Institution: University of Hull

Unit of Assessment: A3: Allied Health Professions, Dentistry, Nursing and Pharmacy

a. Context

There are three main groups of beneficiaries of the research undertaken in UoA3. These are patients and society, health care services, and industry; the latter being through close commercial partnerships and/or new spin out companies particularly in the area of medical devices. The need for improved health-care is a priority as Kingston upon Hull and the surrounding regions have some of the highest rates (top percentile) of obesity, heart disease, diabetes and cancer (Hull Primary Care Trust has the 6th highest cancer mortality rates) in the UK. Furthermore Hull ranks 5th worst local authority in terms of national deprivation. Finally, the city is in the lowest percentile in terms of socio-economic factors such as graduate employment and the number of highly-skilled jobs. These factors all contribute to broader psychosocial consequences for society and have major implications for the delivery of medical and nursing care.

The University of Hull (UoH) acts as an anchor institution providing effective and wide-ranging engagement with external agencies and communities to ensure that discovery is effectively translated into practice. Importantly the issues that are acute locally are serious on a national and global stage, thus innovative practice and devices developed at UoH have world-wide reach. For example the cardiac resynchronisation pacemakers (Case Study 1) have demonstrated significant patient benefits across the UK and USA, with concomitant benefits for health care providers and device manufacturers. The pioneering cough studies undertaken in Hull (Case Study 2) have altered the national and European guidelines for managing cough, and have been highly influential in identifying this as an important disease entity rather than just a troublesome symptom.

There has been close collaboration between UoH and the NHS for the past 20 years since the establishment of the Postgraduate Medical Institute that subsequently evolved, through a partnership with the University of York, to facilitate the creation of the Hull York Medical School (HYMS) in 2003. Following the highly successful UoA12 submission in RAE 2008 the University has continued its strong support for translational bio-clinical work, which was highlighted as a strength in the feedback *"The achievements in translational research were considered impressive*; (RAE 2008)", by investing substantially, e.g. Faculty of Health & Social Care (FHSC, 4 new Chairs in 20011-13) and School of Biological, Biomedical & Environmental Sciences with 7 new appointments (2010-13). In recent years the city too has invested substantially (£205 million) in major new hospital facilities, e.g. Queens' Oncology and Haematology Hospital and a Centre for Cardiothoracic & Cardiovascular Surgery, all of which have included significant UoH representation and input at design and delivery levels to ensure maximum opportunities for exploiting translational science. These and planned initiatives have all been truly collaborative ventures, with the twin aims of improving patient care through the application of innovative research and stimulation of increased levels of world-class research activity in pure and applied aspects of health-care.

b. Approach to impact

Involving patients and the public (PPI) - PPI is an essential factor for the UoH's health-care research. National and local user-groups are extensively involved at all levels of discovery and applied research. Patients and public are informed through bespoke publications generated by the project teams at regular intervals. These newsletters describe progress of the work; explain potential benefits as well as providing an opportunity for input into or testing of new products. In this way patients not only benefit from UoH research but act as champions in their communities as they "own" the product. Good examples include the group of parents with babies or young adults who require assisted feeding and community nurses who have contributed substantially to the design of a location-sensing nasogastric tube throughout its development phase, and are keen to test once the final device is manufactured. Similarly the local cancer support group were fully involved in the COMICE trial (Case Study 3) and have been amongst first to benefit from altered practice: removal of un-necessary MRI scans and improved treatment.

Investing in translational medical/health science - The University's Higher Education Infrastructure Fund (HEIF) has been utilised in line with its strategy to support our four areas of real or potential world-leading science. Two outstanding examples demonstrating successful interdisciplinary application and impact of HEIF 4 & 5 are the HONEI (Humber Obesity, Nutrition, Education and Innovation) Centre and the Centre for Telehealth. HONEI's aim is to facilitate and lead innovation in public and commercial enterprises with interests in food and health. HONEI staff use state-of-

the-art methodologies to improve health by introduction of programmes of education and by undertaking a portfolio studies into the nature of food and their effects on obesity; a regional and national priority area of concern. The Centre has attracted significant funding for clinical trials and mechanistic studies of functional foods (approximately £1 million) from a variety of sources including the Technology Strategy Board, Industry and the Food Standards Agency. The Centre for Telehealth positively impacts all groups of beneficiaries (Patients, Healthcare providers and Industry) and involves staff from every discipline in this submission. Staff in the Faculty of Science & Engineering (Depts. of Chemistry and Computer Sciences) have developed improved heart-monitoring devices with intelligent software making the user-interface more intuitive and powerful; staff in FHSC have field-tested these devices on patients suffering with Heart Failure and other long term conditions in a number of primary and social care settings (Impact Case Study 4). Staff in HYMS are using these in hospitals and highly cost effective service delivery models have been developed, in large part due to extensive patient input. User satisfaction is high as people need fewer visits to hospital, with the concomitant benefit of saving NHS resources. Furthermore, earlier diagnosis generally leads to improved outcomes and subsequent societal benefits. A similar approach of investing in strategic areas where excellent UoH applied healthcare research can be exploited will be followed in the future.

Building strong collaborations with external organisations - The strong interface between research and service delivery/patient care, underpinned by excellent collaborative relationships with the NHS, is well evidenced within the research groups of the health profession-based Faculties (FHSC & HYMS). Examples include service development in perinatal mental health and sexual health services; promotion of well-being in long term conditions though a lifeworld approach and dermatology services and gastroenterology. In order to lead the University's research themes and enhance uptake and exploitation of outputs a number of senior appointments were made in 2012; Professor Nick Stafford was appointed as the Health & Well-being champion. He is eminently qualified for this role being a highly research active surgeon, who has acted as a strategic bridge between staff in discovery science, applied healthcare and clinical audit for the past 20 years. The University encourages staff to take up strategic positions in the NHS, local council, charities and other business agencies to draw various professional groups together allowing dissemination of research. For example Stafford has been appointed Director of R&D for Hull & East Yorkshire NHS Trust, whilst also being chair of the highly successful Daisy Charity (see R5A); he is largely responsible for the success of the £10m UoH–Daisy-Industry (ABT Louisville, USA) partnership.

Stimulating commercialisation of research - The UoH has been pro-active in exploiting research. Since 2001 the University has operated a Concept Challenge Fund, in partnership with Bradford and Sheffield Hallam universities whereby staff can bid for funding to support commercialisation of discoveries. This funding promoted the ethos that research should make an impact in the relevant sphere, e.g. new spin-out companies, licensing, etc. Notable successes in the Health area include support for the location-sensing nasogastric tube principally for neonatal use, where an original £30k grant led by staff from FHSC pump-primed the current £885k NIHR i4i grant to produce prototype devices and undertake clinical trials – this study will report in 2015. A second Concept grant (£30k) to a multidisciplinary team comprised of academic clinicians and engineers has led to the development of a new speech valve for head & neck cancer patients post-laryngectomy; this will enter clinical trials in 2014. The Enterprise Centre, opened in 2008, gives the UoH a leading role in new business formation in the region. Almost 100 start-up companies have used the Centre's facilities, with 30 tenants in 2013. A full range of commercialisation expertise (marketing, Intellectual Property protection, publicity, etc) complements IT and administrative support. The Centre is open to students, graduates, staff and members of the public and provides a one-stop shop for commercialisation as it also houses the University's Knowledge Exchange and Research Funding Office. To date three Nutrition-based companies have successfully used the Centre to develop their businesses, and a medical supplies company took up occupancy in September 2013.

c. Strategy and plans

Embedding Impact – The Institutional drive for innovative applications of research is clearly articulated and already practised at Faculty and School level through research committees and cross Faculty fora. All staff are actively encouraged and supported, by a dedicated team within the Enterprise Centre, to apply for follow-on commercialisation awards (Research Council, RC; or Technology Strategy Board; TSB). This team assist with identifying potential collaborative projects

and working with all parties to draft the most appropriate form of proposal. Work-load models across the Institution have been modified to include Impact-related activities, highlighting the strategic importance of this type of work. In a similar manner to the Institutional Concept fund, each Faculty or School has a budget to pump-prime new research and, just as Research Councils now request "Pathway to Impact" statements, these are needed for internal applications, albeit in an abbreviated form. Finally, new postgraduate students are trained to consider the Impact of their research projects when planning, so that research and exploitation/impact are fully integrated; this is monitored by the Graduate School.

A successful example of commercialisation was from an EPSRC grant (Haswell and Greenman: EP/D040930/01, £721k) to develop a microfluidic-based forensic unit which subsequently received a follow-on Commercialisation award (EP/H007385). In 2012, the same investigators were awarded a TSB grant to use a similar approach, in collaboration with BioGene plc, to build a device capable of detecting multiple organisms with 60 minutes (TSB 15263-102129, £336k). Thus multiple applications of a particular technology were facilitated through commercialisation awards and strong industrial partnerships. This and other similar cases are used as exemplars and best practice is disseminated through bespoke seminars organised by the Enterprise Centre.

Investment - Strategic support for translational medical/health work is best exemplified by the project to construct the Allam Building (approximately £10m), with an associated radiochemistry PET/CT and SPECT/CT Centre. The combination of skills and new infrastructure will act as a catalyst for new collaborations with major pharmaceutical companies, with the creation of new spin-out, licensing and other revenue options as measurable goals for Faculties and Schools. The Allam building (opened in 2012) physically embodies the interdisciplinary ethos as it links the Dept of Chemistry and School of Biological, Biomedical and Environmental Sciences, and is staffed with academics from these Departments, FHSC and HYMS and actively seeks and supports projects that cut across these disciplines. The choice of creating a Pre-clinical imaging centre was taken in partnership with the Daisy charity and NHS, as the former is establishing a clinical PET centre at the Castle Hill Hospital site (see above) to provide a state of the art service for patients. To ensure maximal impact the University has appointed a cohort of new academics (7) and support (3) staff; the new investigators have skills and experience that perfectly complement those of existing staff. The University also supports a cohort of 8 postgraduate studentships/year in this cutting-edge, interdisciplinary, research area to expand the UK's human resource base for development and implementation of these new imaging modalities. A plan has been developed to build an impact case study based on novel PET imaging agents used in combination with Lab on a Chip technology for personalised patient treatment in oncology for the next REF. UoH plans to support similar multi-faceted units around the other key areas highlighted in the Case Studies; the aim is that each will achieve critical mass and become self-sustaining within 5-10 years.

Enterprise Register - Following the successful pilot in the Dept of Chemistry a formal enterprise register is being developed across the Faculty of Science & Engineering, HYMS and FHSC. The register operates both during and after the completion of any research project and identifies any direct or indirect outputs from the work that have potential novelty so that these can be appropriately protected. This register will be hosted on an intra-university website accessible across the Institution (not just restricted to the cognate departments to maximise potential collaboration). This tool will be particularly useful for staff such as the Health & Well-being champion when discussing strategy at the regional Humberside Health forum, or licensing options with potential companies, charities or individuals.

d. Relationship to case studies

The selected case studies best exemplify the collaborative, translational model operating at the UoH within the disciplines submitted in UoA3. The impact described arises as a direct result of the sustained, 12-year, institutional strategy to support and invest in strategic areas where the UoH has a national/world-leading expertise addressing problems of local and inter-national importance. Each case study demonstrates significant benefits to patients and society, health-care providers and industry to varying degrees. Case Studies 1-3 (Heart Failure; Cough and MRI imaging in breast cancer) highlight the major contribution made to national/international treatment guidelines; case study 4 (Telehealth) demonstrates process and device implementation that improves patient outcome, whilst saving health-care resources. Measurable gains in knowledge, medical and societal health as well as wealth creation locally and nationally for UK plc are the main outcomes.