Institution: University of Birmingham

Unit of Assessment: UOA2

1. Unit context and structure, research and impact strategy

1.1 Context and Structure

Our mission is to tackle global health challenges, prevent disease and improve health and healthcare by applied research and methodological innovations.

This submission is largely based on the work of the Institute of Applied Health Research (IAHR, directed by Cheng). As one of 8 new Institutes formed following the 2015 University-wide Life Sciences Review, it brought together applied clinical and methodological researchers from across the College of Medical and Dental Sciences (CMDS) in a coherent management structure. All but 1.0 of the 46.0 FTE in this submission are based in IAHR.

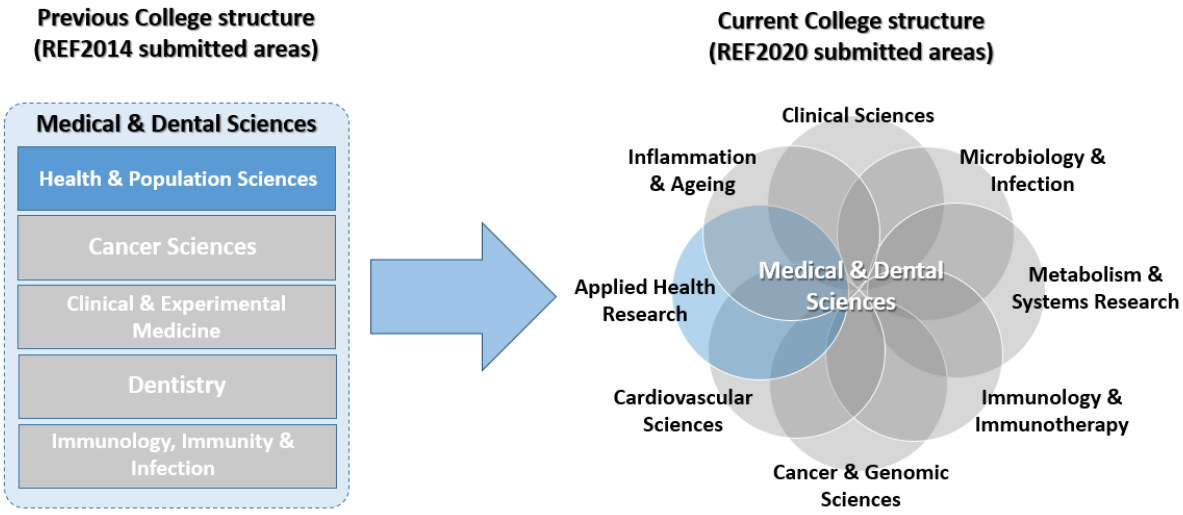

Figure 1: Restructure of the CMDS from five schools to eight institutes (institutes aligned with UOAs1/3 in grey)

Our research is organised in **four cross-cutting and multi-disciplinary research themes: Maternal and Child Health, Chronic Diseases Epidemiology and Management, Global Health, and Methodological Innovations**, with staff working across multiple themes.

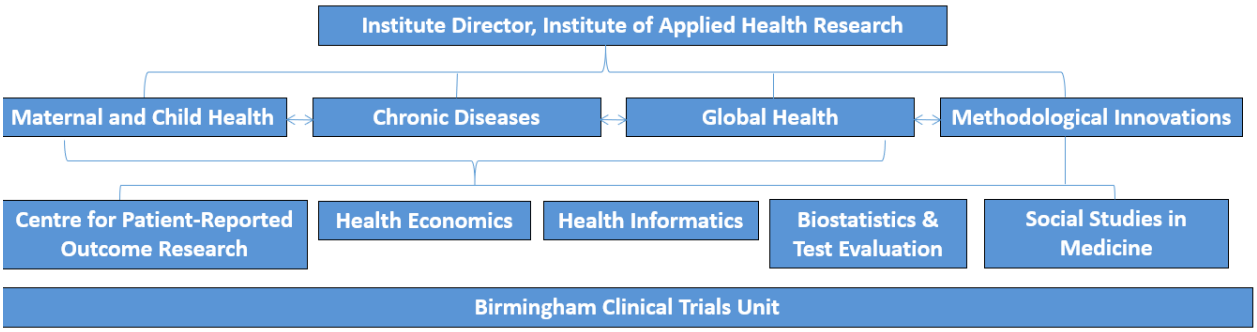

Figure 2: Institute of Applied Health research themes

All IAHR staff are co-located in three adjacent buildings situated strategically between the Medical School and the rest of the University of Birmingham (UoB) campus (Section 3). This creates an environment that enables cognate disciplines for applied research to work closely creating an equal, inclusive, and friendly workplace and allowing the development of multi- and inter-disciplinary work across subject areas, clinical contexts and methodologies.

One of our key strengths is the diversity of staff and disciplines including clinical trials (BCTU) epidemiology, statistics, health economics, evidence synthesis, mathematical modelling, sociology, psychology, and the history of medicine. Co-location with IAHR-based clinical staff breaks down cross-disciplinary barriers. A few staff members are returned in UoA1 (hospital specialists) and UoA28 (historians).

Over the REF period there has been a substantial increase in the number of funding applications, awards and publications (see 3.1 for detailed metrics). There were 26 promotions (7 Lecturers to Senior Lecturer (64% female), 8 to Reader (100% female), 11 to Chair (73% female)). Members were awarded 11 prestigious *ad hominem* research fellowships.

RESEARCH THEMES

Chronic diseases epidemiology and management: aims to promote health and well-being and reduce the burden of disease through the prevention, early detection and management of chronic conditions/multimorbidities and exposures.

Studies examining the effectiveness of non-pharmacological interventions have informed management of people with chronic disease/multimorbidity in community and primary care (e.g. pulmonary rehabilitation, smoking cessation interventions, weight management, atrial fibrillation-stroke management). Our trials evaluate e.g. interventions for primary prevention (e.g. PolyIran; the first hard outcome trial of the Polypill concept for primary and secondary care prevention of cardiovascular disease), screening (e.g. TargetCOPD trial to screen for undiagnosed chronic obstructive pulmonary disease (COPD), ETHOS to screen for chronic disease in healthcare

workers), harm reduction (e.g. tobacco control trials), self-management (e.g. blood pressure (**Impact Case Study**), pulmonary rehabilitation) or treatment (e.g. Parkinson's Disease (PD Med, PD COMM, PD Rehab **Impact Case Study**) of chronic diseases.

Our wide-ranging epidemiological studies are supported by a) cohorts we developed – the two largest population-based cohorts of young cancer survivors world-wide (British Childhood Cancer Survivor Study, n=34,500; Teenage/Young Adult Cancer Survivor Study, n=200,000); Birmingham COPD Cohort, n=2,000; Parkinson's Disease, n=1,800; Guangzhou Biobank Cohort Study, n=30,000; and b) publicly-available databases including DHS, THIN, and CPRD Gold, to address questions on aetiology and prognosis, as well as study-specific materials e.g. investigating mental health responses to the COVID-19 pandemic.

Three professorial promotions were made in the assessment period (Thomas, Boeleart, Turner).

Maternal and Child Health: aims to make pregnancy safer and improve health outcomes for women and children from conception onwards and to develop, evaluate and implement interventions to enable children to adopt healthy dietary and physical activity behaviours. We utilise a range of epidemiological approaches to better understand pregnancy-related morbidity, childhood obesity, and introduce novel interventions for prevention, management and service innovation across the full course of pregnancy. Close collaboration with obstetricians in UoA1 has led to successes including Tommy's National Centre for Miscarriage Research; WHO Collaborating Centre for Global Women's Health; Bill and Melinda Gates Foundation.

Key examples are use of progesterone to prevent miscarriage (PRISM, NEJM 2019); use of antibiotics following miscarriage (AIMS, NEJM 2019); pre-conceptual levothyroxine to prevent miscarriage (NEJM 2019); maternal position in labour (Lancet 2018; BMJ Research Paper 2018 Award), prevention of postpartum haemorrhage (E-MOTIVE), heavy menstrual bleeding (**Impact Case Study**). Co-produced research with local services led to the development of the Birmingham Symptom-specific Obstetric Triage System (BSOTS; Section 4). Research on childhood obesity prevention with local and national policy decision-makers and wider stakeholders has focused on the role of schools, in conjunction with local authorities, with reports on three of the largest school-based trials (UK, China) on the effectiveness and cost-effectiveness of interventions. Further studies evaluate school food policy, impact of COVID on school children and promoting children's health through targeting interventions with fathers with obesity (HDHKUK).

We have established large maternity cohorts including PROLONG (>7000 women from pregnancy to 25 years), Born in Guangzhou Birth Cohort (48,000 mother-child pairs), and have expertise in using large public databases including CPRD Gold, THIN, and HES.

Four professorial appointments/promotions were made (Brocklehurst (UCL), Kenyon, Thangaratinam (QMUL), Zamora (QMUL)).

Global Health: aims to prioritise health improvement and achieve health equity for all people worldwide, and cuts across the other three themes. We collaborate with a wide range of low- and middle-income countries (LMICs), focussing on achieving the UN Sustainable Development Goals (SDGs) (particularly 3,5,6, and 10) by ensuring research is translated into policy and by building sustainable capacity for multidisciplinary research and delivery in collaborating countries. IAHR researchers work in close collaboration with LMIC universities, patients, healthcare providers and NGOs, ensuring multidirectional learning and solutions. In bringing together expertise across the University, e.g. international development, geography, gender, law, and religion, we ensure solutions are embedded in their wider context. IAHR leads the new University Global Health Impact Centre to engage and support academics from all disciplines. IAHR staff also lead UoB Global Challenges themes (Clean Air and Ageing, Frailty, and Resilience) and contribute to a further 6 themes within the multidisciplinary Institute for Global Innovation (IGI; see REF5a-2.3).

Two professorial appointments were made (Davies (KCL), Lilford (Warwick))

Methodological Innovation and Health Data Science: aims to address methodological and practical problems in areas of health/social care research where challenges associated with acquiring evidence are greatest. We both develop methodological research and drive multi-method expertise involvement in the other three themes. There are five main areas:

- **Biostatistics, Evidence Synthesis and Test Evaluation** - we research the application and development of methods for test evaluation, evidence synthesis and evaluation of interventions particularly diagnostic testing and step wedge cluster trial methods. We have contributed to widely-cited reports/guidelines, e.g. CONSORT extension (stepped-wedge trials); reporting guidelines (STARD, PRISMA, PRISMA-DTA); systematic review risk of bias tools (ROBINS-I, QUADAS, QUADAS-C, PROBAST); WHO Essential List of In Vitro Diagnostics (**Impact Case Study**). Significant reviews include a series on skin cancer test accuracy (BMJ/Cochrane Library); living reviews of COVID-19 diagnostic testing (BMJ/Cochrane Library) that has informed World Health Organisation (WHO) guidance; and clinical manifestations, risk factors and maternal and perinatal outcomes of COVID-19 in pregnancy. We host the Cochrane Diagnostic Test Accuracy Editorial team.
- **Health Economics Unit** - we apply innovative methods for within-trial and model-based economic analyses and econometric techniques for big data analysis. We develop methodological approaches to generate economic evidence from a societal perspective, including capability approaches for evaluating health/social care decision-making; healthcare

impacts on wider society (e.g. family carers); and public health policy outside healthcare (e.g. childhood obesity).

- **Patient reported outcomes (PROs)** - Centre for Patient-Reported Outcomes Research (CPROR), the only Centre of its kind in the UK (Section 3), develops methods of measuring the impact of disease and treatment as reported directly by the patient, and promoting the efficient integration of PROs in healthcare.
- **Health Data Science** - we use primary/secondary care datasets to investigate disease aetiology and management, extending trial data to real patient populations and to develop methods for in-silico RCTs. In collaboration with computer scientists, we have developed a unique automated data extraction to streamline epidemiological research with routine data, improving reproducibility and minimising human error. We use AI and machine learning to address intractable data issues. We have been working closely with local NHS Trusts to support analysis of their COVID-19 data to inform patient and capacity management and child protection referrals. We host the £4M HDRUK Midlands Site and lead MRC-funded methodological research on multimorbidity clustering.
- **Regulatory Science and Innovation** - we built on extensive partnerships with major NHS/industry bodies including ABPI and AHPI, regulators (MHRA, EMA, FDA), and patient partners to establish the UK's first joint NHS-academic 'Centre for Regulatory Science and Innovation' through Birmingham Health Partners (BHP) (Section 3 and Institutional template). We have led a global review of good practice and capability in regulatory science and implications for the UK's forward strategy. We led development of international guidance for the use of AI in clinical trials (SPIRIT-AI/CONSORT-AI).

There were seven professorial promotions/appointments (Al-Janabi, Calvert, Frew, Hemming, Mallett (Oxford), Pinkney, Takwoingi)

1.2 Research objectives during the assessment period

Strategic achievements since 2014

Below we summarise key achievements of objectives set following the University-wide Life Sciences Review that superseded those set for REF2014.

(i) Structural reorganisation of the School of Health and Population Sciences

Prior to 2015, the School was large with staff compartmentalised and spread across 7 buildings over the campus. IAHR brought together all cognate disciplines to form four cross-cutting themes. In 2016, we merged the Primary Care CTU with BCTU to form one large non-cancer unit with a new Director (Brocklehurst).

Our co-location and diversity enable us to develop a culture and environment that facilitate rapid responses to changes, exemplified by our ability to **work collaboratively and productively during the pandemic**, and to rapidly respond to COVID-related opportunities. In 2020, we submitted 149 grants, and were awarded 67 (**£30.7M,** with 8 related to COVID-19 (UKRI-MRC and NERC, NIHR, Samaritans, Section 4)).

(ii) Building capacity in Global Health research:

Since REF2014 we have expanded our capacity to respond to global challenges and support capacity building in LMICs, with 21 senior academics (13 female) now working in Global Health. Development of internal capacity has enabled us to work with LMIC partners in capacity building. We have received £31.7M in funding from the NIHR/UKRI/Wellcome Trust/Melinda and Bill Gates Foundation, involving >30 countries. Tailored to local needs, we have mentored/supervised >1300 research fellows, field researchers, PhD/MSc/undergraduates, and research managers. By a 'train the trainer' approach, we support mid-level and senior academics in LMICs to capacity build locally and support our learning of their systems. We run successful MSc and undergraduate programmes that identify and train future researchers.

(iii) Developing a workforce with methodological skills in shortage areas:

Our MSc Clinical Trials programme, supported by UK Clinical Research Collaboration (UKCRC) fellowships and NIHR-funded MOOC series on trials, is developing a future researcher pipeline. Our two Health Economics MSc programmes have produced one of the UK's largest health economist cohorts. We actively promote PROs CPD training (for regulatory agencies, industry, trialists and patient partners) including free online tools (PROlearn and PROTEUS). We run popular international courses on diagnostic test evaluation. We have supported a broad range of fellowship applications and have trained nine NIHR Fellows through the 2-year NIHR Research Methods Programme.

(iv) Enhancing research and impact infrastructure and investigator support mechanisms:

Since REF2014 Research Facilitators have been appointed to support development of grants. We benefit from College teams on post-award, business engagement, and public affairs engagement for policy impact. IAHR lead the £5.5M NIHR Research Design Service WM (Thomas, Mathers, Section 3).

(v) Ensuring that our research engages relevant stakeholders in development and delivery to support impacts on national, regional, and international policy, practice and training.

A wide range of examples are described in Section 4.

1.3 Research impact strategy

Realising benefits for patients and society is central to our research. Most of our work is undertaken in direct collaboration with stakeholders, with a focus on informing implementation, policy and guidelines. We promote impact through team meetings, away days and incorporation into Professional Development Reviews (PDRs) and promotion processes. IAHR has a designated Impact lead (Jolly, Deputy Director IAHR), acting as first point of contact for advice for staff and students. Membership of the College Impact Committee enables learning from other institutes. Achievement in research impact is a key consideration for promotion.

Our approach to research design is informed by our own research on methodological frameworks for impact in healthcare research (Plos Med 2017). Our internal review processes for all new research proposals include a dedicated 'pathways to impact' focus that optimises the research design, including initial assessment of current practice. For example, in the NIHR BUMPES trial, internal application development feedback informed creation of a current midwifery practice questionnaire to examine current practice and maternal birthing positions. Changes in practice are monitored using our automated GP data extraction system (DExtER). Policy activities range from working with local guideline developers to national government, regional consortia, and multilateral global organisations, including the WHO, World Bank and UNICEF.

Our approach is complemented by College- and University-level infrastructure and strategic support (Section 3, and REF5a-2). Briefly this includes support for public engagement; close working with the College Marketing and Communications team; systematically identifying new grants and publications for increased visibility through press releases and dissemination plans which target key stakeholders; 'Impact' grants from central UoB funds, supporting advocacy, policy and guidelines development, and training for uptake into practice. For example, Kenyon was given support to organise the BSOTS training for maternity health care professionals, and to visit Australia to deliver training. Manaseki-Holland was supported by College MRC CiC funds to develop a toolkit to support a weaning food hygiene intervention to reduce diarrhoeal disease, resulting in a £2M MRC grant to trial the toolkit in Mali.

Supported by the University's dedicated public affairs team, we have hosted a range of government delegations, including WM Combined Authority Mayor Andy Street, Jeremy Hunt, Matt Hancock, Greg Clarke, Lord O'Shaughnessy and Baroness Blackwood.

1.4 Supporting interdisciplinary research

We actively encourage interdisciplinary research to address important intractable issues. We illustrate with two examples here. See further examples in sections 3.1(ii) and 4.

In air-pollution research, our £4.9M NERC WM-Air programme is improving understanding of pollution sources (£4.2M NERC supersite at UoB) and levels in the region (Bartington, Thomas) in partnership with staff across the campus. We actively engage with businesses, policy bodies and other actors contributing to economic development. Partners include WM Combined Authority, individual local authorities, Transport for WM, Network Rail, HS2, National Express, NHS STPs, and private sector organisations. Globally, our pollution research utilises networks in Africa (Ethiopia, Kenya, Rwanda, Uganda), Asia (China, India, Mongolia), and the Americas (Chile) (Wellcome Trust, NERC, EPSRC, UNICEF, NIH, Newton, DFID-funded). These university-wide initiatives include urban planning, engineering, economic geography, social sciences, international development studies, with a range of African partners, e.g. Uganda National Roads Authority, Kampala Capital City Authority.

Our team researching violence and abuse (Nirantharakumar) has secured >£10M funding in collaboration with local, national and international partners. Focusing on building the evidence base to support a public health approach to violence and abuse, our work has led to changes in practice across national police forces and parliamentary briefing documents during the COVID-19 pandemic. The team produced data for Global Burden of Disease study on the epidemiology of abuse and violence, which led to membership of the Lancet Commission on Gender Based Violence and Maltreatment of Young People (Chandan). Our success has been facilitated by partnerships within UoB (Social Policy, Business School, Computer Science, and Psychology), and regionally (WM Local Authorities, Public Health England, WM Police, Office of the Police and Crime Commissioner, WM Violence Reduction Unit and UHB NHS Trust), as well as national partners including HDRUK, where we play a leading role in a consortium on mental health effects of violence and abuse.

1.5 Future strategic aims and goals for research and impact

We have six key strategic aims that also align with those of the University (see REF5a-2.1):

(i) To secure investment and deliver high quality research in our main areas of strength whilst remaining flexible to adapt to emerging health challenges and needs.

We will build on our record in obtaining substantive NIHR/UKRI funding for applied health research and methodology. We will diversify our funding portfolio to include charities and industry, targeting larger infrastructure/consortium grants in addition to project/programme grants. We will focus on equitable capacity building through fellowships and mentorships to support funding applications.

(ii) To improve the quality, relevance and reporting of medical research by methodological innovation.

We will continue our activities in applied health methodological research, supporting our internationally-leading teams in biostatistics, trials, bioinformatics, health economics, PROs, PPI,

regulatory science, and AI, to develop, evaluate and improve methodologies and reduce research waste.

(iii) To work equitably with our global partners to deliver high quality impactful research and capacity building to improve the health of disadvantaged people living in LMICs.
We will expand our equitable network of global partners and increase our portfolio in collaboration with the cross-University Centre for Global Health Research Impact and IGI. We will put particular emphasis on co-developing research which matters to local people and translating research findings into practice through local, national, and global policy makers.

(iv) To drive innovation and build applied health research capacity via development of strategic partnerships and investment in our workforce.
We will continue working with BHP, NHS Trusts, local authorities and other key organisations in the West Midlands region to build on our pioneering clinical scholars programme (which predates MRC CARP) in which consultants, selected to ensure diversity and inclusivity from local NHS Trusts, spend one day/week in IAHR supported by methodologists to generate research grant applications. We aim to expand this scheme to public health, social care and other allied professions with the NIHR Research Design Service WM. As with (i), we will particularly focus on equitable capacity building of future research leaders through fellowships and mentorships to support funding applications.

(v) To continue promoting Equality, Diversity and Inclusivity (EDI) in the workplace to ensure we represent the populations we serve.
We will actively engage with key staff networks (including Parents and Carers, BAME, Rainbow and Women's Networks; REF5a-3.4.5), with named role models. We will advance the College-wide Athena Swan Silver Award principles, including promoting training of all staff to ensure confidence in embedding EDI in practice, and further highlighting our beacon role models as exemplars of our inclusive, friendly workplace.

(vi) To maximise the relevance and impact of our research by effective stakeholder engagement.
We will promote equitable engagement with a wide variety of stakeholders including patients/carers, clinicians, ethicists, regulators, SMEs, policy-makers and industry to develop relevant, efficient and ethical research to improve health and well-being, drive innovation and economic growth in line with the UK industrial strategy, following a strategic model developed in IAHR. We will also increase training and support for staff, clinicians, patients and the public, with emphasis on under-represented groups to integrate PPI throughout the research life cycle in all

our activities. We will achieve this in collaboration with partners including our NIHR-supported Applied Research Collaboration (ARC), Biomedical Research Centre (BRC) and Trauma Centre.

1.6 Towards an Open Research environment

Our approach is embedded in the University-wide system (REF5a-2.2).

Overall open science infrastructure: we have a designated lead to implement key principles of open science, in line with current recommendations from research funders and regulators. The University is a signatory to the **San Francisco Declaration on Research Assessment** (DORA). As such we emphasise the primary quality of research content, rather than journal or citation metrics, and use this as a basis for assessment and recruitment decisions. We advocate and communicate open science principles through seminars and mandatory training. IAHR PIs maintain an *ORCID ID* to ensure their outputs are easily traceable and linked with their PURE account.

Open access publications: We mandate uploading research papers to the PURE data management system within 3 months of acceptance and provide administration support and reminders. Institutional funds are used to support publication of GOLD open access publication for UKRI funded work and publication in fully open access journals. A budget is available to ensure all publications can be published in an open access format. Publications, particularly pre-print publications, are made available through ResearchGate as appropriate.

Open Data: We are committed to making our data Findable, Accessible, Interoperable and Reusable (FAIR) and these principles are included in our research data policy. We have dedicated free storage facilities for research data that is archived for 20 years and encourage publication of full experimental details and open analysis codes with all publications (e.g. our THIN data analyses). In collaboration with ARC East Midlands, we created a consolidated NHS and UoB centre for database research (Margaret Peter's Centre after the pioneer of Hospital clinical decision support systems). We have strict use of version control for tracking changes to ensure data integrity, appropriate backup and to support distributed, non-linear workflows.

Open algorithms for data extraction: At IAHR we have developed a software (DExtER), the first of its kind in UK, to aid with extracting data from large databases in a transparent reproducible manner. As often only a proportion of source data is used, extraction algorithms and a flow chart on how subjects are included or excluded can be provided using the extraction tool.

Registering studies: Much of our work involves methods such as clinical trials and systematic reviews, for which there is long tradition of study registration, and now also for observational

studies. There are strong emphases on the conduct of systematic reviews before initiating new research and publication of study protocols.

1.7 Research integrity

Research integrity is enshrined in **Codes of Practice for Research and Ethics** and follows a national framework for good research conduct and its governance. The **Clinical Research Compliance Team** delivers expert support and follows external regulatory standards (REF5a-2.2) through standard operating procedures, clinical project audits, expert advice and guidance, and training programmes. The team works closely with the University's Research Governance and Ethics team to ensure that responsibilities under the NHS Research Governance Framework are undertaken ethically, effectively and efficiently. IAHR line managers ensure all staff are aware of the University's policies e.g. Policy and Procedure on Public Interest Disclosure, 'Whistleblowing', Harassment and Bullying, Data Protection/Security requirements, Data management/archiving, Quality Management, and Equality and Diversity (REF5a-3.4.5).

All staff and students must complete our Online Research Integrity Training programme supported by face-to-face sessions. Most importantly, we provide our staff and students with a supportive environment that promotes a culture of freedom and creativity that conveys the importance of personal and academic integrity, and through collaborative collegiate work we aim to reduce perceived performance pressures.

2. People

IAHR employs 314 staff, 67% female, 27% BAME. There are 28 Professorial staff, 57% female, 4 (including the Institute Director) BAME. The Institute Executive Committee (IEC) has 22 members, 59% female, 18% BAME. During the REF period the College received the Athena Swan Silver Award.

2.1 Staffing strategy

Our collegial approach fosters a supportive, caring and inclusive environment irrespective of career stage, with mentorship and support to all staff and students, and aligns with the University's strategy (REF5a-3). Our philosophy is to proudly embrace diversity amongst staff and develop all to their maximum potential, whilst enabling flexible working to suit caring and other responsibilities. Our strategy has resulted in a vibrant mix of clinical and methodological researchers at different career stages and an environment that maximises academic interactions.

Our success is reflected in a healthy distribution of service duration amongst staff. Of the 16 female professors, all but one were internally promoted, and twelve commenced at lecturer/research fellow grades (including 2 BAME). Seven of the twelve male professors were appointed through

internal promotion, and many had caring roles. Eleven (8 females) were promoted to chairs during the assessment period. Several have had parental leave whilst in IAHR, with some working part-time. They provide role models for junior staff, highlighting career progression opportunities for those with diverse backgrounds and personal circumstances. IAHR also recruits a substantial number of posts at post-doctoral/lecturer level, providing vital staff continuity and growth.

Specific strands of our strategy include:

Recruitment

- Section 1 describes how we have recruited and promoted key individuals to ensure leadership and critical mass in our key research themes (1.1), with a particular expansion in Global Health and Methodological Skills (1.2.1).

Career Development

- Active identification of 'rising stars' to provide mentorship and tailored support for fellowships/senior award applications.
- Reviewing the training and career progression needs of all staff annually, advising on next career steps, opportunities and timely encouragement for seeking promotion. The latter was supported by proactively offering application and CV support and practice interviews (MacArthur). Our model was highlighted as best practice by Athena Swan and has been rolled out across CMDS.
- Active promotion of internal case studies/role models around career progression and development.
- EDI representation on promotion panels.
- Audit of PDRs to ensure SMART objectives are set to support progression and development.
- Optimising and tailoring University-wide development programmes including the Aditi Leadership Programme (for BAME staff), Research Leaders, Emerging Leaders and the Aurora Leadership programme (REF5a-3.4.5).

Promoting networking and interdisciplinary working

- We ensure gender balance in our seminar series to ensure the visibility of role models through high-profile speakers.
- We facilitate attendance at our popular monthly 'Tea at 3' programme for networking and sharing research ideas by varying event timing.
- Seminars/networking events have continued using virtual media during the period of restricted campus access.

- PDRs are used to highlight the importance of research impact, networking and interdisciplinary work.
- We ensure that integration of new, especially international, staff is supported by tailored induction, regular meetings and follow-up support. A 'buddying system' led by a post-doctoral researcher provides support on practical matters including help with accommodation and social activities.

EDI

- Mandatory training for all staff to ensure equality in recruitment and promotion.
- Having a designated EDI lead on the Executive Committee, who also takes part in PDR moderation and promotion panels. We have 4 local EDI champions, who act as points of contact for ideas and ensure that issues are addressed and policies are implemented.
- We ensure parity for those on fixed-term appointments in their leave arrangements. This includes allowing enhanced maternity leave for a further 3 months even if they cannot return to work because their contracts have ended.
- We listen to and action staff ideas to improve the working environment. An example includes development of a 'Privacy Pod' offering a private space for breastfeeding, relaxation, meditation and prayer.

Recognition, reward and celebration of staff achievements

- We have a well-received Staff Thank You and Recognition Scheme (STARS), offering opportunities to nominate fellow workers for internal awards including research excellence, outstanding support for others and the unsung hero award.
- We support wider College awards for best paper/research, annual nomination for best supervisor, and PGR annual awards.
- Our communications policy focusses on recognising staff achievements, both within and outside of work. This has been especially important during the period of restricted campus access in 2020.

2.2 Support for Early Career Researchers (ECRs)

We are fully committed to developing our staff, through the principles of the Concordat to Support the Career Development of Researchers, with a comprehensive system of support both at Institutional and College level:

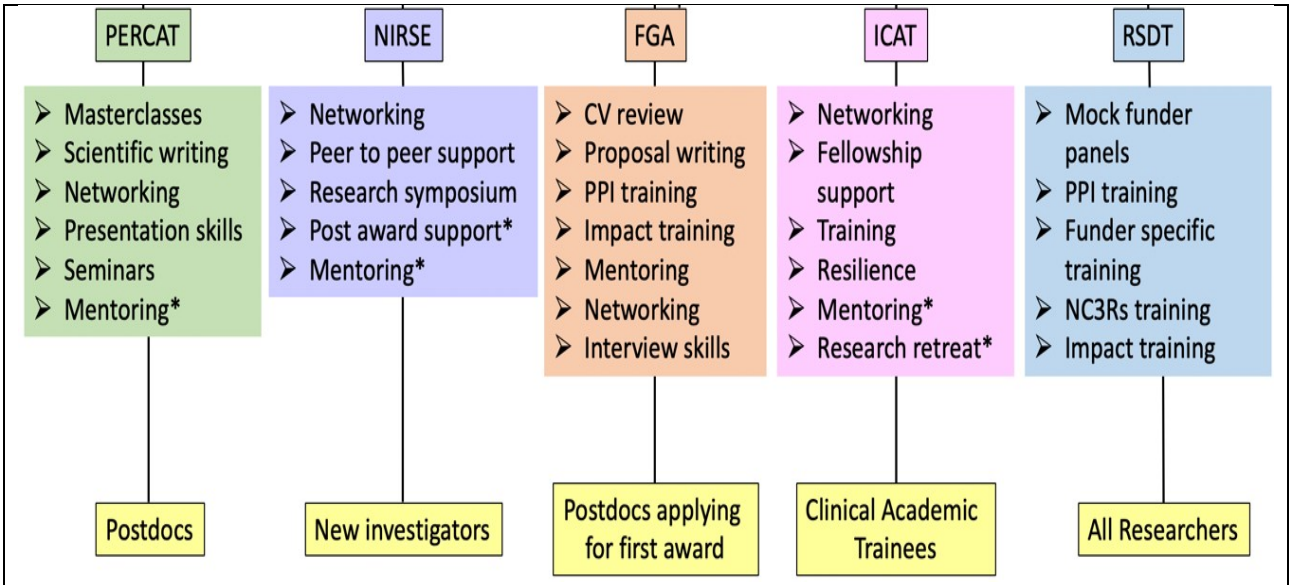

Figure 3: Overview of early-mid career development support structures for College

IAHR leads a strong **Early Career Research Academic Group** (ECRAG), with around 100 members, providing a wide variety of training/support opportunities through monthly meetings, social events, and a blog allowing sharing of ideas. The group supports ECRs on their academic work/life including research methods, ethics, EDI issues, wellbeing, grant/fellowships applications, improving online profiles, and promoting their research. An ECRAG representative sits on IAHR Executive Committee.

There is close cooperation with the ECRAG-inspired College **Post-Doctoral/ECR development And Training** (PERCAT) programme to provide training and support opportunities for all College ECRs. Activities include masterclasses (e.g. Scriptoria for scientific writing, transferable skills workshops, and resilience training), symposia, research networking, and mentoring/career support. PERCAT priorities and activities are informed by annual surveys. The latest biannual Vitae Careers in Research Online Survey provided evidence of strong ECR engagement, with clear progress between surveys in 2017 and 2019, including 84% agree/strongly agree that they were encouraged to engage in personal/career development; 89% taking ownership of career development and 73% maintaining a formal record of CPD activities. Dedicated professional careers advice is provided via a bespoke PGR service and PERCAT-coordinated external consultants.

In recognition of the stresses that an ECRs may experience, we have an academic well-being champion, and support from trained Mental Health First Aiders. Career development of all academic staff is supported by annual PDR, mentorship schemes, leadership development, coaching and courses offered by the University's People and Organisational Development (REF5a-3.4).

Integrated Academic Training Programme (ICAT) in College is also led by an IAHR member (Boelaert) and in total has been awarded 155 NIHR ACF posts and 73 NIHR ACLs, of which 16 ACFs and 11 ACLs are within UoA2. Of the 12 completed ACFs, 4 are completing their clinical training, 3 have returned to clinical practice and 4 have progressed to academic posts and ACL positions. 8 of the 9 ACLs have progressed to senior academic or academic-clinician positions and 1 is a research active clinician.

ACFs (67%; national average 47%) have progressed to clinical research training fellowships or other academic posts and all NIHR ACLs have progressed to senior academic or academic-clinician positions (79%; national average 69%). During the assessment period Birmingham was in the top quartile for NIHR-funded training posts in a broad range of specialties including General Practice and Public Health. IAHR also supports other clinicians with interests in applied health research. IAHR hosts ACFs during their training and provides them with the opportunity to undertake a MPH/MSc Health Research Methods. We actively encourage research across diverse areas, support trainees to develop PhD proposals and integrate candidates within relevant academic teams in IAHR. An annual trainee survey is conducted to inform future training events and assess satisfaction: most recently, over 80% of respondents rated their academic experience as 'good/excellent', 100% rated the training events as 'good/excellent and relevant' and 90% rated the academic supervision as 'good/excellent'.

We established the **Fellowship and Grants Academy** (FGA) that was subsequently adopted by CMDS. It supports academics at all stages of their careers, and especially those taking their first steps towards academic independence. We offer tailored training including: CV review and advice from senior academics, funder-specific grant workshops, bespoke proposal grant and fellowship clinics with senior researchers and successful fellows, as well as interview skills training and mock interviews for short-listed candidates. Since launching, the Academy has supported 161 ECRs, with 45 applications submitted of which 10 have been funded totalling £5.1M, and 25 under review. This initiative has now evolved to support ECRs in managing their awards with provision of post-award support, including personal training on budgets, career progression and difficult conversations.

Together, these initiatives have contributed to IAHR's outstanding success in supporting researchers of all career stages in obtaining prestigious fellowships and first grants.

- Four Pre-doctoral fellowships (Finnikin, Scandrett, Dhanji and Afentou)
- Nine early/mid-career fellowships (Edgar, Kyte, Takwoingi, Turner, Quinn, Anderson (all NIHR), Reulen (AMS Springboard), Nirantharakumar (Rutherford Fellow), and Willis (one of

only 3 GPs awarded an MRC Clinician Scientist Fellowship during last 20 years, and the only one during the assessment period)).

- Fourteen researchers secured their first significant grants as PI from the NIHR, MRC, KRUK, Wellcome and BHF (Kinghorn, Ferrante di Ruffano, Jones, Sumilo, Kinghorn, Slade, Farley, Kyte, Nirantharakumar, Riley, Watson, Hodgkinson, Diwakar, Lavis).
- Eight senior fellowships were competitively awarded (Al-Janabi, Frew, Hemming), including NIHR Professorship (Frew), Wellcome Trust Investigator (Al-Janabi), and NIHR Senior Investigator Awards (Deeks, Brocklehurst, Calvert).

2.3 Research students

Internal and external investment

Our aim is to attract, develop and retain the best PGRs who are central to our research community, and support them to develop a broad range of skills and to reach their maximum potential. Between 2014-20, 117 IAHR PGRs (100 PhD; 20% international) funded by a range of sources (NIHR, MRC, self, overseas Government, charity) have graduated.

We are committed to fairness and inclusivity. Our diversity is a key strength underpinning the exchange of ideas, innovation and debates. We enrol PGRs on merit and provide them with flexibility to accommodate their needs, including reasonable adjustment plans to support disabilities and responsibilities. We are responsive to changing circumstances and support modifications, where appropriate, to their registration (e.g. parental/maternity leave, extensions, transfers).

Wellbeing

In the 2019 PGR Experience Survey, 84% (53/63) of our PGRs were satisfied with their research degree experience (sector average 81%). PGR satisfaction with supervision, research culture, progression, responsibilities, research skills and professional development exceeded sector averages. 67% of our students had a good work-life balance and 79% good mental health.

Each PGR is actively encouraged to become part of the peer support community where our PGR representatives run a WhatsApp group and monthly coffee meetings and since March 2020, virtual weekly discussions. The College wellbeing team run monthly drop-in clinics within IAHR. We encourage Mental Health First Aid (MHFA) Awareness Training for all supervisors and a number are now trained mental health first aiders.

Monitoring and review

Our Director of Postgraduate Studies (Jones), supported by a PGR committee, works closely with the College and University Graduate Schools to ensure all PGRs have a minimum of two trained

supervisors and a personal mentor with regular audited progress meetings and rigorous annual performance review (APRs), reviewed and monitored by an academic Progress Panel. Students encountering difficulty are supported via regular review by committee members to ensure actions to remedy problems.

Careers support

ECRAG provides career-development support, role models and seminars on career steps. We offer skills training courses for PGRs looking to find their niche in the jobs market. There are practical opportunities to gain an understanding of business and develop entrepreneurial flair at our Enterprise Summer School, opportunities to undertake outreach activity: school visits, shadowing, and co-developing activities and presentations, talking to the media, social media awareness, patient and public engagement training platforms.

Outcomes

Employability of PGRs is high, with many taking up positions at Universities, in industry, or returning to clinical posts. Notable PGR successes include first author publications in leading journals including JAMA, BMJ, PLoS Medicine, and major conference presentations resulting in awards (e.g. International Society for Quality of Life Research 2017, 2018) with findings informing guidelines (e.g. NICE, PHE). 17 of our PGRs have secured competitive grants and fellowships (including NIHR postdoctoral and dissemination fellowships, Stroke Association fellowship) and project grant funding (e.g. Chest Foundation, ATS Foundation).

2.4 Equality and Diversity

IAHR has a proactive EDI culture regardless of age, disability, gender identity, marital or civil partnership status, pregnancy or paternity/maternity status, race, religion or belief and/or sexual orientation, as reflected by our 67% female, 27% BAME staff profile. This is integral to our vision and is embedded within our working practice, and championed by our Career Development and Equality Lead (MacArthur), and EDI Lead (Takwoingi) to ensure a fair and accessible environment. The EDI lead provides a confidential contact point for advice on EDI-related matters, and represents IAHR on the College EDI Committee which includes representatives from Professional Services and EDI-related University networks including the Parents and Carers Network, BAME Network, Rainbow Network and Women's Network (REF5a-3.4.5). EDI training is mandatory for all staff, and staff involved in recruitment and promotions panels undergo additional mandatory unconscious bias training. The Institute adopted a scheme run by the BAME staff network which trains volunteers who wish to participate in the University's Interview Panel Register aimed at increasing the diversity of shortlisting and interview panels. Brocklehurst is one of only 3 men elected as honorary members to the Women's Medical Federation in recognition of his contribution

to women in medicine and is a mentor for the AMS Sustain programme which supports women in academia, and for AMS for LGBTQ early career researchers.

We regularly review our processes, e.g. annual College EDI surveys. The 2018 survey identified the IAHR promotion support as exemplary practice through prompting potential candidates to apply, and encouraging proactive engagement with the development of applications and interview preparation; this forms the basis of the 2020 College best practice guide. Through the Institute's weekly circular and monthly newsletter we raise awareness of key issues and initiatives (e.g. Black History Month, Bring your family to work day, World Menopause Day) and provide access to relevant information and vacancies on University committees to encourage diversity.

A family-leave booklet was introduced for colleagues about to begin extended leave. The booklet is used in combination with a one-to-one meeting, providing all required information. We implemented a 3-month advance-of-return check which ensures line managers keep in regular contact with colleagues on extended leave, with a return to work plan always agreed.

To promote career development, we have expanded existing initiatives like our Staff and Student Development Fund (SSDF) for external conferences and CPD. Since 2017, IAHR has supported 77 (64 F, 13 M), including 17 (22%) PGRs. The College's Parent and Carer Fund complements the SSDF by providing support towards additional costs incurred by individuals with caring responsibilities attending such events.

IAHR promotes the Aurora and Aditi Leadership Programmes for female and BAME staff in Higher Education including developing a communication strategy and promotion of available opportunities.

Staff wellbeing is taken extremely seriously. We have two champions with close links to the University services. Staff are actively encouraged to take advantage of the leafy University campus and take activities such as working walks. Many staff take advantage of the University's new £55M Sports Centre, including gym, swimming pool and variety of active lifestyle classes. The Institute provides bike racks and showers to support staff cycling and walking to work. IAHR actively promotes and supports the annual College Wellbeing week.

3. Income, infrastructure and facilities

IAHR staff occupy three adjacent large modern buildings located between other main buildings of CMDS and the University's other four colleges on the main campus. We are a 5-minute walk to the three large NHS Trusts (acute hospital, woman's hospital, mental health). This allows close

collaboration with colleagues across all UoAs (especially UoA1 and 3) and NHS colleagues, as well as access to cross-Institutional infrastructure.

3.1 Research funding strategy

We have taken a proactive and strategic approach to the development of a growing funding portfolio across our themes to meet our strategy of securing investment and delivering high quality research in our main areas of strength. Our research portfolio is supported by a range of funding bodies including NIHR, UKRI and Charities. Since 2014, £93M new grants have been awarded. As a measure of research volume, the annual number of research publications from IAHR has increased from 185 in 2014/15 to 293 in 2019/20 (58% increase). Our research applications and awards have risen 58% and 118% respectively, from 185 applications delivering £10.4M awards in 2014/15 to 293 applications and £22.7M awards in 2019/20.

Specifically, we have built on our record in obtaining substantive NIHR/UKRI funding for applied health research and methodology and continued to broaden our funding portfolio by the following:

(i) A key part of our strategy has been investment to support larger consortia awards, through strategic partnership posts and cross-cutting project management team. This has delivered several major infrastructure awards including the NIHR WM Applied Research Collaboration (ARC, Lilford), NIHR Clinical Research Network (CRN, Cheng), NIHR Research Design Service West Midlands (Thomas). In addition, IAHR contributes key strategic methodological leadership roles within HEI-NHS-industry-patient partnerships and major NIHR and Industrial Strategy infrastructure e.g. the £24M BEIS co-funded Institute for Translational Medicine, NIHR Biomedical Research Centre (Deeks, Calvert), NIHR Surgical Reconstruction Microbiology Research Centre (SRMRC, Calvert), NIHR Trauma Management MedTech Co-operative (MIC Trauma, Calvert) and Innovate UK Midlands and Wales Advanced Therapy Treatment Centre (MW-ATTC, Calvert).

(ii) IAHR has actively promoted the interdisciplinary collaborations that are required to address critical healthcare issues through provision of a supportive environment that removes key barriers and incentivises such approaches e.g. “sandpit” events, seed funding and recognition through PDR and promotions. New areas of research have emerged through this approach. For example, in the theme of Methodological Innovations we have secured new funding for a Birmingham-led Health Data Research UK Midlands Site (Nirantharakumar, Calvert) as well as two of the seven national Health Data Research Hubs in Acute Care (PIONEER (Lasserson, Chief Data Officer/Deputy Director) and INSIGHT: Eye Diseases and Oculomics (Niranthakumar). Other examples are highlighted throughout this document including air pollution and violence/abuse as described in 1.3 and section 4.

(iii) In 2016, the Primary Care Trials Unit merged with BCTU to form one large non-cancer unit, which alongside the CRUK-CTU forms one of the UK's largest clinical trials portfolios. Merging the units under a new Director (Brocklehurst) allowed improved access for researchers and increased BCTU's portfolio by 20% to 53 live clinical trials in 2019/20. Our success has been underpinned partly by our NHS clinical scholars scheme that aims to build a cohort of clinical scientists and improve the local NHS research environment. The scheme targets specialties with smaller research local portfolios. We work closely with the CRNWM and local Trusts.

(iv) In Global Health we have received £31.7M, including two NIHR Global Health Units (£7M each for Surgery and Slum Health), two Groups (£2M each for COPD and Atrial Fibrillation), NIHR RIGHT grant (£5M, Leprosy and Buruli Ulcers), MRC grant (£2M, weaning food hygiene), Melinda and Bill Gates Foundation award (US$11M, post-partum haemorrhage). Our research focusses on capacity building and achieving the UN SDGs. Our work involves >30 countries with equitable and sustainable collaborations.

(v) IAHR's historical record in industry research funding was modest. Since 2018, we have strengthened support by a dedicated College Business Engagement Partner, who develops and grows relationships with companies through identifying challenges of mutual interest and facilitating the development of proposals and agreements. Between 2014 and 2018, the IAHR has received just over £2.7M support from industry e.g. GSK, Takeda, UCB, Janssen, Gilead, but in 2019/20 alone, the level has increased to just over £1.2M, with many proposals in the pipeline.

(vi) A key principle of our research funding strategy is developing researchers of the future across all career stages. We support people internally within IAHR and CMDS, regionally (particularly staff in NHS/social care), and globally. We also target geographical areas or disciplines with more pressing staffing needs to ensure equitable capacity building that addresses local priorities. Details and examples of success are described in the relevant sections.

3.2. Organisational infrastructure supporting research

Within IAHR, NIHR core-funded BCTU is amongst the largest Clinical Trials Units in the country. We have considerably increased staffing (from 87 in 2014 to 122 in 2020). In addition to the portfolio of trials BCTU hosts the Birmingham Surgical Trials Consortium (Royal College of Surgeons, CRUK, Rosetrees Trust). This brings together activity and expertise in surgical trials, centrally coordinates support and training programmes for new surgical investigators, and maintains and delivers new surgical trials. It has been instrumental in nurturing the region's surgical trainees into fully-fledged researchers, now running their own RCTs (11 surgical trials, see section 4). The model has expanded nationally and then internationally, and to other disciplines. The team was awarded the NIHR Global Health Research Unit on Global Surgery with

Edinburgh and Warwick (£7M). In 2019 the Royal College of Surgeons funded the appointment of a Professor of Surgical Clinical Trials (Pinkney).

The Centre for Patient Reported Outcomes Research (CPROR) has led international guidance for PRO trial design (SPIRIT-PRO), codesigned tools with patient partners to support use of PROs, contributed to standardised approaches for analyses of PRO data in oncology trials (SISAQOL) and worked collaboratively with national and global regulatory agencies (e.g. HRA, MHRA, EMA and FDA), organisations and patient partners (e.g. HDRUK, BEIS, ABPI, Trials Network, CRN, IET, NCRI, Macmillan, ASCO, NCI, EORTC), trialists, ethicists and policy makers to optimise PRO data collection worldwide. CPROR leads methodological themes in major NIHR infrastructure including: Biomedical Research Centre, Birmingham, Surgical Reconstruction and Microbiology Research Centre, ARC WM and the Midlands Wales Advanced Therapy Centre and is driving national and international strategy for PRO research and real-world evidence generation.

The NIHR Research Design Service WM (RDSWM) (£5.5M) supports over 300 research teams annually, and is led by UoB (Thomas), with Warwick and Keele as partners. It capitalises on the complementary streams of research and methodological expertise at the three host universities. It has strong links with regional and national NIHR infrastructure e.g. CTUs, ARC and NHS clinical researchers.

The College Research Support and Development Team (RSDT) has a dedicated IAHR Research Facilitator, providing bespoke support to IAHR researchers in the preparation of funding applications, in particular advice and training around developing important skills such as patient involvement, interview technique and impact development supported by senior IAHR academics.

Our comprehensive range of relevant disciplines, methodological expertise and specialist units e.g. BCTU, RDSWM, allow us to support all investigators applying for funding for applied health research from within College, other Colleges, regionally and across the country. All NIHR funding applications across the University are supported by IAHR.

Cross- campus Health Data Science Infrastructure: UoB leads the Health Data Research UK (HDRUK) Midlands Site. We undertake methodological research and are developing international collaborations with Netherlands, Spain and Thailand. We also lead MRC-funded methodological research on multimorbidity clustering using routine datasets. The unique automated data extraction we developed maximises the utility of primary and secondary care datasets in the investigation of disease aetiology and management and in the development of methods for in-silico RCTs. Collaborating with the Centre for Computational Biology, clinical researchers, PHE, private software companies (Cegedim), charities (BHF) and international primary care database

holders, our team is developing fully automated clinical epidemiological tools. We host two of the seven national Health Data Research Hubs awarded through the Industrial Strategy Challenge Fund, focussing on acute care (PIONEER £1M) and ophthalmology (INSIGHT £3.4M). We joined the Alan Turing Institute in 2017 and have a major focus on Life Sciences as one of our two core themes.

The recently established Institute of Mental Health (IMH) led by Psychology aims to improve the care and outcomes of those suffering from problems in their mental health, and to ensure a sustained impact on public policy and practice. The IMH takes a multidisciplinary approach across the campus, with a particular focus on youth mental health. IAHR staff (Al-Janabi, Hardy, Lavis) contribute to and lead on Wellcome and NIHR-funded studies to evaluate interventions in depression, psychosis, self-harm and bipolar disorder.

Our **partnerships with the local NHS community** have contributed to our multidisciplinary research. Especially important is BHP, a strategic alliance between the UoB and Birmingham Women's and Children's, and University Hospitals Birmingham NHS Foundation Trusts. The aim of this collaboration is to bring healthcare innovations through to clinical and public health practice.

3.3 Infrastructure for public and patients

We have developed a team of patient involvement specialists who support numerous major infrastructure projects including the NIHR RDSWM, ARC, Global Surgery Unit, Surgical Reconstruction and Microbiology Research Centre; PIONEER; NIHR/CRUK ECMC and the UK SPINE CCF award on healthy ageing. We work with NHS partners to develop and implement a clear strategy across BHP which embeds the patient voice, not only in new research projects, but also at the heart of our major infrastructure programmes. The Public Involvement and Lay Accountability in Research and Innovation group, led by RDSWM, is an NIHR exemplar of good practice. We also have NIHR support to bring together best practice for Community Engagement and Involvement within ODA eligible countries. UoB received an **NCCPE Silver Watermark Award** for our coordinated approach to public engagement with research.

3.4. Operational and scholarly infrastructure

College research management oversees a team of 90 staff that work within grant awards and implementation, regulatory compliance, research integrity, translation and training. They work closely with University-level teams covering Business Engagement; Strategic Projects; Charitable Funding; Interdisciplinarity (IGI, incorporating our Institute for Advanced Studies); Commercialisation (UoB Enterprise); External Relations (including Public Engagement with Research); International Collaboration; and Research Finance to actively support researchers applying for funding and in the management of successful bids to ensure efficient delivery.

To improve understanding of Funder policy we have established 'think tanks' of academics who sit on relevant boards/panels/committees (e.g. Wellcome/NIHR/MRC) to advise colleagues and inform broader UoA2 research strategy regarding future priorities, which has e.g. supported the successful expansion in our global health research portfolio.

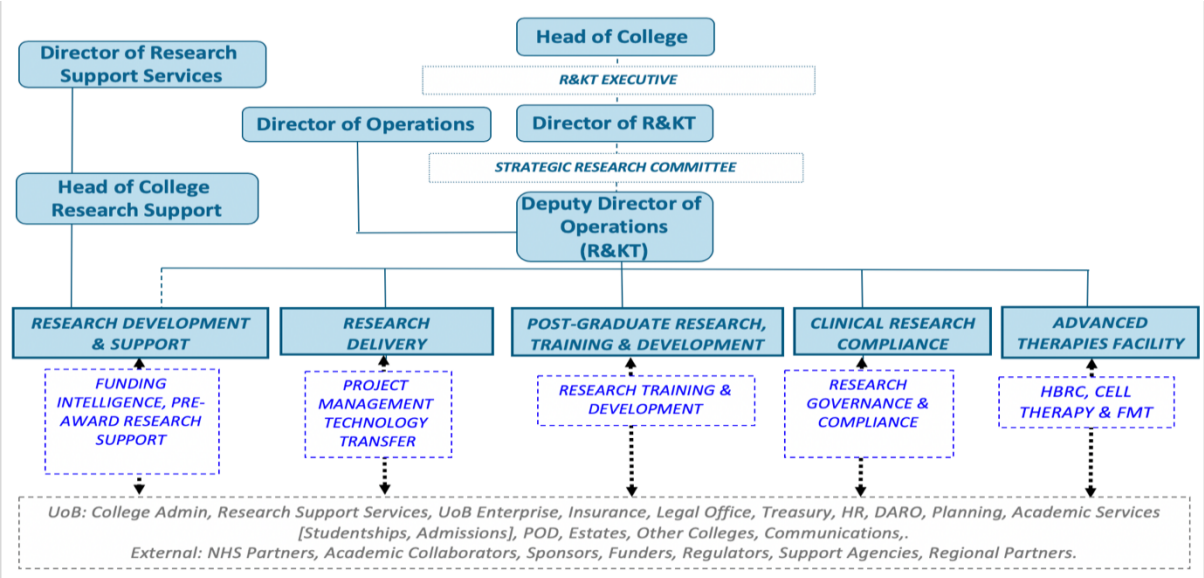

Figure 3: Overview of Research and Knowledge Transfer organisation in UoAs1-3

4. Collaboration and contribution to the research base, economy and society

We have further developed our collaborations, networks and partnerships locally, nationally and internationally during the REF period. These partnerships are crucial for the delivery of impactful reproducible (Section 1.6) interdisciplinary research that addresses local needs and enriches the IAHR research environment. Seed funding from both College and the University actively supports the development of collaborative networking. Successes from such collaborations in response to national or international priorities and initiatives illustrated below have contributed to the economy and society. Co-production and in-depth engagements with diverse communities where we operate is a guiding philosophy. We have selected the following examples of collaboration to illustrate our approaches and successes in addressing the issues stated in the panel working methods.

4.1 Local, regional and national collaborations

The NIHR ARC, previously CLAHRC, undertakes research to strengthen service delivery in the local NHS. The collaboration (£4M of £9M, Lilford-Director) includes University of Warwick, Keele University, and University Hospitals Birmingham Foundation Trust, and 12 regional NHS Trusts, local city councils and the Academic Health Science Network, building on 2 previous CLAHRCs. Two of the four substantive themes (maternity and child health, and long-term conditions) and

three of the four cross cutting themes (public health, social care research methods, health data science/informatics) are led by IAHR (MacArthur, Kenyon, Jolly, Lilford, Marshall). Our research pump-priming has leveraged significant additional funding (£60M), e.g. eight successful NIHR HS&DR grants secured by the preceding CLAHRC. Collaboration with Advantage West Midlands and RAND Europe secured government funding for a cluster RCT of 100 SMEs to evaluate an intervention to promote employee health (Lilford). Evidence generated by CLAHRC-WM has been translated into health and care practice. Examples include an obstetric triage system (BSOTS) endorsed by the Royal College of Midwives and adopted in >30 UK maternity units and training delivered in >20 others, including centres in Australia and New Zealand; home haemodialysis (WM Region went from lowest to highest provision nationally following introduction of an incentive system); and Statistical Process Control (adopted by NHS Improvement on basis of work showing poor uptake in the NHS). Our work has attracted international markers of esteem. e.g. the BUMPES RCT of birth positions was awarded BMJ best research paper of the year in 2017. REACH-HF (Rehabilitation Enablement in Chronic Heart Failure) won BMJ 2020 Stroke and Cardiovascular Team of the Year. This programme has rolled out into a further 10 UK beacon sites, and offered free on-line training during COVID.

We have increased our engagement with Health Care Providers/Commissioners through BHP (REF5a-4.2), other local NHS Trusts, local authorities and Public Health England (PHE). This has led to the co-creation of a shared vision for delivering transformational change at local, regional and national levels. We have increased our applied research capacity in areas of need by strategic recruitments, including at Chair level, e.g. clinical trials, applied health methods, and medical specialties (e.g. respiratory, endocrine, maternal health). These roles also help extend our collaborations across CMDS and the University. Examples of success include the highest regional recruitment in the 100,000 Genomes Project and facilitation of the rapid setup of time-critical studies such as the COVID-19 COPE-Birmingham study involving 4 regional Trusts (UKRI). The alliance offers a large integrated ecosystem which enables the full spectrum of translational medicine. IAHR members lead on 3 of the 4 clinical themes (Women's and Children's Health (Morris), Chronic Diseases (Turner), and Health and Wellbeing (Lasserson)) and have joint appointments based at the Institute of Translational Medicine, a key component of the BHP. In addition, a large proportion of our active awards in UoA2 include partners in the alliance as co-applicants.

Developing Chief Investigators to design trials for patient benefit is a key strategy developed and led by IAHR. Important applied research is driven by healthcare workers, patients/carers (e.g. James Lind Alliance) and policy makers identifying the problems that limit their ability to deliver the best care possible within their settings. Recognising the paucity in particular of Chief Investigators, we worked with the CRN/local Trusts to develop a ground-breaking programme of

support to second clinical staff from NHS roles to BCTU to develop funding proposals to address clinically important challenges and to mentor future research champions. This scheme is supported by CRN and local NHS Trusts and includes a £2.5M investment by the University. It aims to build a cohort of clinical scientists and improve the vitality of the local NHS research environment. Twenty-five scholars (mainly clinical consultants, including from limited capacity specialties such as ophthalmology, paediatrics and pharmacy) have been appointed since late 2018. These scholars act as prime conduits between NHS staff in their host Trusts and methodologists. It is an approach that the NIHR CRN and MRC CARP programmes are now mirroring.

IAHR is a site for the NIHR Clinical Research Network WM (CRNWM) and enables close working and support of academics in research delivery within the NHS, social care, and other community (non-NHS) settings. It provides important training, early research support, feasibility, cost attribution, and support for active studies critical for UoA2 activity. In 2019/20 CRNWM was the highest recruiting LCRN in England (>65,000 recruits); one third from Primary Care.

IAHR/BCTU was instrumental in the founding of the West Midlands Research Collaborative (WMRC) Surgical Trainee Research network in 2008. Since then, we have actively disseminated the model and there are now general surgical research collaboratives in every region of the UK and national collaboratives for each surgical sub-speciality area. WMRC established a new paradigm for evidence-based surgical practice, engaged thousands of surgical trainees and their consultant mentors and created an active network of research-active clinicians in every hospital in the UK. The WMRC alone has initiated 11 trainee-led RCTs with competitive funding worth £9.7M. The model has spread to medical students (STARSurg) and all 42 medical schools in the UK now have an active network student research collaborative. More recently similar collaboratives have formed, utilising our established core principles, in non-surgical specialities across the UK. In the West Midlands alone there are active groups in paediatrics, geriatrics, gastroenterology, radiology, oncology, anaesthetics, non-malignant haematology, paediatric cardiology and palliative care.

Our team recently created the NIHR Associate Principal Investigator (PI) Scheme to develop junior doctors, nurses and allied health professionals to become the PIs of the future and provides formal recognition of an individual's engagement in NIHR Portfolio research. The six-month Associate PI status is formally assessed according to pre-defined criteria; the endorsement and certification is conferred by the NIHR and co-badged the majority of medical Royal Colleges. The scheme has successfully rolled-out across all speciality areas and recently into the new Urgent Public Health (UPH) studies including the RECOVERY trial. Over 350 individuals are currently participating in the scheme.

4.2 International collaborations

The WMRC trainee research network model is a model that has also been successfully translated to other countries including Australia, Portugal, Italy, Sweden, Holland and Canada. Medical students across Europe (EuroSurg) have adopted the model. Together these have prospectively recruited thousands of patients into >30 separate projects. One of our standard collaborative models of using 'snapshot audits' of current surgical practice has been taken up by a variety of groups at all levels across the world. Cumulatively, these groups have collated individual patient-level data on over 185,000 patients undergoing a variety of surgical operations, collecting patient, operation and outcome data. These groups recently combined forces to create the CovidSurg collaborative to collate real-time patient-level data exploring the impact of COVID-19 in surgical patients and services across the world. Over 117,000 patients were included from 1566 centres across 112 countries, creating the largest prospective surgical study every conducted. The analyses of this data are ongoing but have already resulted in practice-changing risk evidence and national and international guidance on how to provide safe surgery during the pandemic.

Our NIHR Global Surgery Unit established in 2017 is led in the UK by UoB in partnership with Edinburgh and Warwick, international partners in sub-Saharan Africa, the Indian sub-continent, SE Asia and Central America, with the aim of creating sustainable 'hubs' in partner countries. The hubs based in larger hospitals act as independent research centres, running clinical trials and cohort studies, and supporting research training and education locally. The Unit has initiated large clinical trials in the prevention of wound infection (FALCON >5000 participants, CHEETAH >12,000 participants) and peri-operative care (PENGUIN >13,000 participants), and pilot studies in nutritional intervention in cancer surgery (CRANE) and task-shifting from surgeons to non-surgeon physicians for inguinal hernia repair in Nigeria (TIGER), and stoma care interventions in the Philippines (STARFISH). Our 66-country, global epidemiology study on wound infections after gastrointestinal surgery catalysed international guidelines on surgical site infections (Global Surgery collaborative, Lancet Infectious Diseases).

IAHR has a wide range of non-surgical collaborative trials globally. For instance, the weaning-food safety and hygiene intervention conducted in rural communities in the Gambia involved a number of external organisations including engineers and Water Sanitation and Hygiene (WASH) experts from a UK University, and Water Aid Global HQ, as well as the Gambian Ministry of Health, UNICEF Gambia office, nutritionists and public health officers from the National Nutrition Agency (NANA), and microbiologists from the Gambian National Public Health Laboratories. Pilot funding was initially obtained from UoB IGI, and subsequently from the Share (DfID) Consortium, UNICEF Gambia, and the International Development Bank. We also have a highly successful research

collaboration in Malawi, Pakistan, Tanzania, and Uganda in obstetrics, producing an RCT on antibiotic before miscarriage surgery (Middleton, NEJM). Our PolyIran trial was the first polypill trial reporting mortality and major cardiovascular events as endpoints, indicating primary and secondary care benefits and is already included in the national treatment guidelines in Iran.

In NCDs, a research collaboration between UoB, Heidelberg, Gottingen, Harvard, and 56 LMIC institutes assessing access to care has led to more than 10 high-impact journal articles, and a strong development in research capacity. Our microsimulation model of costs of care scale-up for diabetes and hypertension in South Africa in collaboration with the South Africa DoH, and Stanford and Wits Universities has informed policy in South Africa. We lead the Special Interest Group on Obesity on behalf of the International Association of Health Economics comprising over 100 economists from over 70 countries.

IAHR success in Global Health research demands, among other things, strong collaboration not only with local academic institutions, but with policy makers, think tanks, and industry. These networks often take years to cultivate and some come from staff's previous employments. Support for these connections, when needed, is provided by the UoB IGI. Affiliations with institutions in LMICs are also encouraged to ensure embedding of our researchers in these academic settings and facilitate their ability to provide context tailored capacity and policy development. For example, UoA2 staff have honorary positions and affiliations at Wits and Stellenbosch Universities, South Africa, University of Global Health Equity, Rwanda, University of Sierra Leone and Njala University, Sierra Leone, Wits University, South Africa, Peking University, Sun Yat-sen University, and the University of Hong Kong, China.

Staff in IAHR have a long history of collaboration with China. Cheng is co-PI of a general population cohort in South China (Guangzhou Biobank Cohort, N=30,000, est. 2004) and Born in Guangzhou Cohort (N=48,000 mother-child pairs, est. 2012). In addition to generating over 60 publications during the REF period, the two cohorts have also provided platforms for training for more than 30 postdoctoral fellows and research students from China. As Founding Head of General Practice at Peking University, Cheng and his team have organised courses for 4000+ GPs (including academic GPs) from 80+ cities and 30+ medical schools, thus contributing to the development of primary care research capacity in China as the country undergoes an unprecedented expansion of general practice. A network of primary care centres has been established, which has contributed to two NIHR Global Health funded projects recently.

4.3 Research reproducibility

See Section 1.6.

4.4 Contribution to the discipline and wider research base

12 IAHR staff (7 female) are/have been members of 21 different **National and International funding panels** (6 as **panel chairs** shown below), including:

NIHR and MRC: Adab (NIHR PHR FC), Jolly and Roberts (PGfAR sub-panels), Brocklehurst (HTA WCH Panel, MRC/NIHR MRP panel, DH PRP Commissioning panel) and Parry (NIHR Advanced Fellowship Committee), Thomas (Deputy Chair, All Wales Prioritisation panel, RfPPB panel, Health and Care Research Wales)

Four staff contribute(d) to 7 **national health advisory panels**, including:

Lilford (Cabinet Office 'What Works' advisory committee), Parry (NIHR Academy Dean's Advisory Board) and Adab (Obesity Health Alliance Independent Obesity Strategy Working Group).

Ten staff (6 female) have been elected to leading positions in **professional associations or learned societies**:

Chair, Academy of Medical Royal Colleges (AoMRC), GP Principal and Chair of the National Academy for Social Prescribing (NASP), Chair, Royal College of General Practitioners (RCGP) (Stokes-Lampard). Adab and Frew (Trustees Association for the Study of Obesity), Adab (Obesity Health Alliance Independent Obesity Strategy Working Group), Brocklehurst (Chair, UKCRC Pregnancy Research Review sub-group), Calvert (National Research Ethics Advisory Panel and International Society for Quality of Life Research Board of Directors), Cheng (Lancet Commission of Primary Care in China and Advisory Committee, Chinese Society of General Practice), Hawkins (Scientific Advisor, French, German and Japanese National Committees for follow-up of child/young adult cancer survivors), Jordan (Chair of the IPCRG research sub-committee), Kyte (NCRI Methodology Workstream Chair), Parry (Chair, Research and Development Committee, and Board Member of University Clinical Aptitude Test (UCAT) Consortium).

A large proportion of our staff are members of **editorial boards**, e.g. Social Science and Medicine (Al-Janabi), Chief Statistical Editor BMJ (Deeks).

Prestigious awards, honours and prizes were received by 9 staff (4 female), including:

Lilford (CBE), Brocklehurst, Lilford, MacArthur, Cheng (Fellowship of Academy of Medical Sciences, first 3 elected during review period), Calvert (NIHR Senior Investigator), Frew (NIHR Professor), Brocklehurst and Deeks (Emeritus NIHR Senior Investigator), Calvert (Ware Career Achievement Award), Jordan and Riley (RGCP Research papers of the year 2016, 2017), Brocklehurst and MacArthur (BMJ UK Research Paper of the Year 2018).