Institution: University of Aberdeen

Unit of Assessment: 1 - Clinical Medicine

a. Context Our research portfolio encompasses basic science and translational research, with maximisation of impact a priority. Our emphasis is on understanding: (i) mechanisms underlying the maintenance of health, including the role of nutrition, and; (ii) the pathogenesis of disease with the aim of developing and validating disease prevention strategies and treatments. Research into the maintenance of healthy living and the role of nutritional factors in disease and disease prevention, has been given additional impetus through the integration of the Rowett Institute of Nutrition and Health (RINH) into the University College of Life Sciences and Medicine. Now in its centenary year the Rowett is recognised internationally for its research in nutrition and health. The merger fulfils the aspirations of the University and Scottish Government for the establishment of a national integrated research centre investigating relationships between diet and human health. A key strength of our research is its translational impact and influence on human behaviour and clinical practice. This has led to wide ranging benefits regionally, nationally and internationally. Beneficiaries of our research include:

Policymakers, NHS and Government. Advising and informing health policy makers through membership of relevant committees and participation in Department of Health working groups has been a longstanding commitment. Within the REF period we have continued to both catalyse and lead discussion of new issues through insights from our novel research and emerging societal needs. Examples include: [i] **Devereux** and colleagues undertook immunological studies which were fundamental in leading to a change in the policy and advice given by the Department of Health about maternal prenatal exposure to food allergens. [ii] **Forbes**' team investigating *Campylobacte*r molecular epidemiology, which has been central to the implementation of action plans with the Food Standards Agency (FSA) and the Department of Environment, Food and Rural Affairs (DEFRA) to reduce Campylobacter transmission. [iii] Working within the Translational Neuroscience programme, **Reid-I**'s work has altered the policy of Scottish Government and the Department of Health on anti-depressant prescribing, cited in the Quality and Outcomes Framework for UK General Practice, and part of the evidence base for NICE changing clinical guidance on anti-depressant use. [iv] **Duthie's** optimal quantification of folate status in the National Diet and Nutrition Surveys has changed how blood folate concentrations across the UK population area are assessed. [v] New technology has been introduced for screening for diabetic retinopathy, based on collaborative work between the Aberdeen Biomedical Imaging Centre and NHS clinicians. [vi] **Cruickshank's** work has been important to changes being made to the NHS Cervical Screening Programme. [vii] Work in the **Aberdeen Biomedical Imaging Centre** is part of the evidence for MRI screening of younger women at high risk of breast cancer used nationally (MARIBS Trial). [viii] **MacDonald's** and **Haggarty's** work on vitamin D is being used to inform the Scientific Advisory Committee on Nutrition (SACN) in its nutrition guidelines and identification of the link between folate and colorectal cancer trends formed part of SACN advice to the CMO.

Business and Industry. We have fostered and developed knowledge exchange and partnerships leading to spin-out companies that have impacted economically, with the creation of jobs and introduction of successful marketable products nationally and globally. Examples include: [i] The spin-out company Provexis, which has developed a new food product, Fruitflow™, now marketed globally with the potential for improved vascular health. [ii] Understanding of control of appetite and its role in obesity has led to a partnership between **Johnstone** and Marks & Spencer to produce a top selling range of healthy eating products, the Fuller Longer™ range, as one way to help address the obesity epidemic. [iii] GT-Biologics, a new spin-out company undertaking the commercialisation of novel drug products from bacteria for the treatment of inflammatory bowel disease, generated from **Kelly's** work on the therapeutic use of bacterial products. GT Biologics' lead candidate has been granted Orphan Designation in the United States for the treatment of Paediatric Crohn's Disease. [iv] Commissioned work by **Reid-D** and others via engagement of industry is developing radiological biomarkers of osteoporosis risk and progression and identifying biomarkers of response to chemotherapy in breast and gastrointestinal cancers.

b. Approach to impact

Approaches of the Unit to achieving impact include:

1. A high quality research portfolio addressing key societal challenges

The first strand of our strategic approach enabling the generation of impact is to have a portfolio of relevant research activity that is internationally excellent and focused on important health challenges. We have established and resourced six research programmes in*, Immunity, Infection and Inflammation; Musculoskeletal; Cardiovascular Medicine; Cell, Developmental and Cancer Biology; Translational Neuroscience;* and *Microbiology*. These provide support and infrastructure for our researchers within a strong framework of research governance. We draw on expertise within the NHS Research and Development Programme (facilitating clinical collaboration and translation), charities, industry and patient groups, to allow us to address clinically important questions and to ensure that our research responds to emergent priorities. We work closely with Scottish and UK Governments, recognising their priorities relating to nutrition and health. We have an open, collaborative culture to facilitate research and address these challenges.

2. Communication and public engagement with our research

The University's Communications Team facilitates links between researchers and local, national, and international media, and promotes community engagement. The Team issues on average 400 press releases a year, in addition to placing stories with key media outlets, and identifying researchers for expert comment. Examples of UOA 1 researchers featured in the media include: **Brown-G** (development of a new treatment approach for fungal infections), **Heys** and **Collie-Duguid** (biomarkers of chemotherapy response), **Reid-D** (osteoporosis prevention), **De Bari** (osteoarthritis), **Frenneaux** (treatment for cardiac failure), **Reid-I** (appropriateness of prescribing anti-depressants), **Johnstone** (weight loss and obesity), **Murray-A** (imaging of dementia from Aberdeen birth cohort), **Haggarty** (nutrition in pregnancy). These are underpinned and disseminated by a portfolio of support structures, including:

[i] *University Public Research Profile web site (Public Research Profile):* contains copies of the University's research papers, and details activities and research communications to the media.
[ii] *Institute of Medical Sciences (IMS) and Rowett Institute of Nutrition and Health websites:* define our research groups and their expertise.
[iii] *Public Engagement with Science Team:* recognised as one of the most active in the UK, it works closely with Unit members who present their work to the public with a variety of mechanisms and local venues (e.g. Café Scientifique, Café Med, Café Controversial, Sceptics in the Pub). TechFest is Aberdeen's annual public science festival which was extended via the British Science Festival (in Aberdeen in 2012), where our scientists played major roles. We engage new generations of learners with school lectures and seminars e.g. on nutrition, cancer, the musculoskeletal system. The effectiveness of our work is recognised by an "Engagement catalyst award" (£300k) to train staff and expand interaction with community groups and a BBSRC "Sparking Award", (Excellence with Impact (£100k)), supporting impact acceleration from our BBSRC portfolio.

3. Identification, interaction and collaboration with key stakeholders and policymakers

Our directors of research, research programme leaders and principal investigators identify key stakeholders and ensure engagement through a wide variety of mechanisms, e.g.:

[i] *Participation in Council, Boards, Committees and Advisory Committees:* Unit researchers are encouraged to contribute their research experience and generate impact via membership of research boards, e.g. MRC, BBSRC, Arthritis Research UK, Department of Health, Wellcome Trust, British Heart Foundation, Breast Cancer Campaign, Swedish Research Council, Agence d'Evaluation de la Recherche et de L'Enseignement Superieur, France, National Medical Research Council of Singapore, European Calcified Tissue Society Board, Food Standards Agency.
Our work has informed national and international guidelines and Governmental policy papers, e.g. maternal allergy, change in anti-depressant prescribing, folate measurement, varicose vein evaluation, NHS Cervical Screening, MRI in Breast Screening for high risk women.

[ii] *Briefings of Members of Scottish Parliament (MSP) and Select Committee advice:* annual briefings are held at the School of Medicine between MSPs with senior academics highlighting successes and concerns. The Unit also works with the University Public Affairs team which forges links with Scottish and UK Governments and the EU and supports researchers in promoting their

work to political and civic audiences and discussing their needs.

4. Commercialisation, business and research support and knowledge transfer
We receive specialist support and guidance regarding intellectual property protection, patent application and spin-out company formation from the University Research and Innovation (R&I) unit, whose staff work closely with our researchers to translate research excellence into commercial application and knowledge exchange. They also support our researchers in developing their Pathways to Impact Plans. Since 2008, researchers have played key roles in the spin-out of 7 companies: Antoxis Ltd, Cyclogenix Ltd, GT Biologics Ltd, Novabiotics Ltd, Provexis PLC, Sight Science Ltd, Signal Pharma, contributing to Aberdeen's status as a rapidly growing bio-business centre. Our researchers have access to University Knowledge Exchange and Transfer Fund awards to support knowledge transfer activities and for facilitating work with industry, public or third sector organisations. In June 2013 the latest Praxisunico Spinouts UK Survey annual report ranked the University of Aberdeen as 6th in the UK for success in 'spinning-out' research into commercial company formation for the period 2010-2012.

5. Kosterlitz Centre for Therapeutics
Our Kosterlitz Centre for Therapeutics was founded in 2010 to support drug discovery and discovery projects including inventions in the diagnostics and biomarkers sectors and is a key resource for linking our researchers to industry. It has already attracted over £3 million of external funding, and has filed 11 patents since 2008. The Centre provides leadership, guidance and bespoke resources to enable new ideas to be taken forward to proof of concept. Our medicinal chemistry facilities are strengthened by other core facilities (e.g. next generation sequencing, high performance computing, imaging) supporting commercial research.

c. Strategy and plans

Our strategy for maximising the impact of our research is based on delivering the highest quality research which is relevant and accessible to end-users. Our work is guided by policies of the University Committee for Research, Impact and Knowledge Exchange (CRIKE), which is responsible for the institutional impact strategy and has wide cross-university representation. The Unit's strategy and plans for taking impact forwards include:
[i] Developing and maintaining research and infrastructure excellence. We have developed research groupings which address key questions important to society, with robust governance mechanisms to manage and engage with our staff. These groupings continue to be strengthened. Specific examples of recruitment of new staff include development of a cardiovascular medicine research programme and underpinning our renowned fungal biology research portfolio with an investment of a further £1 million (detailed in REF 5). There has been continuing development of the infrastructure, e.g. our new Centre for Genome Enabled Biology and Medicine, and a £40 million investment, including a contribution of £12 million by Scottish Government and £250,000 by the Wolfson Foundation, to co-locate a new Rowett Institute of Nutrition and Health adjacent to the principal research laboratories in the IMS Building on the Foresterhill Health Campus. The University is investing in four overarching themes (*Pathways to a Healthy Life, Environment and Food Security, Energy, The North*) to allow creativity and promote interdisciplinary research and knowledge exchange that cuts across conventional boundaries and in particular our researchers contribute to the first two overarching themes.
[ii] Training of future researchers and leaders. We train and stimulate our researchers to give them opportunities to become future research leaders, supporting flexibility in career structures. We give them knowledge and skills to maximise impact from their research through a seminar series on maximising impact and making research accessible to stakeholders.
[iii] Enhancing communication and public engagement. Public engagement by researchers is being further developed and supported by the Communication Team. We support the use of a range of initiatives and formats, e.g. science festivals, events, conferences, web sites, social media and interactive media so as to stimulate and inform. Each research programme has designated Champions working with the Public Engagement Unit to allow us to engage effectively.
[iv] Identification, collaboration with, and involvement of, key stakeholders/policymakers. We support, continue to train and encourage researchers to engage with Government, policymakers, the 3rd sector, guideline developers and patient groups to allow the maximum impact to be generated from our research. Mentoring processes have been put in place for new staff.

Contribution to impact related activities is an integral part of appraisal and promotion.
[v] Developing and supporting commercialisation, business and knowledge exchange. Our research leaders promote interactions via R&I to facilitate and support all areas required for knowledge exchange, and partnerships with industry, promoting spin-out activity. The Life Science Innovation Building on the Foresterhill Health Campus (£3.5 million partnership with Scottish Enterprise and European Regional Development Fund) provides facilities for spin-out companies. Knowledge Exchange and Transfer Awards will continue to pump prime activity; we will continue the *SFC Innovation Voucher Scheme* to facilitate small and medium enterprise collaboration.
[vi] Enhancing the Kosterlitz Centre for Therapeutics. Our Kosterlitz Centre for Therapeutics will continue to enhance our capacity to link with industry. It will be developed through further investment targeted at priority research areas, for example, clinical cancer models.
[vii] Evaluation and review of impact. Monitoring and evaluation of our impact strategy is achieved by our directors of research, internal and external peer-review with horizon-scanning for areas of new opportunity and dissemination of good practice. Impact registers monitor these activities and are reviewed annually through our research governance structure.

d. Relationship to case studies

Our six case studies illustrate the successful collaboration of our researchers with different stakeholders to facilitate the translation of fundamental science into non-academic benefits.

1. The close partnership between Marks & Spencer plc and **Johnstone** and colleagues led to the development of a range of commercial health food products for sustained appetite control and weight loss. This illustrates how fundamental human volunteer research into diet and behaviour led to dietary intervention trials which were supported by R&I to facilitate a programme of knowledge exchange with industry. The team helped develop the Fuller Longer™ range and though its communication expertise promoted public awareness through media interactions.

2. Due to concern about over-prescription of antidepressants, Government policy recommended a reduction of prescriptions in Scotland by 10%. However, **Reid-I** and his team were concerned about the appropriateness of this advice. Using their expertise, and linking with local NHS expertise and resources, they found that there was actually an under-prescribing of appropriate anti-depressant therapies. **Reid-I's** involvement with key government committees (Scottish Audit Committee) led to the Scottish Government reviewing its policy, with the Health Minister citing the Aberdeen research as the reason for withdrawal of this target.

3. Research into digital imaging was applied to diabetic retinal disease. Linking with local NHS expertise, proof of concept was demonstrated and software developed to allow automated evaluation of the extent of disease. R&I's expertise in knowledge exchange with industry developed an industrial collaboration and supported continued refinement of the product, "iGrading"™ that was licensed to Medalytix with a sub-licence to Digital Healthcare. As a result of the team's published Health Technology Assessment, Scottish Government adopted the technology for national screening, with 225,000 patients now screened annually.

4. Our research confirmed that *Campylobacter* infection in humans was related primarily to *Campylobacter* infections in poultry and not other sources. Findings were published by the FSA. Impact was achieved by **Forbes** being invited to join the European FSA BIOHAZ panel, which set regulatory standards for *Campylobacter* load in poultry. The research also provided instrumental evidence for a UK joint action plan of the FSA and DEFRA to reduce campylobacter transmission.

5. Our work on maternal allergen exposure during pregnancy and associated childhood allergy has changed UK public health policy across the UK. A published high profile study by Aberdeen researchers led to work with the British Nutrition Foundation and the FSA. This generated data that was at variance with the then current UK Department of Health (DH) advice and resulted in engagement and inclusion of **Devereux** on UK Committees (e.g. Toxicity of Chemicals Consumer Products and the Environment Committee), which resulted in the DH issuing revised advice.

6. The spinout company Provexis plc globally markets food ingredients for maintenance of healthy blood-flow. Its origins are in fundamental research at Aberdeen on atherosclerosis. Taking these research findings with support from the R&I unit led to patenting and then securing funding for human trials using our expertise and, subsequently, commercialisation. University investment in Provexis enabled engagement with multinationals (e.g. Coca Cola, Nestle and Cargill).