Institution: Robert Gordon University & University of the Highlands & Islands (RGU-UHI)

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

a. Overview

RGU-UHI Health Research Alliance is a partnership between the Institute for Health &Wellbeing Research (IHWR) at the Robert Gordon University (RGU) in Aberdeen and the Division of Health Research at the University of the Highlands & Islands (UHI) in Inverness, embracing the highest calibre health research from across the two organisations to create a strong collaborative unit (www.rgu.ac.uk/rgu-uhi).

RGU gained full University status in 1991 and comprises three faculties: Health and Social Care; Design and Technology, and the Aberdeen Business School. Building upon achievements from RAE2008, the IHWR was created to concentrate the highest quality research from the Schools of Pharmacy& Life Sciences, Nursing & Midwifery, Health Sciences and Applied Social Studies, along with two research Centres (Centre for Obesity Research and the Aberdeen Centre for Trauma Research), into a single organisation. Research is focused in three inter-disciplinary themes: **Cardiovascular & Metabolic Health (CVMH)**; **Psychosocial& Mental Health (PMH),** and **Environmental & Occupational Health (EOH),** where the primary aim is to combine fundamental, applied and practice-based research to address major health issues relevant to these themes. Examples include studies of: the mechanisms (e.g. Weichhaus*et al*, *Oncol Rep* 2011, 25: 477-483), dietary intervention (e.g. Hession*et al* 2009, *Obes Rev* 10: 36-50) and clinical management of obesity-induced co-morbidities (e.g. Dombrowski*et al*, *Patient Educ & Couns* 2012, 87: 108-119); physical (e.g. lower back pain Hedberg *et al*, 2013, *Man Ther* 18: 169-171) and psychosocial challenges within the workplace (Yuill 2009, *Int J Man Con Phil* 3: 239-256).

UHI gained full University status in 2011 and comprises 13 colleges and research institutions across the Highlands & Islands of Scotland. Since RAE2008, health-related research at UHI has grown substantially, spawning the Highland Diabetes Institute-based Division of Health Research, which includes the Centre for Rural Health, the Highland Clinical Research Facility, and the Department of Diabetes & Cardiovascular Science. The Highland Diabetes Institute itself is a ground-breaking collaborative venture between UHI, Lifescan Scotland (the largest life science employer in Scotland) and NHS Highland. The health research priorities for UHI are reflected in the five inter-disciplinary themes within the Division: **Rural Health**; **Free Radical Research**; **Genetics & Immunology Research**; **Lipidomics Research,** and **Clinical Research**. The principal thrust of our research effort is to develop and evaluate the potential of novel drug (e.g. Treweeke *et al, Diabetologia* 2012, 55:2920-8) and dietary (e.g. McGeoch *et al*, *Diabetic Med* 2013; in press) interventions to improve the management of diabetes and its complications and to examine new strategies to improve rural health and care (e.g. Farmer *et al, Austr J Rural Health* 2012, 20:185-9). We also have a substantial interest in genetic predisposition to diseases with an autoimmune component (e.g. Schizophrenia; Halley *et al* 2013, *Immunogenetics* 65:1-7).

The geographical region in which RGU-UHI is located accounts for >50% of the land area of Scotland, much of which constitutes a remote, and sometimes hostile, environment. Finding effective healthcare solutions to serve sparsely distributed residential communities and working populations (e.g. within the oil, gas and renewable energy sectors) is both challenging and critical for their wellbeing. Moreover, there are specific disease hot-spots within the region (e.g. Type 1 diabetes is twice as prevalent in Orkney and Highland region than the rest of Scotland), while the increase in body weight across the general population presents significant occupational health challenges to a remote workforce. Collaboration between RGU and UHI has been nurtured by the research leaders over recent years to create a framework for an effective research partnership. As a result of strategic investment, complementarity of facilities available within the RGU-UHI partners has been assured. For example, facilities exist at RGU for synthetic chemistry, drug formulation and animal-based studies and are made available to UHI, while UHI offers access to a dedicated clinical research facility and a world class mass spectrometry facility (Lipidomics) to researchers at RGU, thus representing a cost-effective means of generating a highly attractive, broad-ranging entity that could not be realised by either in isolation. RGU-UHI (Figure 1) was formally created to take advantage of the host of unique research opportunities that our geographical location offers, including a relatively stable and under-researched regional population that represents an ideal test-

bed for evaluation of novel technologies. RGU-UHI is also well-placed to research an as yet underexploited natural resource in the form of unusual terrestrial and aquatic biodiversity with the capacity to offer novel nutritional and pharmaceutical solutions for the health issues that we face.

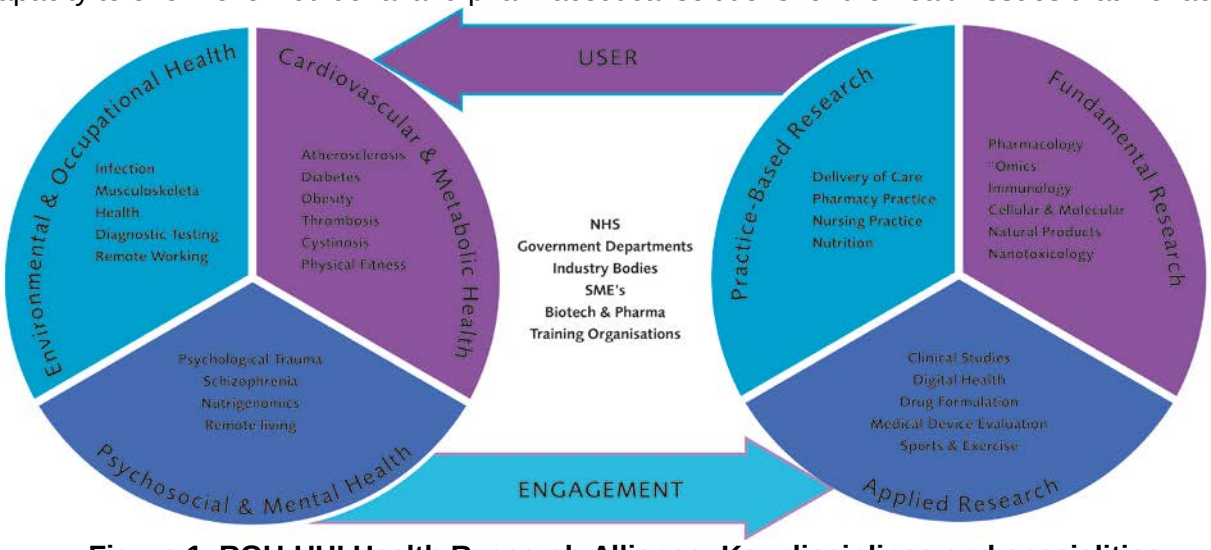

Figure 1. RGU-UHI Health Research Alliance: Key disciplines and specialities

b. Research Strategy

Whilst the partners in the RGU-UHI Health Research Alliance have their own mission statements, these encompass a shared vision: *To undertake internationally excellent translational research that creates high impact and useful knowledge that can be implemented in all areas of health, including development of new interventions and technologies, changes in health policy and improvements in practice.* In the census period, both institutions have made step-changes in research governance and management systems and have developed critical partnerships for research, both within RGU-UHI and with external partners. Formation of RGU-UHI has helped to crystalize the areas of research focus described above, which are built around our unique environment and the pre-existing research strengths in our combined academic community.

Research Governance: Research at RGU-UHI is overseen and reviewed against key performance indicators by Senior Strategic Planning Groups and Research Committees at each institution, all of which meet 3-4 times per year. Research degree governance is overseen by the respective Graduate School Boards, chaired by the Graduate School Leaders, which meet 4-5 times a year. Both Institutions have Research and Enterprise Service departments that support the researchers in: costing proposals for external funding; administering grants; promoting Business Development Services; facilitating knowledge exchange and technology transfer; development of new companies, and external reporting on activities. As RGU-UHI moves towards a joint provision of knowledge exchange activities, these offices will be critical in developing sub-contracting agreements between the two institutions. Administrative support for Research Degrees is provided by the respective Research Degrees Offices; the remit of these offices extends to quality assurance procedures and systems in support of research students and their supervisors from application to examination.

Knowledge Exchange: The broad research infrastructure and expertise across RGU-UHI lends itself to providing an attractive, needs-driven research and consultancy portfolio for external stakeholders. An “Engage” event with a broad range of research users (from business, NHS and charitable organisations) was held in October 2013 to: gain an understanding of the needs of potential customers; identify how RGU-UHI could assist as academic partners, and identify the most appropriate sources of joint funding. RGU-UHI will continue to work with these organisations through a variety of routes, including KTPs (5 current with Oil & Gas UK, NHS Highland, Fitnut and Rowlands Pharmacy) and bids (e.g. to TSB), to complement those projects already funded through this route (see income section below). RGU-UHI research has led to several patent applications during the census period (e.g. Megson; US20100112095 & US20090305222; Kong,US2012238487), some of which are currently under discussion for licensing agreements. With the support of the business development and knowledge transfer teams at the partner institutions, commercial partners and investors are actively being sought to fully exploit these technologies in partnership

with external collaborators.

Changes in research environment since RAE2008: Both partners within RGU-UHI have experienced significant enhancements in their research capabilities since RAE2008. The creation of the IHWR has made a substantial difference to the research environment at RGU by creating a critical research mass (currently 42 members) and focusing research in the thematic areas described above led by dedicated Theme Leaders (Bermano, Klein & Wainwright). Internal collaboration with members of the Institute for Management, Governance & Society (IMaGeS) and the Institute for Design, Innovation and Sustainability (IDEAS), as well as external collaborators, has been key to generating inter-disciplinary teams capable of tackling complex issues (e.g. "Visualising the Invisible"; an AHRC/SFC-funded project which draws on the expertise of researchers in nursing, art and microbiology). Strategic engagement with external stakeholders has also been a major objective. While our existing track record of collaboration with the NHS has continued (e.g. Evaluation of Pharmaceutical Services) over the census period we have engaged more widely with external partners through: collaborative PhD studentships (e.g. MRC CASE Award with Astra Zeneca); industry-sponsored, solution-based research (e.g. through SFC Interface innovation funding) and KTP projects (e.g. Oil & Gas UK), and commissioned research (e.g. the acquisition of an evidence-base to inform the development of a revolutionary remote offshore healthcare strategy for Shell International, and a systematic review of musculoskeletal injury resulting from ladder climbing for Renewables UK).

The Division of Health Research at UHI has seen its academic staff more than double over the census period and has consolidated its research teams around a single focus (diabetes management) that aligns with the burgeoning local R&D strength. In particular, co-location of the Division with Lifescan Scotland in the Highland Diabetes Institute provides a vital link with a multi-national company that feeds into all three facets of the Division's operation (Clinical, Biomedical and Rural Health Research) and supports a range of joint projects, including funding for PhD studentships, technicians and clinical assistants. Growth in PhD student numbers has been facilitated through Industrial (Lifescan) and EU funding, and support of students is greatly enhanced through formation of a dedicated Graduate School. The Research Office at UHI has also grown substantially, with appointments to VPs of Research and Enterprise and a Dean of Research. The Research Office is now fully equipped to deal with complex grants and contracts, IP and knowledge exchange.

Future Research Strategy: The close geographical location and complementary research makes UHI and RGU ideal partners for an enduring joint research strategy. We aim to build upon the established collaborative research (outlined in Figure 1) by increasing the number of joint funding bids and collaborative projects facilitated through RGU-UHI "Sandpit" events, where researchers from across the Alliance will identify new projects to receive seed-corn funding as a springboard to external funding bids. Projects will be monitored by a Project Board comprising Senior Researchers from across RGU-UHI and external advisers. RGU-UHI also has ambitious plans to extend its research and knowledge exchange portfolio into additional areas of common focus, in particular:

Remote and Rural Health was identified as a crucial target at a recent research foresight exercise commissioned by RGU to consider the key challenges facing society in the next 20 years, with a focus on developing strategies to improve the health of the workforce engaged in vital industries for the UK economy: oil, gas and renewable energy. This population was recognised to represent a particular healthcare challenge, with the difficulties associated with deployment to remote and hostile environments compounded by the fact that workers drawn from the local population are at particularly high risk of carrying long term health conditions (e.g. diabetes, obesity, cardiovascular disease and mental health problems) compared to the rest of the UK. This strategy resonates with the long-term vision of UHI, which is focused on remote healthcare delivery and evaluation in rural communities. Consequently, we have established an external panel of experts (practitioners in the field of remote healthcare; medical advisors to industries that have a significant remote workforce, and scientists), to assist in the development and monitoring of a RGU-UHI research unit that will explore the major issues (e.g. clinical decision making; occupational and environmental influences on health, and remote diagnosis) that affect both remote workers and rural dwellers, optimising the breadth of multi-disciplinary expertise across the Alliance. In addition, at the time of writing, a team led by Klein, Stewart & Munoz is preparing a bid to a current Scottish Government call for

innovations on “Future care outside hospital in Scotland”

Natural Products Research: The North of Scotland is a hugely diverse source of terrestrial and marine-derived natural bioactive products that are ripe for development in health-related applications. Wainwright & Megson are currently leading a pan-Scotland bid, with Highlands & Islands Enterprise backing, to provide a pipeline for natural products research from source to clinical evaluation, on the back of a number of successful collaborations with SMEs from Scotland (e.g. BödAyre, IQ Ingredients, Deeside Water; Aquapharm Biodiscovery; Veromara, and GlycoMar), funded through SFC Innovation Vouchers and Interface Food & Drink pump-priming grants, and Europe (e.g. ABC Biosciences, Norway). Bermano is also leading a COST-Action application to the EU to bring together academics and SMEs from across Europe with an interest in the health benefits of waste products from juice or oil extraction. Commercial activity in this arena complements our academic research into potential health benefits and mechanism of action of natural actives (e.g. Küpper*et al*,*J Exp Bot* 2013, 64:2653-64;Gadad*et al*, *Int J Pharmaceutics* 2013, http://dx.doi.org/10.1016/j.ijpharm.2013.09.006 ; Meja*et al*, *Am J Respir Cell Mol Biol*. 2008, 39:312-23;TSB 2nd Generation Antioxidants project with Aquapharm Biodiscovery/Rowett Institute for Nutrition & Health (Megson); EU Interreg PhD studentship (http://www.northsearegion.eu/ivb/projects/details/&tid=122) (Megson), and a completed BHF Studentship on dietary omega-3 supplementation (Wainwright)).

c. People, including:

i. **Staffing strategy and staff development:** The significant expansion of the research teams at RGU-UHI has been fuelled by strategic investments by both partners. *UHI*: in recognition of the importance of the area to the University’s strategic priorities, has utilised funding from a range of sources, including successive European Regional Development Fund (ERDF)-led initiatives (£1.8M from 2006-2009 and £2.3M from 2010-2012) to support new research posts, space and equipment. *RGU*: strategic spending (£2.3M) of REG and overhead income by the IHWR funds time “buy-out” for academics and technical staff, based on annual evidence-based evaluations of research excellence. Since the creation of the IHWR, the number of IHWR members has risen from 32 (2009/10) to 42 (2013/14; 8 members are ECR’s). There are currently 9 post-doctoral research assistants undertaking directed and independent research in RGU-UHI. The academic teams are supported by substantial administrative (5) and technical (9) staff. Lifescan Scotland have sponsored 2 new technical posts, while the IHWR has invested in 3 research assistant posts within the biomedical, nursing and public health/epidemiology fields to retain skills and to provide support for short-term and externally sponsored research projects. The complementarity of these posts means that RGU-UHI has the capacity to undertake a broader range of joint research projects than would be possible for either partner to pursue alone. The future staffing strategy has a strong focus on continuing to build on the complementary skills base and to ensure continued strengthening of the research themes, thus optimising the resources of both partners. The Alliance has been cemented by mutual honorary positions being awarded to key individuals (Wainwright; Bermano; Kong; Klein; Megson, Whitfield; Wei, and Doherty).

RGU-UHI is strongly committed to the Concordat to Support the Career Development of Researchers. Since 2006, a number of bespoke events have been organised to train research staff across all levels, including research students. These include: (i) a three day workshop on preparing research proposals (*Angel’s Nest to Dragon’s Den); (ii) Research Project Management* workshops; (iii) *Public Engagement in Science* workshops in collaboration with the Satrosphere Science Centre, and (iv) Short courses in various topics such as “Ethics”, “Good Clinical Practice”, “Nvivo” and JBI Systematic review. In addition to the provision of in-house training, all re searchers are encouraged to join professional societies. Financial resources are made available to provide additional extra-mural specialist training (e.g. Lipidomic training for Post-doctoral Research Fellow, Harvard Medical School; Personal/Project Licence training) as required. Across RGU-UHI, formal annual performance management plans are conducted by line managers, with a specific focus on career development and training opportunities. In the last 3 years, this process has helped 3 members of the IHWR to achieve promotion to Professorial status (2 male, 1 female), 2 promotions to Reader (both female) and 5 “Developing” researchers (4 female) to achieve “Established Member” status, in recognition of their development as independent researchers with their own research income. In addition, a number of staff members in clinical departments at RGU have taken advantage of the Doctorate in Professional Practice degree, which was introduced in 2010

as an alternative means of obtaining doctoral level training compared to the traditional PhD route. At present an informal mentoring system exists across RGU-UHI, whereby experienced researchers advise others on grant submissions, CPD and career progression. However, a more formal mentoring scheme is currently under development to facilitate mentoring of early career researchers across RGU-UHI. There is also a strong commitment to advancing women's research careers in STEM subjects; RGU gained Athena SWAN Charter Membership in 2012 and will submit for a Bronze University Award in April 2014 under the steer of the Director of the IHWR. UHI is preparing to apply for Charter membership and will submit for Bronze Award soon after. It is the intention of RGU-UHI to apply subsequently for a Department Bronze Award.

ii. **Research students:** All doctoral students within RGU-UHI undertake formal training, overseen by the Graduate Schools in the respective partners. While the Graduate Schools have independent processes, the nuances are subtle and they operate to the same high standards, with student progress and monitoring being undertaken by each Institution's Research Degrees Committee. Students at RGU complete the University's PgCert in *Research Methods* (2 x SCQF level 11 modules, delivered intensively in 1 week blocks), while the UHI Graduate School makes use of training offered by a range of organisations (University of Aberdeen; University of Edinburgh Transkills programme; Vitae; NHS R&D, and Wellcome Trust Clinical Skills) to provide courses in an array of topics such as "*Effective Researcher*"; "*Writing and Presentation Skills*"; "*Knowledge Exchange*"; "*Entrepreneurship*" and "*Business Management*". Both institutions provide induction programmes for all students that include: general introduction; health and safety; ICT; human resources; registration and monitoring; ordering processes, and information and library services. Students also attend additional seminars and training sessions on a variety of topics, such as "*Developing research proposals for funding applications*"; "*Preparation for the viva*" and "*Teaching and demonstrating for ad hoc tutors*". Supervisory quality is paramount in ensuring an excellent student experience and both institutions run mandatory Supervisor Training Programmes.

Students are required to deliver regular oral presentations of their research to a variety of audiences, including weekly departmental research/journal club meetings and wider Faculty presentations. Since 2011, the student communities at the 2 institutions have been brought together at every opportunity: students from UHI attended and contributed to the IHWR annual showcase and students from RGU participated in the annual UHI postgraduate research students' conference. In addition, the RGU Research Student Association will hold a student-led conference (July 2014) that will be open to students throughout RGU-UHI, and an inter-collegiate sports day will be held in summer 2014. The IHWR has taken advantage of its move to new premises to draw together the formal seminar programmes from different disciplines, which students from across RGU-UHI are expected to attend. Further opportunities for students to be exposed to a research audience are afforded through conferences hosted by both partners in RGU-UHI (e.g. Scottish Cardiovascular Forum (UHI, 2009; RGU, 2014); Lipids, Diabetes and Blood Vessels Symposium (UHI, 2011); International Conference on the Bioscience of Lipids (RGU, 2014); The Scottish School of Primary Care (UHI 2013); Scottish Mental Health Nursing Research Conference (RGU, 2013), and Highland Research Forum (UHI, 2013). Students are expected to attend at least 1 external conference per annum, at which they must present a poster or oral communication; funds are available within the Graduate Schools to support conference expenses when external funding is not available. Students are also expected to join relevant societies.

Funding for PhD students comes from a range of sources: external funding is received through charitable organisations (e.g. British Heart Foundation, Schizophrenia Association of Great Britain), Research Council (e.g. MRC CASE Award), industry (e.g. Lighterlife, Lifescan Scotland) and Europe (European Social Fund; FP7, and Northern Peripheries Programme). The IHWR also supports a number of strategic studentships (at least one for a joint RGU-UHI project per annum). As the RGU-UHI partnership develops, it will link further PhD training through joint proposals to relevant funding sources (e.g. Wellcome Trust 4-year training programmes).

Our dedication to the quality of the research student environment provides a vibrant and sustainable programme of training, borne out by: (i) our excellent completion rates (UHI 7; RGU 35 in the REF census period – all completed within 4 years); (ii) the rise in number of students registered for research degrees across RGU-UHI (65 in 2012/13 *vs* 45 at the census date for RAE2008); (iii) how we are viewed by our students; In PRES 2011, under *Supervision*, RGU outperformed its national benchmarks in terms of the supervisory support offered to students,

including subject expertise, mentoring and availability, and (iv) employment statistics for our post-graduates: all went on to full-time employment (~15% industry; ~65% academia and ~20% health professions).

d. Income, infrastructure and facilities

Income: Over the census period, RGU-UHI has been awarded a total of £11.32M in academic research and £1.29M in commercial research grants from a broad range of sources, including UK Research Councils and Charities, the Scottish Government and associated departments and the European Union. Of particular note has been the significant income to support: (i) **nutrition, obesity and diabetes**-related research (e.g. >£900K Counterweight Scotland, >£400K LighterLife, >£400K Food Standards Agency; >£260KChief Scientist Office; >£700K TSB; >£200KLifescan Scotland); (ii) research into professional **training and practice in pharmacy** (e.g. ~£250K, NHS Education Scotland), **nursing** (£100K - AHRC/SFC, >£120K - NHS Education Scotland) and **remote and rural health and care** (£0.8 M - Northern Periphery Programme; >£200k - ESRC; >£90K - AHRC-SFC; >£100K - 2 x KTP with NHSH); (iii) **occupational health/lifestyle research** (£140K KTP with Oil & Gas UK, ~£50K industry-sponsored research) (iv) **mental health/trauma research** (£350K -ESRC; £150K - Headley Court Trust; >£500KSchizophrenia Association of Great Britain); (v) **cardiovascular research** (£110K MRC; >£380K BHF) and (vi) **nanotoxicology**(~£150K NERC; ~£350K MRC).

***Infrastructure and Facilities*:** RGU-UHI has benefitted from major capital equipment investment during the census period (£2.35M, including an EDRF Infrastructure grant). Moreover, there has been substantial investment in building infrastructure, with the IHWR being relocated to the brand new £79M custom-built facilities at RGU's Garthdee campus (June 2013) and in the UHI Division of Health Research within the Highland Diabetes Institute (HDI), Inverness (Nov 2008). Collaboration is inherent in the design of the Institutes at both sites: IHWR is co-located with the RGU Schools of Pharmacy & Life Sciences, Computing & Digital Media, Engineering and the IDEAS Research Institute, while the HDI is located in the Centre for Health Science building adjacent to Raigmore Hospital in Inverness. The Centre is one of the first in the UK to bring together public, private and academic sectors to deliver excellence in health science and biotechnology, and houses research, education, training, patient care and business development under one roof. Co-tenants in the building include: Clinical Skills (University of Aberdeen); Nursing & Midwifery (University of Stirling); Oral Health Science (UHI); NHS Education Scotland; Lifescan Scotland, and several health-related SMEs. The HDI encapsulates a novel approach to research and healthcare by bringing together NHS clinics, the UHI Division of Health Research and Lifescan Scotland R&D under a legally binding "Formation Agreement" to foster collaboration and slipstream IP arrangements. Flexible accommodation is available in both Institutes to facilitate research networking events and seminars. The research laboratories have been designed with the RGU-UHI Health Research Alliance in mind: some core facilities are available at both sites (e.g. tissue culture), but mutual access to specialist equipment is implicit in the spirit of RGU-UHI, avoiding unnecessary duplication of expensive kit and expertise. Both sites benefit from the latest equipment necessary to support top-flight laboratory research, from molecular biology (real-time RT-PCR, gene and protein array); histology; microscopy and imaging (light and fluorescent microscopes, image analysis software); cell and molecular analysis (flow cytometry, cell counting and imaging), and functional analysis (platelet aggregometry, and vascular myography). In addition to these generic capabilities at both sites, there are a number of specialised facilities:

Clinical Research: The UHI Highland Clinical Research Facility (HCRF), established in response to recommendations from the Chief Scientist Office to encourage greater participation in clinical research within Highland region, is staffed with research nurses (4 FTEs), pharmacy (1 FTE), clinical staff and primary care researchers. HCRF can accommodate day and overnight studies and is well equipped for physiological measurement (e.g. cardiovascular parameters; pulse wave analysis, and continuous glucose monitoring) and processing blood samples, providing 'near patient' physiological and metabolic measurements. IHWR's Clinical Research Facility has 2 consulting rooms; disabled changing; a clinical analyser, and facilities to determine body composition (Bod Pod), anthropometric analysis (3-D laser scanner) and metabolic rate, in addition to routine blood and tissue sampling. The adjacent Faculty of Health & Social Care building accommodates additional specialist research facilities, including a ***human performance laboratory*** *(*motion capture, biomechanics)*, a* ***clinical skills centre*** and ***interview rooms*** with video and audio recording for one-to-one and focus group sessions with observation via a one-way

viewing window. **Fundamental research**: ***Animal facilities*** are available within IHWR, with holding facilities for rats and mice (including a number of GM colonies) and associated *in vivo* and *in vitro* laboratories for undertaking acute surgical, metabolic, isolated organ/tissue and haematological studies. A *histology & imaging suite* allows detailed analysis of tissue structure and real time analysis of cell function using fluorescent imaging techniques. ***Analytical facilities*** are available at both sites*:* IHWR has laboratories equipped with NMR, mass spectrometry (LC-MS, GC-MS), molecular modelling and a range of fundamental analytical instrumentation (e.g. Raman spectrometry), while the ***Lipidomics Research Facility*** at UHI is the first of its kind in Scotland, equipped with a state-of-the art mass spectrometry suite (three LC-MS/MS systems and one GC-MS platform) and associated bioinformatics tools. The facility applies global and targeted lipid profiling strategies to investigate disease processes and also has expertise in proteomics, particularly with respect to protein turnover. In addition, RGU-UHI incorporates ***Free Radical*** *(*electron paramagnetic resonance spectrometry, nitric oxide analyser and electrochemistry), ***Microbiology***, ***Genetics & Immunology*** (includes a biobank of >1000 blood samples frompatients with Schizophrenia and case controls) and ***Drug formulation and delivery*** research facilities. Taken together, the laboratory facilities across RGU-UHI have the required technical and academic expertise necessary to extract the maximum information from every sample received and the close relationship between analytical and clinical facilities ensures highly effective translational research.

Social Science Research: The UHI component of the ***Centre for Rural Health (CRH),*** is co-located with the laboratory sciences in the HDI, reflecting the combined laboratory science/social science approach to improving diabetes healthcare, and provides expertise on the use of technology in new ways to deliver improved health services in rural areas. In January 2013, a pilot virtual diabetes clinic was launched to support patients living at a distance from specialist services across the Highlands and Islands. The CRH team provide expertise in user engagement in health services design and delivery for NHS and RCUK funded projects.

Shared access to the infrastructure across RGU-UHI therefore significantly enhances the scope and strength of research opportunities and facilitates the development of wider collaboration. This has already resulted in joint publications (e.g. Keown et al., *Br J Clin Pharmacol* 2010, 70:180-8) and joint applications for funding. Pump-priming support (~£120K) provided by both partners has been used to generate pilot data, e.g.: lipidomic analysis of cardiovascular tissue in GPR55 KO mice demonstrating marked difference in the lipidome of heart, brain and liver (Wainwright, Walsh, Doherty,Whitfield; manuscript in preparation); lipidomic analysis of grape pomace (Kong, Doherty& Whitfield); genetic polymorphisms in obesity & schizophrenia (Bermano & Wei). Several research students are also jointly supervised across the institutions (supervisors: Megson, Whitfield, Wei, Wainwright, & Bermano).

e. Collaboration or contribution to the discipline or research base

Collaboration: The very nature of RGU-UHI demonstrates a commitment by both partners to collaborative research and affords the opportunity for innovative cross-disciplinary projects, particularly in response to strategic calls for funding (see section b). However, RGU-UHI also participates in substantial external collaboration with a broad range of national and international partners. Selected examples of funded collaborations during the census period:

Bermano: Carnegie Trust Travel Award to spend time at the University of Hawaii to commence collaboration on a 2-centre study for the identification of molecular mediators linking obesity to breast cancer development. **Broom**: Centre for Obesity Management and Prevention Research Excellence in Primary Health Care (COMPaRE-PHC; http://compare-phc.unsw.edu.au), undertaking collaborative research to address key gaps in current knowledge about obesity prevention (RGU plus partners from 6 Australian, 1 USA and 1 New Zealand University). **Doherty & Whitfield**: Co-Is on TSB grant, joint with University of Liverpool & several SMEs. **Kong:** Dawei Foundation funding to establish collaborations with Osaka University, Japan to study the development of a new and rapid method for the analysis of DNA damage. **Megson**: Co-I on NERC and MRC projects led by the University of Edinburgh, investigating the role of free radicals in nanoparticle toxicity; Co-I on a TSB project with Aquapharm Biodiscovery and the University of Aberdeen to screen for novel antioxidants; Co-I on a Chief Scientist Office project (MacRury, UHI PI) with University of Aberdeen to investigate potential benefits of oat-enriched diet in type-2 diabetes. Principal Supervisor for EU Interreg-funded student (James Hutton Institute, Dundee, Scandanavia & Germany). **Muñoz**: Researcher on UHI-led NPP research project for rural older people's services involving 5 northern

European countries; PI on two AHRC-SFC knowledge exchange programmes on outdoor health with Forestry Commission and NHS; PI on NPP preparatory project looking at rural men's health with Northern Ireland and Faroe Islands; Co-I on MRC-ESRC methodology grant with Scottish Group on Social Business and Health led by GCU. **D Stewart**: PI on MHRA-funded study on pharmacovigilance and non-medical prescribers (with collaborators from Universities of Aberdeen, Surrey and Queens University Belfast). **Wainwright**: PI on BHF-funded PhD studentship to determine the role of endocannabinoids in the beneficial effects of fish oil-derived LCPUFA's (with Rowett Research Institute); PI on MRC CASE Award with Astra-Zeneca, Sweden to investigate the role of GPR55 in cardiac function. **Wei**: Consultant at Jilin University, China (2011-14); two collaborative projects (anti-tumour therapies and diagnostics in Schizophrenia) with Glory Biomedical Co Ltd, Taiwan. **Whitfield**: Co-I and management Committee Member for EU COST Action in Farm Animal Proteomics (http://www.cost-faproteomics.org/).

Formal collaborations have also taken the form of co-supervision of students at RGU-UHI: Rossi (Edinburgh); Duffin (Edinburgh); Stewart (James Hutton institute); Rahman (Rochester, NY); Duthie, Shaw; St Clair; Ford; Semple, and De Roos (all Aberdeen), are some of the collaborators who have co-supervised our students. In return, our researchers have co-supervised students at other HEIs (e.g. Megson - Edinburgh; Whitfield - Liverpool). The Lipidomics Research Facility is also affiliated to the Scottish Universities Life Science Alliance (SULSA), providing access to our facilities for all SULSA members (http://www.sulsa.ac.uk/proteomicsmetabolomics#Lipidomics). Informal collaborations include those with: the Chinese University of Hong Kong (Wainwright); University of Porto (Kong); HMID Medical Corporation Qatar and Ministry of Health; Kingdom of Saudi Arabia (D Stewart); La Trobe Rural Health School (Muñoz), University of Turin (Megson); Universities of Hawaii & Grenada (Bermano),and the University of Adelaide (Whitfield).Several of these collaborations have been supported by Royal Society and Royal Society of Edinburgh travel grants (see above) to foster continued collaborations. Further links have been developed at Institutional level: for example in 2013, RGU hosted placements for research students from the International Medical University of Malaysia to encourage collaborative projects; an arrangement that will be expanded to a bi-lateral exchange of RGU-UHI post-graduate research students and post-doctoral fellows. An MoU for research collaboration is under negotiation with KLE (India).

Collaborative success is also measured in terms of outputs: for example, during the REF census period, approximately 30% of papers published by RGU-UHI researchers have been in collaboration with UK or international colleagues including: the Universities of Aberdeen (e.g. Sutherland *et al*, *J Bone Joint Surg Br*, 2010); Edinburgh (e.g. Japp *et al*, *Circulation*, 2010); St Andrews (e.g. McKinlay *et al*, *J Am Chem Soc.* 2008); Hertfordshire (e.g. Thompson *et al*, *J Microencaps*, 2009); Cork (e.g. Markos *et al*, *Pflugers Arch*, 2012); Rochester (e.g. Kode *et al*,*Am J Physiol.* 2008); Turin (Montanaro *et al*, *Bioorg Med Chem*. 2013); California (Ostrowski*et al*, *J Med Chem*2010); Porto (e.g. Costa Lima *et al, Int J Antimicrob Agents*, 2012), and the Chinese University of Hong Kong (e.g. Leung *et al, Cardiovasc Diabetol*, 2009).

Contribution to the Discipline:

Our researchers support the activities of numerous learned bodies and societies, contribute to academic journals and sit on advisory panels. Some examples include: ***Editorial Boards***: *Br J Clin Pharmacol* (D Stewart); *Br J Pharmacol* (Wainwright & Megson); *Advances in Medicine* (Wei); PLoSOne (Bermano); *Obesity in Practice* (Broom); ISRN *Medicinal Chemistry* (Kong); *Genomic Insights* (Whitfield), and *Diabetes, Obesity & Metabolism* (Trayhurn). ***Society Fellows***: Society of Biology (Megson &Whitfield); Royal Society of Edinburgh (Trayhurn); Higher Education Academy (Megson & Wainwright); British Pharmacological Society (Wainwright) and the European Society of Cardiology (Wainwright). Doherty is also a Member of the Royal Society of Edinburgh Young Academy of Scotland, and Doherty & Kong are Chartered Chemists. ***Expert Panels/Grant Committees***: British Council Researcher Links Panel (Doherty); BBSRC Pool of Experts (Whitfield); Committee for the National Natural Science Foundation of China (Wei); National Institute for Health Research (D Stewart); MRC strategic review committees (Trayhurn); Scottish Trauma Advisory Group (Klein), International Olympic Committee working group on body composition (A Stewart), grant review committees for the Royal Society (London), Diabetes UK, Spanish Ministry of Science and the International Association for the Study of Obesity (all Trayhurn).