Institution: Queen's University Belfast

Unit of Assessment: 2

1. Overview

1.1 Organisation and Structure of the Unit: During this REF cycle, medical research at Queen's University Belfast has undergone significant and far-reaching changes to improve its scope, depth and excellence. A new School of Medicine, Dentistry and Biomedical Sciences (MDBS) has been formed within the Faculty of Medicine, Health and Life Sciences, with advice from an eminent Scientific Advisory Board (SAB) chaired by Prof Teo Forcht Dagi (Harvard Medical School). Our research is conducted within an Institute of Health Sciences, which integrates strong research teams in four interdisciplinary groupings where we have focused our resources:

- the Centre for Cancer Research and Cell Biology*
- the Centre for Infection & Immunity*
- the Centre for Experimental Medicine*
- the Centre for Public Health (CPH)

*Note: Research conducted within these Centres has been returned in UoA1.

These Centres provide the critical mass of internationally-competitive principal investigators and inter-disciplinary expertise needed to deliver cutting edge, clinically-relevant research. They link seamlessly with our three Education Centres (Medicine, Dentistry and Biomedical Science) and collectively create an innovative and dynamic research and learning environment.

1.2 Research Structure:
CPH is led by a Director (**Young**) and has four successful, aligned research themes: Public Health; Cancer Epidemiology; Genetic Epidemiology; and Nutrition and Metabolism. These encompass a range of multidisciplinary programmes, and national and international collaborations, which promote linkages and translation between public health, policy and clinical research. As a result, our productivity has increased dramatically in this REF period.

2. Research Strategy

2.1 Achievement of Strategic Aims during the Assessment Period and Development of Infrastructure to Facilitate Research:
The overarching mission of CPH is to advance the health of the public at a regional, national and international level, by increasing knowledge and influencing clinical and public health practice and policy. This is underpinned by:

a) capacity building in public health research in terms of critical mass, interdisciplinary working, methodological development and key research infrastructure, including longitudinal studies and data linkage.
b) embedded partnerships with communities, practitioners, policy makers and the public, to ensure knowledge co-creation, dissemination, and translation into policy and practice.

Since the last RAE, CPH has obtained funding from key national initiatives aimed at developing public health and clinical research capacity in the UK. These successes include the:

- Centre of Excellence for Public Health (Northern Ireland), one of five UKCRC Public Health Centres of Excellence (£6.85M)
- All-Ireland Hub for Trials Methodology Research, one of the eight Medical Research Council Methodology Hubs (£665K)
- The Northern Ireland Administrative Data Research Centre, with ESRC core funding of £6.26M
- The Northern Ireland Clinical Research Facility, a newly developed 10-room facility funded by the Wellcome Trust and Wolfson Foundation (£4.00M).

Together with a University-funded initiative that provided £1.2M to support multidisciplinary health and health care research within the Faculty of Medicine, Health and Life Sciences, these developments

have enabled us to significantly expand our existing research strengths, build capacity and enhance the methodological basis of our research. The award of the UKCRC Centre of Excellence endorsed and facilitated our increased emphasis on trans-disciplinary research, extended the range of our collaborations, and created a step change in our engagement with the practitioner and policy communities. The renewal of this funding in 2013, for a further five year period, has confirmed our vision and the quality of our activities in this area.

In addition to the above, additional exciting infrastructural developments include establishment of:

a) The Northern Ireland Cohort Study of Longitudinal Ageing (NICOLA, Phase 1 Funding Portfolio, £5.2M). NICOLA will recruit 8,500 subjects aged over 50 years and follow them over at least 15 years. This will investigate the dynamic social and economic relationships that shape health and functioning, social and personal wellbeing, and economic position as people age. NICOLA will contribute fully to an international network of ageing studies, including the English Longitudinal Study of Aging (ELSA) and the Irish Longitudinal Study of Ageing (TILDA).
b) The Northern Ireland Longitudinal Study (NILS), a large-scale data linkage study, which includes longitudinal data on Northern Ireland residents from the Census, vital events (births, deaths and marriages) and health registration datasets, *inter alia*. NILS is being used to explore a wide range of cultural, demographic, economic, health, housing and social issues, which are relevant to public health.

Our successes in achieving embedded partnerships with communities, practitioners, policy makers and the public are described and discussed fully in our Impact Statement. This will continue to drive our knowledge co-creation, dissemination, and translation into policy and practice agendas.

2.2 Main Objectives and Planned Activities for the Next Five Years:
We will build on our progress since the 2008 RAE to expand existing research strengths and introduce new programmes which fit with the overall aim of delivering benefits for public health through fundamental and applied research. The research activity of CPH is currently focused within a number of specific areas of critical mass (Themes), with clear evidence of a strong profile and recognised international excellence. We will further develop and focus these themes over the next five years.

The Centre's Strategy and Research Plans are developed by the Senior Management Team, comprising the Centre Director and the Theme leads, in the context of School and University research priorities. An International Scientific Advisory Board advises on overall strategic direction, on individual research streams and on key national and international research initiatives, focusing on areas where CPH can deliver unique, high quality research, and engage with stakeholders for long term impact on clinical and public health practice and policy.

2.2.1 Public Health Research Theme (Kee, Linden, Cupples, Patterson, Cardwell, O'Reilly, Young, Stevenson, Clarke and Tully)
The internationally recognised strengths of this Research Theme lie in cardiovascular and diabetes epidemiology and prevention science, social determinants of disease, and evidence synthesis. The majority of their work is underpinned by EU, MRC, UKCRC and ESRC funding and builds upon international excellence developed through their participation and leadership of major International Consortia.

Cardiovascular Disease (CVD) Epidemiology Programme (Kee, Linden). This programme has its origins in the WHO MONICA (Multinational **MONI**toring of trends and determinants in **CA**rdiovascular disease) Project which gave birth to local case-control and cohort studies exploring the importance of novel risk factors for coronary heart disease and stroke (Impact Case). The subsequent EU sponsored MORGAM (**MO**nica, **R**isk, **G**enetics, **A**rchiving and **M**onograph) Project has enabled us to play a leading role in a much larger consortium of Coronary Heart Disease (CHD) Cohort Studies across Europe (**Kee** is a member of the Management Group). Our partnership with

Blankenberg's lab in Hamburg, in the MRC MORGAM Biomarker study (**Kee**, co-PI), not only enabled us to investigate the role of 30 novel biomarkers for coronary heart disease and stroke but positioned us to become a partner in an even larger consortium (BiomarCaRE, EU 7th Framework, with **Kee** on its Management Group). Through this we will explore the potential role of other biomarkers (including miRNAs) in refining CHD risk prediction in a primary care setting and in predicting response to treatment. **Kee** also leads the Cardiovascular Work Package of the CHANCES EU 7th Framework funded Consortium on Ageing, which is evaluating the performance of risk prediction algorithms in older cohorts across Europe.

Type 1 Diabetes Epidemiology Programme (Patterson and Cardwell). **Patterson** leads the EURODIAB collaboration of Childhood Diabetes Registers, which analyses the trends and distribution of Type I diabetes across Europe. He has been responsible for worldwide estimates of numbers of childhood Type 1 diabetes cases, published in the last four editions of the International Diabetes Federation's Atlas of Diabetes. As well as conducting primary research into environmental risk factors for Type I diabetes, **Cardwell and Patterson** are also co-ordinating a data pooling project, investigating risk factors using individual patient data from over 30 published studies, comprising more than 10,000 cases.

Epidemiology, Prevention and Management of Long Term Conditions Programme (Cupples, Tully, Kee). This group focuses primarily on the prevention and management of cardiovascular disease. They have been particularly successful in engaging with a range of non-academic partners, to evaluate primary care and community-based disease prevention programmes. For example, the National Prevention Research Initiative funded evaluation for a local community greenway project in an area of social deprivation has demonstrated the added value of working across sectors in a major public health programme modifying the built environment. This has led to an ESRC Knowledge Exchange Award, to disseminate tools for measuring the walkability of neighbourhoods. We have built on these networks to carry out more complex interventions at community level in the area of physical activity, with the support of the MRC Trials Methodology Research Hub.

The Social Determinants of Disease Programme (O'Reilly, Kee, Young). **O'Reilly** was instrumental in establishing and developing the Northern Ireland Longitudinal Study (NILS), which in the last four years has been a platform for 8 PhD and 4 MSc theses covering a wide array of socio-epidemiological and health service related areas. He has pioneered linkage of the Census to Health and Social Services data, and novel mechanisms for joint analyses of the three UK Longitudinal studies. He secured ESRC funding to establish the NILS Research Support Unit and has been its first Director. This expertise in record linkage has been extended to the development of other health service datasets, particularly those related to GP prescribing, which are unique to Northern Ireland, and ESRC have recently awarded at further £6M to establish The Northern Ireland Administrative Data Research Centre, with **O'Reilly** as its Director. This group has also recently attracted major funding of £5.2M to establish the NICOLA cohort of people over 50 years of age, and will focus on studying the social, economic and biological determinants of healthy ageing in the Northern Ireland population.

Evidence Synthesis (Clarke, Patterson, Cardwell). **Clarke** leads the Cochrane Methodology Review Group, which oversees the production of a unique collection of systematic reviews of studies that have evaluated the methods of healthcare research. This collection of reviews received the highest unofficial impact factor for 2010 among the more than 50 Cochrane Review Groups, at 18.0, compared to the average for Cochrane Reviews as a whole of 6.2. **Clarke** recently joined the Public Health Research Group as Director of the All-Ireland Hub for Trials Methodology Research and is Chair of the MRC's Network of Hubs. He leads a Programme of research to improve the quality and relevance of clinical trials, including work in relation to public health, pragmatic, prioritized trials, and the use of evidence synthesis at all stages in the design, conduct and interpretation of trials.

2.2.2 Cancer Epidemiology Research Theme (**Murray, Gavin, Donnelly, Cantwell, Cardwell, Watson, Anderson, Coleman**)

The Cancer Epidemiology Group, including the Northern Ireland Cancer Registry, has developed a Programme of research focused on premalignant diseases and cancer health services, which has significantly influenced service delivery on a national and international level.

Aetiology and Progression of Premalignant Disease and Cancer Programme (Murray, Cantwell, Cardwell, Watson, Anderson, Coleman). This Programme includes world leading research involving a unique population-based register of Barrett's Oesophagus (The Northern Ireland Barrett's Register), which demonstrated a low rate of progression from Barrett's Oesophagus (BO) to oesophageal adenocarcinoma (OAC), and identified modifiable risk factors for malignant progression and potential biomarkers for identifying patients at high risk of progression. These findings have enormous implications for the management of BO patients, including the current practice of endosopic surveillance, which is heavily resource intensive and of questionable cost-effectiveness (see Impact Case Study). This research has substantially influenced recommendations from leading Gastroenterological Associations e.g. the British Society of Gastroenterology guidelines 'Diagnosis and Management of Barrett's Oesophagus'. Other work in this field includes the all-Ireland Case Control Study of OAC (the FINBAR study), which identified key factors associated with the development of this cancer.

In addition to continuing this work, the group, in collaboration with the School of Pharmacy, has investigated the potential impact of commonly used drugs on cancer risk and progression. This research uses data from the UK Clinical Practice Research Datalink and unique population-based linked databases on cancer diagnosis, treatment, and prescribing which have been newly constructed within the Northern Ireland Cancer Registry (NICR). Work in this field has examined oesophageal cancer risk in bisphosphonate users and has been used in safety reviews of these drugs by the US Food and Drug Administration (FDA), the UK Medicines and Healthcare Products Regulatory Agency (MHRA) and the European Medicines Agency. This Programme will expand to include the exploration of the potential impact of the use of beta-blockers, other anti-hypertensives, antiplatelets (including low-dose aspirin) and statins on the progression of colorectal, breast, lung and prostate cancers.

Cancer Health Services Research Programme (Gavin, Donnelly, Murray, Cantwell). This Programme is aligned to two national priorities in the cancer field: the National Awareness and Early Detection Initiative (NAEDI) and the National Cancer Survivorship Initiative. A series of interrelated studies examining early detection of cancer is being undertaken, primarily under the auspices of the Northern Ireland Cancer Registry (NICR), which is located within CPH (**Gavin** is Director of the Registry). NICR is also playing a key role, including the provision of data, technical support and academic input, into the International Cancer Benchmarking Project, which is a unique global partnership of clinicians, academics and policymakers investigating how and why cancer survival varies between countries. NICR has contributed data and academic input into the EUROCARE and CONCORD series of studies, which have examined European and worldwide variation in cancer survival rates (and which led to NAEDI).

2.2.3 Genetic Epidemiology of Common Complex Diseases Theme (**Maxwell, McKnight, McKay, Fogarty, Kee, McKeown, O'Neill, Passmore, Hughes**)

CPH academics have collaborated nationally and internationally to establish large, well powered, case-control and cohort studies to identify genetic risk factors for common public health problems such as chronic kidney disease, cardiovascular disease, neuropsychiatric disorders and diseases associated with aging.

Chronic Kidney Disease Programme. (Maxwell, McKnight, Fogarty and McKay), as part of the GEnetics of Nephropathy: an International Effort (GENIE) Consortium recently published meta-analyses of three genome-wide association studies using published data from the US and novel data from the UK and Republic of Ireland. This international research partnership involves Queen's University Belfast, Broad Institute (MIT/Harvard, USA), University College Dublin and the Folkhalsen Institute Helsinki (Finland), with a total of 56 collaborating centres across Europe. Epigenome-wide association studies have identified epigenetic signatures predisposing to chronic kidney disease and predicting renal transplant outcomes. Belfast has extensive clinical information (>40 years follow-up) on all kidney transplants performed in Northern Ireland and this rich data resource has contributed the largest proportion of DNA samples included in the Wellcome Trust Case Control Consortium 3 Renal Transplant Dysfunction Study (**Maxwell** is on the WTCCC3 Management Committee). It has also led to novel national and international collaborations, notably highlighting that *CAV1* and *ABCB1* gene variants are significant risk factors for transplant failure in independent renal transplant cohorts.

Fogarty is currently Director of the UK Renal Registry and leads its work on the determinants and epidemiology of renal disease.

***Diseases of Ageing Programme (*Passmore, O'Neill, McKeown, Hughes). Passmore** has led a Programme of translational ageing research, which is mainly focused on genetics. He is Chief Investigator for a major multicentre clinical trial of amlodipine to prevent vascular dementia funded by the British Heart Foundation and Alzheimers' Society and this will provide the focus for his work over the next five years. **O'Neill** works closely with Kendler (Virginia Commonwealth University) on a series of large studies of family pedigrees in addiction and schizophrenia, acting as co-PI for several of these studies. **McKeown** is Director of the Centre for Medical Education, and a member of several major international consortia investigating the genetics of cardiovascular disease, contributing clinical data and serving on writing committees. **Hughes'** group focuses on the genetics of macular degeneration and aortic aneurysm.

2.2.4 Nutrition and Metabolism Research Theme (**McKinley, Woodside, Young, McEneny, McGinty, Lewis**). Research within this Theme is focused on how diet and lifestyle factors affect chronic disease risks and outcomes, including obesity, diabetes, lipid metabolism and cardiovascular disease, and male fertility. The ultimate aim is to translate findings into either changes in public health policies and practice, or improvements in patient care and healthcare delivery.

The Dietary Intervention Programme (McKinley, Woodside, Young) focuses on the conduct of controlled dietary studies, particularly whole food (e.g. fruit and vegetables) and whole diet (e.g. Mediterranean diet) interventions, in relevant patient and population groups. This work will continue and expand to include complex interventions (for instance, a food in schools trial; feasibility completed) with the involvement of the MRC Methodology Hub and Public Health Agency.

Novel Approaches to encouraging and supporting Diet and Lifestyle Behaviour Change Programme (McKinley, Woodside). This Programme tests novel technologies and develops interventions for diet and lifestyle behaviour change, based on the needs of target groups. A randomised study comparing different methods of delivering Mediterranean diet advice showed that this diet could be adopted and maintained over a one year period in those who have just had a CHD event. A new study has just been funded under the National Prevention Research Initiative to explore the use of peer support to encourage adherence to the Mediterranean Diet in those at high risk of CVD. This will lead to a major trial with clinical endpoints in this area.

Biomarker Identification and Assessment Programme (McEneny, McGinty, Young, Woodside, Lewis). A broad range of assays for biomarkers of disease risk and nutritional status have been developed and validated, for application in population-based and clinical studies. Phenotype assessment has been applied to a number of cross-sectional and longitudinal studies both within and outside the Centre. These include the EUREYE and INDEYE studies (cross-sectional studies examining determinants of age-related macular degeneration risk in older people in Europe and India), the Hyperglycaemia and Pregnancy Outcome study (HAPO; see Impact Case) and the PRIME prospective cohort study of cardiovascular disease risk in France and Northern Ireland. Development of novel biomarkers of disease risk occurs as part of this Programme. **Woodside** has current funding from the Medical Research Council to examine the utility of a combined biomarker approach to better assess fruit and vegetable intake, and the group will lead the development of nutritional biomarker strategies for the International Consortium of Ageing Studies. **Lewis** has developed a novel diagnostic test for male fertility and a successful spin-off company (http://lewisfertilitytesting.com/) which is currently the focus of large scale clinical trials.

3. People

Since RAE 2008 we have invested significantly in our staff:

- New external Professorial appointments in Research Methods/Evidence Synthesis (Clarke, from the University of Oxford) and internal promotions to Professor (Woodside, Human Nutrition; Cupples, Primary Care; and Patterson, Medical Statistics).
- Growth in Category A academic staff from 23.5 FTE in RAE 2008 to 29.6 FTE in REF 2014.
- Research Fellowship awards from NIHR, MRC, CRUK, NCI (USA).

3.1 Staffing Strategy and its relationship to Research Strategy and Physical Infrastructure:
In RAE 2008, Queen's submitted 23.5 Category A staff to Unit of Assessment 6 (Epidemiology and Public Health). Re-configuration of the School and investment in public health research, including the recruitment of new staff means that 29.6 Category A staff are submitted to REF UoA 2. The distribution of staff amongst the various grades is Professors (13), Readers (2), Senior Lecturers (10), Lecturers (2) and Early Career Researchers (3). Since 2008, one Professor (**Clarke**) and three Lecturers have been recruited to the Centre. In addition, 3 Professorial, 1 Readership and 5 Senior Lectureship promotions have been made internally. The staff cohort, supported by 26 post-doctoral researchers (14.2 in RAE 2008) and 38 support staff, now provides for long-term stability and succession planning, with staff well distributed across the levels of the professoriate, reader/senior lecturer, lecturer and early stage career appointments. These appointments and promotions have been focused exclusively in the areas of the four Research Themes discussed above or in support of key infrastructure developments. This will continue to be our strategy. For instance, a further clinical academic appointment in the area of Care of the Elderly has been made recently in support of our investment in the NICOLA study.

3.2 Development and integration of early career researchers:
Staff development is a key issue, given the continuing expansion of the Centre, with full commitment to implementation of the Concordat to Support the Career Development of Researchers. Early career researchers/probationary staff members are assigned lower initial teaching loads and minimal administrative duties in order to allow them time to develop their independent research portfolios. They are also provided with financial support in the form of a Career Development Award. In addition, we have a 'pump-priming' policy which funds a PhD studentship for each new staff member and provides enhanced funds for conference attendance. An individually agreed, three year structured Development Programme forms an integral part of the academic probation process, monitored by a group of senior staff from within the Centre and the School. Each probationary staff member also has a Mentoring Committee, comprising three senior staff, which meets with and advises the staff member at least quarterly. A University-wide Staff Development and Training Programme offers a range of courses appropriate to the development of research skills. Early career staff are encouraged and supported to undertake periods of research and training at leading national and international institutions to further their personal development, to strengthen existing research collaborations and to establish new collaborations e.g. **Anderson** and **Cantwell** have undertaken the US National Cancer Institute Cancer Prevention Fellowship. Academic staff are encouraged to apply for competitive National Fellowships and currently three are held (**McKay** – MRC Career Development Fellowship; **Cardwell** – NIHR Career Development Award; **Coleman** – CRUK Postdoctoral Fellowship).

There is also full support for the National Concordat for Contract Research Staff. Postdoctoral research staff are vital to the development of Public Health and we actively support and mentor contract researchers to maximize their opportunities for academic appointment. For example, they are encouraged to teach and undertake the Postgraduate Certificate in Higher Education, and to attend courses on writing Fellowship applications. They are actively supported in making these applications by senior staff members. The School also has a vibrant 'Postdoctoral Society', the main aim of which is "to provide a voice for the postdoctoral community within the School and to promote opportunities for career advancement, personal development and social interaction". This is achieved through an annual symposium, various social events and formal quarterly meetings, as well as an active discussion forum. The Society Committee meets regularly with the CPH Academic Associate Directors for Postgraduate Affairs and annually with the Senior Management Team for the School. Postdoctoral researchers from the Centre are very active members within the Society and CPH academic staff strongly support its activities. Early career researchers are also offered training opportunities related to dissemination and impact, and have regular exposure to practitioners and policy makers who contribute to our Centre's team-building and strategy retreats.

3.3 Postgraduate Research Students
Postgraduate research studentships are vital to research development within the Centre. PhD

studentships are funded by the Department of Employment and Learning (DEL), and other regional and national funding bodies**.** Clinicians in training can avail themselves of the Clinical Academic Training scheme, which is supported by Queen's, the Northern Ireland Medical and Dental Training Agency (Deanery) and the Belfast Health and Social Care Trust (University Teaching Hospital). Five clinicians have held Academic Clinical Fellowships/Lectureships within CPH since 2008. The total FTE research student complement, including MD research students, has doubled from 46 to 94 since 2008. There is a strong and structured mentoring and training Programme for postgraduate students, which is compliant with UKRC recommendations, and all doctoral students must complete 30-days of skills training over the course of their research degree. All CPH students are required to undertake a course in statistical methods, which includes a formal assessment. Students may also take the Public Health Sciences module of the Queen's Masters in Public Health, which includes teaching on demography, epidemiological methods, health economic evaluation, evidence synthesis and qualitative research. The Centre runs a very active Seminar Programme, which incorporates a wide range of distinguished visiting researchers. Research groups also run journal clubs and research seminars specific to their research area. Students are encouraged and supported to attend relevant training courses at other institutions. They are expected and supported to present their findings at national and international conferences.

3.4 Equality and Diversity

The School of Medicine Dentistry and Biomedical Sciences holds a Silver SWAN Award from Athena, and we are fully committed to identifying and implementing good practices to support the careers of female academics and all contract research staff. The School established a Gender Equality Office and appointed an academic as Director of Gender Equality in September 2011 (0.2 FTE) with clerical support (0.5 FTE). This is closely linked to the Queen's Gender Initiative, which supports women's career opportunities across the University. The majority of internal promotions in CPH since the last RAE have been awarded to female staff, as have the majority of new academic appointments. All staff members complete a training course on 'Equality and Diversity' and there are additional courses for senior staff with managerial responsibility. University policies, including those pertaining to REF, are compliant with current legislation in this area and the University has a well-established Equal Opportunities Unit that is responsible for developing policies, monitoring Equality and Diversity issues, staff training and compliance with relevant legislation. There is a policy of reduced teaching loads for six months for returning academics following maternity leave, to facilitate re-engagement with their research Programmes. We have robust policies around disability and other equality issues, and special circumstances of all staff have been fully considered in relation to this REF return.

4. Income, Infrastructure and Facilities

CPH researchers have generated £22.5M in research income during the REF period, of which £4.4M (20%) was from UK Research Councils. This represents an increase of 41% from the previous RAE period, and Research Council Funding has increased by more than fourfold. Until the last year of the REF period, Northern Ireland-based researchers have not been eligible to apply for NIHR funding and this has significantly restricted funding availability in key areas of clinical research. As a result of a change in Government policy, some NIHR funding schemes have become available in the last 12 months, although it is of note that NI researchers cannot apply to the large infrastructure schemes (BRU/BRC funding etc).

Key infrastructure developments within CPH during the REF period have been highlighted above – the Centre of Excellence for Public Health (Northern Ireland), the All-Ireland Hub for Trials Methodology Research, The Northern Ireland Administrative Data Research Centre and The Northern Ireland Clinical Research Facility. CPH is based in two recently refurbished buildings on the Royal Group of Hospitals Campus of the Medical School. Since the last RAE, extensive new facilities have been provided, including complete new suites of offices, multi-user rooms for postgraduate students and postdoctoral researchers, seminar rooms and refurbished laboratory space. This includes accommodation for the Centre of Excellence for Public Health (Northern Ireland), and the MRC Methodology Hub for Ireland. In addition, the Wellcome Trust / Wolfson Foundation Northern Ireland

Clinical Research Facility is based on the University Floors of Belfast City Hospital. The CRF opened in September 2013 and provides a fully equipped state-of-the-art facility for clinical research studies, and for detailed physical and clinical assessment of participants in population based studies, including those recruited into the Northern Ireland Cohort for the Longitudinal Study of Ageing (NICOLA). The total cost of these infrastructural improvements exceeds £7.0M. The Genetic Epidemiology and the Nutrition Metabolism Research Themes require high throughput equipment to undertake their large scale studies and significant investment (£2.0M in total) has been made in purchasing equipment for these groups.

The MRC Trials Methodology Hub, CRF and the COE are partnerships involving the University of Ulster, and the CRF is utilised by researchers from the University of Ulster and Belfast Health and Social Care Trust. In terms of research governance, there is a close relationship with Belfast Health and Social Care Trust, which sponsors the majority of CPH research. The Director of CPH is also Director of Research and Development for the Trust, which has provided substantial funding and sponsorship for equipment in the Genetic Epidemiology laboratories.

5. Collaboration and Contributions to the Discipline

5.1 Contributions to the wider Research Base

Each of the Research Groups within CPH has strong academic collaborations at national and international levels. Key collaborators of the Public Health Group include many universities and academic public health organisations in Europe, through the MORGAM and CHANCES Consortia and the EURODIAB collaboration of Childhood Diabetes Registers. Researchers working within the Cancer Epidemiology Theme have strong national and international links e.g. with the National Cancer Institute (USA), the International Agency for Research on Cancer (IARC), the National Cancer Intelligence Network, the National Cancer Registry Ireland, the Hutchison/Medical Research Council Research Centre (Cambridge, UK), the Mayo Clinic (USA) and the Western Australian Institute of Medical Research. The Genetic Epidemiology Group has many international collaborations including with the Broad Institute (MIT/Harvard, USA), University College Dublin and the Folkhalsen Institute Helsinki (Finland). Important collaborations of the Nutrition and Metabolism Group include the London School of Hygiene and Tropical Medicine (EUREYE and INDEYE studies), University of Aberdeen and University College London. Until recently, **Clarke** was Director of the UK Cochrane Centre and he maintains strong international research links as Coordinating Editor of the Cochrane Methodology Review Group. Several crucial research collaborations have been developed and fostered by the appointment of Visiting Professorships within CPH e.g. Professor Kenneth Kendler, Virginia Institute for Psychiatric and Behavioral Genetics, Virginia Commonwealth University, USA (Genetic Epidemiology of Schizophrenia) and Professor Annie Anderson, Centre for Public Nutrition Research, University of Dundee (Public Health Nutrition). CPH staff play a key role in the University's strategic international collaborations with the University of Malaya (UM) and Vanderbilt University. Public Health Research forms the largest component of the Queen's/UM collaboration, with a focus on cardiovascular disease risk (especially in adolescence/early life) and cancer (population awareness and survivorship). The CPH/Vanderbilt collaboration is currently focussed on pharmaco-epidemiology and cancer epidemiology, and CPH is developing a Masters in Global Health with international partners.

5.2 Interdisciplinary Research

CPH is a multidisciplinary Research Centre. Academic staff come from a wide variety of professional backgrounds and disciplines including public health, epidemiology, clinical specialties (e.g. clinical biochemistry, renal medicine, geriatrics, psychiatry and general practice), biostatistics, evidence synthesis, genetics, biomedical and laboratory science, nutrition, health services research and psychology. Inter-disciplinarity is a common feature of many of the Research Programmes and projects and CPH staff have close relationships, and undertake joint projects, with other disciplines within and beyond the University. These include: modelling of health service and public health initiatives, with operational researchers and mathematicians; pharmaco-epidemiology research with pharmacists; and many others. Members of our UKCRC Centre of Excellence for Public Health also

include QUB academics from the School of Social Policy, Sociology and Social Work, from the School of Management, the School of Biology, and from the School of Mathematics and Physics.

5.3 Indicators of Wider Influence and Contributions to the Discipline

A key element of the CPH's philosophy is the translation of research findings into policy and practice. Centre staff work closely with key external stakeholders including Government and Local Authorities, non-governmental organisations (e.g. the Institute of Public Health in Ireland), the NHS including Clinical Research Networks, and the voluntary sector. The NI Public Health Centre of Excellence plays a particularly important role in ensuring strong engagement with regional policymakers and politicians at all levels. Professor **Kee** leads the Northern Ireland Public Health Research Network, which brings together academics from all universities in the province and interested public health professionals/practitioners across the Health and Social Care (HSC) sector and outwith the NHS (e.g. Civil Service, local authorities). **Kee** is also a member of the Population Sciences Group within the MRC Population and Systems Medicine Board, and the MRC Early Phase Development of Public Health Interventions Scientific Panel. He serves on the Public Health Funding Board of NIHR and sat on the Chief Medical Officer's Advisory Panel to select the academic departments constituting the National School of Public Health in England. Until 2010 he sat on the NICE Public Health Topic Selection Panel.

Young is Director of the Northern Ireland Clinical Research Network and in addition chairs the Obesity Prevention Steering Group and Alcohol Advisory Group for Department of Health, Social Services and Public Safety. He is a member of the Department of Health Scientific Advisory Committee on Nutrition (now affiliated to Public Health England), the Chair of the Scientific Division of the International Federation for Clinical Chemistry and Laboratory Medicine (the world's leading laboratory medicine organization), and a member of the American Association for Clinical Chemistry Global Harmonization Steering Group (www.harmonization.net). In addition, he is Associate Editor of Clinical Chemistry, the number one ranked Journal in its field.

Engagement with the NHS and key policy making bodies is a key goal for all CPH staff. Examples include the role of **Fogarty** as Director of the UK Renal Registry, **Gavin** as Director of the Northern Ireland Cancer Registry and Co-Director of the National Cancer Intelligence Network (seconded for two days per week). **Maxwell** is also the Lead Clinical Nephrologist in NI advising the HSC on the development of Renal Services and has chaired the expert groups developing and disseminating Guidelines for Acute Kidney Injury (AKI) and Chronic Kidney Disease (CKD). **Cupples** leads the Northern Ireland Primary Care Research Network. **Lewis** is Chair of the British Andrology Society. **Woodside** is an advisor to the International Atomic Energy Authority on food irradiation/safety and is the Editor of Nutrition Research Reviews, a top five ranked journal in Nutrition and Dietetics. **O'Neill** is Associate Editor of the British Journal of Psychiatry.

Awards, Prize Lectures & Fellowships: A range of prizes have been won across all academic grades within the school. Notable examples have included the Chiron Medal of the Royal College of Physicians of Edinburgh (**Maxwell**), the Silver Medal of the Nutrition Society (**Woodside**) and the Foundation Award of the Association of Clinical Biochemistry (**Young**). The Cancer Registry was a key contributor to the Cancer Programme Queen's Diamond Jubilee Award 2011. **Clarke** has recently been identified as one of the top 400 living core biomedical researchers based on bibliometric indices (Eur J Clin Invest. 2013 Sep 3. doi:10.111/eci.12171) and won the 2013 Unorthodox Prize (www.unorthodoxprize.org) for Evidence Aid (www.EvidenceAid.org), which provides resources for decision-makers before, during and after disasters and other humanitarian emergencies.