



# THE FARR INSTITUTE OF HEALTH INFORMATICS RESEARCH

## ANNUAL REPORT 2014-2015

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Funded by



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## SECTION 1: THE FARR INSTITUTE DIRECTORS' OVERVIEW

### *Purpose of this report*

This is the second annual report of the Farr Institute of Health Informatics Research, reporting on the period March 2014-February 2015. The format of the report has been modified from last year's structure to reflect feedback from the International Advisory Board (IAB), the greater collaboration that has occurred across the four Farr Centres and the development of the Farr Institute Network. In Section 2 we illustrate this through the reporting of activities against the strategic themes of The Farr Institute. Section 3 highlights each Centre's activities against the research work streams outlined in their original eHealth Informatics Research Centre (eHIRC) award. Impact, as measured by new grant acquisition, publications, appointments and invitations to speak at external meetings are listed within the appendices.

## HIGHLIGHTS OF THE YEAR

### *Engagement and Innovative Governance*

The IAB advised that the building and maintaining of public trust should be at the top of the Farr's list of strategic priorities. We therefore report upon it first in this Annual Report.

Considerable progress has been made on the development of proportionate governance standards for data use to enable high quality outcomes research. A Farr-led Consultation Workshop with data-linkage researchers was held in November 2014. It attracted numerous delegates including from the Administrative Data Research Network (ADRN), UK Biobank, National Cancer Intelligence Network (NCIN), NHS Greater Glasgow and Clyde Safe Haven and the Nuffield Department of Population Health.

Farr members collaborated on and submitted an evidence review titled *A Review of Evidence Relating to Harm Resulting from Uses of Health and Biomedical Data* (<http://nuffieldbioethics.org/project/biological-health-data/>), commissioned jointly by the Expert Advisory Group on Data Access, a committee convened by the Wellcome Trust, CRUK, ESRC and MRC, and the Nuffield Council on Bioethics (NCOB). This document was published alongside the Nuffield Council of Bioethics' major report on Big Data.

The Farr Institute joined the #datasaveslives twitter campaign. This popular public engagement campaign has co-ordinated many principal investigators, clinicians, researchers and academics to pledge their support to a project aiming to overturn negative perceptions about the use of data in research.

Farr Institute Investigator Andy Goldberg won the National Institute for Health Research (NIHR) New Media competition for the best recruitment and patient information video, aimed at encouraging participation in clinical trials. The film was produced at University College London and the Royal National Orthopaedic Hospital and directed by filmmaker Jan Letocha. It features Hollywood actor Sylvester McCoy, as well as other patients discussing their experiences with ankle replacement and ankle arthrodesis. The film was produced in conjunction with the TARVA (total ankle replacement versus arthrodesis) trial, a clinical trial for patients with ankle arthritis that are considering surgery.

During the year Farr Institute members contributed to the development of a number of important policy discussions and documents including, the EU Green Paper on mobile health, UK National Information Board Strategy, the Cabinet Office's updated proposals on data linkage, the Expert Advisory Group on Data Access, Welsh Government's "Prudent Healthcare" policy initiative and Early Years Outcome Framework, and Scotland's Safe Haven Charter.

The first Farr Institute annual Scientific Research Forum was held in Edinburgh in May 2014. Prof Leslie L. Roos and Prof Noralou Roos from the University of Manitoba gave the Inaugural Farr Institute Lecture. The second Industry Forum was co-hosted with the ABPI in London in December 2014 focusing on identifying areas of shared interest with the pharmaceutical industry. The Farr Institute supported the Digital Health Assembly Open Innovation Conference in Cardiff in February 2015, attracting over 300 international delegates and speakers including attendees from MIT Center for Digital Business, World Health Organization, the European Space Agency, IBM, CISCO, Siemens Healthcare and the NHS. The

event focussed on the key themes of Big Data, Empowering Patients and Staff and Innovative Business Models.

### *Infrastructure development*

During the year the capital investment in purposely designed buildings became operational in London, Manchester, Edinburgh and Dundee. The Data Science Building in Swansea that will house the Farr, ADRC-Wales and SAIL databank will be occupied in August 2015. There also has been considerable development in e-infrastructure with funding for the Safe Share Project, a collaboration with JISC ([www.jisc.ac.uk](http://www.jisc.ac.uk)) to enhance the UK joint academic network (Janet) to facilitate: secure data transfer between centres; and the use of a single security credential for accessing distributed resources across the Centres. It will test the feasibility of delivering single sign on with two factor authentication to safe havens and HPC resources for The Far Institute and also with Medical Bioinformatics Centres, and ADRN. The UK Secure eResearch Platform (UKSeRP), a large scale secure data sharing platform, is now operational with the SAIL databank first to use its services. A joint Dataset Access Project has been established to develop a sustainable catalogue of the data assets held across the Farr with 300 indexable sources of retrospective data included in a prototype access framework using the Comprehensive Knowledge Archive Network (CKAN).

The Farr Telepresence system has been extensively used to host meetings, substantially reducing the time and cost of attending meetings.

### *Investment in People*

The year has seen substantial strengthening of the Farr UK Research Network team, with the appointment of a new Network Manager and Administrator and completing the team with the appointment of the Industry Engagement Manager and Chief Scientific Officer. Across The Farr Institute there have been 43 new staff appointments (see [Appendix 4](#)).

### *Development of Strategic Partnerships*

There has been considerable progress made during the year in developing strategic partnerships with a number of organisations and developments, including the Health and Social Care Information Centre (HSCIC), Clinical Practice Research Datalink (CPRD), UK Biobank, Genomics England, MRC Medical Bioinformatics Centres, The ADRN, NIHR Health Informatics Collaboratives, and the MRC Network of Hubs for Trials Methodology Research.

### *Research grants, developments and publications*

Farr Institute Investigators have continued to contribute to inter-disciplinary collaborative awards across the UK which harness electronic patient records.

Leveraged research awards totalled £58.62M, excluding big item tickets such as the £25M investment in Genomics England and £12M for the Dementias Platform UK in which the Farr Institute featured. A noticeable and welcome development has been the growing extent of cross centre and wider collaboration in new bids. Within the year, external collaborative opportunities have been further explored, and current priorities for development include leading a Genomics Clinical Interpretation Partnership (GeCIP) for Genomics England, (see below) the MRC Medical Bioinformatics Centres, The Turing Institute, The Crick Institute, NIHR, CPRD, HSCIC and UK Biobank. While partnerships between The Farr Institute and these organisations are still in their early development, the vision of how partnerships can significantly aid the development of UK science and health Informatics research has been well considered.

Cross-Institute research submissions were exemplified by the Genomics England GeCIP application with a proposal entitled *Electronic Health Records (EHR) in the 100,000 Genomes Project: methods for standardisation, quality improvement, deep phenotyping, lifelong linkage and translational exploitation*. Other cross-Farr submissions included *EMERALD: An open-access repository of EHR metadata, phenotypes, analytical methods and excellence exemplars for translational research* (Wellcome Biomedical Resource Development Scheme), a bid for pharmacoepidemiology research

in children (MRC) and *Supporting Distributed Studies & Portability of Methods* (MRC Methodology Call).

Farr Institute investigators published 417 peer –reviewed scientific papers, many in high-ranking journals.

### *Future Strategy*

The Farr Institute hosted an International Advisory Board (IAB) on 15<sup>th</sup> December 2014 in London. IAB members made a series of recommendations to the Directors that have shaped a core part of the current strategy going forward, including the need to communicate a clear vision of The Farr Institute's identity, role, remit, and objectives to stakeholders both nationally and internationally. This needs to demonstrate the 'added value' The Farr Institute creates over that of the sum of the centres, to be recognised as a trusted entity and to think beyond the current research funding cycle, giving significant thought to future service offerings, future customer base and future sources of funds. Subsequently, the Directors and the MRC held a number of away days and developed plans for the future structure, governance and operation of an expanded and unified Farr Institute.

## SECTION 2: IMPACT OF THE FARR INSTITUTE AND FARR INSTITUTE NETWORK MARCH 2014-FEBRUARY 2015

At a national level The Farr Institute organises its activities through Working Groups as partnerships of colleagues across The Farr Institute and other professionals within the UK. Current members of the working groups are listed in [appendix 2](#).

The Farr Institute aims to deliver impact in the following areas

- Advocacy through Patient and Public Involvement and Engagement
- Research at larger scale
- New Science
- Greater interoperability and use of standards
- New partnerships with academia, NHS and industry
- Increase the UK skill base in health informatics

### PATIENT AND PUBLIC INVOLVEMENT AND ENGAGEMENT

Public and patient involvement and engagement (PPIE) is a core work programme of the Farr Institute and each of the four centres has a public engagement team who deliver public events, workshops and public panels. Representatives meet biannually (virtually or face-to-face) and are in regular contact to encourage collaboration and co-ordination of activities.

#### *Public Panels*

Each of The Farr Institute Centres has now established a public panel of lay members who meet regularly to advise on strategy and research. These panels constitute key mechanisms to embed PPIE into the work of individual centres and The Farr Institute as a whole. All four Centres are working on strategies to involve a broad range of people with relevant experiences and opinions on their panels, reflecting the diversity of their respective local populations. In January 2015 the Public Panels of each of the four Farr Centres held a joint meeting connected through The Farr Institute telepresence system, allowing members to discuss membership, activities, and future plans.

Centres are integrating public involvement using a variety of methods. For example, the CIPHER team have been working with their public panel (the Consumer Panel for Data Linkage Research), in order to develop a clear strategy for bringing public engagement to the wider community. A quarterly monitoring mechanism has been introduced to evaluate their activities, as well as a mechanism by which Panel members can report on events that they have attended and bring to our attention any external groups that CIPHER could involve in future public engagement work. Furthermore, HeRC's PPI forum are taking a pivotal role in informing each of its research themes through focused specific targeted working groups to advise and consult with individual theme leads on key issues of public and patient involvement and engagement.

There have also been conscious efforts to develop capacity among members of public panels as a key resource and asset. To ensure that the HeRC PPI Forum understand the landscape in which Farr operates they have been brought into direct contact with key stakeholders and involved in activities such as: setting challenging briefs to Master's Level students on how to use technology to engage and empower patients to self-manage their own health; working with policy makers from the National Information Board to inform a new strategy to increase the uptake of data and technology within the NHS; and inputting into local and EU-wide consultations on the use of mHealth and technology to monitor their health.

#### *Supporting and training researchers*

Centres are also working to establish ways of supporting and training researchers (within and external to The Farr Institute) to develop their skills and confidence in PPIE in health informatics research; for example, UCL developed a short course ('Public Trust and Public Engagement') and also trained researchers in communication skills as part of a Soundboard Event organised to disseminate their research in woman and child health to the public. Furthermore, HeRC have established a small projects scheme to encourage methodological innovation in PPIE. To date, two internal calls have been released inviting applications for projects (to a value of £5,000) involving the public as either a

co-applicant or as the people driving the research/formulating the research questions. Three of these projects have been funded so far: Dynamic consent; (Van Staa/Dixon, UoM); Access to Records (Mason; Born In Bradford); How is Britain Breathing? (Brass, UoM).

### *Wider public engagement and dissemination*

In addition to focused involvement of public panels, several public engagement events have been delivered to reach a wider general audience. As part of the Edinburgh Fringe in August 2013, Mhairi Aitken from The Farr Institute Scotland (Research Fellow at University of Edinburgh) presented a show '*I know what you ate last summer*', challenging the audience to think about the issues around the large amounts of data collected on them via supermarket loyalty cards. In an entertaining and engaging show, issues relevant to privacy, data sharing and the value of data were posed to the audience. For example, should the data be used not only to provide discounts to them as a consumer but also by researchers in universities and governmental departments to study patterns in consumption, design public health policies or target healthy living campaigns? Issues such as 'Should our information be thought of as private and belonging to us?' or 'Is it a public asset that should be sold in all our interests?' were discussed.

The Farr Institute London are undertaking a number of projects to ensure that research outcomes are being fed back to the public whose medical data informed the research conclusions. Examples include:

- A series of seminars 'Let's talk hearts', providing a forum, open to all, to learn about heart conditions, how (and why) you should keep your heart healthy, and the latest research on cardiovascular health.
- The UCLP AF initiative (Robson) reaching out to with patients and wider stakeholders concerned with atrial fibrillation and the charities that represent them.
- Developing novel methodology for mining social media and comments posted on national media websites in response to media reporting of our research on antimicrobial resistance. This is a novel approach to "listening" to the public's response to our research.
- Engaging with WikiProject Medicine and Cancer Research UK on improving Wikipedia's coverage of health information

PPIE is planned to be a cornerstone of The Farr International Conference of 2015; PPI and Engagement theme leads from across the four centres are actively engaged in shaping and developing this programme with the conference organisers and PPI forum representatives will be invited to attend.

The Farr Institute's researchers are actively engaged in the wider local, regional and UK level landscape, including involvement in public discussions on Care.data restart (Autumn 2014) and participated in the launch of the new Nuffield bioethics report: <http://nuffieldbioethics.org/publications/> (Feb 2015). PPIE is further enhanced by the #datasaveslives twitter campaign. The popularity of this public engagement campaign has seen over 30 principal investigators, clinicians, researchers and academics pledge their support to a project that is aiming to overturn negative perceptions about the use of data in research. The #datasaveslives campaign promotes positive case studies and new articles to help drive a sea-change of opinion about the use of health information in having a positive impact on UK health and health services.

The #datasaveslives campaign is now being adopted by the UK-wide Farr Institute and its nodes.

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## INNOVATIVE GOVERNANCE

The Farr Institute Innovative Governance Working Group have developed a programme of work which aims to take forward the development of approximated proportionate Governance standards for data use to enable high quality outcomes research. The work commenced by holding a Consultation Workshop with data-linkage researchers in November 2014. It attracted delegates from, for example, the Farr Centres, the ADRN, UK Biobank, NCIN, NHS GGC Safe Haven and the Nuffield Department of Population Health. Due to the technique employed (Nominal Group Technique), rich data were collected highlighting not only the barriers and enablers to cross-national and cross-

sectoral data-linkage, but also how we should prioritise our next steps. When analysis is complete, these will inform the next stage of enabling research (not only) across Farr Centres.

The Working Group has welcomed five external members, who bring significant expertise. They are Rosemary Agnew (Scottish Information Commissioner, Co-Chair), Beth Thompson (Policy Advisor at the Wellcome Trust), Natalie Banner (member of the Wellcome Trust's Expert Advisory Group on Data Access), Sarah Dickson (Head of MRC Regulatory Support Centre) and Janet Messer (Director of Systems Development, Health Research Authority).

All The Farr Institute Centres have been developing the information governance policies and procedure for their data safe haven and associated data services. The UCL Data Safe Haven has been accredited with the award of ISO27001 in August 2014 (Peacock). Farr HeRC has achieved NHS Information Governance Toolkit level two compliance and is implementing an ISO27001 Information Security Management System, planning to formally certify by Summer 2015.

Farr Institute CIPHER and Farr Institute Scotland have collaborated on and submitted an evidence review titled *A Review of Evidence Relating to Harm Resulting for Uses of Health and Biomedical Data* (<http://nuffieldbioethics.org/project/biological-health-data/>). This was commissioned jointly by the Expert Advisory Group on Data Access, a committee convened by the Wellcome Trust, CRUK, ESRC and MRC, and the Nuffield Council on Bioethics (NCOB). Please see section 'Influence on UK and International Policy' for further details.

A coordinated response to the HSCIC five-year forward strategy document contained contributions from all Farr Centres, and was collated by Farr HeRC. Ainsworth (Farr HeRC) and Ford (Farr CIPHER) are members of the care.data expert reference group.

A Farr-wide IG paper is in review with International Journal of Medical Informatics. Authors: Nayha Sethi & Graeme T Laurie, (Scotland); John Ainsworth & James Cunningham, (HeRC); Christine Dobbs, & Kerina H Jones (Cipher) Dipak Kalra & Nathan Lea (London). Title: *On moving targets and magic bullets: can the UK lead the way with responsible data linkage for health research?*

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## METHODOLOGY RESEARCH

The aim of the Methodology working group is to advance methods for harnessing health record data, at-scale, for better health science & care.

### *College of Experts*

Forty experts were invited into The Farr Institute College of Experts: all accepted. The College comprises the UK's academics publishing primarily in the field of Health Informatics at an international level, plus leading Statisticians, Bioinformaticians, Computer Scientists and Epidemiologists drawn from The Farr Institute Investigators. The Experts are connected via the email group [HICE@jiscmail.ac.uk](mailto:HICE@jiscmail.ac.uk), which is used to for two main purposes: research policy support for funding agencies, and recruiting scientific advisors for Network based events. For EPSRC the group has produced "EPS Challenges in Health Data Science" and participated in a strategic workshop.

### *Advancing Methodology*

Group members contributed over 90% of the UK's total output in the top two conferences and top five journals in Health Informatics over the past two years. The Farr Institute embedded/enhanced projects led to a distinguished paper prize and Medinfo 2013; an investigator prize in Primary Care Informatics; and a strong showing at AMIA 2014, including three full papers, a workshop and a keynote. In Statistics the outputs include: two strong papers in Statistics in Medicine inspired by Farr Institute challenges; and a debate on the difference between personalised and stratified Medicine at the International Society for Clinical Biostatistics.

### *Methodology Career Paths*

The group has identified a problem with supporting the careers of software engineers whose outputs are not fully captured in most academic environments. Such people may work alongside statisticians and informaticians making strong intellectual contributions to methodology research, but they are often employed on non-research contracts. This has been fed into the Academy of Medical Sciences review on "Team Science" and a workshop is being arranged between Farr Institute software

engineers and the Director of the Wellcome Trust in early 2015. Discussions are also being had with both the MRC and the ESRC research Councils.

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## COHORT STUDY ENHANCEMENT

This group aims to build upon the MRC commissioned report 'Maximising the Value of UK Population Cohorts' published in February 2014 and chaired by Professor Jill Pell (The Farr Institute Scotland). The UK supports an unparalleled collection of large scale population cohort studies which provide a wealth of longitudinal phenotypic, biological and social data for studying health and wellbeing throughout the life course. The ability to link to health and other routine records, collect data and samples from consenting participants and apply cutting edge imaging and omics technologies, places the UK in an optimal position to fully capitalise on these major research assets. A striking feature to emerge from the MRC Cohort Strategic Review is the number of people in the UK who have participated in the 34 cohort studies reviewed. Altogether 2.5m people have taken part and currently around 2.2m people - 3.5% of the population - are cohort members.

The work of the sub group has started to form after Professor Michaela Benzeval was appointed as co-chair to replace Professor Jane Elliot who was appointed as ESRC Chief Executive to join with Professor Ronan Lyons in leading this group. Cohort enhancement is a complex environment with a number of other initiatives ongoing, including the £5m investment in CLOSER ([www.closer.ac.uk](http://www.closer.ac.uk)) by ESRC and MRC involving eight cohorts, and the £12m investment by MRC in the Dementias Research Platform UK (DPUK) that now involves up to thirty four cohorts. Professor Benzeval is involved with the CLOSER group and an initial joint meeting has been held with that group. Professor Lyons also leads on the development of the DPUK analysis platform that will utilise the UK Secure eResearch Platform (UKSeRP) funded by the MRC capital investment in the Farr Institute. An initial meeting has also been held with HSCIC to discuss the potential to place a research data appliance (created with Farr capital investment) with them to facilitate supply of data to cohorts.

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## EINFRASTRUCTURE

The aim of the eInfrastructure working group is to create an electronic infrastructure to scale and accelerate the science of The Farr Institute.

### *Connecting people.*

**The Farr Telepresence.** We have established a high quality, video conferencing network between all the organisations across the four Farr Institute Centres. It enables high quality video multipoint video conferencing to be set up instantly at the touch of a button. The network uses Cisco equipment and includes a range of 26 systems across The Farr Institute partners including fully immersive telepresence, seminar rooms, meeting rooms and personal systems. The system is operational and well used for communication across The Farr Institute facilitating cross-Institution and cross-centre collaboration, resulting in greater communication and a significant reduction in travel in terms of time and cost.

### *Connecting data*

**UK SeRP.** As part of the MRC capital investment in The Farr Institute, The Farr Institute CIPHER has been taking forward the development of a large scale secure data sharing platform, to support the safe reuse of linked health data. The UK Secure e-Research Platform (UKSeRP) has been designed specifically to provide highly secure, easy to use, fully IG compliant facilities to single or groups of organisations, who wish to pool or link their data and then share it with the wider research community. This large scale facility, capable of storing, linking and sharing the data of up to 600 individual projects, comes equipped with a choice of data storage options (databases), data models, and analytical tools (software) powered by a dedicated high performance compute infrastructure. UKSeRP has now been delivered and is in the final stages of testing. Accreditation to ISO 27001 is underway. Initial discussions are in progress with a number of pathfinder including the MRC-funded UK Dementia Platform (UKDP), which aims to pool and share data from up to 34 cohort studies. Wales' SAIL Databank will be the first user of UKSeRP over the next few months and we expect this to be followed by early adopter programmes to follow soon thereafter.

**Dataset Access.** This project has been established to develop a sustainable catalogue of the data assets held across The Farr Institute. This will provide a system for researchers to discover datasets

accessible through The Farr Centres and the associated policies for access and linkage to other data. The diversity of data holdings across UK sites and the complexities of governance make this a non-trivial task. The value of a single-point-of-search is well recognised, but its provision requires a common approach that is difficult to apply retrospectively and consistently at scale. For this reason, we have undertaken a due diligence study to get to the heart of the scalability problem and also ensure user requirements are met. It has been vital to understand the reasons why several previous efforts to produce single points of search have foundered and also connect with UK development efforts that are showing promise. Thus far, we have enumerated and listed over 300 indexable sources of retrospective data in a simple listing and created a prototype access framework using The Comprehensive Knowledge Archive Network (CKAN) at HeRC. The choice of CKAN was influenced by its wide use in storage and distribution of datasets and in various government data catalogues, such as the UK's *data.gov.uk*, the Dutch National Data Register, the United States government's *Data.gov* and the Australian government's *Gov 2.0*. To support new models of distributed team science, we have recognised that future access requirements need to go beyond simple "web listing" of static datasets. One emergent model is the development of a *Farr Institute Research Brokerage Service* that can manage the entire process of data set search and provisioning, including invoking human workflows to manage data governance. The development options for both short-term quick wins and the longer-term pipeline take into account past successes and failures. Other concurrent activities in UK data access within the computer science community are relevant for review and will be adopted where necessary.

The planned MRC-funded migration of a virtual machine (VM) of the **Barts-Bridge Cardiovascular Clinical datamart** to a QMUL-hosted server has been completed. The Datamart contains a limited-extract of pseudoanonymised cardiovascular clinical data derived from ~100,000 patients. The datamart is currently being used to populate clinical data to the Barts Cardiovascular Registry. The QMUL Bioinformatics team (Barnes) and QMUL Research IT (Christie) have deployed open source TransSMART datamart VMs to support data integration, analysis and data sharing for three MRC stratified medicine projects (MRC-RA-MAP, MRC-PSORT and MRC-MATURA). This has created a unique, common datamart infrastructure across three closely related MRC projects investigating immune-inflammatory disease, creating opportunities for future data integration and integrated analysis for stratified medicine and drug discovery. The use of VMs to support medical bioinformatics research has informed the design of the **eMedLab infrastructure** (Christie, chair of design group) for the MRC-funded Medical Bioinformatics consortium (£8.9M, UCL-QMUL-LSHTM-Crick-Sanger-EBI-KCL). The eMedLab consortium is closely linked to both The Farr Institute and Genomics England (Hemingway, Caulfield, Hubbard, co-PIs).

### *Connecting centres.*

**The Safe Share Project.** The Farr Institute, has established projects with JISC ([www.jisc.ac.uk](http://www.jisc.ac.uk)), to enhance the UK joint academic network (Janet) to facilitate: secure data transfer between centres; and the use of a single security credential for accessing distributed resources across the Centres. These facilities will scale and accelerate UK data science research by (i) improving access via a common security framework (ii) enabling the sharing of computational facilities amongst Centres (iii) enabling collaborative data analysis (iv) facilitate data linkage through secure data exchange capability. This project has been awarded £865,000 by JISC.

As part of this work, The Farr Institute has initiated collaboration with Medical Bioinformatics initiative (MRC, £39M) and the Administrative, Business and Local Government Data Research Centres (ESRC £48M) that has opened new opportunities for linking data.

The safe share access project is composed of two subprojects:

#### A. High Assurance Networking

The sub-project will deliver a higher assurance network infrastructure, overlaying the Janet network, to support access to and sharing of pseudonymised data. The project will connect at 1 Gb/s all Farr Centres, selected Farr centres and project partners, selected Farr Centres and ADRCs, with up to a total of 20 endpoints, providing network level encryption.

The project commenced on 1<sup>st</sup> December 2014 and will run for 2 years.

#### B. Common Authentication, Authorisation and Identity management

This sub project is composed of a number of pilots to test the feasibility of providing a common Authentication, Authorisation and Identity Management system across The Far Institute and also with Medical Bioinformatics Centres, and ADRN. Eventually we aim to provide single sign on across The Farr Institute for accessing data and computational resources. The home institution will be used for identity management, enabling a single point of credential management for any researcher. The pilots will address:

- Single sign on with two factor authentication
- Single sign on to HPC resources
- Single sign on to safe havens.

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## CAPACITY BUILDING

Provision of training and education across not just the academic research base but also with our NHS and Industry partners to capitalise on the excellent education opportunities within the UK is a key aim of The Farr Institute. Building a critical mass of UK professionals with the skills and knowledge to harness electronic health records for research is essential to translate research opportunities within the UK and Internationally into improvements in patient care and economic benefits.

Across The Farr Institute we are offering arrange of training and educational opportunities from Continuing Professional Development (CPD) short courses to Masters and PhDs aimed at both full-time students and professionals looking to directly apply new understanding and methods within their current positions through part-time study. The team's objective is to gradually build up a complete Health Data Science education programme focused on cultivating the key skills required by young professionals who will be called to work with diverse and complex datasets from the healthcare domain.

### *CPD/Short Courses*

Since March 2014, the Health Informatics Teaching Team at Swansea University have worked in putting together material for two sets of modules, at introductory and advanced levels which can be undertaken for CPD purposes. The introductory modules cover database systems with applications to health and social care data; scientific computing in healthcare; and turning clinical information to data. The advanced level modules cover health data modelling; analysis of linked health data; machine learning in healthcare; health data visualisation; and advanced analysis of linked health data. The two modules on analysis of linked health data are delivered in collaboration with colleagues from the University of Western Australia. The introductory level module in *database systems with applications to health and social care data* has had two intakes so far, attracting 12 students.

The Farr Institute HeRC builds on already established CPD/short courses in *Fundamental Statistics & Biomedical modelling* attended primarily from professionals with an NHS background. These continue to be run attracting an increasingly broad cohort due to interest from academia and industry. The 4<sup>th</sup> cohort of the '*Informatics for Healthcare Systems*' short course commenced in January 2015 with students from NHS and industry backgrounds. New lines of CPD course in development include: *Introducing Statistics for Analysing Health Data* and *"Introduction to Modelling for Health Data"* tailored to a range of scenarios and stakeholders.

The Farr Institute London has crafted a unique 3 week programme of inter-related short courses, spanning a wide range of basic and applied health research applications to be run twice a year starting in March 2015 (<http://www.ucl.ac.uk/farr-short-courses/scfarr09>). The 1-2 day courses are entirely modular allowing individuals to select the courses most relevant to their needs. The courses critically evaluate scientific opportunities and challenges, in what is being proposed as a new paradigm in medical research. They span data-intensive biomedical research across diverse forms of EHR (nationally available data from primary and secondary care), regional data in hospital informatics, as well as genomics as applied to EHR research. The courses are intended for people from a wide range of backgrounds - including health care, epidemiology, biostatistics, health informatics, NHS IT, bioinformatics, genomics and computer science - and at different career stages, from those thinking of doing an MSc or PhD to established researchers. The courses are grouped into themes; *Using National Patient Data in Research*; *Deeper EHR Data for Better Research*; *Putting the Patient in the Centre*.

**Modernising Scientific Careers (Health Informatics pathway):** Starting in October 2014, colleagues at HeRC and London will train the next generation of health informatics scientists for the NHS. A common first year is shared with genomics and physical scientists followed by two years of specialisation.

**Safe Researcher Training.** This course is being produced in response to the Scottish Government's recommendation that there is a single course to accredit access to data held in Scotland's safe havens. The Safe Researcher Training will evolve through collaboration with The Farr Institute Scotland, ADRC, Scottish Government and NHS Scotland. The training will be created in a modular format so that topics applicable across the UK can form the core of safe researcher training in England, Wales and Northern Ireland. We hope to see this launched by Q2 2015.

### *Masters level training programmes*

The Farr Institute is launching a complimentary set of Masters degrees that can be taken part or full-time to ease the bottle neck of suitably qualified health informatics professionals. Both Swansea University (CIPHER) and the University of Manchester (HeRC) successfully recruited students to each of their newly launched MSc in Health Data Science in October 2014. The Farr Institute London will launch the MSc Data Science for Research in Health & Biomedicine through University College London and the London School of Hygiene and Tropical Medicine in October 2015. The University of Edinburgh (Scotland) has launched the MSc Global eHealth.

### *PhD studentship programme*

Each of the Farr Institute Centres has recruited between 5-10 PhD students either through the initial eHIRC award funding or through subsequent awards. A one day symposium in May and a three day summer school for all Farr Institute PhD students is being planned, the latter to integrate with The Farr Institute International Conference in August 2015. This will provide the opportunity to bring together the PhD students as a group for both education and networking purposes. The summer school will be a mix of workshops and a team task based on a real world challenge. The student teams will have the opportunity to present their solutions for judging at a session within the International Conference.

### *Succession and Progression*

The Farr Institute HeRC is commencing a research exchange with Harvard University in Spring 2015 that will support researchers in achieving career pathways including fellowships through collaborative Farr Institute -US research grants.

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## COMMUNICATIONS AND CONFERENCES

The Farr Institute has created a **website** as a central resource for communicating our activities both within the Farr and to those professionals and publics who wish to engage with us. The website was launched at the start of 2014 and has been utilised to publish meetings and events, news and publications of the Farr Institute. The website is currently undergoing a re-design to allow us to broaden the information we can provide and to improve navigation through the site.

The senior management realise the importance in a distributed research network such as The Farr Institute of providing opportunities for the researchers from across The Farr Institute to come together to allow collaborations to flourish and achieve the aim of scaling current research activities from individual institutes to a UK wide endeavour. The Farr Institute held its **first** annual **Scientific Research Forum** (SRF) in May 2014 attracting 140 delegates. This was used as an opportunity to ensure that researchers across The Farr Institute were aware of the research currently in progress and to generate new research ideas and collaborations. A number of new research proposals are being worked up as a result of the meeting. We were also privileged that Prof Leslie L. Roos and Prof Noralou Roos from the University of Manitoba attended the SRF and gave the Inaugural Farr Institute Lectures.

On 16<sup>th</sup> December 2014 The Farr Institute hosted its **second Industry Forum**. This year the focus was on identifying areas of shared interest with the Pharmaceutical Industry. An impressive programme of speakers, case studies, and research presentations pertinent to industry secured an audience of some 50+ senior industry representatives from pharmaceutical and related industries. Matched by some 50+ academics, the environment was ideal for developing contacts to lay the foundations for industry-academic collaboration in the future. As a result of discussions at the forum, The Farr Institute has been asked to provide representation to a roundtable on re-engineering medicines development, and a number of the companies represented have been in touch to explore potential projects and

collaborative working. So far we have four opportunities identified as a result of the forum, and more will likely follow when further substantive follow up has been undertaken.

Two major International Conferences are planned for 2015. The Farr Institute supported **The Digital Health Assembly Open Innovation Conference** that took place in Cardiff between February 10-12<sup>th</sup> (2015). The conference attracted over 300 international delegates and speakers including attendees from MIT Center for Digital Business, World Health Organization, the European Space Agency, a number of NHS organisations, IBM, CISCO and Siemens Healthcare. The event focussed on the key themes of Big Data, Empowering Patients and Staff and Innovative Business Models, bringing together leading individuals from the rapidly developing digital health sector to highlight the opportunities available to create sustainable healthcare if open innovation is embraced.

**The Farr Institute International Conference: Data Intensive Health Research & Care** will be held in St Andrews, August 26-28<sup>th</sup> preceded by a 3 day summer school of The Farr Institute PhD Students. This will build on the successful conferences under the auspices of SHIP attracting delegates from across the world including New Zealand, Australia, the United States, Canada and Europe. The conference is designed for researchers, practitioners and policy makers interested in record linkage and the use of routine health data in their research. During the three days we will have a variety of plenary sessions, workshops and keynote speakers as well as social networking opportunities. Confirmed key note speakers include John Mattison (Kaiser Permanente), Michael Schull (Inst, for Clinical Evaluative Sciences), Charles P. Friedman (University of Michigan) and Munir Pirmohamed (University of Liverpool).

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## PARTNERSHIPS

### *Strategic Partnerships to facilitate Data Access for research purposes*

#### **Health and Social Care Information Centre (HSCIC)**

The Farr Institute Directors are leading discussions with HSCIC on new partnership ways of working after the Care.data publicity in early 2014 led to a public and media outcry to the unconsented use of routinely collected health data, and threatened the future of research using electronic health records. Professor Ronan Lyons was invited to HSCIC Board meetings in Bristol and The Farr Institute HeRC hosted the January 2015 HSCIC Public Seminar and Board Meeting. Senior members of The Farr Institute have also had a number of meetings with Kingsley Manning (Chair, HSCIC) to explore partnership opportunities. The Farr Institute is currently preparing a proposal to utilise The Farr Institute safe heavens to facilitate appropriately governed research using the data assets held by HSCIC. The Farr Institute HeRC has been advising the HSCIC on technical solutions to provide secure remote access to data, which was one of the recommendations of the Partridge Review.

#### **Clinical Practice Research Datalink (CPRD)**

Professor Harry Hemingway has led discussions regarding the future collaborative opportunities with CPRD. The Farr Institute have tabled papers suggesting CPRD provides data access to The Farr Institute for research purposes, enabling The Farr Institute to formulate research questions with other parties that can be framed in the context of the MRC/NIHR Methodology Research Programme. These will lead to the development of transparent, reusable and computable phenotypes with clinical face validity that can be shared nationally and internationally through CPRD. CPRD and The Farr Institute are committed to work collaboratively to avoid duplication of effort and to maximise the output available to the research community. The Farr Institute methodology and innovative approaches could inform future applications of CPRD data: areas of development proposed include the development of ontologies to address the issues raised by data with multiple code sets, the application of natural language processing to develop the utility of free text and the governance thereof, development of probabilistic linkage methodologies to aid linkage to wider data sets and tracking of patients across different systems, and the development of evidence based workflow systems.

### *Strategic Partnerships with other Research Networks and Organisations*

The Farr Institute is naturally engaged through its membership with a number of other collaborative research networks and organisations. These include UK Biobank, Genomics England, MRC Medical Bioinformatics Centres, The ADRN, NIHR Health Informatics Collaboratives, MRC Network of Hubs for

Trials Methodology Research, and eMedlab. The Farr Institute ensures that we maximise the effectiveness of the investment made by our funders into us and these other networks by combining forces whenever appropriate. Section 3 contains further details of established collaborations but examples include:

- Submission of an expression of interest to Genomics England GeCIP domain *Electronic Health Records (EHR) in the 100,000 Genomes Project: methods for standardisation, quality improvement, deep phenotyping, lifelong linkage and translational exploitation*. This brings together experts from across The Farr Institute, Oxford Big Data Institute, NIHR HIC, Genomics England and the ADRN.
- The Farr Institute Chief Scientific Officer is a participant in the Network Group for Informatics Leads across all NHS Genomic Medicine Centres. The network is intended as a collaborative means of sharing experiences, raising and resolving issues and escalating queries and proposals as applicable, through the formal programme structures.
- UK Biobank: several Farr Institute members contribute to the Expert Working Groups including Mark Caulfield, Ronan Lyons, Frank Sullivan, Ian Ford, and Harry Hemingway. The Farr Institute is committed to helping UK Biobank extend the access it currently has to national health databases to enrich this national resource.
- Enhancing existing Cohorts for example; ALSPAC, Wales Electronic Cohort for Children, Dementias Research Platform UK, UK Multiple Sclerosis Research Register, Asthma Centre for Applied Research, and CALIBER.
- ADRN: Co-location of Farr Institute and ADR Centres in Edinburgh, London and Swansea maximises the opportunities to share resources and best practice and initiate joint research projects.
- On the International scene The Farr Institute is co-chairing the Global Alliance for Genomic Health eHealth Task Team (Andrew Morris) , David Ford is Director of The International Population Data Linkage Network (2015-16), and Iain Buchan a Fellow of the American Medical Informatics Association. The Farr Institute HeRC commences a research collaboration with Harvard University in Spring 2015.

### *Strategic Partnerships to facilitate access to industry – academic collaboration*

The Farr Institute is building relationships with a number of “multiplier” organisations that will increase the visibility of The Farr Institute, and facilitate access to Industry and other bodies nationally and internationally through their networks. Examples of this include The Association of British Pharmaceutical Industries (ABPI), One Nucleus, Scottish Development International, The Welsh Development Agency, the Digital Catapult and other Catapult and Innovation Centres, Knowledge Transfer Networks and UK Trade and Investment, in addition to Innovate UK.

One Nucleus is the foremost networking group for SMEs in bio & pharma in the South East and Cambridge area. The Farr Institute is working with One Nucleus to promote data science capacity building programmes, in addition to collaborative opportunities. In early 2015 following a meeting with the chief executive we have a dedicated account manager, speaking engagements at One Nucleus events and an ambition to run an industry forum in parallel with the Genesis conference in London in December 2015.

The Farr Institute has explored initial areas of mutual interest with the Digital Catapult, and is currently exploring how best the Catapult can capitalise on our capacity building programmes, governance and ethics expertise, as well as acting as a collaborative research partner in Catapult projects. These discussions are in the early stages, but it is anticipated that these will be developed into more concrete opportunities over the next year.

To date The Farr Institute Centres have agreed a set of common goals to pursue with the ABPI, and the relationship has been formalised through a Memorandum of Understanding. We have reciprocal arrangements for members to attend scientific conferences, and a commitment to holding a collaborative event that serves mutual objectives together every year.

The Farr Institute HeRC has extended several of its established relationships and initiated new exploratory collaborations across the digital and creative sectors. Intel have provided servers equipped with their latest chipsets for testing in HeRCs safe haven eInfrastructure and provided 'Basis' health monitors for evaluation in the COOP theme. A multi-faceted relationship with FutureEverything, has brought to fruition a number of diverse collaborations such as: civic data analysis; strategic Local

Enterprise development; and bespoke design for a research theme that is focussing on dynamic consent models. The Farr Institute HeRC have also built new relationships with a number of commercial organisations including Apple, Merck Sharp & Dohme, McLaren, Intelligent Medical Object; MUJO mechanics and Eagle Genomics. Specifically Merck Sharp & Dohme have invited Prof. Buchan to sit on their Advisory Board; MIDAS have invited Prof Buchan to become a Global Ambassador for the Manchester Inward Development Agency <http://www.investinmanchester.com/>; and several commercial entities are currently enquiring about the 'Spin-in' opportunity that The Farr Institute HeRC and the University of Manchester could potentially offer.

At the micro SME level, we have significantly scaled up and deepened the relationship with Manchester-based SME. MDSAS, who are now a valued and key partner on several ongoing bids including £5m EU submission through to second stage (EuroCard; Prof A. Renehan, UoM)

UK, EU and global interoperability forums attended by multiple UK electronic health record (EHR) suppliers will become increasingly important for The Farr Institute to catalyse standards adoption for research interoperability. Relevant to this, the Chief Scientific Officer was invited by EUROREC to write and contribute an expert panel theme on Research Interoperability in a European Industry Forum called *Realising Semantic Interoperability Across Health IT Systems* co-organised with COCIR in Brussels on January 26-27, 2015. He also contributed to an invited session on Research Interoperability held by HL7 UK in London on Dec 3<sup>rd</sup> 2014. The CSO has also made consistent contributions to the Global Alliance for Genomics and Health workgroups (GA4GH, <http://genomicsandhealth.org/>) of relevance to tackling major problems in international interoperability and data analysis. These external expert group investments of time will pay off both in gaining external innovations to impact The Farr Institute business model as well as disseminating its innovations widely.

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## INFLUENCE ON POLICY IN THE UK AND INTERNATIONALLY

Farr Institute CIPHER's research has been used to inform the development of **Welsh Government's new "Prudent Healthcare" policy initiative**, aimed at helping the NHS in Wales respond to the twin challenges of rising costs and increasing demand, while continuing to improve the quality of care Shantini Paranjothy contributed 'Prudent healthcare for future generations' (<http://www.prudenthealthcare.org.uk/children/>), Ronan Lyons 'Achieving better outcomes through information technology' (<http://www.prudenthealthcare.org.uk/it/>) and Keith Lloyd 'Making prudent decisions in mental health care' (<http://www.prudenthealthcare.org.uk/mentalhealth/>). The Centre's work has also informed the Welsh Government's Early Years Outcome Framework (<http://gov.wales/consultations/education/early-years-outcomes-framework/?lang=en>).

SID-Cymru, a suicide case control data linkage study led by Ann John has informed the new **Suicide and self-harm Strategy for Wales** which is currently out for consultation (<http://wales.gov.uk/newsroom/healthandsocialcare/2014/five-year-plan/?lang=en>) and the Child Death Review for Probable Suicides in Wales 2006-2012 ([http://www2.nphs.wales.nhs.uk:8080/ChildDeathReviewDocs.nsf/5633c1d141208e8880256f2a004937d1/ce6956a584dd1f6b80257c9f003c3fa1/\\$FILE/PHW%20probable%20suicide%20web.pdf](http://www2.nphs.wales.nhs.uk:8080/ChildDeathReviewDocs.nsf/5633c1d141208e8880256f2a004937d1/ce6956a584dd1f6b80257c9f003c3fa1/$FILE/PHW%20probable%20suicide%20web.pdf))

The Farr Institute HeRC's Director provided a written contribution to the **National Information Board Strategy, Chapter 5: a new strategy for increasing uptake of data and technology within the NHS**. Members of the HeRC public forum were also invited to contribute. The strategy was published in December 2014. HeRC's Deputy Director & Programme Manager led a Farr-wide response to an invitation to provide detailed input to a **EU green paper on Mobile Health**. The consultation sought views specifically on 11 identified barriers to the uptake of mHealth in the EU and was released in October 2014.

Currently, Scotland has regional 'Safe Havens' located within Aberdeen, Dundee, Edinburgh and Glasgow, and a National 'Safe Haven' at NSS. The Federated Model of Safe Havens within Scotland is concerned with optimising the flow of data between these different Safe Havens, in a safe and secure manor to efficiently provide data and services to enable research. All data remain under the control of the NHS and complies with all legislative and NHS policies. During 2013/14 significant progress has been made to agree a **Safe Haven Charter**, and this will be formally approved by the Scottish Governments Data Management Board and Chief Scientist Office in the first quarter of 2015.

Professor Graeme Laurie, University of Edinburgh, Innovative Governance lead for The Farr Institute Scotland together with Dr Sara Grainger (Office of the Chief Statistician and Performance, Scottish Government) was consulted by senior civil servants in the Cabinet Office about good governance frameworks in data linkage. This fed directly into the **Cabinet Office's updated proposals on data linkage**, published on 9 April 2014: <http://datasharing.org.uk/current-proposals/>. As a Fellow of the **Academy of Medical Sciences**, Laurie participated in two policy-oriented events that will lead to publications from the Academy. These related to: (i) Clinical Trial Data Sharing: Science, Privacy and Ethics (2013), and (ii) Open Innovation in the NHS (2014). Graeme has also been appointed as member of the **Canadian Academies Expert Panel Assessment on Access to Health & Social Data**. His role is as international expert to this body, and it will report towards the end of 2014 on legal, ethical and governance challenges and opportunities for Canada, and internationally, arising from linkage and sharing of health and social data.

The Farr Institute CIPHER and The Farr Institute Scotland have collaborated on and submitted an evidence review commissioned jointly by the **Expert Advisory Group on Data Access** (Andrew Morris is a member), a committee convened by the Wellcome Trust, CRUK, ESRC and MRC, and the Nuffield Council on Bioethics (NCOB). Titled '*A Review of Evidence Relating to Harm Resulting for Uses of Health and Biomedical Data*', to our knowledge this was the first piece of interdisciplinary work in this area, bringing together expertise in law and social psychology, as well as areas of expertise around information governance and data linkage security. This was a scoping exercise examining the nature of the actual harms resulting from data misuse or security breaches involving sensitive personal biomedical and health data; the relevant, regulatory definitions; the appropriate context in which to assess harm; the effectiveness of sanctions and remedies; and the opportunity costs to institutions or individuals of not sharing or linking data. The review will be published on the NCOB web-site in February next year, and we anticipate that future publications will be of particular relevance to the impact of big data on society, as well as a novel scrutiny of how the impact of actual harm is mitigated in the legal setting.

The **Birthplace in England study**, which included nearly 80,000 women (64,000 were at low risk of complications in labour) has led to NICE making clear recommendations that women at low-risk of complications should be encouraged to plan their birth outside of a hospital setting. The **UK Obstetric Surveillance System (UKOSS)** to study rare disorders of pregnancy in 2005, has since completed over 40 studies of rare disorders of pregnancy, informing clinical care for a range of conditions including eclampsia, pulmonary embolism, stroke, ruptured uterus and solid-organ transplants. A/H1N1v influenza in pregnancy was an important cause of mortality and morbidity during the influenza epidemics. UKOSS enabled very rapid collection all hospital admissions in the UK of pregnant women with influenza, allowing the provision of prompt and timely guidance to clinicians during the epidemic (Brocklehurst).

The Chief Scientific Officer made contributions to an invited **Royal Academy of Engineering** expert panel on the theme of Connecting Data on Tuesday 9 December 2014 and a final report will follow.

**Flu Watch** provides definitive measures of the community burden of seasonal and pandemic influenza (around 20% infected each year, most infections asymptomatic, around 1 in 5 illnesses lead to GP consultation). Results informed national pandemic response and recent decision to introduce routine influenza vaccination for children. The 2014-15 Flusurvey is a collaboration between UCL, Public Health England and the London School of Hygiene all partners of the Farr Institute @ London.

Research has highlighted that GPs continue to prescribe to a very high proportion of minor respiratory tract infections despite guidance that most do not require an antibiotic. It also showed that the risk of severe complications following such infections was extremely low, regardless of whether antibiotics were used. It showed that several thousand patients need to be treated to prevent a single severe complication, but highlighted, that in the elderly, the benefits of using antibiotics to prevent pneumonia are much greater (Hayward). **Prevention of hospital infections: a systematic review of hand hygiene interventions** and evaluation of the national **CleanYourHands campaign** demonstrating important reductions in MRSA informed international and national hospital infection control guidelines. (Hayward: epic2. JHI 2007;65:S1-S59, epic3 JHI 2014;86:S1-S70).

Please see also list of speaking engagements in [appendix 6](#).

## SECTION 3: CENTRE UPDATES ON RESEARCH WORK STREAMS PROPOSED IN EHIRC AWARDS

### CIPHER

#### *RP1: Methodological Innovation*

##### **A. Supporting traditional cohorts**

During 2014 Farr Institute CIPHER contributed to the development of cohorts, including UK Biobank ALSPAC, and LifeStudy. Brophy and Lyons are members of the UK Biobank Follow Up and Outcome Adjudication Group, providing data to UKB on Welsh residents and access to linked UK Biobank/UK health data via the SAIL Gateway/UKSeRP for the distributed team of outcome adjudication analysts.

Alongside the Wellcome Trust funded Project to Enhance ALSPAC through Record Linkage, Farr Institute CIPHER has contributed to the development of the infrastructure allowing follow up of participants in the ALSPAC birth cohort in administrative data. This infrastructure enables the linkage based follow up component of three large epidemiological projects whose applications for support were successful in 2014. These include a cross-cohort comparison of alcohol related harms (ESRC PI Simon Moore); a study of the causes and consequences of drinking in young adulthood (MRC PI Matt Hickman) and a study of the epidemiology of psychotic illness (MRC PI Stan Zammit). Using linked data in ALSPAC to address bias related to missing data is the subject of an MRC Strategic Skills Fellowship awarded to Rosie Cornish in 2014.

During 2014 two grants were won leveraging cohorts: the Dementias Research Platform UK (DPUK - PI: Gallacher), a £12m MRC public/private initiative bringing together data on 34 cohorts and ELAS<sup>t</sup>iC (Alcohol Misuse: Electronic Longitudinal Alcohol Study in Communities PI: Moore), a £1m initiative bring together data from 6 cohorts/e-cohorts to study impact of alcohol over the life course.

##### **B. Development of e-cohort methodologies**

The Wales Electronic Cohort for Children (WECC) has been extended to the end 2013 with linked data now available on >1 million children. A number of publications have been produced and the data used to inform the development of Welsh health and social policy through Welsh Government's Prudent Healthcare policy and the development of the Early Years Outcomes Framework. There have been a number of publications following the development of other anonymised population cohorts focussing on mental health, arthropathy, epilepsy, multiple sclerosis and alcohol. Further development of e-cohorts will be a core activity of the new National Centre for Population Health and Wellbeing (NISCHR PI Ronan Lyons, £2.25M), Wales Kidney Research Unit (NISCHR PI Donald Fraser, £1.3M), and National Centre for Mental Health (NISCHR PI Ian Jones, £3M).

##### **C. Innovation in data linkage and privacy protection**

During 2014 we published on the development of the SAIL Gateway remote analysis facility and spent considerable effort in developing the UK Secure eResearch Platform (UKSeRP) powered by newly developed research data appliances (RDAs, created in partnership with colleagues from Curtin University, Australia and industry). The appliances/UKSeRP were developed with capital funding from MRC for the Farr Institute and will be deployed in 2015, supporting the analysis platforms for DPUK, ELAS<sup>t</sup>iC and other studies.

##### **D. Routinising more data/NLP**

A considerable amount of effort was invested in retaining and recruiting GP involvement in SAIL around the time of the care.data saga. This has brought excellent results with GP sign up increasing from 40% to 78%. The deployment of the RDAs in all health boards in Wales and a number of health organisations in south west England in 2015 will substantially increase the breadth and depth of data available to researchers. We also held a number of research development meetings with involvement of Farr Institute CIPHER investigators from Brighton/Sussex and industry (IBM and CliniThink) during 2014 and launch pilots of NLP research activity in injury, epilepsy and dementia (latter with DPUK) in 2015.

## **E. Natural Experiments/trials**

Work on the evaluation of a number of natural experiments funded by NIHR continues with investigations into the impact of housing on health. The CHALICE study (impact of changing alcohol exposures of alcohol related health) led by David Fone concluded with a report provided to NIHR. Clinical and cost effectiveness findings from the SAFER1 trial led by Helen Snooks were published in PLOS ONE. HTA funded trial SAFER concluded, with the final report currently in peer review.

A number of bids were made to develop e-trial methodologies with a feasibility study for a trial of physical activity in teenage girls funded (Sebire, Bristol). The recently funded Wales Centre for Primary and Emergency Care Research (NISCHR funding: £2.7m) includes a cross theme workpackage focusing on e-trials, to be led by Helen Snooks. Helen Snooks leads the emergency care theme within this Centre and is currently interim director of the Swansea Clinical Trials Unit, bringing further development opportunities for data linkage in e-trials. Associate Professor Alan Watkins was also recently appointed at Swansea to increase e-trial activity in The Farr Institute CIPHER.

### *RP2: Injury/built environment*

#### **A. Link population survey, emergency department, inpatient, mortality education and other administrative datasets to increase understanding of the population burden of injuries.**

This theme has been developed through a number of international collaborations: International Collaborative Effort on Injury Statistics' (Injury ICE) 'Grand Research Challenge: Global Collaboration in Measuring the Incidence and Burden of Injuries' (Washington, Nov 2014); the Global Burden of Diseases research consortium; the Australian NHMRC funded INJURY-VIBES and RESTORE projects (PI: Gabbe, Monash/Swansea); and the Wales Electronic Cohort for Children. Linked data are being used to create a new ICD10 trauma mortality prediction model for use in the US and Europe (Osler, Vermont). An evaluation of the new Emergency Medical Retrieval and Transport Service (EMRTS) has been funded by Welsh Government.

#### **B. Evaluate a set of population based injury prevention initiatives**

Work continues on the creation of a new model of individual and household risk factors for house fires by creating anonymised case control and cohort studies linking Fire and Rescue Service data (n=16,000 fires) to health data within SAIL. A multi-centred bid has been submitted to NIHR to evaluate the impact of the national 'Safe At Home' scheme on injury rates in children under 5 using linked routine data sources (Orton, Nottingham)

#### **C. Create e-cohorts to evaluate natural experiments on the impact of energy efficiency interventions on excess winter mortality and care and repair interventions on injury and independent living.**

Work continues on the NIHR funded evaluation of the ongoing housing improvement and energy efficiency interventions (Carmarthenshire Housing Regeneration Project and ARBED energy efficiency project) with results due in 2017. The creation of the 10 year total population anonymised e-cohort including data on 430,000 interventions (mainly insulation, heating interventions with some micro-generation and smart meter fitting) between 2000 and 2012 from the Home Energy Efficiency Database (HEED) is awaiting implementation of an improved household anonymisation system facilitated by MRC capital investment in The Farr Institute. The Fuel Poverty section of Welsh Government has funded an analyst (three years) to work on this through the linked ADRC-Wales centre. A funding bid to the ESRC is in preparation to evaluate the most effective components of the Care & Repair Cymru intervention using data collected by Care & Repair staff and anonymised into the SAIL databank.

#### **D. Combine GIS, cohort and routine health data to explore the relationship between urban design and health.**

Considerable work is being undertaken into creating a local authority run web-based tool (initially in Neath Port-Talbot) to collect data on children's exposure to active transport, road and environmental hazards as a tool to stimulate intervention and support evaluation following on from a pilot funded by the EU funded Tools to Address Childhood Trauma, Injury and Children's Safety (TACTICS) study. This has led to an application to Leverhulme for funding to investigate the difference to injury rates using mode-adjusted child pedestrian numbers.

Additional research into the built environment and health is being conducted by a new PhD student, Amy Mizen, in a collaboration with the MRC funded DECIPHER public health research centre that includes Bristol, Cardiff and Swansea universities. This involves complex data linkages combined with home to school modelled routes and exposure to the environment, specifically fast food outlets, and the relationship to childhood obesity.

Further collaboration with DECIPHER led to a successful grant for an intervention trial to encourage people to walk to work: 'The effectiveness and cost effectiveness of an employer-led intervention to increase walking during the daily commute' (NIHR, PI Suzanne Audrey).

The protocol for the NISCHR funded study 'Did the *Communities First* regeneration programme improve mental health and enhance social cohesion? A natural experiment' led by James White utilising the eCATALYST cohort has been published.

### *RP3: Determinants of psychological and social wellbeing*

In 2014, The Farr Institute CIPHER contributed to the joint funding of two posts successfully recruited to in Bristol (see [Appendix 4](#)) related to this research theme. Colin Steer is currently working on a CPRD based project investigating the effect of substitute prescribing in primary care on drug related harm amongst injection opiate users. Alison Teyhan has recently completed an evaluation of the "Lifeskills" injury prevention and risk reduction intervention nested within the ALSPAC cohort. We are currently preparing an application to the Confidentiality Advisory Group of the Health Research Authority to access psychological health (depression and psychosis) outcome information held by the HSCIC within our Section 251 approvals. Permission to link to self-harm outcome information held by HSCIC was recently granted to Dr Becky Mars to allow her to extend her ALSPAC based work (including linkage derived outcomes) on the epidemiology of self-harm. This work was the subject of a paper published in the BMJ in 2014 with further papers currently under review.

### *RP4: Population aspects of infection*

The aim of this programme was to develop a unique platform for translational research, linking early symptomology from primary care data with clinical and microbiological profiles from hospital admissions and laboratory data for a complete population of three million. Progress in establishing this platform includes the incorporation of urine and blood culture data in to the SAIL databank; we are currently examining these data to inform the feasibility of potential analyses. This platform will support the proposed analyses in the NIHR funded doctoral fellowship (Ahmed, supported by Francis, Butler and Paranjothy) to improve outcomes for older people with urinary tract infection in primary care. Other ongoing work programmes a NISCHR funded study that will record link data on 30,000 mothers and babies in Wales to primary care and hospital admissions (The Welsh Study of Mothers and Babies) data to explore the health effects in the first five years of childhood (e.g. urinary tract infections) associated with renal markers detected during pregnancy (Paranjothy et al). In September 2014 we appointed an analyst (Hywel Jones) to work with the team in Cardiff in delivering the objectives set for this work programme.

### *RP5: Chronic disorders*

2014 saw a considerable amount of research initiated in relation to a number of specific chronic disorders and diseases, including Asthma, Dementia, Multiple Sclerosis, Arthropathy, Epilepsy, and Renal Disorders. Gwyneth Davies leads a work programme of the £2m multicentred Asthma UK Centre for Applied Research led by Aziz (Edinburgh) with a new Swansea based studentship in asthma informatics (Al Sallakh) utilising development and outputs from the UK Burden of Asthma study. Al Sallakh is creating an Asthma Observatory for SAIL, identifying new data that could be routinised into SAIL and helping to develop algorithms to be used to recruit participants to clinical trials through GP surgery, including for ARISSA-UK (NIHR HTA, PI Andrew Wilson, University of East Anglia) a primary care intervention trial of people at high risk of admission to hospital for Asthma. ARISSA-UK also plans to use UKSeRP to integrate data from SAIL supplying practices in Wales and other systems in England.

John Gallacher is PI of the £12m MRC Dementias Research Platform UK with Ronan Lyons leading on the development of an analysis platform for 34 cohorts, using UKSeRP. Kerina Jones was successful in obtaining funding to extend the UK Multiple Sclerosis Research Register. Shantini Paranjothy was funded by NISCHR for the 'Welsh Study of Mothers and Babies: Prospective electronic cohort study of renal disease in early childhood'.

Farr Institute CIPHER was successfully involved in bids to the NISCHR re-commissioning of health research infrastructure in Wales. A number of these have been successfully funded, including the National Centre for Population Health & Wellbeing Research, National Centre for Mental Health Research and the Wales Kidney Research Unit.

## HERC

The Farr Institute at HeRC's workstreams are divided into five research themes with four enrichment themes. (Information Governance; PPIE and Capacity Building are now reported within the main body of The Farr Institute text.)

### *Co-producing Observations with Patients (CoOP)*

The ClinTouch trial (experience sampling for patients with serious mental illness) is in trial phase with two NHS Trusts. HeRC Investigator and PI Prof Shon Lewis accepted an invitation to meet with government at Downing Street to explore the application of such technologies in mental health provision. The HeRC York team (Stochl) have established a new collaboration to implement adaptive testing in the application. ClinTouch's Sister project, Actissist, investigates the feasibility of online CBT via mobile phone and completed beta testing.

The PhD studentship (Natalie Berry) funded under this theme investigates how technology can be used to deliver interventions for people with serious mental health problems: she has been shaping research questions and is currently developing a systemic review of the literature prior to conducting qualitative work with service users into attitudes and clinician acceptability.

Five projects have been awarded in this period. REMORA (Remote Monitoring of Rheumatoid Arthritis) was jointly funded between ARUK and NIHR CLAHRC GM. "Cloudy with a chance of pain" (MRC CIC) will develop a validated algorithm for MSK disease severity using passively collected data and examine the association between weather and joint pain in rheumatoid arthritis. Recruitment has commenced and data collection will be completed by June. Thirdly, Innovate UK has awarded a £606k grant application ('MUJO') to develop connected rehabilitation tools for musculoskeletal surgery, in which HeRC partners with MuJo Mechanics Ltd, Qinec Ltd, and the Royal National Orthopaedic Hospital NHS Trust to combine innovative fitness equipment with sensors, connected devices and eHealth methodology to speed-up the recovery from complex shoulder complaints and open-up new research opportunities. HeRC will facilitate the analysis of co-produced data for purposes of research and quality assessment. EMPOWER is an international (UK and Australia) trial using ClinTouch technology for early warning signs of relapse in schizophrenia, (funded by NIHR HTA (UK) and NHMRC (Aus) for £874k). HeRC and CIPHER were also successful in the Dementia Platform UK CRI award with £500k allocate to wearable devices and connected health.

### *Community Health Intelligence Partnership- Semantic Epidemiology Toolkit (CHIP-SET)*

A cross-Farr Institute (all four nodes) submission to support *distributed studies & portability of methods, building on activities enabled by The Farr Institute* (eg. Stellar/eLab platform) is planned for the June 2015 MRC Methodology call; success would allow deeper distributed analysis nationally across datasets.

UoM's awarded Clinical Proteomics Centre (CPC): The Farr Institute at HeRC is delivering infrastructure to provide storage, search and linkage functionality for the project datasets; collaboration platform (HeRC eLab environment) and Telepresence facilities across the CPC network.

This theme is also supporting a number of current grant applications by extending e-Lab services to provide storage, search and linkage functionality for the project datasets and related documents. (incl. EU ERC Bid, Rutter).

A team led by and involving staff from HeRC achieved excellent results in this top international shared task in clinical text mining, organised by i2b2 (Informatics for Integrating Biology and the Bedside), an NIH-funded National Centre for Biomedical Computing. One of the two tasks was de-identification of clinical narratives: identifying and removing all mentions of personal health information from clinical data, so they can be used to support data sharing for clinical/biomedical research. The methodology

is now being further tested in two hospitals in Manchester. The team achieved the 2nd place (from 22).

A new collaboration between The Farr Institute HeRC and SAVSNET (University of Liverpool) to develop health informatics in the field of veterinary science has been developed and now includes a co-supervised PhD student (Jenny Newman) investigating text mining of the clinical narrative. Three papers are at various stages of preparation and have been used to increase the profile of health informatics within the veterinary profession. Through its collaboration with HeRC, University of Liverpool has successfully passed the preliminary phase of a Wellcome application for a multi-user equipment, biomedical resource / technology development grant and has now submitted a full application.

### *Feasibility Improvement Network (FIN)*

Work is focused on further developing the opportunities in conducting simple randomised trials at point of care using EHRs in collaboration with The Farr Institute London (Smeeth), the pilot trials report has been completed (see van Staa Health Technology Assessment 2014). We submitted a two-stage application for a large simple trials with statins (QIRC-S: Quality Improvement via routine Randomisation in Clinical practice: Statins. Although not funded, importantly, we identified the systems that can be used to run these large simple trials (FarSite; ResearchOne). Also, we developed understanding of the current challenges in conducting research in primary care and established relationships with networks that can help to overcome these (including the MRC funded program START which aims to improve the evidence-base concerning trial recruitment; the NIHR Clinical Research Networks & CCGs). Work is ongoing to develop new proposals; most recently we successfully applied for a European IMI grant: 'GetReal'. This project aims to improve the efficiency of the medicine development process by better incorporating real-life clinical data. HeRC's contribution is to develop better methods for running simple trials.

Maria Sudell, a Liverpool based HeRC PhD student continues to progress an analysis of trials: '*Methodology and software for joint modelling of time to event data and longitudinal outcomes across multiple studies*'.

Tjeerd van Staa participated in a symposium co-sponsored by the Department of Epidemiology at Columbia University and the Centre de Recherche INSERM Epidemiologies et Biostatistique, PRES Sorbonne Paris Cite. This forms part of a symposium series hosted by Columbia University dedicated to exploring cutting edge scientific topics in epidemiology and population health (see [CUESS.org](http://CUESS.org)). This invitation-only series explores both the state-of-the science and develop the research agenda.

Investigators also collaborated in a meeting organised by the ABPI on the reengineering of Medicines Development.

International impact of this theme is evidenced by invitations to deliver courses in pragmatic trial design. This include at Utrecht University (Van staa; Advanced Epidemiology Course – Simple trials module) and INSERM, Paris (Van Staa: MSc Comparative effectiveness: Simple trials)

Rollout of the FarSite tool for improved clinical trial management across three Academic Health Science Networks continues at pace.

In cross-theme work with DOT, the CHES (CPRD-COPD Hawthorn Effect Study in Salford) study characterises patients enrolled in the Salford Lung Study and evaluates a potential Hawthorne effect. This supports the Salford Lung Study (a first of its kind, pragmatic trial evaluation of novel agent in usual care) by exploring outcomes for COPD patients in the rest of the UK. This will allow evaluation of the Hawthorne effect, and the generalisability of the Salford Lung Study, using routinely collected observational data.

Further cross-theme (Fin/DOT) success has been shown by the RfPB grant awarded (Renehan; Williamson): *Development of a core outcome set for informed consent, clinical trials and treatment policy in patients with anal cancer*. The UK has led the world in large-scale national trials in the treatment of anal cancer. Until now, these trials have improved the cure of anal cancer, but at a price – namely, high rates of short and long-term complications. HeRC are developing a new generation of clinical practice and trials focusing on maintaining high cure rates, whilst minimising adverse effects and loss of quality of life. To date, studies have reported outcomes as tumour control and survival. There is now a need to develop a wider but core set of outcomes that are relevant for patients. Investigators from Manchester, Liverpool, and other national experts, linked with national initiatives, propose to develop these outcomes within the COMET (core outcome measures in

effectiveness trials) framework. We will use a stepwise systematic research plan to establish 'what' outcomes are most relevant for patients, and 'how' and 'when' to measure these. This will benefit patients through better information on current treatment and will improve patient information as part of recruitment into future trials, in turn, enhancing trial recruitment.

### *Scalable Endotypes for Asthma, Allergy and Andrology (SEA-3)*

STELAR eLab (developed in cross-theme work with CHIP-SET) initial release in user testing phase. A Case Study exemplar currently being designed and support investigates the Atopic March by allowing access to cohort data for download to carry out latent class analysis to identify asthma phenotypes. Analysis summarised graphically, with the graphs then available through the eLab for wider discussion.

Grant submitted to Wellcome Trust for future funding; incl. extending to include BIB and Leicester cohorts. A further submission to EU H2020 is also in progress.

The HeRC director and SEA3 lead have also looked at future strategy for development of the eLab platform and in support of this sent a discussion document to the MRC to consider new models for SME-enhanced science.

The EU FP7 funded iFAAM project is the world's biggest study of food allergies involving leading experts across the UK, Europe, Australia and the US. The HeRC e-Lab team are developing the Allerg-e-lab informatics platform, underpinning technology that is transforming the way iFAAM data are collected, shared and analysed. These developments have included an online tool (AlleRiC) for gathering objective reports of food reactions in real time, addressing the shortfall of information about patients' previous allergic reactions during clinical consultations. AlleRiC is now being piloted throughout the UK. Allerg-e-lab tools have been developed to allow the iFAAM project to build on previous studies of food allergy by gathering new follow-up data about past study participants, providing important longitudinal information. These tools have been piloted and are now being used by study centres across Europe. The e-Lab has been engineered to ensure that new and existing study data are captured and described, creating harmonised data sets that can be easily combined and shared for analysis, advancing our understanding of food allergies.

### *Diabetes Obesity Translator (DOT)*

The NAEDI project 'Development of a risk prediction tool for early cancer detection in patients with type 2 diabetes' progresses; organisation of applications and initial submissions to receive linked data from GP databases, HES, ONS and cancer registry records have been approved. Partial data have been obtained from CPRD with preliminary models being explored. A Post-Doc in statistics has been recruited to work on this project. To support Ellena Badrick, whose advances on this in 2014 include a key presentation at the EASD conference in Vienna, paper exploring the detection bias of cancers after diagnosis of Type 2 Diabetes. A DOT specific PPIE working group has been established to inform and shape this research.

A grant has been submitted to 'Wellbeing of Women' that will look at whether weight 'cycling' impacts on (breast) cancer outcomes.

HeRC funded and hosted the 2015 DCRC Annual Conference (Diabetes and Cancer research Consortium). Bringing together leading academics and researchers from across Europe; US and Australasia this working meeting aims to share, deepen and broaden research and impact. This consortium is bridged by key HeRC investigators and so develops a broad base for collaboration. A current example of this strength is evidenced by the £5m submission to EU H2020 call: EuroCARD (Manchester/HeRC led; Prof Renehan)

A new research group, CORGI (Childhood Obesity Research group Initiative), has been established. This is a partnership between HeRC and Greater Manchester NHS to address the growing problem of childhood obesity in Greater Manchester. Two grants are being submitted. The first, to the Lottery fund, is to increase frequency of height and weight measurements of children in Greater Manchester, and to analyse these data and identify trends and tipping points in the emergence of obesity. The second grant, submitted to the British Heart Foundation, proposes the development and validation of a battery of technology interventions designed to reduce the emergence of child obesity.

Work in latent class analyses of trajectories of biomarkers is ongoing, with an MRC methodology grant submitted in support of this work, and applied work in a range of cohorts (Salford Integrated Record,

American Association of Retired Persons) being prepared for publication. With the SEA3 theme, we are beginning to use latent class analysis to identify different endotypes of obesity and diabetes.

Pioglitazone Pooled Analysis: HeRC researchers successfully contributed to work lead by Prof. Helen Colhoun at the University of Dundee, funded by the EASD, to combine data from several centres in Manchester, Scotland, GPRD, Finland, Rotterdam and Canada on the association of pioglitazone exposure with bladder cancer using micro-aggregated pooled analysis. The Dundee team prepared common code to be run at each centre, we worked on each release and took part in code issue fixing, the final analysis were published in *Diabetologia*.

### *Missed Opportunities Detector (MOD)*

A body of work around clinical audit databases such as BCIS (British Cardiovascular Intervention Society) continues, with a series of publications improving tools for clinical audits, and highlighting targets for potential outcome improvement. For an example of the former, a new risk score to predict outcomes from percutaneous coronary intervention (PCI) has been developed. For the latter, a series of papers comparing outcomes of radial access with femoral access have been published, with more in preparation. A PhD student (Will Hulme) is exploring the drivers for changes in outcomes for PCI over time, and will also be looking at competing risks analysis using cause of death data. Another example of a clinical audit we are working with is in TAVI (transcatheter aortic valve intervention); a PhD student (Glen Martin) is using this smaller database as an exemplar for building risk scores by combining contemporary data with prior information from pre-existing risk scores.

Improved modelling techniques to exploit longitudinal biomarker information have been developed, with a paper accepted for MedINFO 2015 that illustrates a two-stage approach to predicting hospitalisation and mortality using eGFR trajectories. A second paper will also be presented at MedINFO, in which a method for patient-tailored alerts for abnormal lab test results is developed. An NIHR grant looking at methods for revising and updating clinical prediction models has been completed, with two papers in submission.

In cross-theme work with both Co-Op and DOT, we have been analysing data gathered from Withings smart weighing scales, to understand 1) how users of such technology compare with the general population; and 2) whether engagement with such technology is associated with weight loss.

Within this theme, a strategic partnership has been established with the NIHR Greater Manchester Primary Care Patient Safety Translational Research Centre (2012-2017, £6.3M Director: Prof A. Esmail) to develop and evaluate informatics methods and tools primary care. Within this partnership, we specifically focus on electronic audit and feedback interventions that enable GPs to identify patients for whom there are missed opportunities. One of these interventions consists of a primary care medication safety dashboard and will be evaluated in the city of Salford in 2015/16. A second intervention aims to identify chronically ill patients with actionable shortcomings and is in the early stages of development; early versions are being tested with GPs in Salford. This work is carried out by Wellcome Trust Fellow Ben Brown. Ben has recently joined the Student Editorial Board of the *Journal of the American Medical Informatics Association (JAMIA)*. In October 2014, he won the inaugural British Computer Society's Young Health Informatician Award.

### *Cross-cutting*

HealthNorth: The NHTA-led proposal to pilot Connected Health cities across 4 sites was funded by treasury in the 2015 budget (£20m). Farr Institute at HeRC are a key delivery arm of this programme which forms part of the 'Northern Powerhouse' movement.

Maths in Healthcare: The University of Manchester have submitted an outline application to the EPSRC 'Maths in Healthcare' call within which Farr Institute at HeRC are leading a work package that will use mathematical modelling techniques to develop mechanistic models in non-communicable disease epidemiology, and in epidemics.

Dynamic Consent: A series of exploratory workshops held in collaboration with HeRC PPI theme to canvas public opinion in designing a user friendly interface and gather requirements. Further funding avenues are now being actively investigated including MRC Methodology.

### *Kidney disease: an emerging cross-Farr theme*

Kidney disease affects an increasing number of people in the UK. Timely detection of the condition, improving self-management, and optimising referral to secondary care are some of the challenges

kidney care is currently facing. To stimulate potential solutions, Farr Institute at HeRC held a workshop with the research group. The output is now being used to inform a meeting to discuss the potential for a collaborative theme on kidney disease across the Institute. The group will include all four Farr partners who will be joined by key stakeholders: the UK Renal registry, Scottish Renal Registry, the UK renal data collaboration (UKRDC), and Patient View [<https://www.patientview.org>]. In parallel, as a first step in getting patients involved in designing this cross-Farr theme, Farr Institute at HeRC will organise a regional PPI research event later this year.

### *Animal – Human Health interface*

Collaborations between the University of Liverpool's veterinary group and SAVSNET Animal Surveillance project have developed extremely positively with second round proposal made to Wellcome Trust Biomedical resource call and strategic development of 'Farr@Vet' theme being shaped at present (Buchan; Radford). This theme could support and enhance across the themes – clinical trials (FN); pathway improvements (MOD) and clinical coding; and offer insights in animal health; zoonosis and animal-human companionship (mental health).

### *Born In Bradford*

HeRC-provided smartphones (100) supported research into use of social media by Bib 'ambassadors' and development an inhouse app to help 'gamify' the activity. Research questions are now being addressed in the 3 HeRC funded PhD studentships. The national lottery has funded the 'Better Start' project (£50m) to improve child readiness for school. This programme will involve Bib hosting an Innovation Hub, led by Kate Pickett, to develop innovative solutions to improve health. This will include a new cohort of over 7,000 pregnant mothers to evaluate the impact of the Programme. Also, HeRC investigator at York analyzed psychometric properties of Strength and Difficulty Questionnaire (SDQ) for Bib currently the drafting of the paper is in progress.

### *Operations*

HeRC has been focussing on team science with a particular emphasis on supporting roles that both add value and reduce the burden on academics and research fellows. The team have also supported consultations by Wellcome Trust; The MRC and EPSRC on developing and rewarding the team Science model. A centre wide programme portfolio has been developed to provide management and support research priorities; this allows effective planning and feeds informs growth plans. Improved communication and better sharing of information have allowed a more streamlined and balanced programme management system to be deployed across the Centre's regional spokes and embedding this within the Farr Institute.

Furthermore, a strategic value stream map has now be developed to help deliver more efficient programme management and programme support. In response to feedback from this activity, the development of a funding toolkit is currently underway to help assist researchers with grant applications and reduce any duplication of effort. This toolkit has the potential to develop into a Farr-wide resource to aid joint funding applications and better partnership working.

A multi-platform communications strategy has developed HeRC's online presence ([www.herc.ac.uk](http://www.herc.ac.uk)) at the heart of a programme of activity that engages its key audiences through events, PR, traditional and e-marketing, social-media and by applying a structure to the flow of information through HeRC and The Farr Institute pushing out to patients and the general public; to strengthen both brands through association. There has been a strategic intention to drive web traffic to The Farr Institute's site through cross-Farr activity reporting and effective signposting; this includes the development of The Farr Institute specific section of the HeRC website. Over an 8 month window, we have seen a fivefold increase in unique website hits alongside a 950% increase in the number of followers on Twitter. This has enabled increased brand awareness for both HeRC and The Farr Institute with the ability to more clearly signpost shared successes.

## LONDON

Our research has spanned the full translational pathway. The clinical focus has been on our three initial priority themes: cardiovascular, maternal and child health, and infection. However, we have also made progress in the planned second wave of clinical themes, particularly in neurodegenerative diseases and cancer. Cross-cutting development work and methodological achievements in biostatistics and in informatics have underpinned the substantive clinical research, along with an active programme of public engagement. The summary below illustrates the range of work by highlighting specific examples.

In discovery and genomics (translational stage 1) The Farr Institute investigator Professor Mark Caulfield became Chief Scientist for Genomics England and with other partners we were awarded £24 million to create the UK Clinical Genomics Research Data Infrastructure. We also helped lead the successful £8.9 million MRC Bioinformatics Award that has created a major new collaboration between our partner universities and the Crick, European Bioinformatics and the Sanger Institutes. Our work at translational stage 2 is focussed on capitalising on the opportunities offered by electronic health recording systems to undertake randomised trials. In collaboration with HeRC, the first two feasibility trials based in the Clinical Practice Research Datalink (CPRD) were completed. "Design your own clinical trial" was a successful workshop with 13-14 year old school children is highlighted an example of our public engagement activity. At translational stage 3, quality of care and outcomes, international comparative work includes an influential study of care for acute myocardial infarction in the UK and Sweden. In public health research (translational stage 4) we have demonstrated our ability to take a higher resolution approach using the power of electronic health records, for example to show the differing relationship between obesity and the 21 commonest cancers.

In the informatics arena, with the Barts NIHR Biomedical Research Unit we have developed an informatics system that allows us to extract all information on consenting patients from the Barts Health Cerner System and multiple companion databases. In maternal and child health, research on linkage methodology resulted in new linkages between national surveillance and clinical datasets. This work developed into a successful Sir Henry Wellcome fellowship on maternal and child outcomes of preterm birth. In area of infection, a Wellcome Trust DH Health Innovation Challenge Fund Iconic grant in collaboration with the Sanger Institute we are investigating the role of high throughput viral sequencing to inform infection control, surveillance and clinical management.

### *Research across the translational pathway*

#### **Translational stage 1: Discovery and genomics**

The Farr Institute London investigator Mark Caulfield became Chief Scientist for Genomics England in 2013. The UK 100,000 Genomes Programme will accelerate the application of whole genome sequencing into routine care for National Health Service (NHS) patients with rare diseases, cancer, and infectious diseases, transforming the processes of diagnosis and management. With the Farr Institute and other partners we were awarded £24 million to create the UK Clinical Genomics Research Data Infrastructure.

The Farr Institute investigators (Caulfield, Smeeth, Hemingway) were Co-Investigators on the MRC Medical Bioinformatics Award to the e-Med Lab partnership which establishes a data centre in partnership with University College, Queen Mary, the London School of Hygiene, Kings College, the European Bio-informatics Informatics and the Sanger Institute (£8.9m). The Farr Institute led clinical aspects and key aspects of the informatics strategy which will link Genomic and Imaging data with Primary, Secondary and Tertiary NHS datasets to enable and add value to translational research. This is a strategically critical bid for establishing medical bioinformatics in the UK, enabling us to build on our existing strengths to improve health. The eMedLab will also interface with industry-derived data and the new Global Alliance for Genomics and Health to allow secure sharing of genomic and clinical data. The consolidated, integrated information, along with associated tool and analytics, will provide new substrate for research performed by The Farr Institute. This bid leverages >£10M of grant investment plus £1.8M industry investment, and provides opportunities to apply for additional funding for infrastructure and capacity growth.

#### **Translational stage 2: Using EHRs in Randomised Trials**

Our work at stage 2 is focussed on capitalising on the opportunities offered by electronic health recording systems to undertake efficient, powerful randomised trials. This work involves developing novel approaches to tackle existing road blocks. In collaboration with Professor Tjeerd van Staa (The

Farr Institute HeRC), the first two feasibility trials based in the Clinical Practice Research Datalink (CPRD) were completed summarised in an influential monograph (van Staa Health Technol Assessment 2014). This work is having major impact on the evaluation of clinical interventions, led to a national funding call from the NIHR, and has fed directly into national policy through the Cabinet Office. We have launched the world's first randomised controlled trial of Video Observed Therapy to support adherence to tuberculosis drug therapy – this is also the first multicentre randomised controlled trial of tuberculosis patients in the UK for several decades. Making extensive use of EHRs in primary care allowed us to complete a cluster randomised trial with more than 200,000 participants at a total cost of less than £0.50p per participants. The trial was of text reminders for flu vaccine targeted at people aged under 65 years in high risk groups. James Carpenter (LSHTM) is a programme leader in methodology and is collaborating closely with the MRC Clinical Trials Unit (at UCL). In particular, we are collaborating on a new trial Add Aspirin, which is starting recruitment in early 2015, and is seeking to assess whether there is any long-term benefit of a small daily aspirin dose to patients undergoing treatment for cancer. The trial provides an excellent opportunity for comparing the accuracy and completeness of follow-up data from electronic health records with that from the scheduled trial follow up visits and procedures. We are working with Max Parmar and Ruth Langley (both at the MRC CTU) to embed this evaluation in the trial. NIHR Post-Doctoral Fellow, David Ishola is working with PHE on trials of quadrivalent meningococcal vaccine funded by DH Policy Research Programme which have been used by Joint Committee of Vaccination and Immunisation to inform their recommendations, the trial use EHRs to identify eligible patients and to contribute to outcome monitoring.

The Farr Institute London statistician Dr Elizabeth Williamson is working with the MRC funded Hubs for Trials Methodology. Dr Williamson has been appointed the co-lead of the Working Group on Health Informatics. In this capacity she will be helping develop a strategy of looking at using electronic health record data to enhance planning, recruitment, follow-up, and interpretation of RCTs.

One example of our public engagement work in this area was a workshop held in collaboration with the BRU at Barts entitled "Design your own clinical trial". The workshop was successfully piloted with 13-14 year old school children.

### **Translational stage 3: Quality of care and outcomes research**

One major theme in 2014 has been international comparison of care and outcomes using EHR, registry and administrative data sources. One example (Chung Lancet 2014) compared care for acute myocardial infraction in the UK and that in Sweden. These are the only two countries in the world with ongoing mandatory heart attack registries in which all hospitals in the country participate. Based on an analysis of over 500k patients we found that innovations in care were slower to be implemented in the UK than in Sweden and that the UK had a substantially higher 30 day mortality.

A second example, funded by an expanding Industry partnership with Astra Zeneca, was presented at a Hotline session of the European Society of Cardiology 2014. This involved a population largely neglected in coronary disease research – patients who have already survived to their first anniversary after a heart attack. Based on samples drawn from diverse records in the US, France, Sweden and the UK (total N =140k) this study was able to demonstrate the high risk (approximately 1 in 5) of this population in terms of subsequent death, heart attack or stroke. Both these studies attracted substantial media interest.

A third example is our research with PHE using the THIN database to monitor GP adherence to national guidance on antibiotic prescribing (Hawker et al JAC 2014). This shows continuing high levels of inappropriate prescribing and has been used by the CMO and others to support continuing policy and research emphasis on primary care prescribing. A fourth example is our work with PHE evaluating the impact of the pilot of the pre-entry screening programme for tuberculosis. This has involved validation of probabilistic matching algorithms without address data (showing 96% sensitivity and 100% specificity compared to matching by NHS number) followed by matching of the Institute of Migration (IOM) pre-entry screening database 2006-2012 (640,000 records) to the UK TB case notifications 2006-2013 (68,000 records) to determine the post-migration incidence of tuberculosis in those screened.

**Translational stage 4: Public Health research- Enhancing investigator led cohorts.** We demonstrated a higher resolution approach to cardiovascular epidemiology (Rapsomaniki Lancet 2014) and cancer epidemiology (Bhaskaran Lancet 2014) exploiting the statistical scale >10 million person years follow up, and phenotypic depth (12 different cardiovascular diseases distinguished) in studying risk factors like blood pressure and body mass index. The CALIBER observations on blood pressure provide

substantive new findings (such as the discordance between the absent systolic and strong diastolic association with abdominal aortic aneurysm) as well as demonstrating the potential of linked EHR to provide a meaningful 'scaffold' for consented, biobanked cohorts. Our approaches in The Farr Institute London to EHR phenotyping are informing the approaches being used in the UK Biobank.

NIHR Academic Clinical Lecturer Charlotte Warren Gash is working with the Health Survey for England linked to Hospital Episode Statistics (thereby creating a virtual cohort) to use survey serum samples to study the association between Varicella Zoster antibody titres and Stroke (Warren Gash, Hayward)

### *Research across clinical themes*

#### **Cardiovascular**

2014 has seen several contributions in the Lancet from the CALIBER platform based on linkages of 4 national record sources, primary care, hospital episode statistics, the national acute coronary syndrome registry and cause specific mortality records. Principally these have focussed on 'higher resolution' epidemiology in relation to the initial presentation of 12 cardiovascular diseases affecting the head, heart, abdomen and legs. These have concerned blood pressure (Lancet Rapsomaniki 2014), and diabetes (Shah *et al* Lancet Diabetes Endocrinol 2014) and each combining replication of what has previously been demonstrated in much smaller cohorts and new findings (such as the inverse association of type 2 diabetes with aneurysms in in the abdominal aorta and sub-arachnoid haemorrhage. In addition (Chung *et al* Lancet 2014) demonstrated a major mortality gap between UK and Sweden in short term mortality after heart attack, not explained by measured treatments.

A major new initiative in 2014 was the NIHR Health Informatics Collaboration. The NIHR HIC project: The NIHR Health Informatics Collaborative (HIC) is the Chief Medical Officer's challenge to 5 leading Biomedical Research Centres (BRCs) to extract and share routinely collected clinical data for the purposes of enhancing clinical care and research outcomes. The two objectives of the programme are to:

- (a) Develop, design and provide an IT capability that mines and extracts routinely collected data from existing trust clinical systems to generate rich, detailed, patient level, episodic datasets to share and be used by researchers
- (b) Showcase this capability, by developing and running exemplar projects to demonstrate the benefit of sharing data across centres in order to support life science research, to engender stakeholder confidence throughout the life of the programme and to demonstrate improved value through collaboration with existing science initiatives.

Five distinct themes have been chosen with each BRC leading on one theme with others contributing. These include critical care, renal transplant, ovarian cancer, viral hepatology and acute coronary syndromes. UCLH leads on critical care and contributes to the others except renal transplant.

#### **Barts Heart Centre (due to open 2015).**

The research structure and strategy for the new Barts Heart Hospital which will create a unified tertiary care and research centre at UCL Partners and The Farr Institute. This is led by Mark Caulfield who working with The Farr Institute and colleagues has developed the UCLP CV Strategy which will guide the research undertaken in the Barts Heart Hospital for the foreseeable future. In the new Barts Heart Centre as part of our NIHR Biomedical Research Unit and The Farr Institute we wish to extend generic consent for patients enabling us to collect and store all clinical data, store a core set of blood samples for DNA, serum, plasma and RNA in the Barts Cardiovascular Registry on consented patients. We developed with The Farr Institute and NIHR Biomedical Research Unit funding an informatics system that allows us to extract all information on consenting patients from the Barts Health Cerner System and multiple companion databases. The data is stored inside an NHS safe-haven in identifiable format and can be exported in anonymised format so researchers can analyse data in confidence but with the opportunity to relink through the clinical team to the patient. All participants are followed longitudinally and we are able to recall the patients to offer the opportunity to participate in research up to 4 times per year. This provides a huge opportunity to identify and engage patients in clinical studies and to provide pilot data from patient blood samples and human tissue samples offering important mechanistic insights into a number of CV diseases. The Barts CV Registry was initiated by the NIHR CV BRU at Barts and The Farr Institute London in close collaboration with all Cardiology stakeholders and our Public and Patients Group.

## Maternal and Child Health

This work stream brings together research involving the use of administrative health care data to evaluate service provision and to support the design, recruitment, follow up and generalisability of trials and cohort studies. Research projects in the past year have included topics from health care provision for vulnerable children and young people, preventive strategies for hospital acquired infections, the burden of flu and respiratory syncytial virus infection in children, the contribution of health inequalities and health care to cross-country variation in child deaths. Dezauteux and team are using administrative data to support sampling and follow up for the UK's major new birth cohort, Life Study, using administrative data. Collaborations between Farr work streams have led to projects on influenza, antibiotic resistance and RSV (with Hayward and Pebody), and to a PhD studentship on the contribution of health care acquired infections both in and outside hospital (Henderson and Muller-Pebody at Public Health England). Collaboration with the LSHTM/RCOG group on service evaluation in maternity care has resulted in a post-doc Sir Henry Wellcome fellowship for Harron on maternal and child outcomes of preterm birth (with van der Meulen). Research on linkage methodology has developed from the NIHR-funded trials (CATCH and PREVAIL –Harron, Gilbert), which involve new linkages between national surveillance and clinical datasets and evaluation of alternative approaches to probabilistic linkage. This work led to an ESRC methodology innovation project and collaboration with HSCIC on linkage error, which is ongoing (Harron, Hagger-Johnson, Goldstein, Gilbert). Joint research between The Farr Institute Centres includes the Children's Policy Research Unit report on diverging patterns of hospitalisation in England and Scotland for children with injuries related to maltreatment (Gonzalez-Izquierdo 2014) and the project on health care amenable deaths (Hardelid, Gilbert). Collaborations have been established with the Karolinska (Anders Hjern) and Ontario ICES (Astrid Guttmann) with Farr researchers visiting these centres to work on comparative analyses in 2015 (Harron – Ontario, Zylberstein –Karolinska).

## Infection

The investment in The Farr Institute and the subsequent development of the UCL Institute of Health Informatics Research has enabled the creation of a new UCL Research Department of Infectious Disease Informatics (IDI) based at the Farr at 222 Euston Road and led by Professor Andrew Hayward. The Department aims to maximise opportunities for infectious disease research across the translational pathway through better use of electronic health records and information and communication technologies. The Department has a strong emphasis on training at doctoral and postdoctoral level and works closely with colleagues across PHE.

**Infection Genomics Theme** - Through the Wellcome Trust DH Health Innovation Challenge Fund Iconic grant and in collaboration with the SANGER we are investigating the role of high throughput viral sequencing to inform infection control, surveillance and clinical management. We have established systems to extract pseudonymous data on patient characteristics, laboratory findings and ward locations to link to sequence data and are currently using this to investigate transmission of influenza and norovirus in hospital settings. We are active discussion with SANGER over collaborative opportunities to use CPRD to identify and recruit well characterised infection phenotypes through CPRD to investigate infection genomics.

**Antimicrobial Resistance and Healthcare associated infection theme**– We recently published our analysis of GP antibiotic prescribing behaviour (JAC 2014) which received widespread media attention and has been used by the CMO and others to support continuing policy and research focus in this area. We are developing novel methodology to extract comments made in response to the press coverage to better understand public views on antibiotic prescribing. NIHR Academic Clinical Lecturer Laura Shallcross is working with the Chief Medical Officer focussing on antimicrobial resistance and prescribing policy and is working with University Hospital Birmingham to analyse antibiotic use within the trust using their electronic prescribing data linked to other paperless health records.

**Infections and chronic disease theme** – NIHR Academic Clinical Lecturer Charlotte Warren Gash has obtained funds from the Academy of Medical Sciences to work with PHE to link records of respiratory infections from the PHE national laboratory database to HES in order to study the role of respiratory infections as triggers of respiratory and cardiovascular hospitalisations. NIHR Clinical fellow Logan Manikam is investigating respiratory infections in children with Down's syndrome using linked CPRD HES data.

**Tuberculosis Theme** – Wellcome Trust PhD fellow is working with PHE to validate probabilistic linkage algorithms and has matched the Institute of Migration (IOM) pre-entry tuberculosis screening database 2006-2012 (640,000 records) to the UK TB case notifications 2006-2013 (68,000 records) to determine the post-migration incidence of tuberculosis in those screened. We have launched the world's first trial of video observed therapy for tuberculosis in collaboration with the University of San Diego allowing patients to have their treatment observed remotely with a smart phone app instead of regular clinic attendances. NIHR methodology research fellow Oliver Dukes is working with PHE to develop a clinical decision support tool to predict risk of multidrug resistant tuberculosis based on epidemiological and clinical data using linked analyses of linked notification and laboratory data. This will enable targeting of rapid diagnostics to those most at risk and guide initial treatment and isolation decisions. The Farr Institute PhD student Catherine Smith is investigating geographical approaches to study of tuberculosis and outbreak investigation. The Farr Institute PhD student Bilal Yassin is developing computer aided decision support software to identify tuberculosis from serial chest radiographs.

**Respiratory Infections Theme** -We are working with Google and Microsoft Research to investigate the use of search engine logs and twitter to monitor influenza occurrence and secondary household transmission rates validating the methodology against Flu Watch community cohort as part of the EPSRC I-Sense project. Wellcome Clinical Research Fellow. Nishchay Mehta is using the CPRD linked to HES to investigate variations in tonsillectomy rates and recurrent sore throat infection and developing decision support tools for patients considering undergoing the procedure.

**Phase 2 clinical themes:** We undertook to broaden out our clinical focus from year 3 onwards to neurodegeneration, eyes, cancer and musculoskeletal. This is already well underway, principally in Neurodegeneration. Led by Farr Investigator Martin Rossor, and building on major national initiatives in dementia research with UK as the G8 lead, The aim of 'Join dementia research' is to improve the timeliness of study recruitment for researchers, and provide a service to thousands of potential volunteers who want to be involved in research. 2014 saw the 'join dementia research' initiative launched and first 500 patients recruited. As a researcher, what will you be able to do? **Perform a feasibility search.** This will be based upon a wide range of anonymised key demographic and health information collected from volunteers. It will help you determine how feasible a new or future study would be to set up and deliver. **Use the service for recruitment** to identify potential volunteers who match your study criteria. **View more detailed information.** If your study is uploaded on to the 'Join dementia research' system, you will be able to see more detailed information from volunteers whose information matches your study requirements. After this initial match, a more detailed review can be carried out on a case by case basis. Volunteers registering for this service will have already provided consent for their medical records to be reviewed by approved researchers and NHS staff. **Make contact with suitable volunteers.** Once pre-screening has been carried out, you will be able to make contact with volunteers who match your inclusion criteria, to discuss whether they'd like to participate in your study. **Track the status** of volunteers against a study, from matching through screening to recruitment.

### *Methodology Innovation and new tools*

Farr London has focussed considerable effort on EHR phenotyping in order to scale electronic health records (EHR) for research. During 2013/14 the CALIBER platform grew to be a successful proof of concept (>70 researchers, 11 groups, 3500 views, 250 users/month, ~30 publications). In the Farr we aim to transform our current platform in size (currently only 10m person-years, only 4 national linked record sources), diversity of data (currently only 6 ontologies) and clinical breadth (currently cardiovascular disease). Genomics researchers cannot operate without the tools and publicly available data on, for example, the [EMBL portal](#) (4m views/day). By contrast, in the rapidly expanding field of using diverse large-scale EHR for translational research (from discovery, through trials to outcomes research) there has been no 'go to' open-access portal providing curated algorithms and tools. There is a fundamental lack of data-driven methods and cross-disciplinary EHR tools usable by clinicians and researchers. There is no standardized methodology for defining, sharing and evaluating EHR-derived phenotypes and no systematic manner for transforming raw EHR data into research-ready variables for statistical analysis. Similar resources do not exist in Europe. Even basic information (e.g. hierarchical '[Read codes](#)' in primary care EHR, '[OPCS-4](#)' used for recording procedures, and drug information ([BNF](#)) are not in the public domain in a curated manner that makes them accessible and comprehensible by researchers). Useful resources in the US (e.g. [eMERGE](#), [PheKB](#))

focus in genetic epidemiology using unstructured data from hospitals rather than structured data from national sources similar to what we have available in the UK. Our aim is to create a resource that will converge the different approaches to EHR phenotyping.

## SCOTLAND

### *RP1: Health Illness and Society through Time*

#### **A. Fetal Growth patterning, early life development and health in later life**

Fetal epidemiology studies, where fetal size and growth during pregnancy are linked to postnatal outcomes, provide important insight into the nature and timing of potentially preventable antenatal insults which are linked to non-communicable diseases in post natal life. Novel linkages between routinely acquired fetal ultrasound measurements made since 1985 and healthcare and environmental data have been established and a programme of research is underway to explore associations between fetal measurements and childhood obesity, maternal smoking, environmental exposures, childhood diseases including asthma and autism. A novel approach to analysing data is being taken in conjunction with colleagues in computer science. A new collaboration with Dr Dan Park at the University of Warwick will enable exploration of fetal growth and orthopaedic outcomes in childhood. Researchers are working with Farr Colleagues in **CIPHER** to develop a larger dataset of antenatal scan data.

#### **B. Impact of stressful environments on individuals, families and society**

We have been continuing work examining the effect of exposure to various physical and social environment characteristics for the outcomes of pregnancy. We are currently completing minor revisions on a manuscript examining the effect of air pollution on birth-weight for the journal environmental research and are shortly to submit a manuscript to Paediatric and perinatal epidemiology which looks at the effect of living in a high crime environment for the same outcomes. We are drafting a paper which examines the effect of living in urban, rural and island communities for birth outcomes and have submitted an abstract for the same work to be presented at the international medical geography symposium in July. In collaboration with colleagues at Aberdeen University, we have produced initial and preliminary findings related to the effect of exposure to air pollution for *in utero* fetal growth and are in the process of creating enhanced air pollution exposure information which includes a temporal component to the annual average concentrations we have been working with up until now. These findings will be written up into an abstract to be presented at The Farr Institute conference in August. We are nearing completion of first drafts of privacy advisory committee forms following discussion with E-DRIS. These projects broadly examine the effects of stress (both within families i.e. looking after sick siblings and the external world including both physical i.e. pollution, noise exposure and weather and the social i.e. high crime environments) for the health of individuals and other family members. These projects will entail new linkages to a wide range of cross-sectoral data (education, environment, health) and entails developing a method for the identification of family units within the ISD data system.

#### **C. Understanding early life determinants of resilience and vulnerability to chronic disease and the impact of chronic disease in adult life**

In our ageing population, chronic physical and mental ill health and cognitive decline represent the major Public Health, healthcare and social care challenges of the current era. This workpackage is already providing new insights in our understanding of cognitive ageing, multi-morbidity and resilience. A review of resilience (M Johnston, 2014) has summarised the main methodological challenges with a view to identifying approaches applicable to health informatics research. A validation of multi-morbidity scoring comparing hospital episode data to clinical case note review demonstrated the value of routinely collected morbidity data in electronic health records (M Johnston, 2015). A systematic review of the role of education and occupation in cognitive resilience has been presented (D Chapoka, 2014) and how these factors interact with early life IQ to influence cognitive ageing has been explored in unique birth cohort data with long term follow up and brain imaging (D Chapoka, 2014). New collaborations have been established with Dr. Maria Glymour at the

University of California, San Francisco and Department of Primary Care at University of Melbourne in November 2014.

Attracting external funding from Wellcome, the Resilience theme has been extended to include determinants of resilience to Chronic Kidney Disease following Acute Kidney Injury. This attracted a Wellcome Clinical Fellowship to enable one of our clinical lecturers to undertake a PhD. The work has identified, from a systematic review, the key research gaps in understanding (S Sawhney, 2014). Novel work evaluating the impact of the new NHS England eAlert system for AKI has recently been submitted for publication (S Sawhney, *Kidney International*) in collaboration with colleagues from the Farr Institute **London** who host another Wellcome Fellow working with us on Acute Kidney Injury.

#### **D. Cross-sectoral record linkage: education and health**

The Farr Institute exemplar projects have been adopted by the Data Sharing and Linkage Service (DSLS) of the Scottish Government as Pathfinder Projects to test their processes including attachment of databases from different sectors to the national spine and linkage of and access to these databases within the national safe haven. The governance and data sharing agreements for this research are more complex. Because of the complexity involved multiple approvals have been required. To date, the following approvals have been obtained:

- Privacy Advisory Committee (PAC) approval to link education data held by ScotXed to health data held by NHS National Services Scotland (SMR01/02/04/06/11, SBR, births/deaths, Prescribing, Child Health) and externally (SCI-Diabetes) was approved in September 2014.
- Data sharing agreement with ScotXed to allow education linkage identifiers to be provided for linkage and education payload data to be released into the national safe haven for analyses.
- Data sharing agreement with the Scottish Diabetes Research Network (SDRN) to allow diabetes payload data to be released into the national safe haven for analyses
- Data processing agreement between Glasgow University, DSLS and ISD (who will link and store all data on behalf of GU)
- Application to the Caldicott Forum seeking permission to link SCI-Diabetes data to education data was approved.

Data progress

- Linkage of the education data to the CHI database was completed in January 2015. The various payload datasets are now being produced by ISD and ScotXed. We anticipate some of the data will be in the safe haven and ready to analyse by mid-February.

### *RP2: Studies of Interventions*

#### **A. Natural experiments**

Evaluating the impact on asthma “puffer” prescriptions and hospital admissions of the abolition of prescription fees in Scotland: a natural experiment (Leads: Williams and Frank, SCPHRP, Edinburgh, with The Farr Institute Scotland collaborators Bennie, Dibben, Jepson, Kattikireddi, Ludbrook, and Pell)

#### **B. Clinical Trials**

This work package started with the appointment of Paul Martin in Glasgow to work with Professors Ford and McCowan. The work in Glasgow will focus on pilot work in the following areas:

- Development of a simplified standard routinely collected dataset across Scotland to support feasibility and recruitment into clinical trials.
- Development of a registry of trials and participants with permission to link to routinely collected health records and associated work to address confidentiality concerns.
- Development of extraction tools to collate information for central adjudication of potential events identified from record linkage (e.g. extraction of ECG results, troponins, images, documents [eg discharge summary]) with appropriate approaches for redaction of personal identifiers.
- Development of tools to facilitate extraction of lab results for trial participants across Scotland.
- Development of disease specific cohorts with integrated NHS costs for follow-up events to support study feasibility assessment and subsequent economic evaluations.

Activity in Edinburgh was delayed due to Professor Aziz being on sabbatical in the US. An appointment will be made soon to identify the key opportunities for routine data to support the planning and execution of clinical trials, understand the barriers and facilitators to more widespread use, and

formulate policy recommendations that can help move the agenda on, with Asthma as an exemplar clinical area linked with the Asthma UK Centre for Applied Research

A more limited work programme will take place in Dundee (Prof MacDonald) developing high quality, low-cost methods to exploit randomising subjects within record-linkage systems.

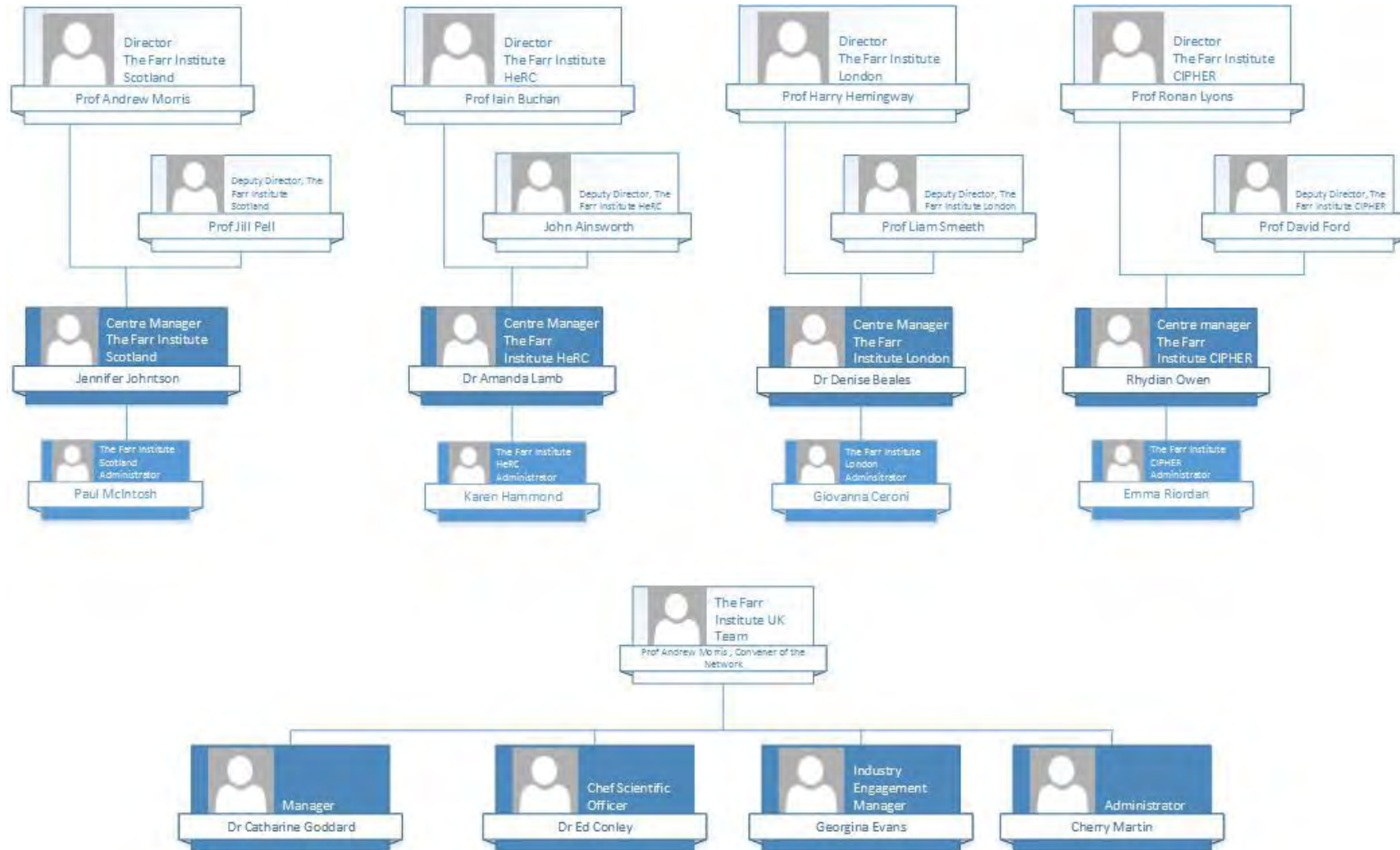
Contributions were made at a BHF organised Health Informatics workshop in London in April 2014. A successful workshop on record linkage in trials was held in Manchester on June 23 2014, in collaboration with the MRC methodology and the UK-wide Farr groups. This UK-wide Farr group has subsequently submitted a successful proposal for a Panel Session at HTAi in Oslo in 2015. Further presentations will be made on record linkage and trials at a European Society of Cardiology workshop on 'Electronic Health Records (EHR) to improve patient care and facilitate clinical research' in London in April 2015.

### C. Pharmaco-epidemiology

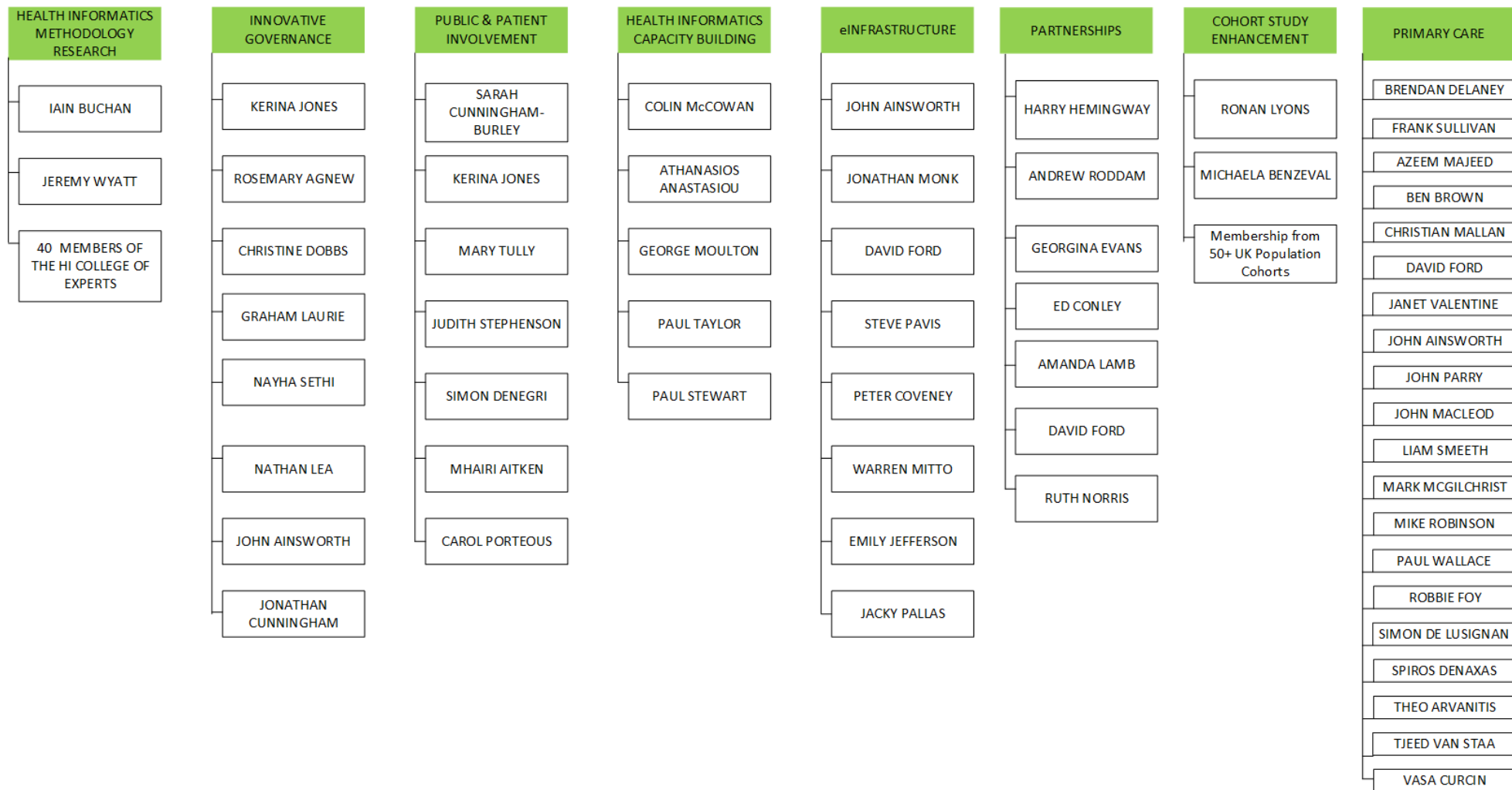
The activities in this workstream are currently focused in three areas:

1. **Improved data provisioning of the national primary care prescribing dataset** – investment through The Farr Institute has enabled strategic review of the current dataset and agreement of prioritised work to improve
  - a) standardisation of drug coding/classification across prescribing, dispensing and claimed drug data,
  - b) coding of dosage instruction using natural language processing techniques. Significant progress has been made towards the goal of establishing a formatted database from which cumulative drug dosage through time for any drug can be evaluated rapidly.
2. **Clinical exemplar studies focused on safety, clinical and cost-effective use of medicines** – currently ongoing:
  - Use of new anticoagulants in thromboprophylactic treatment in Scotland
  - Pharmacoeconomic evaluation of new anticoagulants in thromboprophylactic treatment in Scotland
  - Use of antiplatelets in the treatment of patients with acute coronary syndrome for secondary prevention of atherothrombotic events in Scotland
  - Utilization, health and social care outcomes of biologics in patients with rheumatoid arthritis in a Scottish Health Board
  - Child education outcomes following in utero exposure to antihypertensives, asthma therapy and psychotropics in Scotland
  - Diabetes safety studies - Evaluating adverse effects of new diabetes therapies – GLP1 agonists, DPP4 inhibitors, SGLT2 inhibitors etc. on a range of outcomes including CVD and respiratory and Urogenital effects. Significant progress has been made with the data transformation and preparation of the diabetes database formatting. Once the 2015 extract of diabetes data has been carried out analysis work will start.
3. **National/International networking**- collaborations evolving to support cross national pharmacoepidemiology studies and funding bids include:
  - Pharmacoepidemiology methods standardisation across The Farr Institute (Scotland, Manchester, UCL)
  - Cross national studies – anticoagulants (Scotland, Sweden)
  - H20:20 - Diabetes and Cancer Research Collaboration (Scotland, Manchester, International partners)
  - Infection Informatics – CSO funded: Scottish Healthcare Associated Infection Prevention Institute (SHAIPi) - clinical informatics work stream with a focus on risk modelling and clinical decision support tools for clinicians (Scotland, UK partners).

## APPENDIX 1: THE FARR INSTITUTE SENIOR MANAGEMENT TEAM



## APPENDIX 2: THE FARR INSTITUTE NETWORK WORKING GROUPS WITH REPRESENTATIVE MEMBERS



## APPENDIX 3: INTERNATIONAL ADVISORY BOARD

The Farr Institute hosted an International Advisory Board (IAB) on 15<sup>th</sup> December 2014 in London.

### International Advisory Board Members in attendance

|                        |   |
|------------------------|---|
| Nancy Pedersen (Chair) | Professor in Genetic Epidemiology, Department of Medical Epidemiology and Biostatistics, Karolinska Institute, Sweden, Director of LifeGene project   |
| Phil Burstein          | VP Health Care Data Optimization, GlaxoSmithKline   |
| Ian Crichton           | Chief Executive, NHS National Services Scotland   |
| Simon Denegri          | Chair of INVOLVE and NIHR's National Director for Public Participation and Engagement in Research   |
| Georges De Moor        | Immediate Past President and Member of the Board of European Institute for Health Records and Head of the Department of Medical Informatics and Statistics at the State University of Ghent, Belgium. |
| William Lowrance       | Consultant in Health Research Ethics & Policy, La Grande Motte France, and author of <i>Privacy and Confidentiality in Health Research</i> .  |
| Michael Parker         | Professor of Bioethics and Director of the Ethox Centre, University of Oxford   |
| Dan Roden              | Assistant Vice Chancellor for Personalized Medicine Vanderbilt University Medical Center  |
| John Speakman          | Senior Director, Research Information Technology, NYU Langone Medical Center  |
| Graham Spittle         | Chief Technology Officer Europe & Vice President, Software Group, IBM   |

### Apologies

|                |  |
|----------------|--|
| Isaac Kohane   | Professor of Pediatrics and Health Sciences and Technology, Harvard Medical School, Chair, Informatics Program, Boston Children's Hospital, Children's Hospital Informatics Program (CHIP) |
| Michael Parker | Professor of Bioethics and Director of the Ethox Centre, University of Oxford  |

## APPENDIX 4: NEW APPOINTMENTS SINCE MARCH 2014

| Name                | Farr Centre/Participating Institution | Job Title                               | Duration of appointment | Funding source                     |
|---------------------|---------------------------------------|---|-------------------------|------------------------------------|
| Ed Conley           | UK                                    | Chief Scientific Officer                | 2 years                 | UK Grant HIRN                      |
| Georgina Evans      | UK                                    | Industry Engagement Manager             | 2 years                 | UK Grant HIRN                      |
| Catharine Goddard   | UK                                    | Manager                                 | 3 years                 | UK Grant HIRN                      |
| Cherry Martin       | UK                                    | Administrator                           | 3 years                 | UK Grant HIRN                      |
| Haroon Ahmed        | CIPHER / Cardiff University           | Research Fellow                         | 5 years                 | NIHR                               |
| Hywel Jones         | CIPHER / Cardiff University           | Analyst                                 | 4 years                 | CIPHER                             |
| Donald Fraser       | CIPHER / Cardiff University           | Clinical Senior Lecturer                | Permanent               | CIPHER                             |
| James Chess         | CIPHER / Swansea University           | Honorary Clinical Senior Lecturer       | Permanent               | CIPHER                             |
| Dr Alan Watkins     | CIPHER / Swansea University           | Associate Professor (e-trials research) | Permanent               | Swansea University                 |
| Dr Alison Teyhan    | CIPHER / University of Bristol        | Analyst                                 | 4 years                 | CIPHER                             |
| Dr Colin Steer      | CIPHER / University of Bristol        | Analyst                                 | 4 years                 | CIPHER                             |
| Dr Gwyneth Davies   | CIPHER / Swansea University           | Associate Professor                     | Permanent               | Swansea University                 |
| Mohammad Sallakh    | CIPHER / Swansea University           | PhD student                             | 4 years                 | Asthma Centre for Applied Research |
| Niels Peek          | Farr HeRC                             | Reader                                  | Tenure                  | HeRC                               |
| Tjeerd Van Staa     | Farr HeRC                             | Professor                               | Tenure                  | HeRC                               |
| Ruth Norris         | Farr HeRC                             | Research Programme Manager              | 3 years                 | HeRC                               |
| Karen Hammond       | Farr HeRC                             | Administrator                           | 2 years                 | HeRC                               |
| Jane Candlish       | Farr HeRC                             | Research Assistant                      | 2 years                 | HeRC                               |
| Stephen Melia       | Farr HeRC                             | Communications Delivery                 | 2 years                 | HeRC                               |
| Sabine van der Veer | Farr HeRC                             | Honorary Research Fellow                | 2 years                 | ERA-EDTA                           |
| Alexander Pate      | Farr HeRC                             | Research Associate                      | 1.5 years               | HeRC                               |
| Hannah Lennon       | Farr HeRC                             | Biostatistician                         | 2 years                 | HeRC                               |
| Paul Stephenson     | Farr HeRC                             | Software Engineer                       | 1.5 years               | HeRC                               |

|                   |                                     |  |           |                  |
|-------------------|-------------------------------------|--|-----------|------------------|
| Ellena Badrick    | Farr HeRC                           | PhD Student; Doctoral Programme        | 3 years   | HeRC             |
| Natalie Berry     | Farr HeRC                           | PhD Student; Doctoral Programme        | 3 years   | HeRC             |
| Glen Martin       | Farr HeRC                           | PhD Student; Doctoral Programme        | 3 years   | HeRC             |
| Jenny Newman      | Farr HeRC                           | PhD Student; Doctoral Programme        | 3 years   | HeRC             |
| Ozgur Asar        | Farr HeRC                           | PhD Student; Doctoral Programme        | 3 years   | HeRC             |
| William Hulme     | Farr HeRC                           | PhD Student; Doctoral Programme        | 3 years   | HeRC             |
| Rebecca Howard    | Farr HeRC                           | PhD Student; Doctoral Programme        | 3 years   | HeRC             |
| Rosalind Eggo     | UCL                                 | Research Associate                     | 2 years   | UKBiobank        |
| Alireza Moayyeri  | UCL                                 | Research Associate                     | 2 years   | MRC              |
| TBA               | UCL                                 | Professor                              | Permanent | HEFCE            |
| TBA               | UCL                                 | Professor                              | Permanent | HEFCE            |
| TBA               | UCL                                 | Senior Lecturer                        | Permanent | HEFCE            |
| TBA               | UCL                                 | Senior Lecturer                        | Permanent | HEFCE            |
| TBA               | UCL                                 | Health Data Architect                  | 2 years   | BRC              |
| TBA               | UCL                                 | Health Data Analyst                    | 2 years   | BRC              |
| Paul McIntosh     | Scotland, University of Dundee      | Administrator                          | 2 years   | Scotland         |
| Paul Martin       | Scotland, University of Glasgow     | Research Student                       | 3 years   | Scotland         |
| Tanja Mueller     | Scotland, University of Strathclyde | Research Student                       | 3 years   | Scotland         |
| Giorgio Ciminata  | Scotland, University of Strathclyde | Research Student                       | 3 years   | Scotland         |
| Grant Wyper       | Scotland, University of Strathclyde | Research Student                       | 3 years   | Strathclyde      |
| Clifford Nangle   | NSS                                 | Database Developer/Analyst             | 3 years   | Farr             |
| Melanie Turner    | University of Aberdeen              | Research Fellow                        | 1.5 years | NAEDI            |
| Anthony Chapman   | University of Aberdeen              | Research Student                       | 3 years   | Farr             |
| Shifa Sarica      | University of Aberdeen              | Research Student                       | 3 years   | UoA/NHS Grampian |
| Gordon McAllister | University of Dundee                | Informatics Postdoc                    | 3 years   | Farr             |
| David Rorie       | University of Dundee                | Phd Student (Supervisor Tom MacDonald) | 3 years   | BHF              |

## APPENDIX 5: GRANT ACQUISITION SINCE MARCH 2014

| Lead Investigator   | Funder                                      | Title of Grant   | Award Value | Farr Institute Centres involved |
|---|---|--|-------------|---------------------------------|
| Martin Rutter   | Diabetes UK                                 | Prescribing to reduce cardiovascular events in patients with diabetes  | £220k       | HeRc/UoM                        |
| (Georgina Moulton Co-I; in collaboration with Richard Gater Mental Health and NICE) | NHS England                                 | Mental Health Informatics Literacy   | £50K        | HeRC                            |
| Alison Kemp   | Healthcare Quality Improvement Partnership  | National Confidential Enquiry into Patient Outcome and Death   | £1,400,823  | CIPHER                          |
| Andrew Gumley (Glasgow)   | NIHR-HTA                                    | EMPOWER "Early warning signs of relapse in schizophrenia"  | £874k       | HeRC/UoM                        |
| Andrew Malcolm Wilson   | NIHR Health Technology Assessment Programme | At-Risk Registers Integrated into primary care to Stop Asthma crises in the UK (ARRISA-UK)   | £1,691,831  | CIPHER                          |
| Andrew Morris   | MRC Proximity to Discovery                  | <b>i<sup>2</sup>Health</b> ; Health Informatics, Open Innovation, and Community Interface  | £200k       | Edinburgh University Scotland   |
| Andrew Renehan  | CRUK  | NAEDI: National Awareness & Early Diagnosis Initiative: Development of a risk prediction toll for early cancer detection in patients with type2 diabetes   | £141k       | HeRC                            |
| Andrew Renehan & Paula Williamson   | RFPB  | Development of a core outcome set for informed consent, clinical trials and treatment policy in patients with anal cancer  | £229k       | HeRC                            |
| Angharad Marks  | NHS Grampian R&D                            | Renal Bone Disease: the effect of Renal Impairment on Orthopaedic Related Morbidity and Mortality  | £8,244      | Scotland                        |
| Ann John  | NISCHR social care studentship              | Self Harm electronic Portal (SHeP).  | £66,000     | CIPHER                          |
| Blandford   | NIHR  | ECLIPSE (Exploring the Current Landscape of Intravenous Infusion Practices & Errors) studying medication practices with infusion devices, to document the variety of existing practices and deliver recommendations for best practice in | £ 556,803   | London                          |

|                          |  |   |            |              |
|--------------------------|--|---|------------|--------------|
|                          |  | different situations  |            |              |
| Brocklehurst             | Wellcome   | Infection and immunity from a life course perspective: Life Study enhancement pilot study   | £1,112,484 | London       |
| Caulfield                | MRC  | UK Clinical Genomics Research Data Infrastructure   | £25M       | London       |
| Colin McCowan            | NIHR Public Health Research Programme                | Long term weight loss trajectories in participants in a randomised controlled trial of a weight management and healthy lifestyle programme for men delivered through professional football clubs: the Football Fans in Training follow up | £342,000   | Scotland     |
| Colin McCowan            | Merck  | Modelling long-term/ lifetime benefits of LDL lowering using the WOSCOPS cohort   | £294,000   | Scotland     |
| Colin McCowan            | Scottish Government/ ESRC studentship                | Health inequalities & multimorbidity: exploiting administrative data to understand the role of social care  | £51,000    | Scotland     |
| Colin McCowan            | Astellas   | Clinical outcomes and costs following hospitalisation for Clostridium Difficile   | £180,000   | Scotland     |
| David Ford               | National Institute for Health and Care Excellence    | CEDAR Collaboration Agreement   | £94,927    | CIPHER       |
| David Ford               | European Social Fund                                 | HGT5 funding for SBRI Innovation Catalyst Programme   | £49,552    | CIPHER       |
| David Ford               | Welsh Government (A4B programme)                     | International Digital Healthcare Conference grant   | £50,000    | CIPHER       |
| David Ford               | Cardiff University                                   | NICE Cardiac Ablation Project   | £19,624    | CIPHER       |
| David Ford               | Welsh Government                                     | Welsh SBRI Innovation Catalyst Programme  | £785,010   | CIPHER       |
| David Ford & Ronan Lyons | NISCHR   | Secure Anonymised Information Linkage (SAIL) Databank   | £2,059,669 | CIPHER       |
| David Taylor-Robinson    | Cystic Fibrosis Trust                                | Cystic Fibrosis Epidemiological Network (CF EpiNet)   | £140,000   | CIPHER, HERC |
| Donald Fraser            | NISCHR   | Wales Kidney Research Unit  | £1,492,658 | CIPHER       |
| Emily Jefferson          | H2020  | ENSAT – HT: Application of omics-based strategies for improved diagnosis and treatment of endocrine hypertension.   | £850,000   | Scotland     |
| Emily Jefferson          | Health Foundation                                    | QISIP: Quality Improvements Science Informatics Programme   | £500,000   | Scotland     |
| Ernest Choy              | Arthritis Research UK, NISCHR and Cardiff University | Cardiff Regional Experimental Arthritis Treatment and Evaluation (CREATE) Centre  | £450,000   | CIPHER       |

|  |   |  |   |  |
|--|---|--|---|--|
| Ernest Choy                                | Heath Technology Assessment Exercise              | Reducing Arthritis Fatigue – clinical Teams using cognitive behavioural approaches (RAFT)  | £448,025                                    | CIPHER   |
| Ernest Choy                                | Roche   | The Role of SL-6R Mediated Trans-signalling in Cardiovascular Morbidity  | £100,000                                    | CIPHER   |
| Georgina Moulton                           |   | NHS Modernising Scientific Careers Health Informatics Pathway  | £ based on the number of students per year. | HeRC/UoM and Farr Institute London/UCL)  |
| Gilbert                                    | ESRC  | National Centre for Research Methods. Estimating matching variable error rates and match probabilities for linkage of large administrative data sources. | £159,055                                    | London   |
| Gilbert                                    | NIHR  | PREVAIL trial (Preventing infections using antibiotic impregnated long lines)  | £1,856,285                                  | London   |
| Haroon Ahmed                               | National Institute for Health Research (NIHR)     | NIHR Doctoral Fellowship   | £247,752                                    | CIPHER   |
| Harron                                     | Wellcome Trust                                    | Sir Henry Wellcome Postdoctoral fellowship   | £250,000                                    | London   |
| Hemingway                                  | MRC   | Medical Bioinformatics eMedlab   | £975,209                                    | London   |
| Hemingway                                  | AstraZeneca                                       | Prognostic model for Risk  | £375,000                                    | London   |
| John Ainsworth (jointly with Chris Taylor) | EPSRC   | NewMind: Sensing Technology partnership with MindTech  | £180k                                       | University of Lancaster; University of Nottingham; University of Sheffield; University of York |
| John Gallagher                             | MRC   | Web-Based recruitment to cohort studies  | £93,000                                     | CIPHER   |
| John Gallacher (Cardiff)                   | DPUK / MRC CRI                                    | DPUK: "Dementia Platform UK" CRI award for wearable devices and connected health.  | £500k                                       | HeRC; CIPHER   |
| Julie Peconi                               | NISCHR  | NISCHR Health Fellowship Award 2014: The impact of social and residential mobility on future health outcomes and healthcare resource use.                | £258,167                                    | CIPHER   |
| Kerina Jones                               | MS Society  | UK MS Register   | £897,833                                    | CIPHER   |
| Laurence Moore/Rona Campbell               | MRC, BHF, CRUK, ESRC, Welsh Govt, Wellcome, UKCRC | DECIPHer, public health research centre of excellence  | £2,935,822                                  | CIPHER   |
| Manikam                                    | NIHR  | Doctoral training award focussing on   | £346,684                                    | London   |

|   |                                       |  |  |   |
|---|---------------------------------------|--|--|---|
|   |                                       | respiratory infections in children with Down's syndrome.   |  |   |
| Marion Bennie                                       | CSO                                   | Development of a generic system to estimate the association between community prescription of antimicrobials and healthcare associated infections – developed and illustrated with Clostridium difficile infection | £118,000   | Scotland                                |
| Marion Bennie                                       |                                       | PhD Studentship - Use of antiplatelets in the treatment of patients with acute coronary syndrome for secondary prevention of atherothrombotic events in Scotland   |  | Scotland                                |
| Marion Bennie                                       |                                       | PhD Studentship - Use of antiplatelets in the treatment of patients with acute coronary syndrome for secondary prevention of atherothrombotic events in Scotland   |  | Scotland                                |
| Marion Bennie and Colin McCowan                     | CSO                                   | Scottish Healthcare Associated Infection Prevention Institute (SHAIPi)   | £4,249,749   | Scotland                                |
| Martin Wildman                                      | Programme Grants for Applied Research | Development and evaluation of an intervention to support Adherence to treatment in adults with Cystic Fibrosis (ACTiF)   | £1.5million  |   |
| Matt Sperrin  | GSK                                   | CHES: Salford Lung study matched CPRD Comparison cohort study  | £420k  | HeRC                                    |
| Matthew Hickman                                     | MRC                                   | Excessive drinking and alcohol related harms in Adulthood: ALSPAC at 24  | £2,196,345   | CIPHER                                  |
| Mehta   | Wellcome trust                        | Doctoral training award focussing on variations in adult tonsillectomy rates   | £458,329   | London                                  |
| Neil Basu   | UoA/NHS Grampian                      | PhD Studentship - Health burden of autoimmune disease  | £45,000  | Scotland                                |
| Niels Peek (for HeRC; led by Industry partner MUJO) | Innovate UK                           | Connected rehab for musculoskeletal surgery  | £606k  | HeRC                                    |
| Paul Elliot (Ronan Lyons)                           | MRC                                   | UK MEDical BIOinformatics partnership – aggregation, integration, visualisation and analysis of large, complex data (UK MED-BIO).  | £5,941,410   | Imperial:<br>CIPHER                     |
| Prof John Gallacher                                 | MRC                                   | UK Dementias Platform  | £12,007,473 to CIPHER<br>£484k to Farr@HeRC (of £16m fund) | Scotland;<br>London;<br>HeRC;<br>CIPHER |
| Prof John Gallagher                                 | MRC                                   | Web-Based recruitment to cohort studies  | £93,000  | CIPHER                                  |
| Robson  | CLARHC                                | Improvement in anticoagulation and management of atrial fibrillation   | £282,000   | London                                  |
| Ronan Lyons   | DVLA                                  | DVLA/Dept for Transport commissioned   | £100,000   | CIPHER                                  |

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|---|---|--|------------|----------------|
|   |   | research (Package Order: PS/13/59)   |            |                |
| Ronan Lyons   | European Commission 3rd Health Programme                        | Bridging Information and Data Generation for Evidence-based Health Policy and Research (BRIDGE Health)   | £4,559,270 | CIPHER         |
| Ronan Lyons   | NISCHR  | NISCHR Centre for Population Health & Wellbeing Research   | £2,250,000 | CIPHER         |
| Ronan Lyons   | Wellcome Trust  | Using health record linkage in the Millennium Cohort Study to investigate childhood obesity, asthma and infections                                   | £316,797   | CIPHER; London |
| Ronan Lyons   | NISCHR  | Senior Faculty Award (2014/15)   | £15,000    | CIPHER         |
| Ronan Lyons   | MRC   | UKDP: Integrated DEmentia research environment (IDEA),   | £321,000   | CIPHER         |
| Sam Sheppard  | NISCHR  | Demographic inequalities in hospital-acquired infections in Wales: a pathogen population genomics approach   | £258,167   | CIPHER         |
| Sarah Cunningham Burley                               | ESRC/Scottish Government  | PhD Studentship – Trust of Government Data   |            | Scotland       |
| Sebastian Johnson                                     | MRC   | Phenotyping immune responses in asthma and respiratory infections - a systems approach to understanding changes from childhood to adulthood          | £2.6m      | UoM/Imperial   |
| Shantini Paranjothy                                   | National Institute for Social Care and Health Research (NISCHR) | Welsh Study of Mothers and Babies: Prospective electronic cohort study of renal disease in early childhood   | £170,000   | CIPHER         |
| Simon Moore   | ESRC  | Alcohol Misuse: Electronic Longitudinal Alcohol Study in Communities (ELAStic)   | £978,102   | CIPHER         |
| Simon Sebire  | NIHR  | Development and feasibility cluster randomised control trial evaluation of a Peer-Led physical Activity iNtervention for Adolescent girls (PLAN-A)   | £522,571   | CIPHER         |
| Smeeth  | MRC   | Population Health Scientist award for Adrian Root: understanding polypharmacy, balancing risks and benefits  | £248,911   | London         |
| Smeeth  | GSK   | Improved methods for studying drug effects   | £490,065   | London         |
| Smeeth  | Newton Fund/MRC   | A collaboration Brazil UK on e health preparing a virtual cohort of 80 million Brazilians  | £100,000   | London         |
| Smeeth and Scott (jointly with Public Health England) | NIHR  | Health Protection Research Unit: Immunisation,   | £3,544,954 | London         |
| Stan Zammit   | MRC   | Pathways to psychosis: Investigating environmental, cognitive and genetic mechanisms underlying development of psychotic experiences in young adults | £1,328,163 | CIPHER         |

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|-------------------------|--|--|---------------------------------------|----------|
| Stefan Siebert          | Pfizer Inflammation-Competitive Research Programme | The cost of ankylosing spondylitis using patient reported outcomes and routine anonymised linked data.                 | £44,234                               | CIPHER   |
| Stephenson              | NIHR   | Senior Investigator Award  | £360,000                              | London   |
| Suzanne Audrey          | NIHR PHR   | The effectiveness and cost effectiveness of an employer-led intervention to increase walking during the daily commute. | £972,682                              | CIPHER   |
| Tom MacDonald, Ian Ford | BHF  | Treatment In the Morning versus Evening (TIME) Study   | £1,070,448                            | Scotland |
| Tony Whetton            | MRC  | Clinical research Infrastructure: Clinical proteomics Centre   | £1.1m to Farr@HeRC (of £12.8m to UoM) | HeRC     |
| Will Dixon              | MRC CIC  | MRC CIC: Musculoskeletal severity tool using sensors   | £109k                                 | HeRC     |
| Will Dixon              | Arthritis UK                                       | remote monitoring of patients with arthritis: Pushing collected data from apps to the EPR                              | £200k<br><i>*award letter pending</i> | HeRC     |
| Williamson              | MRC  | Missing data in propensity score analyses of Electronic Health Records Data  | £396,357                              | London   |
| Zofia Miedzybrodzka     | Scottish Government Health Directorates            | Establishment of the Scottish Familial hypercholesterolaemia outcome register.   | £30,000                               | Scotland |

## APPENDIX 6: INVITATIONS TO SPEAK AT EXTERNAL MEETINGS

| Event title   | Month          | Presenter   |
|---|----------------|---|
| Accelerated development of vaccine benefit-collaboration in Europe (ADVANCE) Review Panel   | March 2014     | Athanasios Anastasiou   |
| 'Health informatics for respiratory disease research'. Presentation to NISCHR SEWAHSP/GSK meeting, Caerleon   | March 2014     | Ronan Lyons   |
| 'Farr Institute: Safe havens'. Presentation at Academy of Medical Sciences' Data in Safe Havens meeting, London   | March 2014     | Ronan Lyons   |
| 'Health informatics for respiratory disease research'. Presentation to NISCHR SEWAHSP/GSK meeting, Caerleon   | March 2014     | Ronan Lyons   |
| CRUK/Winton Big Data Analytics meeting  | April 2014     | Ronan Lyons   |
| International Health Data Linkage Conference, Vancouver, Canada   | April 2014     | Andrew Morris, Ronan Lyons, David Ford, Martin Heaven, Sarah Lowe, Shantini Paranjothy, Nayha Sethi, Simon Thompson, John Frank |
| Patient Safety Congress (ACC, Liverpool). Panel Discussion: Using Smart Data to Improve the Safety of Patients.   | May 2014       | Andrew Morris   |
| 'Wales Electronic Cohort for Children (WECC) study: design, early results and creation of a hybrid e-cohort'. Presentation to Chief Economist and Child Poverty Group, Welsh Government | May 2014       | Ronan Lyons   |
| 'Potential to use UK Secure e-Research Platform (SeRP) for some access needs to UK Biobank data'. Presentation to UK Biobank team, Swansea  | May 2014       | Ronan Lyons   |
| Seminar: Linking Health System Data for Research: Early Experience in the UK Farr Institute. Danville (PA), USA   | June 2014      | Harry Hemingway   |
| UK BioBank Frontiers: Data Linkage and Outcomes Adjudication  | June 2014      | Ronan Lyons   |
| 'Using linked data for research and continuous quality improvement'. Presentation at Welsh Stroke Conference, SWALEC Stadium, Cardiff   | June 2014      | Ronan Lyons   |
| IHAWC conference  | June 2014      | Jill Pell   |
| Nuffield Trust Conference: Predictive Risk and Data Linkage   | June 2014      | Liam Smeeth   |
| Royal Statistical Society lecture, University of Glasgow  | June 2014      | Steve Pavis   |
| 'Data Linkage in major trauma: the key to improving clinical effectiveness, NHS efficiency and reducing population impact'. Presentation to South Wales Trauma Collaboration, Bridgend. | July 2014      | Ronan Lyons   |
| Development of Brain Image Banks and Age-Specific Normative Human Brain Atlases, Royal Society of Edinburgh   | August 2014    | Steve Pavis   |
| Royal Society Of Medicine - Electronic Health Data For Population Health Benefit, Lodon   | September 2014 | John Ainsworth  |
| International Mortality and Longevity Symposium   | September 2014 | Harry Hemingway   |

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| 2014: Plenary Talk: Big Health Data: Perspectives Across the Patient Journey from Linking Multiple Record Sources  |                |                              |
| 'Enhancing longitudinal research through record linkage: experience in the Avon Longitudinal Study of Parents and Children'. Electronic Health Data for population health benefit. Royal Society of Medicine, London | September 2014 | John Macleod                 |
| 'UK Dementia Platform Informatics' Presentation to joint meeting of UKDP, EMIF (European Medical Information Framework) and eTRIKS (European Translational Information and Knowledge Management Services), London    | September 2014 | Ronan Lyons                  |
| 'Big Data. Why Asthma, why us, why now?' Presentation to industry and research funders on 'Big Data for Asthma, Wales in London  | October 2014   | Ronan Lyons                  |
| 'Data linkage: the key to long term outcomes'. Keynote presentation at British isles Network of Congenital Anomaly Registers (BINOCAR) Conference, Swansea   | October 2014   | Ronan Lyons                  |
| Informatics Platform. Launch of the MRC UK Dementias Platform, Royal Society, London   | October 2014   | Ronan Lyons                  |
| 'Grand Research Challenge: Global Collaboration in Measuring the Incidence and Burden of Injuries'. International Collaborative Effort on Injury Statistics and Methods, Washington DC                               | October 2014   | Ronan Lyons                  |
| 'Use of UK Secure e-Research Platform (UKSeRP) for some access needs to UK Biobank data'. Presentation to UK Biobank and Oxford Big Data Institute Swansea   | October 2014   | Ronan Lyons                  |
| NIHR, ePrescribing Programme Conference. Guest speaker on "Big Data and Data Analytics   | October 2014   | Will Dixon                   |
| Community Health Index Advisory Board, Scottish Health Services Centre   | October 2014   | Steve Pavis                  |
| 'Data Linkage to Cohort Studies'. Presentation to CLOSER research group, London  | November 2014  | Ronan Lyons                  |
| 'Evaluating environmental influences on health using privacy protecting data linkage'. Presentation to environmental health research group at CREAL, Barcelona   | November 2014  | Sarah Rogers and Ronan Lyons |
| Big Innovation Centre: Trusted Data Platform/ Accelerator  | November 2014  | Iain Buchan                  |
| HSCIC Board invited guests   | November 2014  | John Ainsworth, Ronan Lyons  |
| 'Prudent Healthcare: achieving better outcomes through information technology'. Presentation to NHS managers/clinicians  | November 2014  | Ronan Lyons                  |
| 'Realising the potential of Big Data: Secure Anonymised Information Linkage (SAIL)'. Presentation to UK Asthma Centre for Applied Research scientific meeting, Oxford  | November 2014  | Ronan Lyons                  |
| Scottish Government Chief Scientist Office   | November 2014  | Steve Pavis                  |
| National Caldicott Guardian Forum, Scottish Health Services Centre   | November 2014  | Steve Pavis                  |
| Scottish Community Care Benchmarking   | November 2014  | Steve Pavis                  |

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| Network, Raploch Community Campus Stirling   |               |  |
| 'Sensitivity of national injury presentation estimates'. Presentation to Joint Action on Monitoring Injuries in Europe (JAMIE) project group and national injury data administrators, Berlin | December 2014 | Ronan Lyons  |
| Dementias Research Platform UK. Presentation to Farr Institute International Advisory Board, London  | December 2014 | Ronan Lyons  |
| 'Privacy protecting data linkage for population health'. Presentation for Fondazione Lanza, Padua  | December 2014 | Ronan Lyons  |
| Meeting with Chairman of Health and Social Care Information Centres, Skipton House, London   | 2014          | David Ford   |
| Meeting with Frances Maude, Cabinet Secretary and officials about changes to data sharing legislation  | 2014          | David Ford   |
| Farr – ADRN – Medical Bioinformatics: eInfrastructure Workshop, London   | Jan 2015      | Steve Pavis  |
| MEDMI – Connecting health and environment data project; Evaluating environmental influences on health using privacy protecting data linkage, London,.  | January 2015  | Sarah Rogers   |
| 'SAIL and identification of mental health conditions in routinely collected data'. UK Biobank Mental Health Outcomes Group.  | January 2015  | Ann John   |
| Keynote talk at "ThinkCloud Health" event, 15 Jan 2015.  | January 2015  | David Ford   |
| HSCIC Public Board meeting: The Challenges and Opportunities of Data and Research  | January 2015  | Evangelos Kontopantelis  |
| HSCIC Public Board meeting: The Challenges and Opportunities of Data and Research  | January 2015  | John Ainsworth   |
| Health Is Wealth – Liverpool Health Partners Conference  | January 2015  | Iain Buchan  |
| Nuffield Trust- Health Policy Summit   | February 2015 | Andrew Morris  |
| Digital Health Assembly Conference   | February 2015 | David Ford, Ronan Lyons, John Gallacher, Andrew Morris, Neils Peek, Munir Pirmohamed |
| Academy of Medical Sciences "Health of the Public 2040" workshop, chaired by Dame Anne Johnson   | 2014-2015     | David Ford   |
| Innovate UK / Welsh Government supported ABMU Board SBRI Project Board   | 2014-2015     | David Ford   |
| Meeting with Programme Manager of Care.Data from Health and Social Care Information Centre   | 2014-2015     | David Ford   |
| NHS Wales Health Intelligence Unit planning group  | 2014-2015     | David Ford   |
| Novatis / Welsh Government shared risk scheme pilot  | 2014-2015     | David Ford   |

## APPENDIX 7: PUBLICATIONS FROM THE FARR INSTITUTE MEMBERS

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