Institution: University of Dundee
Unit of Assessment: UoA1 Clinical Medicine
a. Context

The main areas of research focus within UoA1 are in Cancer, Diabetes & Metabolic Disease, Cardiovascular & Lung Disease, Pharmacogenomics & Molecular Toxicology and Molecular Dermatology. During the assessment period, our research has delivered tangible benefit to a range of important beneficiaries that include:

i. The public and patients: We have prioritised working with the general public and patient groups to improve the understanding of medical research and to ensure that our research addresses issues of concern to the population. For example, through the Dundee Cancer Centre, we host laboratory visits and discussion groups involving fundraisers and cancer patients. Similarly, we regularly host Diabetes Discovery Days for patients with Types 1 and 2 diabetes and their families. The Clinical Research Centre holds regular open days for the public, including contribution to the Dundee Science Festival.

ii. Government and public policy makers: Our research addresses issues that affect the design of healthcare services, the understanding of disease mechanisms, and the identification of novel diagnostic approaches and therapies that change outcomes for patients with common disorders. To ensure that our research findings achieve maximum impact we work with government through involvement in development of national guidelines, for example through the Scottish Intercollegiate Guidelines Network; and with major charities, including those involved in shaping research priorities (for example Cancer Research UK, the Breast Cancer Campaign, the Wellcome Trust, the British Heart Foundation, Diabetes UK, the Juvenile Diabetes Research Foundation and the Scottish Diabetes Group).

iii. The NHS locally and nationally: We work closely with the NHS in Tayside and across Scotland to ensure that the needs of patients inform the development of our research and that our findings are rapidly translated into benefit for patients. Our close relationship with the NHS in Tayside facilitates this translation, with the new development of a more formal Tayside Academic Health Sciences Network designed to ensure that our research has rapid uptake into the NHS and results in better outcomes for patients.

iv. Charitable bodies and other third sector agencies: We work closely with major charities to ensure that our research is informed by the needs of patient groups. For example, the Dundee Cancer Centre, based in the School of Medicine, allows us to work with Cancer Research UK. We are also actively involved with diabetes and cardiovascular charities such as British Heart Foundation, Diabetes UK and the Juvenile Diabetes Research Foundation, allowing us to bring together researchers, NHS staff involved in cancer, cardiovascular and diabetes care, patients and the wider public to ensure that the impact of our research programmes is maximised.

v. Industrial and commercial partners (local, national and international): We take very seriously the need to create economic benefit from our research and to work with industrial partners to develop our programmes effectively. This relationship extends to clinical translation, embodied by our nationally accredited biorepository and very active programme of clinical trials, led by the nationally accredited Tayside Clinical Trials Unit. Our research has resulted in significant financial benefit to the University and the local economy in Tayside: the biotechnology/ science/research sector accounts for approximately 16% of the Tayside economy.

b. Approach to impact

Our approach to impact is reflected in research strategy at both Medical School and University levels, and is underpinned by a range of support services (e.g. Research and Innovation Services, Press Office) whose role is to assist the research community in capitalising on its successes.

Within the Unit, impact development is enabled through our research culture and a range of practical and educational activities. We adopt an entrepreneurial approach, with numerous

examples of commercialisation of research underpinned by a proactive research office which has extensive industrial connections and employs a business development manager as well as intellectual property and commercialisation specialists. Many clinical staff are involved with policy agencies that influence healthcare policy, treatment guidelines and public opinion on health matters. We take an integrated approach to clinical impact via the Tayside Academic Health Sciences Network, which brings together the NHS and the University through joint structures.

We believe it is crucial that the next generation of researchers appreciates the importance of impact, and therefore include training opportunities for doctoral students and early career researchers in our generic skills curricula. The Dundee Clinical Academic Track programme (http://medicine.dundee.ac.uk/dcat/), which integrates research training and advice through the entire career pathway, provides specific training support for academic clinicians.

In addition, the Venture Programme is the University of Dundee's enterprise initiative which supports, trains and mentors our early career researchers and postgraduate students. This central programme offers a series of workshops (on the development, funding and communicating of research and/or business ideas), one-to-one mentoring and an optional competition, all within a strict 8 week timeframe. The competition element of the programme involves the preparation of a 2 page business plan and a PechaKucha 20x20 (http://www.pechakucha.org) pitch in front of an expert panel of judges from both academia and business. The impact of Venture can be seen as both research and business outputs as well as identifying early impact and providing developmental support for our innovative research population. For example, Venture 2011 was won by Dr Lee Baker (Medicine), who went on to secure a Scottish Enterprise/Royal Society of Edinburgh Enterprise Fellowship, allowing him to develop his business idea, Chi-Squared Innovations (http://www.chi2innovations.com/).

i. Influencing public opinion and behaviour. Many of our activities have had a significant impact on the public awareness of major scientific and medical issues. Our research is publicised widely and, for example, provided the first evidence of beneficial effects of the smoking ban on respiratory function in secondary smokers.

ii. Public engagement and outreach. Our outreach and public engagement opportunities for research staff and students are co-ordinated through the Revealing Research Programme (http://www.dundee.ac.uk/revealingresearch/). This provides training opportunities for staff and students wishing to hone the skills required for effective communication of research and science to the public. The Dundee Science Centre (http://www.sensation.org.uk/) is one of the city's major visitor attractions (>60,000 per year), and staff and students take part in a range of outreach and public engagement activities related to raising public awareness of science. The Café Science (http://www.cafesciencedundee.co.uk/) series of informal discussions between scientists/clinicians and members of the public is very popular, and we have numerous interactions with local schools. Within the Dundee Science Centre, the Science Learning Institute (http://www.dundeesciencecentre.org.uk/contents/professional-development.html, in which the University is a major partner) supports researchers in learning excellent science communication skills and presenting their research to the public.

iii. Influencing government and public policy. Professor Andrew Morris is the Chief Scientist for Health for Scotland; additionally, in recognition of their research reputations, many other Unit staff either chair or have membership of major national and international committees, thus influencing health and research policy through direct contact with senior government and public officials. This has led to changes in policy in areas such as disease screening (e.g. cystic fibrosis, diabetes and diabetic retinopathy) and eHealth.

iv. Influencing healthcare policy and treatment outcomes. Research in a significant number of key areas has led to major changes in policy. Our staff are members of a range of healthcare policy committees (e.g. NICE, SIGN and Healthcare Improvement Scotland) that are responsible for drawing up guidelines for treatment, and research outputs from the unit are frequently quoted in guidelines issued by UK and international agencies.

v. Commercial exploitation. We have established and nurtured spin-out companies, filed patents, licensed technologies and led a range of other interactions with relevant industrial sectors including pharmaceuticals, biotechnology and medical devices. Examples include the pioneering medical

informatics research leading to the formation of Aridhia Informatics Ltd. and the groundbreaking transgenic models that underpinned the success of CXR Biosciences Ltd. Our reputation has led to very substantial partnerships (and significant income) with a number of industries, and in particular led to the £50M Translational Medicine Research Collaboration with Wyeth (now Pfizer). This activity has made a major contribution to the local economy; these three examples alone account for well over 100 jobs in Dundee.

c. Strategy and plans

Our strategy is based on the following key aims:

i. **To create a strong research base that focuses on excellence.** This is being developed further through the recruitment of high quality staff focused on our key research themes.
ii. **To build translational capacity by collaboration with key disciplines.** See below.
iii. **To work with commercial partners to identify priorities.** Our Research and Innovation Services office enables efficient interaction with commercial partners.
iv. **To exploit our strengths through contribution to national initiatives.** Examples to date include leadership of the UK network of eHealth centres (the Farr Institute) and involvement in the Stratified Medicine Scotland Innovation Centre.
v. **To build further on our strong relationship with the NHS.** Clinical and translational research is delivered and disseminated through joint University/NHS structures such as the Tayside Clinical Trials Unit and the Tayside Tissue Bank, which form part of the Tayside Medical Sciences Centre (see below). The overarching Tayside Academic Health Sciences Network will develop this concept further, bringing further and more rapid benefits to patients and the public.
vi. **To create an entrepreneurial culture.** Our staff are increasingly supported in their personal development, including outreach and entrepreneurship, through mentorship, annual objective setting and review and a range of training supplied through the University's Organisational and Professional Development scheme (http://www.dundee.ac.uk/opd).
vii. **To engage the public.** Our current wide range of activities will be developed further through, for example, staff training and consequent increased involvement. For example, Dundee Cancer Centre is currently collaborating with Dundee Science Centre to train 20 cancer researchers (scientists and clinicians, including nurses and doctors) in public communication with a view to developing a schools outreach programme.

Increasingly, research in many of the disciplines covered by the Unit is carried out collaboratively with researchers in other parts of the university and/or with other institutions in the UK or overseas. Impacts and benefits therefore often derive from large-scale collaborations including large multi-centre trials and population genetic studies. The University of Dundee has therefore identified a small number of institution-wide priority research areas for strategic development. Translational Medicine and research from the Unit are key components of this strategy, in collaboration with researchers from a range of other disciplines (e.g. Life Sciences, Engineering, Mathematics, Computing and Psychology). The Translational Medicine agenda will help to identify priority research areas where the achievements of basic research can be more rapidly and effectively translated into improved clinical outcomes and other benefits. Implementation is currently underway, and includes major capital investment in buildings and equipment and recruitment of a range of clinical and basic science researchers with a strong translational focus. Dundee was also one of only five pilot sites for the MRC's Developmental Pathway Funding Scheme, designed to translate basic biomedical research towards new therapeutics, diagnostics, medical devices or medical procedures. Dundee was awarded £2 million from the scheme, and the projects subsequently supported include several from Clinical Medicine.

Award of Cancer Research UK Cancer Centre status was the catalyst for establishing the Dundee Cancer Centre (in February 2010). This involves staff from across the University as well as the NHS Tayside units involved in treating and caring for cancer patients. The major goal of the Centre is to focus on key clinical problems, particularly in breast, colorectal and skin cancer and, by using a multidisciplinary approach, to bring the benefits of research into clinical practice. The Centre also has an important function in public, fundraiser and patient engagement, supported through the appointment of a Research Engagement Manager.

A further example of how the University is securing future impact is a new venture fund created to help finance emerging spin-out companies. The University of Dundee Venture Fund LP has been launched in conjunction with Frontier IP, a company specialising in the commercialisation of University intellectual property. Frontier IP committed £500,000 to the Fund, with the University investing a further £250,000. Partnership status has been secured with Scottish Enterprise's Scottish Co-investment Fund, meaning that an investment made by the Dundee Fund can be matched pound-for-pound. This potentially makes a total of up to £1.5M available to spinout companies from the University of Dundee, with the potential to improve significantly the rate at which research with commercial potential can be translated into economic benefit.

d. Relationship to case studies

The case studies included in our submission exemplify our approach to supporting the development of impact:

1. **Biomedical informatics transforming the care of people with chronic diseases internationally (Morris)**: The development of a health informatics platform to support chronic disease management nationally and internationally has had impact on the NHS and government policy and led to commercialisation and internationalisation.
2. **BNP as a Diagnostic and Risk Stratifying Test in Cardiology (Struthers/Lang)**: Evidence that testing for brain natriuretic peptide (BNP) can aid the diagnosis of heart failure and identify high-risk aortic stenosis patients has had impact through the recommendation of BNP testing in national and international guidelines for the management of patients with heart failure or aortic stenosis.
3. **Filaggrin - the major predisposing gene for atopic disease and a target for stratified therapeutic intervention (Brown/McLean)**: Evidence that the filaggrin genotype can be used to classify and stratify patients with eczema for clinical care and clinical trials has had impact through the identification of patients at risk of severe disease and of the development of other associated conditions, particularly asthma.
4. **New Approaches to Drug and Chemical Safety Assessment (Wolf)**: The development of new paradigms for toxicity testing and their use in drug and chemical safety assessment has had impact on the Scottish economy and the local population through the activities of two vibrant biotechnology companies.
5. **Spironolactone as a Treatment to extend life in Heart Failure Patients (Struthers/Lang)**: Evidence that spironolactone treatment extends life in patients with heart failure has had impact through the recommendation of spironolactone treatment in national and international guidelines for the management of patients with heart failure.
6. **The use of aspirin as a primary prophylaxis against cardiovascular events in patients with Diabetes (Belch)**: Evidence from the POPADAD trial that aspirin should not be prescribed as primary prophylaxis against cardiovascular events in patients with diabetes has had impact within the NHS and on national and international health policy, leading to improvements in health outcomes through a reduction in adverse events.

Case studies 1 and 4 describe successes that have arisen from the entrepreneurial activities of the researchers concerned, which are underpinned by a culture within the Unit and wider university that actively encourages commercialisation of research, including beneficial financial terms for IP exploitation. These activities are supported by business development and commercialisation specialists within the University's Research and Innovation Services department.

Case studies 2, 3, 5 and 6 describe major improvements in clinical practice, identifying new biomarkers and therapeutic approaches that impact on the diagnosis and management of cardiovascular, respiratory and skin diseases. In these cases, close interactions between senior research clinicians and the major health policy and regulatory agencies have facilitated the rapid uptake of these groundbreaking novel approaches into clinical practice.