-based policy, practice and education for the benefit of patients and the public; its strength lies in its understanding of healthcare delivery and well-developed, robust processes to promote staff engagement and knowledge and to ensure that SH research is informed by patients', carers' and practitioners' needs. The SH undertakes an annual audit of knowledge transfer activity, circulated to all to inform and illustrate the wide range of impacts being generated by staff. We have developed a seven stage model to support understanding of the variety of processes involved in innovation and knowledge transfer http://medhealth.leeds.ac.uk/info/1160/impact_and_innovation.

The SH has well-developed approaches to ensure the involvement of stakeholders: the Service User and Carer Involvement Advisory Group (IAG) informs educational and research activities, and is being extended to provide impact input to research projects. The SH is the home of 'CPD4 Health Innovation', which brings stakeholders together with the central aim of producing innovations designed to have a positive impact on patients and carers via four main areas: patient-led innovation; bespoke leadership and organisational development programmes; bespoke cross-sector health technology related events and the practice development programme http://medhealth.leeds.ac.uk/info/1160/impact_and_innovation. Through CPD4 Health, we obtain valuable impact-related advice from not only patients and carers, but also NHS clinicians and managers. Recent examples include 'North East Excellent Manager Programme' developed with the Association of North East Councils Improvement Partnership for Local Government.

To ensure that expert advice and support for generating impacts are rapidly available to all staff at all stages of the research process, SH uses a wide range of resources, for novices and experts. This includes a central information resource and a dedicated Research & Innovation Unit, comprising 4 administrative and support staff. A marketing manager leads on publicity. The SH central information resources include our R&I functional strategy, Guidelines for Consultancy, Pathways for the development of IKT-based CPD and a digest of Health-related IKT Funding and Support Mechanisms, such as White Rose, the Yorkshire Association of Business Angels, Finance Yorkshire and Medipex as well as national and international sources. We have a platinum subscription to the Training Gateway (enterprise funding opportunities).

c. Strategy and plans

Our vision to embed translation of our findings is at the heart of our research and innovation strategies, with our research directed towards activities that will provide impact in major health challenges. Our objectives for the next five years are focused on developing novice researchers and supporting experienced staff in the generation of research impacts, including the importance of relationships with beneficiaries. To maximise the reach and significance of our impact by improving processes to identify and support impact generation, we will:

Staff, PGRs and School/Unit

- Embed innovation and impact generation into all our core activities, starting with staff induction, probation and consolidate through Staff Review and Development Scheme processes.
- Enhance existing processes via annual audit and case study workshops to ensure sharing of best practice and identify support needed to deliver and quantify impact.
- Ensure a challenge/need based approach to research to maximise impact, through high quality systematic review and involvement of clinicians/professionals at early stages.
- Expand our range of collaborations through local engagement with our Innovation Hubs, dovetailing of their strategies with our own, including methodologists and health economists.
- Increase focus on developing international impact by enhancing and targeting our marketing and communication strategies.
- Continue to improve provision of training for PGRs in IP, commercialisation and impact generation, sharing best practice from DTCs and other outward facing initiatives
- Launch a virtual Practice Academy (SH) for PGRs, providing a virtual learning platform for accelerated dissemination of research findings.

Beneficiaries

- Ensure comprehensive beneficiary involvement. We will continue to expand the size and remit of user groups, in particular PPI activities in the planning, conduct, interpretation and implementation of research, to understand better the nature and delivery of impacts desired by these groups. Researchers (SH) will be supported in using methods devised by the James Lind Alliance for Priority Setting Partnerships with service users and carers, to plan impact activities
- Use our capabilities (REF5) and strategic partnerships to position Health Services Research firmly within the translational pipeline at Leeds, accelerating our research impact for patient and population benefit (SD).
- Establish local communities of practice which embody researchers, practitioners and practice development leads (SH), complemented by the building of relationships with NHS Trust Directors of Research and of Workforce Development via the Centre for Workforce Intelligence.
- Improve mechanisms to facilitate involvement of NHS clinical staff in delivery of research and develop our Practitioner Network to establish expertise for Registry studies (SD).
- Establish more KTPs.

d. Relationship to case studies

For Dentistry & AHP the case studies address significant needs and emphasise the importance for impact generation of carrying out research that is challenge-led. Early involvement of clinicians, development of expertise and collaborations to deliver systematic review and health economics studies are used to identify and quantify these needs at the outset. Case study 1 illustrates the success of our translational research strategy: the effectiveness of the close working of Allied Health Professionals (Podiatry) with medical clinicians, as well as the integration of fundamental research into disease mechanisms; the robust identification of clinical treatment needs; development of novel therapeutic approaches and the completion of high quality clinical trials to bring about step changes in clinical practice and education in relation to arthritis. Working with Credentis to bring Filling Without Drilling (Case study 2) to clinic has educated us in alternative approaches such as Registry studies employed by industry, and developing this capacity/expertise has been incorporated into our strategy. Working via the Medical Technologies Innovation Hub has increased our understanding of pathways to impact and is enhancing our translational and commercialisation approaches. Case study 2 in particular has benefited from the full translational pathway this hub provides, and IKC funding is now allowing the development of second generation SAPs and an expansion in dental applications of this technology. SD's vision of underpinning excellent clinical research with world leading basic science to translate findings for patient benefit is also exemplified by Case study 2; high quality basic science research and close collaborative relationships with industry leading to first in man trials delivered in DenTCRU and the involvement of the SD via DenTCRU and our Practitioner Network in the clinical testing of Curodont™ products.

For Nursing the principles of user involvement and targeted uptake of resources to ensure impact run through each case study, and their successes and challenges have informed our strategy. The work on medication errors in care homes (Case study 3) involved care home staff and managers on the project steering group. Focus groups were undertaken with care home staff, GPs and community pharmacists in order to generate realistic solutions. With support and training from UoL, Raynor and Alldred appeared in numerous newspaper, TV and radio reports, resulting in relevant charities (Age UK and the Health Foundation) taking action as detailed in the case study. The UoL identified a PR company to advise on presentation of findings for key audiences such as policymakers. The Minister of State for Care Services rapidly directed the Chief Pharmaceutical Officer and Director of Social Care to mandate PCTs to implement a national strategy to reduce errors. Case study 4 in pressure ulcer prevention had a clear focus on users throughout. The study protocol was published as a pre-emptive strategy to raise nurses' awareness of the issues before research completion. Impacts were initiated through standard dissemination and this led to involvement with a range of national and international policy groups. This large programme prompted the development of PURSUN, the UK wide Pressure Ulcer Research Service User Network (http://www.pursun.org.uk/aboutus), a forum for patients and the public to get involved in research. Case study 5 illustrates the benefits of our approach to working with patients and the public to improve cancer patient care and experience. It involved working closely with both patients and the public to develop new technologies that delivered improved outcomes and experience for patients. The outputs from that research influenced the establishment of clinical research networks in England. These have been notable for their impact on NHS research intensity, for their wide NHS participation and for their patient centred emphasis and have in turn

reinforced our local approaches to impact.