Institution: Middlesex University

Unit of Assessment: 3. Allied Health Professions, Dentistry, Nursing and Pharmacy

a. Context

We carry out research with potential to improve outcomes for patients, or lower the cost of treatment. The principal beneficiary for our research is the medical and health care sector in the UK and internationally, with impact particularly on the development or refinement of pharmaceuticals, medical instrumentation, measurement, imaging, telemedicine, rehabilitation robotics, product development, healthcare provision and industrial R&D programme development. We work collaboratively with a wide range of research groups and hospitals, industry affiliates and other organisations (e.g. St Mary's Hospital Imperial Healthcare Trust, St George's Hospital London, Midatech Ltd, GlaxoSmithKline – GSK-, Zilico Ltd, and Bristol Hospital).

b. Approach to impact

We recognise that impact in biomedical sciences takes time and that predicting impact timescales is far from easy. Thus we proceed as if everything we do has the *potential* for significant impact, and ensure that our laboratories, policies and processes are all fit for this purpose. Our laboratories are of the highest quality, conforming to all required standards such as the Human Tissue Act. Our procedures for handing data are exemplary, enabling results to be tracked and explored if necessary. Our equipment is of a standard that is acceptable in clinical research and we work collaboratively with clinical partners, including in those areas where the cost of working independently is prohibitively high. The University has invested heavily in this area and regards the development of biomedical science research a strategic priority. Our key focus is translational research, leading to healthcare innovations and improved health care.

Beneficiaries and Users

Central to our approach is collaborative research with industry and research partners. The University is part of UCL Partners, an academic health science network created to improve healthcare in the London region. Researchers also work closely with biomedical industries. For example, Shah has supported development of a metabolomic platform utilising our LC-MS instrumentation in partnership with GSK and is also working with Eisai UK, establishing neurochemical assays and training staff in their use and application. Casimir is a consultant to Atazoa Ltd on the development of retroviral vectors and optimisation of gene delivery to spermatozoa, while Midatech is funding a research fellow with us, to undertake research on gold nanoparticle (GNP).

We also work closely with the NHS, impacting directly on delivery of health care. Since 2008 we have been developing new courses in Healthcare Science for the NHS, in partnership with diagnostics departments in Hospitals and involving service user participation in the design, delivery and quality assurance of the programme. To support the relevance of our research and currency of our courses, we have established employer advisory boards and the North Central London Pathology Liaison Group. We also provide expertise, on a consultancy basis, to NHS London on education and clinical training for healthcare practitioners and have contributed to the Modernising Scientific Careers Placement Flexibility Task and Finish Group.

Identifying Impacts

Collaboration is important for developing and translating our research into implementation, for example through drug development, new technologies and clinical trials. We develop collaborations through various mechanisms (consultancy, responding to modernising careers, establishing networks, student placements) and use these both to ensure impact and to plan future strategies. SMEs play an important role in biomedical innovation. We support the early stage development and potential spin-out of bioscience SMEs in areas aligned with our research by making available space, research facilities and enabling close collaboration with our research

teams. Such support has been given to NALIA Systems Ltd., Denator AB Sweden, Midatech, Zilico Ltd and Celldex (see impact case study). For example, we collaborate with NALIA Systems Ltd on investigating the medical utility of gold nanoparticles and with Zilico Ltd on measuring bioimpedence of cancer cells.

Supporting Staff
We support and develop staff in achieving impact, ensuring that staff are trained and activities leading to impact are properly resourced, rewarded and managed through appraisals and target setting. The university supports academics to engage directly in knowledge exchange, including commercialisation, with financial returns from this being re-invested in research. Staff are supported to take up external positions that assist in developing collaborations and routes to impact. Bayford Chairs the IPEM publication committee, the professional body validating new PTP BSc programme for Clinical Sciences in the healthcare sector, developing further links.

We are developing a research culture where non-academic impact is increasingly planned into the research process. Senior members of staff guide less experienced academics, with additional support coming from the University Research and Knowledge Transfer Office (RKTO). Since 2008 we have filed or had assigned seven patents (PCT, EU and UK) with local adoptions in 12 jurisdictions as the basis for joint R&D activities with commercial businesses.

Institutional Infrastructure
The RKTO constitutes an important central resource with staff expertise in all aspects of knowledge exchange, including IP protection and exploitation, and routes to impact. Dr Mark Gray, Director of Knowledge Transfer, also holds specific responsibility for impact and has personally assisted in developing our Biomedical Science innovations portfolio. The RKTO also supports us in the use of schemes such as Innovation Vouchers, Knowledge Transfer Partnerships, and SPARK awards. The university has simplified mechanisms for IP management, to reduce the burden on researchers and encourage industrial investment.

Other Mechanisms
We recognize the need to become better known as a centre of excellence for biomedical research across a broad spectrum of user communities, and use public engagement activities, to develop routes to impact for the longer term. We run regular events, open to the public as well as representatives of industry, to engage them with key aspects of our research, including the public opening of the Cancer Centre by John Smith and Princess Sara Bint Talal, on behalf of the Lee Smith Foundation. In 2013 we are contributing to the WorldSkillsUK finals in the NEC, Birmingham, where we expect 80,000 visitors to visit our STEM health activity stand, including school children, politicians, policy makers and companies. The School of Science and Technology has also established an innovation centre, in a purpose designed building off campus, fully staffed and resourced to look for potential applications of research across science and technology.

c. Strategy and plans

Our impact strategy rests centrally on our research strategy. The University is committed to enhancing STEM research and teaching. This was a core reason for locating biomedical science in the newly created School of Science and Technology (S&T). A new science building houses over 5000 square metres of laboratory space and houses biomedical sciences alongside facilities for computer science and psychology. This strategic investment and the move to S&T is already paying dividends, in terms of collaborative work with computer science and engineering colleagues engaged in research on bioinformatics. The potential for collaboration with cognate disciplines, while recognized, is yet to be fully realized. Nor, do we believe, have we achieved the full potential benefits of collaboration with UCL Partners, the NHS and industry.

We are committed to making biomedical science a thriving and sustainable area of research, teaching and knowledge exchange. Integration of these elements is core to ensuring the long-term success of this area. Close alignment with NHS (modernizing careers agenda;

collaboration with hospitals) and collaboration with biomedical science industry are crucial not just to ensuring that our research has impact on these potential users, but also to ensuring that research is relevant and teaching current.

We are clear about our core interests: Biophysics and Bioengineering, Biomarkers and Molecular Biology. Laboratory provision is of a standard that it serves our research and teaching, and supports collaborations with industrial and other users (noted above). We now have strong leadership in each of the three areas. Of particular concern to us has been the appointment of outstanding researchers with experience of or collaborative relations with relevant industries and other users, and a commitment to impact. The appointment of Professor Dilworth (viral biologist) and Clyne (proteomics) gives additional strengths in research and industrial links. Shah, previously senior researcher at GSK, further strengthens industrial links. Thus, we now have a firm research base, with outstanding leaderships and strong connections to NHS and other research users.

In the environment template, we note collaborative synergies with the strong computer science and engineering research group working on bioinformatics. In moving forward, we will strengthen this as a collaborative research area. The recent appointment of Professor Hua, gives us further collaborative potential in relation to medical robotics and clinical engineering. Research and potential impact synergies also exist with a strong group of sports science researchers with interests in sport physiology and biomechanics, with outstanding links in sports, including shared facilities with the Saracens Rugby Club.

We will continue to focus on developing strong relationships with partners and collaborators through activities such as joint grants, consultancies, policy formation and careful relationship management. We are actively seeking new collaborative opportunities in areas of research that are emerging, investing in them to reflect their strategic importance. The school is planning significant further investment in staffing in this area, reflecting continuous growth in student numbers, with priority being given to areas that are closely aligned to this submission, and with the potential for high impact research.

d. Relationship to case studies

Case study 1 (Biomedical Imaging) exemplifies impact arising from collaboration across multidisciplinary teams, internally with colleagues in computer science, with external academic partners (primarily UCL-with two EPSRC grants), with clinical providers (GOSH) and with various companies developing products for widespread clinical use. The impact is based on excellent, long-standing research with contributions to both biomedical science and computer science, and many peer-reviewed publications to demonstrate robust results. Two patents have been filed (with support from the RKTO), and we are using our collaborations to identify future opportunities, informing areas of basic science we need to pursue. We have recruited additional staff to support this area, and have used our NHS links within Healthcare Science programmes (Clinical Engineering) to link this research to new programmes, ensuring it remains core to our activities and hence sustainable.

Case study 2 (Development of an anti-hCGβ cancer vaccine) demonstrates how relationships developed over many years, recruiting staff with an established reputation and top quality research effectively resourced and communicated, can lead to routes for exploitation and impact. Butler and Iles had already established a strong reputation working together at the Williamson Laboratory, St Bartholomew's Hospital, when they were recruited to Middlesex during the previous RAE period. They organized a workshop on Vaccines at the second International Conference on Gonadptropins and Receptors, hosted here at Middlesex, leading to discussions with various industrial partners. This identified a potential future strand of work underpinning the case study, and significant support from industry to carry out the underpinning science here. Middlesex invested in additional staff, studentships and equipment to support this work, recognising its significance and value.