

Institution: University of Warwick
Unit of Assessment: A2 Public Health, Health Services and Primary Care
<p>1. Unit context and structure, research and impact strategy</p> <p>1.1 Unit context</p> <p>1.1.1 Overview</p> <p>Warwick Medical School (WMS) (Dean, Kumar) provides a dynamic and enterprising environment for world-class research in the UoA A2 area of Public Health, Health Services and Primary Care. Building on strong REF2014 performance, our research has continued to grow through investment in people in areas of excellence and partnerships to deliver our strategic aims, as described below.</p> <p>Established as a graduate-entry medical school in 2000, our strategy has been to build internationally-renowned expertise in design, evaluation, and implementation of healthcare interventions, including behavioural, medical, technological and organisational interventions. We deliberately focus on challenging settings, including emergency and pre-hospital care, trauma surgery, community settings such as residential and nursing homes, or low/middle-income countries. Recently, this has included COVID-19 work (see Section 4.2.7)</p> <p>Our mission remains to be a leading UK medical school, internationally renowned for our excellent and significant research, with activities focussed on maintaining and improving health locally, nationally and internationally. This aligns with the mission and outstanding multidisciplinary research environment of the University of Warwick (UoW) (REF5a-1.0, 2.1).</p> <p>We have maintained and built our international reputation for applied health services research excellence by focussing on four strategic priority areas (Box 1). Our impact case studies illustrate how research in these areas, underpinned by excellent methodological and theoretical work, enables us to publish in highest quality journals and ensure that this informs and changes healthcare.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">Box 1: Strategic priority areas</p> <ul style="list-style-type: none"> • <i>Clinical trials of complex interventions</i> • <i>Evidence synthesis and health research methodology</i> • <i>Health services research and mental health</i> • <i>Global health</i> </div> <p>1.1.2 Major strategic developments</p> <p>Notable achievements and specific strategic developments during the review period within each priority area are described in Section 1.3. Major highlights include:</p> <ul style="list-style-type: none"> • Continuing research income growth by ~25%, including two substantial EU FP7 projects, 17 major (> £1M) multicentre clinical trials, and two major NIHR Global Health projects.

- Growth in *Warwick Clinical Trials Unit* (head, **Perkins**) to the largest number of NIHR studies of any UK CTU and the second largest NIHR income, now established as a separate division within WMS alongside the *Division of Health Sciences*.
- Growing global health strength and establishment of *Warwick international Centre for Applied Health Research and Delivery* (W-CAHRD) including a £6M NIHR Global Health Unit focused on slum health (founding director, **Lilford**; acting director, **Oyebode**).
- Continued demonstrable improvement of gender equality and inclusivity leading to an Athena SWAN Silver award.
- Sustained capacity-building through internal promotions, maintaining good gender balance (~45% independent researchers and professors female).
- Strengthening links with local NHS including 7 new clinical Professor posts, along with Associate professors and 18 NIHR Research Capability Funding (RCF) funded posts, establishing new and effective partnerships outside traditional clinical academic models.
- Engagement with health services research locally and nationally through NIHR Collaboration for Leadership in Applied Health Research and Care (CLAHRC) and Applied Research Collaboration (ARC) (director: **Lilford**, deputy director: **Clarke**, theme leads: **Lasserson**, **Singh**).

1.1.3 Impact and collaboration with external bodies

In all four priority areas, we maximise the impact of our research, changing healthcare policy and practice at local, national and international levels (see Section 4.2). To achieve this, we work with NHS trusts and local authorities within our region, and national and international bodies such as NICE and the World Health Organisation, patient groups, and specialist societies such as the Resuscitation Council and British Orthopaedic Association. Important roles in these organisations held by many of our staff help ensure we deliver the highest priority research with maximum possible impact on health and healthcare delivery. Impact activities such as engagement with external bodies are facilitated through University schemes and encouraged through annual review and workload management and recognised in promotion criteria (see Section 2.1).

Our research strength is achieved by recruiting and retaining excellent people who receive full support and mentoring, enabling them to achieve their best (see Section 2). We have intentionally built our divisional organisational structure to actively encourage work between academic disciplines, including embedding clinical academics in methodological groups, enabling them to flourish. Our impact case studies show how we work closely across disciplines, focussing on disease areas where we produce high-impact work of international excellence.

1.1.4 Setting within University and local healthcare environment

The University of Warwick creates a lively collaborative research culture through its strong departments, network of research centres and programme of Global Research Priorities (GRPs), including Health, specifically established to encourage interdisciplinary research (REF5a-2.9.1). WMS forms a single department situated within the Faculty of Science, Engineering and Medicine (chair, **Meyer**) (REF5a-1.6). Whilst providing a high level of research autonomy for WMS, this enables faculty-level strategic development such as the Health GRP, facilitating

collaboration with other departments and within WMS essential to our interdisciplinary research. We also have strong and successful partnerships with our local NHS trusts, specifically University Hospitals Coventry and Warwickshire (UHCW) and University Hospitals Birmingham (UHB) (see Section 4). These collaborations have allowed us to appoint to posts of mutual value and invest in integration with frontline clinicians. An established base at UHCW includes WCTU staffing and facilities, actively engaging with frontline clinical staff to maximise research impact. WCTU staff are a regular presence at UHB following the same model. UHCW has an active and successful pathway for developing clinical academic careers in Nursing/Allied Health Professional roles and our high-achieving clinical academics include nurses, physiotherapists, paramedics, psychologists and midwives, amongst a range of professions. This allows us to deliver high quality research with broad scope and high impact on patient care.

1.2 Unit structure

1.2.1 Overall unit structure

Warwick UoA A2 staff are predominantly based in the **Division of Health Sciences** and **Warwick Clinical Trials Unit**, two of the three divisions of WMS, the other being the Division of Biomedical Sciences (DoBMS), mostly returned to UoA A1.

1.2.2 Warwick Clinical Trials Unit (WCTU)

WCTU (head, **Perkins**), established in 2005 with full UKCRC registration in 2007, has ~140 staff housed in a facility purpose-built in 2009. Internationally renowned for our expertise in development and delivery of large multicentre pragmatic clinical trials, we currently manage 41 trials, and are the largest CTU in the UK in terms of number of NIHR studies (currently 37) and second largest by NIHR funding (currently £6.3M/year). By embedding high-achieving clinical staff in a methodologically successful unit we have broken down traditional barriers to delivery of trials in challenging and complex environments. We are proud of our pioneering achievements in delivering trials in especially difficult settings, such the national ambulance network (PARAMEDIC, PARAMEDIC2), residential and nursing homes (OPERA), community dementia care (DAPA), ventilator support for COVID-19 patients (RECOVERY-RS), post-COVID chronic disease (REGAIN) and very large trials (including PreFIT, a >9,000 patient falls prevention trial). RECOVERY-RS was directly commissioned by the UK Chief Medical Officers due to WCTU's recognised excellence in this area. We have developed large clinical trials networks in specialities traditionally under-represented in academic medicine, including Emergency and Critical Care, Trauma and Orthopaedics, Physiotherapy, Maternity Care and General Practice. Trials in all these specialities have had demonstrable impact on the delivery of care nationally and internationally. With particular success in developing senior academic careers across a broad range of health professions, our chief investigators include:

- Physiotherapists (AIR, ARTISAN, SARAH, DAPA trials)
- Nurses and midwives (SELECT-D trial)
- Behavioural psychologists (I-WOTCH trial)
- Paramedics (PARAMEDIC, PARAMEDIC2 trials).
- Surgeons (RACER, START:REACTS, SAFE-TKR, FASHION trials)
- Anaesthetists and critical care consultants (RECOVERY-RS, PARAMEDIC, PARAMEDIC2, REGARD trials)
- General practitioners (OPERA, Pre-Fit, CHESS trials)

We have numerous high impact papers in the highest-ranking medical journals including *New England Journal of Medicine (NEJM)* (3 papers), *Lancet* (3 papers), *Journal of the American Medical Association (JAMA)* (3 papers) and *British Medical Journal (BMJ)* (2 papers) since 2014. PEDRO ranked two WCTU trials (SARAH and FASHION) in the five most impactful trials 2014-2019. PARAMEDIC was declared Society of Clinical Trials International trial of the year in 2014, and the *NEJM* paper by **Perkins** reporting PARAMEDIC2 evaluating use of adrenaline in out-of-hospital cardiac arrest was rated by Altmetric in the top 30 most-mentioned scholarly articles of 2018 in all disciplines.

1.2.3 The Division of Health Sciences (DoHS)

DoHS (head, **Gill**) focusses on design and evaluation of interventions, including behavioural, technological and organisational interventions, and application of knowledge in these areas to change clinical practice and health outcomes. Our research includes applied health services research, methodological development and evidence synthesis, and our expertise in quantitative and qualitative methods informs understanding of physical health, mental wellbeing, social care and nursing, and patient and public involvement in research. DoHS also includes,

- £31M NIHR CLAHRC and £9M NIHR ARC West Midlands, established at WMS to improve health service management and support,
- £8M NIHR Technology Assessment Review group, Warwick Evidence,
- W-CAHRD conducting research in low and middle-income countries,

as well as being part of the Warwick-led NIHR Health Protection Research Units (HPRU) in Genomics and Enabling Data (theme leads, **McCarthy** and **Staniszewska**) and in Gastrointestinal Infections (theme leads, **McCarthy** and **Oyebode**).

1.2.4 Unit research groups

WCTU and DoHS comprise a number of focussed research groups contributing to our four strategic priority areas. This administrative structure facilitates support for research staff, including early career researchers (ECRs) (see Section 2) whilst enabling interdisciplinary work. Our researchers often work across groups to innovate; some key examples are given in Box 2.

Each group arranges a series of research meetings, often organised and/or chaired by ECRs, held in WMS and partner hospitals. These provide opportunities for interactions between staff within groups, spark new research ideas and facilitate development of grant applications. They also provide a friendly and supportive environment for informal peer review and refinement of research proposals, particularly those led by ECRs and other junior staff.

1.3 Research and impact strategy

1.3.1 Overall research and impact strategy

Our strategy, aligning with the aims in Section 1.1.1, is to pursue excellent research in applied health sciences which impacts healthcare policy and practice, locally, nationally and internationally, underpinned by world-leading research methodology and theory. To achieve this, we have developed world-class expertise in the substantive areas in which we focus, and internationally excellent methodology research. Specifically, our strategy has been to continue to grow strength in our four strategic priority areas as described in the remainder of this section, through recruitment and retention of excellent staff (see Section 2).

Box 2: Examples of cross-group working

START:REACTS, an adaptive trial of a new surgical procedure and RECOVERY-RS, a multi-arm multi-stage trial of respiratory support in COVID-19 both utilise WCTU clinical and trials delivery expertise (**Perkins, Metcalfe, Lall, Underwood**) and DoHS innovative statistical methodology (**Parsons, Stallard**).

I-Wotch, a trial of opioid treatment for chronic pain, combines WCTU RCT and clinical expertise (**Sandhu, Underwood**) with DoHS specialist qualitative and process evaluations input (**Seers**)

Development and evaluation of the ReSPECT (Recommended Summary Plan for Emergency Care and Treatment) process by with DoHS medical ethics (**Slowther**) and WCTU clinical (**Perkins**) expertise.

1.3.2 Clinical trials of complex interventions

(**Bick, Brown, Bruce, Couper, Griffin, Hoad, Kearney, Lall, Metcalfe, Nolan, Parsons, Parsons, Perkins, Playford, Sandhu, Smyth, Underwood, Wall, Yeung**)

Clinical trials in emergency and critical care, trauma and orthopaedics and rehabilitation have been a major focus of WCTU since its creation in 2005 and remain a particular strength and important strategic priority. We continue to appoint new PIs into these core fields (**Metcalfe, Kearney, Wall, Yeung, Couper, Smyth, Sandhu** since REF2014).

By embedding clinicians directly into methodological teams, we bring together clinical and methodological expertise, enabling us to deliver the high-impact large-scale pragmatic clinical trials in challenging settings in which we specialise. We have established national research networks covering almost all UK acute NHS trusts across our portfolio. Impact case studies in emergency and critical care and orthopaedic surgery demonstrate the major changes in NHS practice and savings arising from our work.

Our WCTU structure (established by **Perkins** in 2017 when WCTU became its own division), emphasises shared working between clinical academics, statisticians, health economists, qualitative researchers and operational teams, and enables truly collaborative work without artificial departmental boundaries hampering delivery of large and complex research projects. Completed trials have led to numerous high impact publications in the most prestigious journals and our Impact case studies demonstrate that our impact on healthcare has been widespread and demonstrable, including for example a substantial change towards the use of simpler cheaper surgery for wrist fractures following the DRAFFT trial, saving the NHS £2M/year. Through our highly successful strategy of investing in our strengths, WCTU studies are the major contributor of RCF funding to our partner NHS trusts. This leads to further investments from trusts into WCTU, improving our partnership with the trusts and their staff.

Major strategic developments for this group:

- Expansion of WCTU to become a division within WMS.
- New professorial appointments in *Resuscitation medicine* (**Nolan**), *Neurological rehabilitation* (**Playford**), *Maternity care* (**Bick**), *Trials methodology* (**Lall**).
- Promotion to professorship (**Bruce, Kearney**).
- Strengthening of ongoing collaborations including those with Oxford, (UK STAR, CORKA, WOLFF and PROVE trials, SCORE evidence review), Leeds (KARDS trial), Monash, Australia (Lancet Back Pain series) and in the USA and Canada (STABILITY2, \$4M NIH/CIHR)

1.3.3 Evidence Synthesis and Health research methodology

(**Andronis, Bouliotis, Clarke, Dunn, Grove, Hamameeh Al Wattar, Hiller, Kimani, Madan, Marshall, Mason, McCarthy, Mistry, Parashar, Rees, Stallard, Sutcliffe, Taylor-Phillips, Warwick**)

Covering research in Evidence synthesis, Health economics, Epidemiology and Medical statistics, our strategy in this area has been to consolidate existing strengths through the appointment of 2 new Professors in Epidemiology (**McCarthy**) and Health economics (**Mason**), with further Professorial appointments in each of Statistics and Public Health planned.

We continue to host a NIHR Technology Assessment Review (TAR) team, Warwick Evidence, undertaking evidence synthesis on clinical and cost-effectiveness of healthcare interventions for NIHR HTA on behalf of policy makers including NICE. One of nine TAR Teams in the UK facilitating NICE decision-making, this supports improvements in healthcare delivery and reducing NHS drug costs through rigorous appraisal.

The Communicable Disease Control Evidence and Epidemiology group (lead, **McCarthy**) is a co-funded and staffed research and training unit with Public Health England and Health Education England, and a strategic research partner with the national syndromic surveillance centre. We provide research to support public health (health protection) and academic public health training, and contribute to the HPRUs in Genomic and Enabling Data and Gastrointestinal Infections (**McCarthy** leading themes in each).

The Centre for Health Economics at Warwick (CHEW) (lead, **Mason**), with a team of 15 health economists ranging from Research Associate to Professor, undertakes methodological research and collaborates widely within WMS and externally. We conduct economic evaluations alongside randomised clinical trials and systematic reviews of health economic evidence, leading to high impact publications in journals including *Lancet* and *BMJ*.

The medical statistics group (lead, **Stallard**) has world-leading expertise in adaptive clinical trial design. This underpins methodological contributions to clinical trials in WCTU and other groups at Warwick and elsewhere, including multi-arm or adaptive trials in surgery and neurodegenerative diseases. **Dunn** leads WCTU cancer trials statistics. With research interests in the evaluation of prognostic and predictive factors, we are running NIHR funded practice-changing clinical trials with collaborators including Cambridge, UCL and Birmingham and have published in journals including *Lancet*, *Annals of Oncology* and *NEJM*.

We host the NIHR Research Design Service (RDS) for the West Midlands Warwick hub providing methodological expertise for local health and social care researchers (hub leads

Stallard and Rees, and including **Clarke, Griffiths, Kimani, Mason, Parsons, Sandhu, Seers**).

Major strategic developments for this group:

- Establishment of Communicable Disease Control Evidence and Epidemiology group (lead, **McCarthy**)
- Creation of an interdisciplinary cross-departmental University research centre in *Health economics* (lead, **Mason**)
- Strategic expansion of research strength in core methodologies, including new professorial appointments in *Health economics* (**Mason**) and *Epidemiology* (**McCarthy**) and additional senior statistician posts funded by NHS partner trusts
- Promotions to professorships in *Health economics* (**Madan**), *Medical statistics* (**Warwick**) and *Population health* (**Taylor-Phillips**)

1.3.4 Health services research and mental health

(**Atherton, Birchwood, Boardman, Briggs, Crawford, Dale, Draper, Fitzmaurice, Furtado, Giacco, Griffiths, Haywood, Lasserson, Meyer, Nanton, Ocean, Roberts, Schmidtke, Seers, Singh, Slowther, Staniszewska**)

This research theme includes mental health, nursing, primary care, patient experience and ethics research, and focusses on work that improves health and health service management locally, nationally and internationally.

The group includes the NIHR-funded **West Midlands Collaboration for Leadership in Applied Health Research (CLAHRC)** (Director, **Lilford**), and **Applied Research Collaboration (ARC) West Midlands** (Director, **Lilford**; Deputy Director, **Clarke**; theme leads, **Lasserson** and **Singh**), and our new **Unit of Academic Primary Care** (chair, **Dale**).

Warwick Research in Nursing (Director, **Seers**) and the **Medicine, ethics and society** research groups have expertise in patient experience and involvement, social and ethical implications of medicine, patient-reported outcomes and mixed methods. These groups collaborate extensively within WMS, including contributing ethical and patient perspectives and qualitative research expertise to clinical trials including PARAMEDIC2, I-WOTCH, SPHERE, REGAIN and high-impact interventions such as the RESPECT process (see Impact cases and examples in Section 4). The group is also part of the HPRU in Genomics and Enabling Data (theme lead, **Staniszewska**).

Major strategic developments for this group:

- Establishment of NIHR £31M **West Midlands CLAHRC** at WMS in 2014 and of £9M **NIHR ARC West Midlands** in 2019.
- Creation of an interdisciplinary University research centre in **Mental health** (lead, **Singh**).
- Establishment of **Unit of Academic Primary Care** (chair, **Dale**) in October 2017 part-funded through Coventry and Rugby CCG.
- Appointment of new Professors in *Primary care* (**Fitzmaurice**), *Bioethics* (**Draper**) and *Ambulatory care* (**Lasserson**) and new Associate Professors.

- Promotions to professorships in *Health research* (**Staniszewska**), *Clinical ethics* (**Slowther**) and *Social science in medicine* (**Boardman**)

1.3.5 Global health

(**Cappuccio**, **Chen**, **Ellard**, **Gill**, **Haenssger**, **Kumar**, **Lilford**, **Miller**, **Oyebode**, **Saravanan**, **Tuomainen**, **Uthman**, **Watson**)

Capacity-building in Global health has been a key strategic priority, enabling us to develop from links with Liverpool School of Tropical Medicine to independence in this area. A major part of this development has been establishment of the **Warwick international Centre for Applied Health Research and Delivery (W-CAHRD)** (director to January 2020, **Lilford**; acting director, **Oyebode**). This global network brings together individuals, disciplines and organisations to pursue applied health research, transform health systems and improve health in low- and middle-income countries.

W-CAHRD adds to existing strength in global cardiovascular disease (CVD) and epidemiology of the **World Health Organisation (WHO) Collaborating Centre for Nutrition** (Head, **Cappuccio**). Established in 2008 and recently re-designated for a further 4 years until 2022, the Centre has influenced WHO guidelines for preventing CVD and supports implementation and evaluation of salt reduction policies globally with WHO and other international partners (see Section 4).

The group also contributes to the HPRU in Gastrointestinal Infections (theme lead **Oyebode**).

Major strategic developments for this group:

- global health research capacity expansion through establishment of the **W-CAHRD** funded by £30M NIHR and MRC grants.
- capacity-building through appointment of professors in *Public health* (**Lilford**) and *General practice* (**Gill**) and three Associate Professors.
- promotion to professorships in *Diabetes, endocrinology and metabolism* (**Saravanan**) and *Global health informatics* (**Uthman**).

2. People

2.1 Staffing strategy and staff development

2.1.1 Staffing strategy overview

DoHS and WCTU have a total staff of approximately 200 FTE, with 76 independent researchers (38 Professors, 38 Associate/Assistant Professors) and a REF-eligible 65.72 FTE, returned to UoA A2. Other DoHS and WCTU staff are research fellows, administrators, trial managers and teaching-only staff. Our culture is one of informality and friendliness, with all our staff valued as vital parts of our team and treated fairly and with dignity.

Our strategy has been one of sustained growth underpinned by increasing research income (see Section 3). We have made strategic expansion of research capacity in WCTU and DoHS, through key new clinical and non-clinical academic appointments at Associate and full Professor levels. Significant appointments since 2014 include 11 new professorial posts (4 female) in Ambulatory Care, Resuscitation medicine, Neurological rehabilitation, Maternity care, Trials

methodology, Health economics, Epidemiology, Public health, Bioethics, Primary care and General practice, representing expansion across all research activities, with a particular focus on clinical trials and global health. Future growth will be additionally enabled through the launch of a Health and Medical Sciences BSc in 2020.

Our people are our primary asset, and we are proud of our diverse research community and the intellectually stimulating and inspiring environment that we nurture. We have a strategic commitment to continue to grow capacity by recruiting excellent researchers and implementing policies to retain and develop current staff.

2.1.2 Awards and international recognition

The excellence of our staff at all levels is demonstrated by awards and international recognition as described in more detail in Sections 2.2 and 4. The most prestigious are listed in Box 3.

2.1.3 Staff development

We take pride in our staff, who work in small groups led by senior academic researchers, ensuring that they receive support, mentoring and training to enable them to attain their full potential. Groups often include expertise across multiple domains and methodologies, routine interdisciplinary working, regular seminars; and research meetings within and across research groups which provide peer-to-peer interactions that are essential to the open and vibrant interdisciplinary research culture for which we are known. These have enabled us to maintain the feeling of a small medical school through this period of expansion.

All staff are offered an annual Personal Development Review (PDR). Training for reviewers and reviewees ensures that this enables all staff to have positive and structured conversations with their line manager. PDR focusses on individual achievement and contribution towards departmental objectives and gives the opportunity to discuss personal development goals and career development, review activities and agree future priorities and activities in a supportive setting. PDR is also used to review and encourage external activities including roles on external professional bodies and funding panels, to promote research impact activities, for example through the University Impact leave scheme, and to plan workload accordingly. In addition, PDR is used to identify training and support needs. Training opportunities are available through the UoW Organisational Development (OD) Centre, which includes the Academic Development Centre and offers training programmes and workshops as well as online and self-directed training in personal and career development, leadership and management tailored to academic staff at all grades and roles (REF5a-2, 3). OD also offers coaching and mentoring support. Where training needs cannot be met within UoW, funding for additional external training can also be made available for all staff. This is particularly encouraged for ECRs (see Section 2.2). Grant-writing workshops for research-active staff at all levels, including those on applying for large grants for more senior staff, also help researchers to achieve their full potential.

We appreciate the value of our staff and celebrate success and reward excellent performance and extraordinary contribution from individuals above and beyond that which would normally be expected in their job role, through annual staff awards, merit pay and the Senior Performance and Remuneration Review and Clinical Excellence Awards for professorial staff and clinical academics respectively. Merit pay is awarded annually to ~25% of non-professorial researchers (females and males similar).

Box 3: Prestigious Awards

CBE for Services to Health Research (**Lilford**)
 OBE for Services to Medicine and Diabetes Care (**Kumar**)
 OBE for Services to Midwifery (**Bick**)
 RCGP John Fry medal (**Lasserson**)
 Fellowship, Academy of Medical Sciences (**Lilford, Perkins**)
 Inclusion in Thompson Reuters Highly Cited list (**Seers**)
 NIHR Senior Investigator (**Dunn, Lilford, Perkins, Underwood**)
 Lifetime Achievement Award, American Heart Association (**Nolan**)
 Lifetime Achievement Award, Beth Israel Deaconess Medical Center and Harvard Medical School (**Nolan**)
 Fellowship, European Society of Cardiology (**Cappuccio**)
 Founding Fellowship, British and Irish Hypertension Society (**Cappuccio**)
 Honorary Life Membership, Italian Resuscitation Council (**Nolan**)

We prioritise academic career development, reward performance and build capacity through internal promotion at all levels. Clear and recently-revised University-wide criteria for promotion (REF5a-3.3) reflect achievements in four domains of Research and Scholarship; Teaching and Learning; Impact, Outreach and Engagement; and Collegiality, Leadership and Management. Annual PDR is timed to provide opportunities for initial discussion of promotion, with applications reviewed within the divisions and school to ensure equality of opportunity and make cases as strong as possible. Since 2014, internal promotions have included 12 to Professor (7 (58%) female) and 19 to Associate Professor (11 (58%) female).

We are proud to hold an Athena SWAN Silver Award (see Section 2.4). The effectiveness of our equality and diversity strategy is demonstrated by our excellent gender balance at all levels, with 44% of independent researchers and 45% of professors females.

Within WMS, the Head of Academic Career Development leads the WMS-academic mentoring scheme available to all staff. All Assistant Professors are placed on probation and assigned a mentor, with monitoring via annual review at departmental and university levels, including a personal meeting with the WMS Dean, providing support, clear targets for research, impact, teaching and administrative activities, and career development advice. Promotion to Associate Professor is automatic upon successful completion of probation for Assistant Professors.

All staff, including those on Research-focussed contracts, can apply for Study leave through the University Academic Leave Committee, normally granted in the proportion of one for every six terms of service. Impact activities of all research-active staff are taken into account in workload planning and promotion criteria. The UoW Impact funding and Impact leave schemes (REF5a-2.6) also provides dedicated time to enable activities leading to maximisation of the impact of research, including impact at an early stage of development.

We actively back internal and external leadership training for all staff through the Warwick Leadership Training programme and programmes like Aurora which have substantially improved promotion applications, and enhanced development activities for senior staff such as senior

leadership training. In addition to the University's leadership shadowing scheme for senior positions, we have developed a WMS shadowing scheme for academic and professional support staff.

Staff wellbeing, informal networking and social relationships, both within and between WMS divisions, is encouraged through numerous social events, including winter celebration lunches, summer BBQs and monthly 'Coffee, Cake and Catch-Up' meetings. These develop a sense of collegiality without relying on social activities outside core hours and are held at different times to accommodate flexible working patterns. This sense of collegiality has been maintained following the coronavirus lockdown by regular informal online meetings including 'virtual coffee mornings' for research groups, with these augmented by online wellbeing sessions organised by WMS and open to all staff and PGR students. We encourage all our staff to find a work-life balance that is appropriate for them, with the option of part-time, flexibility and remote working and UoW schemes to enable career breaks or the purchase of additional annual leave facilitating this.

2.2 Early career researchers (ECRs)

2.2.1 ECR development strategy

Our ECRs are valued members of research groups, taking a full and active role, and are essential to our current research success as well as the future of research in the discipline. We have a specific academic development programme for ECRs, who are also encouraged to have a senior academic mentor, with this obligatory for probationary staff.

Regular ECR network meetings provide a forum for discussion of relevant issues and training and other needs. These also give important networking opportunities and encourage interdisciplinary collaborations. ECRs are represented on key committees within the divisions and school.

ECRs are encouraged to be active in external activities relevant to their disciplinary area. This includes opportunities to attend appropriate national or international conferences to network, present their work and keep abreast of international research, with funding specifically available to support such activities. This funding can also be used for external training or to support collaboration between ECRs and relevant researchers/groups at other institutions within the UK or overseas, and ECRs are encouraged to consider with their line managers and mentors what external activities would be appropriate to advance their careers, build their reputations and help them become fully established independent researchers (see Section 2.2.2). Through regular reviews with line managers and mentors, they are also encouraged to take appropriate external roles, including editorial panel and society committee membership. These facilitate networking within their discipline, advance their research careers and maximise the impact of their research.

Appropriate training and development are encouraged and provided for all staff levels. Funding is specifically available to support ECR training when this cannot be provided internally. In response to ECR feedback, the UoW Academic Development Centre now offers a route to Associate Fellowship of the Higher Education Academy specifically designed to allow ECRs to map their current teaching portfolios with the pedagogic requirements of the UK Professional Standards Framework and supports ECRs who might not realise that they can work towards this because of their contractual arrangements.

ECRs are encouraged to take part in the WMS shadowing scheme (see Section 2.1.3), enabling them to learn more about WMS management and decision-making processes and leadership

roles. We have an active programme of seminars and specialist discussion groups in core methodologies and clinical topics, supporting our inter-disciplinary activities. ECRs appointed without a doctoral degree are encouraged to register for a PhD to facilitate their career progression.

To ensure ECRs successfully progress in their research careers, our ECR policy gives up to 10 days/year of protected time for research-related development activity including work on personal research publications and fellowship or grant applications. Development of fellowship and grant applications are supported by senior staff through a system of internal peer review to ensure that applications are of the highest standard. Peer review is provided informally within the individual's research group, and through a formal WMS programme including two rounds of internal peer review by academics from other research groups within the applicant's division.

We see fellowship applications as being particularly important for ECR career progression, we hold regular well-attended seminars to give information on fellowship programmes and encourage applications. ECRs making fellowship applications are supported through a tailored programme including funder visits and training days including sessions from successful fellowship applicants, Research and Impact Services (REF5a-1.7, 2.6) and the NIHR RDS. In addition to the peer review programme, mock interviews are provided for fellowship applicants with input from previous successful applicants as well as current and former funding panel members. Feedback on the support given includes the comment from an ECR that "*I think this internal peer review has been extremely helpful which in combination with the RDS goes beyond what other institutions offer*". Since 2014, 86 fellowship applications have been submitted (42% female) with 21 (24%) successful (33% female). ECRs of whom we are particularly proud are presented in Box 4. The impact of the work of **Boardman** and **Taylor-Phillips** on screening is described in Section 4.

Box 4: Notable ECR Success Stories

(all promoted to full Professor within the unit)

Kearney

Arthritis Research UK Fellowship (2009-2012)

NIHR Clinical Lectureship (2013-2016)

NIHR Career Development Fellowship (2017-2021).

NIHR and charity funding for multi-centre RCTs in trauma and orthopaedic rehabilitation

High-profile publications including in Lancet

Taylor-Phillips

NIHR fellowship (2011-2014)

High-profile publications including in JAMA

Project funding from NIHR and Public Health England.

Boardman

ESRC Future Research Leaders Fellowship (2013-2017)

Wellcome Trust Investigator Award.

2.2.2 NIHR Integrated Clinical Academic Training Programme

WMS currently hosts 21 Academic Clinical Fellows (ACFs) (plus 1 non-clinical Public Health ACF) and 6 Clinical Lecturers (CLs) through the NIHR Integrated Clinical Academic Training (ICAT) Programme. To date we have had 42 ACF posts, 77% of completing ACFs have gone on to academic posts and 78% of these doing PhDs. We have had 19 CLs complete their posts, of whom 84% have gone on to academic posts. Only 1 has not continued in an academic post and 2 took a locum post as an interim measure before securing academic posts. None have returned to clinical training, demonstrating our ability to attract and develop independent researchers of the future. Completed CLs include **Wall**, who gained a NIHR Postdoctoral Fellowship and an Associate Professor post at Warwick and oversees the Warwick ICAT programme, two moving to Associate Professor posts in Oxford (one now a professor in London) with large NIHR portfolios, and one awarded a prestigious Harvard scholarship.

2.3 Training and supervision of postgraduate research (PGR) students

We have around 30 PGR students/year with primary supervisors within the unit. These students are part of a single Doctoral College (REF5a-3.8, 3.10) that streamlines admission processes and includes development and mentoring activities, bringing them together in a single cohort to provide an inclusive, supportive and stimulating environment. This enables our PGR students to interact in an interdisciplinary setting and develop core skills. PGR students are part of 3 cross-campus Research Council doctoral training centres/partnerships (DTCs/DTPs); the complexity science DTC, the ESRC DTC including a 'Health and Social Care' pathway and the MRC DTP (REF5a-3.9.1) in Interdisciplinary Biomedical Research, including iCASE studentships collaborative with industry, which includes Microbiology and infection, Artificial intelligence and data science themes. In addition, we host a DTP funded by Novo Nordisk and led by **Saravanan** focussing on diabetes, and have hosted numerous successful doctoral fellowships including fellows funded by NIHR, MRC, Wellcome, British Heart Foundation and Versus Arthritis, in addition to industry-funded students.

We maintain excellent PGR supervision by ensuring that all students have at least two supervisors including at least one experienced supervisor, and all supervisors completing mandatory training every five years. PGR student progress is monitored rigorously through monthly reviews and annual appraisal by an independent Advisory Committee. Students initially register for MPhil/PhD with a formal upgrading process approving registration for PhD during the first year if progress is satisfactory. We offer all students training and development including sessions on academic writing, oral communication, networking, team working and teaching skills. Students can also access modules from our extensive taught Masters programmes including research methods, critical appraisal and medical statistics. An annual research day gives PGR students the opportunity to present their work to peers and staff, and students are encouraged to engage with seminar programmes within their division and research group. PGR students are administered by a single, dedicated member of the academic support team to ensure consistency and continuity.

Many of our current and former PGR students have notable achievements including Imran Ahmed, currently funded by NIHR Doctoral Research Fellowship (DRF) (supervisor: **Metcalfe, Parsons, Hutchinson, Staniszewska**) attending the Global Young Scientists Summit of high-achieving young researchers in Singapore in Jan 2020, Sarah Mitchell funded by NIHR DRF 2014-2020 (supervisors: **Dale, Slowther**) receiving the Society of Academic Primary Care award for outstanding ECR, and **Grove** (supervisor: **Clarke**) funded by NIHR DRF 2013-2016 now holding a NIHR Advanced Fellowship.

2.4 Equality and Diversity

We are proud to have Equality and Diversity embedded in all of our decision-making processes, with a 2019 departmental Athena SWAN (AS) Silver award building on our previous Bronze award. Our processes support all our researchers in achieving their full potential and ensure that this is recognised and rewarded (see Sections 2.1 and 4).

The WMS AS self-assessment team and Welfare Strategy Group (WSG, co-Chaired by two females, an academic and Chief Operating Officer), embraces the wider departmental working, environment and culture of WMS. Members come from all areas of WMS, bringing together a wealth of differing staff and student welfare experiences. The chair of the University-wide AS Group sits on the group both to advise on University and national matters and to ensure that WMS initiatives contributed to successful retention of the UoW AS Silver award. WSG endeavors to take a strategic, pro-active approach to establishing and embedding fair working practices across WMS. The WSG initiatives and AS Action plan are progressed and implemented by 'Task and Finish Groups' with the WSG membership leading groups comprised of the wider department and research community.

Training in Unconscious bias and Diversity in the workplace are obligatory for all staff (REF5a-3.3). To encourage diversity in applications, our job adverts have gender-neutral language and standardised objective job specification criteria. Adverts highlight our commitment to Equality and Diversity. Shortlisting is undertaken by at least two members of staff, with HR oversight to ensure adherence to University recruitment guidelines. We strive to ensure gender balance for shortlisting and interview panels.

Preparation of the UoA A2 submission was led by a group of 6 (3 female) including one ECR, overseen by the UoW REF Submission Steering Group. Outputs were scored independently by two members, with checks on scores and on the gender split both for papers internally rated 4* and 3* and for independent and non-independent ECRs. Average output numbers were similar for females (2.21) and males (2.18) and for BAME (2.20, n=15) and white (2.34, n=50) (n=6 prefer not to say).

We acknowledge the importance of a good work-life balance for our staff, supporting both formal/informal flexible working arrangements to accommodate this (see Section 2.1). We are fully committed to providing appropriate support and promoting equality for all staff during and after all types of parental leave, and staff are encouraged to take appropriate paternity/shared parental/adoption leave (REF5a-3.2). Induction highlights arrangements with guidance and links to UoW policies and processes detailed on the WMS website. Support offered includes up to 10 paid Keep-in-Touch days and time off for ante-natal appointments. The University's Warwick Academic Returners Fellowships (REF5a-3.4) enables for staff returning from parental leave to apply for funding to enable buy-out from teaching and administrative duties to allow a focus upon re-establishing their research activities. Cover for staff on maternity/adoption leave is assessed on a case-by-case basis with cover arranged where appropriate. Vacancies covering maternity/adoption leave are either advertised as FTC, secondments or filled using temps, and timed to enable hand-over of duties prior to and post-leave whenever possible. Recognising the challenges new parents often encounter on returning to work, WMS strives to ensure a smooth return. Line-managers and HR advisors welcome returners and provide information on the University's Returning Parent's Network, Returning Parents Mentoring Scheme and Working Parents Staff Network Buddy Scheme (REF5a-3.4). We are proud that our supportive attitude has led to an excellent maternity return rate. Within WMS of 46 women taking maternity leave in the review period, 6 did not return to work or left within 3-months of returning. Retention over

the longer-term is also excellent, with 35 women still working here 18-months after their maternity leave.

Induction is a crucial element of our recruitment process ensuring all new staff are welcomed through University, School and Division/ Unit level induction activities. Recognising the size and complexity of WMS, we hold termly induction events for new colleagues to meet one another and learn about WMS through presentations from senior team members.

Equality and diversity is also a key part of UoW strategy (REF5a-3.3, 3.7). UoW maintains an institutional AS Silver Award achieved in 2013, has recently been awarded the HR Excellence in Research Award and implements the principles of the Concordat to Support the Career Development of Researchers. The UoW Single Equality Scheme and associated Equality Objectives explicitly cover all research full-time, part-time and fixed term staff.

3. Income, infrastructure and facilities

3.1 Research income

3.1.1 Research income overview

Our financially stable position has given sustainability and the capacity for steady growth through the census period that we expect to continue. This enables us to maintain our thriving vibrant research community, with researchers provided with the security they need to achieve their full potential and for their research to flourish.

Strategic plans for sustainable growth are encapsulated through an annual five-year financial plan developed by WMS and approved by the University with longer-term planning (REF5a-2.3) enabling us to set our research direction beyond the scope of individual project funding.

Excluding the exceptional 2019-20, our external research income exceeds £13M/year (~£200k /PI), a growth of ~25% since 2013-14, the majority coming from competitive and prestigious peer-reviewed national or international grant or fellowship schemes. The largest single funder is *National Institute for Health Research (NIHR)*, the major UK funder for pragmatic clinical trials and applied health services research. Other major research funders include the *European Union's seventh framework programme (EU FP7)*, the *Medical Research Council (MRC)* and *Economic and Social Research Council (ESRC)* and charities including the *Royal College of Nursing*, *Versus Arthritis*, and *Wellcome trust* along with smaller disease-specific charities. External grant funding is underpinned by RCF-funded posts and by UoW funding for impact-promoting activities and seed-funding for new interdisciplinary projects.

3.1.2 Core funding and major research awards

As indicated below and in Figure 1, alongside a substantial portfolio of research grants and fellowships core NIHR funding underpins each research priority area and interdisciplinary partnerships. Particularly significant research grants held since 2014 include two EU FP7 projects and 17 NIHR-funded major (£1M+) multi-centre clinical trials. In these projects, Warwick leads multi-disciplinary research teams of world experts. The projects are supported by specialist operational staff within the divisions and, for the EU grants, funding experts within UoW's Research Finance team, ensuring the smooth running and successful completion of these large and complex projects. In addition to the prestige associated with successful applications to these international and national research funders and leading such major research projects, this work also leads to research outputs of the highest quality with the

potential to yield practice-changing impact at a global scale as described in more detail in the following paragraphs.

Clinical trials of complex interventions

Large-scale multi-centre pragmatic clinical trials are the primary focus of WCTU, with NIHR as a major funder, WCTU has the highest number of NIHR studies and is the 2nd highest ranking CTU in the UK by NIHR grant income. Our exceptional achievements have been made by strategic investment in areas of strength and development and maintenance of an organisational structure within WCTU that ensures full interdisciplinary working. This allows research to be delivered without organisational barriers between academic and administrative teams.

Alongside £2M NIHR core funding, major clinical trials ongoing or completed during the review period include:

- Adrenaline for out of hospital cardiac arrest (£2.3M)
- Prevention of fall-related injuries (£2.7M)
- Wound management of open lower limb fractures (£2.2M)
- Mammography surveillance in breast cancer patients (£2.1M)
- Arthroscopic surgery for hip impingement (£1.8M)
- Exercise in dementia (£1.7M)
- Robotic surgery for knee replacement (£1.6M)

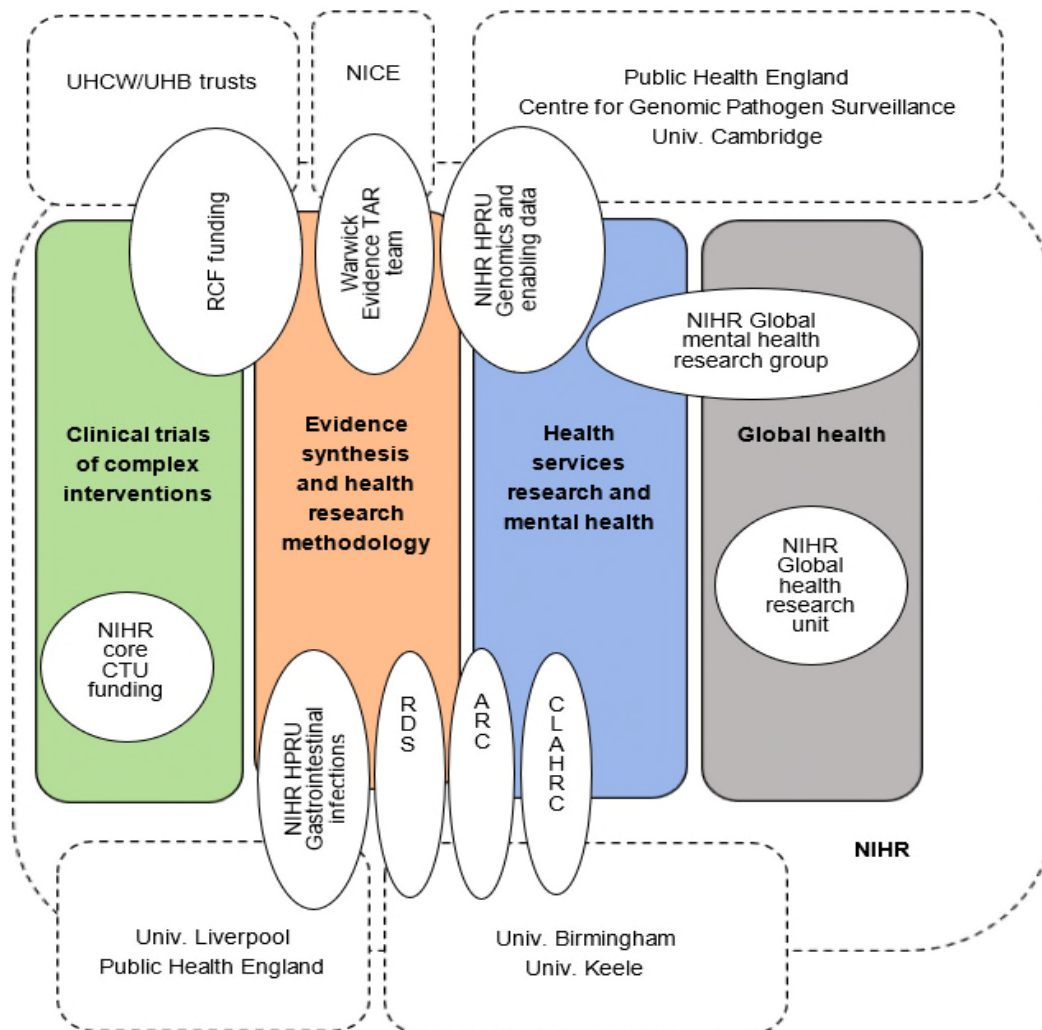


Figure 1: Core NIHR funding

- Personalised treatment of early breast cancer (£1.5M)
- Hyperosmolar therapy in traumatic brain injury (£1.3M)
- Invasive and non-invasive weaning off ventilation (£1.3M)
- Exercise to prevent shoulder conditions in breast cancer treatment (£1M)
- Antibiotic prophylaxis in myeloma (£1.3M)
- Chronic headache (£1.4M)
- Rehabilitation following anterior shoulder dislocation (£1M)
- Image directed redesign of bladder cancer treatment (£1M)
- Respiratory strategies in COVID-19 (£1M)
- Rehabilitation programme for chronic COVID symptoms (£1.2M)
- Improving the wellbeing of people with opioid treated chronic pain (£1.58M)

Evidence synthesis and health research methodology

Core funding for this group includes:

- £8M: Warwick Evidence
- £1.2M: Health Protection Unit in Gastrointestinal Infections for the Communicable Disease Control Evidence and Epidemiology group
- £2M: RDS West Midlands with renewed funding to Warwick of £1.4M for 2018-2023 Faculty of Public Health award for public health training

In addition to the £1M EU FP7 grant on the development of methods for research in small populations (PI: **Stallard**), funding for methodology research comes from MRC Methodology grants (PIs: **Stallard**, **Kimani**) and as a component of NIHR projects, for example large scale trials run by WCTU needing advanced statistical input. Additional funding comes from collaborative grant applications with colleagues in WMS and elsewhere, and methodological grants from Charities.

Health services research and mental health

Core NIHR funding for this group includes:

- £31M: West Midlands CLAHRC
- £9M: ARC West Midlands
- £1.5M: Global Mental Health Research alongside £1.5M from Royal College of Nursing (RCN) for RCN Nursing Research Institute.

Other major funding includes the EU FP7 project on strengthening transition from child to adult mental health care (£4.3M) (PI: **Singh**).

Global health

Core NIHR funding in Global health includes the £6M NIHR Global Health Research Unit on Improving Health in Slums. This sits alongside a substantial portfolio of over 40 NIHR and MRC grants worth £25M.

3.2 Infrastructure and facilities

3.2.1 Infrastructure for interdisciplinary research

Our complex research is effectively achieved through interdisciplinary team working. This is facilitated by our unit structure that co-locates clinical academics with strong methodologists, including the Warwick hub of the NIHR RDS, statisticians, health economists, trialists, ethicists,

reviewers and social scientists, who also conduct world-class research in their own disciplines. The resulting collaborations ensure that our clinical, health services and health policy research is conducted to the highest methodological standards. Close links with local NHS trusts, GP CCGs and patient groups (see Section 4) also maximise the impact of our research.

Unit research staff are co-located with the remainder of WMS and Warwick School of Life Sciences on the Gibbet Hill Campus on the main University site (REF5a-4.2), facilitating collaboration with other departments. We also host permanent staff at offices within our partner hospitals, UHCW and UHB (see below).

3.2.2 Research facilities

Modern office space for research academics in DoHS is provided in the main Warwick Medical School Building (MSB) along with staff in DoBMS, while WCTU staff are located in their own adjacent building, purpose-built in 2009. The Medical Teaching Centre sits alongside these buildings on the same site and provides additional purpose-built teaching space and office space for teaching-focussed academics.

All full-time staff, and all part time staff primarily based at the University have personal office space and we have dedicated offices and study spaces for our PGR students. In addition, we are well provided with hot-desking space for clinical and scientific staff whose primary base is off campus. All staff and PGR students have access to fully supported IT facilities that are available anywhere in the world via secure internet access. Wi-Fi for staff, students and visitors is available throughout all buildings. The MSB includes a dedicated 'Learning grid' library and study space and all staff and PGR students have access to full library facilities here and at the main UoW library as well as access to online journals and ebooks. Dedicated library staff support WMS researchers and students, for example giving training and support in systematic reviews and literature searching.

In addition to dedicated research office and laboratory space, our fully accessible buildings include four large auditoriums seating 100, 200, 200 and 300 respectively. Two of these were refurbished since 2014 and now incorporate electric charging points for all students, and all are equipped with modern high quality projection equipment. Numerous smaller seminar and meeting rooms are also available throughout all buildings and can be booked for use by all staff and PGR students. These rooms are equipped with projection equipment and most also have full tele/video-conferencing facilities. Open 'atrium' spaces have been incorporated into the buildings' designs to encourage meetings and have been furnished with comfortable seating to provide areas for work and informal discussion, and the building also includes a Family room and Multi-faith prayer room available for use by all staff and students.

We also have a purpose-built research building and academic offices at our main NHS partner trust (UHCW), including clinical trial teams (where we host five full trials), statisticians and laboratories, with AV facilities used to share meetings and educational events across both sites simultaneously. UHCW has a successful research team, and was the top recruiter to NIHR trauma trials in the UK in 2018. Working at UHCW allows our trial teams to integrate closely with clinical and research teams at our lead site, maximising the impact of our research by embedding it effectively into day-to-day clinical practice.

3.2.3 Research management and support

Formally, research strategy within the unit is overseen by WCTU and DoHS Divisional Strategy Groups, each including representation from individual research groups in addition to ECRs and

educational leads, chaired by the head of division. Within WMS, these groups report to the Senior Management Group and Research Committee, the latter taking responsibility for overall research strategy and development.

Research support is provided by the University's Research and Impact Services (R&IS), with a dedicated team supporting WMS located in the same building as DoHS. R&IS support researchers preparing grant applications, providing costings information and overseeing approval processes. For funded applications, they oversee the research contracts process and provide research governance support. Support is specifically available to staff writing large applications, with a University office supporting EU applications and grants. R&IS also support development of research and impact strategy at school and divisional level, the latter through their roles on the WMS Research Committee and Divisional Strategy Groups for DoHS and WCTU, and provide a link to development at a university level including internal funding schemes to facilitate and promote impact.

All research involving human subjects is subject to appropriate ethical review. Where the research involves the NHS this is through the Health Research Authority and, where required, the relevant NHS Research Ethics Committee and otherwise through the University Biomedical and Scientific Research Ethics Committee (REF5a-2.4, 2.5). Training in Research Integrity is provided and is mandatory for all research-active staff, with additional training, including Good Clinical Practice training, required for staff involved in the conduct of clinical trials. All research data are collected and stored according to the University's Research Data Management Policy and Information Security Framework, with mandatory GDPR training and online training in Information Security covering these policies.

We have a culture of open research, with funding available for open access publications when not covered by research grants. All research outputs are also available through the open access Warwick Research Archive Portal (REF5a-2.10).

3.2.4 Response to COVID-19 pandemic

Since March 2020 all unit staff have been primarily working remotely, with a return to campus since September where this is essential and can be achieved safely. Collaborative work has continued during this time with online video meetings for both formal meetings and more informal 'coffee and chat' meetings maintaining connection within research groups. Much of our research work, including new work on COVID-19 (see Section 4.2.7) has continued uninterrupted, but some has necessarily been temporarily halted, resulting in a small reduction in income. Where necessary and unavailable from other sources, UoW funding has been provided to extend projects, with impacted PGR students supported by the UoW hardship fund.

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

4.1 Collaboration

The success of our mission for WMS to be a leading medical school in the UK, internationally renowned for the excellence and significance of our research is built on effective collaborations achieved through partnership with policy makers, service providers, commercial organisations, clinicians, patients, carers and the public.

4.1.1 National and international collaboration

We collaborate extensively with other groups within the University (REF5a-2.7, 4.2) and other HEIs both in the UK and overseas as an important way to strengthen our research outputs and impact. A high proportion of our submitted outputs involving collaborators from other parts of the University or from outside of Warwick.

Regionally, we are part of the Midlands Innovation Health group, a network of seven midlands universities working to deliver improved health and regional growth through research collaboration and joint initiatives. We have numerous UK collaborators, including almost all Russell Group universities, and our joint research funding with international partners including those with African Population and Health Research Centre, Erasmus Medical Centre Rotterdam, Goettingen, Harvard, Leuven, London Ontario, Monash, Montpellier, Paris, Pittsburgh, Ulm, Vienna, WHO and Witwatersrand.

We pride ourselves on interdisciplinarity as a key feature of our research. UoW has always maintained a 'low walls' culture and WMS senior management support our researchers in collaborating widely with other departments as well as WMS colleagues in DoBMS (returned in UoA A1). Interdisciplinary research is encouraged through UoW seed funding available for new collaborations and fostered through joint seminars.

Within UoW we have particularly strong collaborations with Warwick Business School, which includes a team working on the Implementation and Organisational Studies theme of the West Midlands CLAHRC and ARC, and with the Institute of Digital Healthcare, a major partnership between Warwick Manufacturing Group (WMG) and WMS which includes collaboration on teaching and funded research housed in a separate facility. We also have strong links with UoW departments of Mathematics, Statistics, and Computer Science, including joint research grants and PGR students.

4.1.2 NHS collaboration

We work closely with the NHS locally, particularly with our key NHS partners UHCW and UHB. There are 12 clinical academics with substantive joint Warwick:UHCW posts and 3 clinical academics with substantive joint Warwick:UHB posts. This close working has led to multiple highly successful collaborations such as the £15M PathLAKE national centre of excellence in Artificial Intelligence at UHCW, the £7M Tommy's National Miscarriage Centre, and multiple clinical trials co-sponsored between UHCW and WCTU. Further collaborative working is illustrated in our submitted Impact case studies.

Our clinical academic researchers play an active role in the NIHR Clinical Research Network (CRN) West Midlands. In particular, within CRN West Midlands, **Perkins** is Clinical Research Lead for Research Division 6 (including Anaesthesia, Critical Care, Surgery, Infectious diseases, Ophthalmology, Respiratory disorders and Gastroenterology) and Clinical Research Speciality Lead for Critical Care, and **Cappuccio, Dale, Gill, Saravanan** and **Singh** are/have been Speciality Clinical Leads for Stroke, Primary Care, Diabetes and Mental Health respectively.

We provide methodology and statistical expertise to both UHCW and UHB to ensure delivery and ongoing growth in high quality collaborative research. In particular, 7 full time methodologists are supported through RCF from UHCW and UHB to support research collaborations between UHCW, UHB and WMS. Statistical advice clinics are held regularly at UHCW and UHB with support from WMS statisticians. We also host a hub of the NIHR RDS

West Midlands (see Section 1.3.3). This maximises the impact of our methodological expertise within the region and strengthens our links with local NHS research networks.

We have a thriving NIHR Integrated Clinical Academic Training programme (see Section 2.2.3), and our researchers also play an active role in MBChB and foundation year training including the Warwick Academic Medicine Society that supports our MBChB students to engage in research.

4.2 Contribution to the research base, economy and society

Our research makes a substantial contribution to the research base, economy and society across all four of the strategic priority areas described in Section 1.1. Particularly notable contributions in each area are highlighted below.

4.2.1 Notable contributions in clinical trials of complex interventions

(see also *Impact case studies from Perkins and Griffin*)

- Emergency and critical care trials including:
 - The PARAMEDIC2 trial of adrenaline in out of hospital cardiac arrest (PI: **Perkins**). Altmetric rated the *NEJM* paper in the top 30 in 2018 across all disciplines
 - PARAMEDIC trial (PI: **Perkins**) received the International Clinical trial of the Year 2014 award from the Society of Clinical Trials
- Trials in Trauma and Orthopaedics including:
 - FASHIoN trial of hip arthroscopy (PI: **Griffin**); published in *Lancet* and listed in the top 5 most influential trials 2014-2019 by PEDRO
 - FixDT trial of locking plate fixation for distal tibia fracture (**Parsons**) published in *JAMA*
- Other influential papers published in highest ranking journals including:
 - *Lancet* (**Underwood**; SARAH rheumatoid arthritis trial) listed in top 5 most influential trials 2014-2019 by PEDRO)
 - *JAMA* (**Bruce, Parsons**; WOLLF negative pressure wound therapy trial)
 - *BMJ* (**Lall**, DAPA physical activity in dementia trial)
 - Lead-author contribution (**Underwood**) to *Lancet* series on Low back pain in 2018 featured on *The Times* front page and in other major national and international newspapers.
- Contributions to guidelines including:
 - NICE:
 - **Underwood**, chair of Accreditation Advisory Committee
 - **Metcalfe**, Guidance Committee member and clinical lead for the External Reference Groups
 - Osteoarthritis Research Society: **Underwood** as one of 2 UK contributors
 - British Association of Surgery of the Knee: **Metcalfe** as working group chair
 - WHO: Maternity Guideline on Intrapartum Care: **Bick**
- Contribution to Reporting template for exercise trials (**Underwood, Rees**)

We have 41 ongoing trials fully managed within the unit (37 NIHR-funded, 2 charity-funded, 2 industry-funded) with major ongoing/completed trials listed in Section 3.1. Completed trials have led to research outputs of the highest quality in the most prestigious journals including *NEJM*, *JAMA*, *Lancet* and *BMJ*.

Our Impact cases demonstrate impact on clinical practice in emergency care, and trauma and orthopaedics. Ongoing trials have potential to lead to similar quality outputs and impact excellence in the future.

4.2.2 Notable contributions in evidence Synthesis and Health research methodology (see also *Impact case study from Stewart-Brown*)

- Development of outcome measures including Warwick-Edinburgh Mental Well-being Scales (WEMWBS) (**Stewart-Brown, Clarke**)
- Hosting NIHR Technology Assessment Review team (PI: **Clarke**) contributing to NICE guidance with additional UK National Screening Committee funding (PI: **Clarke, Taylor-Phillips**) (see below)
- Hosting NIHR RDS Warwick hub (lead: **Stallard**) supporting local health and social care research
- CO-OPS trial including 1.1M participants to assess effect of case order on breast cancer screening funded by NIHR fellowship published in *JAMA* (**Taylor-Phillips**)
- Presentation by **Taylor-Phillips** to the UK Parliamentary Health Select Committee and House of Commons Science and Technology Committee enquiry into Health Screening
- £2M NIHR funding for SMALL trial addressing over-treatment of small screen detected breast cancer (PI: **Taylor-Phillips**)
- Coordinator on €2.3M EU FP7 grant (PI: **Stallard**) developing novel methods for clinical trials in small populations
- Publications in high-ranking methodology-focussed journals including *Biometrika*, *Medical Decision Making*, *PharmacoEconomics*, *Statistical Methods in Medical Research*, *Statistics in Medicine* and *Value in Health*.

Research impact is demonstrated by the work of Warwick Evidence, with particular expertise in multiple sclerosis, diabetes, trauma and orthopaedics and diagnostic screening. This work contributed to changing guidance including NICE guidance TA304 on Total hip replacement and resurfacing arthroplasty which, with work published in *BMJ*, led to a major change in UK practice, and NICE guidance TA477 and TA508 on autologous chondrocyte implantation for repairing articular cartilage defects of the knee, which were the first NICE approvals for a regenerative medicine product in the UK, and led to staff being invited to carry out a set of HTA reports by the European Society of Sport Traumatology, Knee Surgery and Arthroscopy. Other particularly impactful review work includes assessments of aspirin for prophylactic use in the primary prevention of cardiovascular disease and cancer and of the clinical and cost-effectiveness of second- and third-generation left ventricular assist devices. We also contribute to systematic reviews and economic models of screening for national policy-makers including the UK National Screening Committee. This led to national roll-out of new non-invasive prenatal testing for trisomies and to a decision not to roll out screening for Group B Streptococcus in pregnancy despite extensive pressure. In the latter case we advised that randomised controlled trial evidence is required, which HTA have now funded. We make a substantial contribution to national research priority setting with multiple NIHR commissioned calls based on our research, and several examples within the unit of the sequence of systematic review-identify research needs-design trial-secure funds-do the trial, including the NIHR-funded EMERALD and DIAMONDS trials in diabetic eye disease, and MRC-funded studies in gestational diabetes in Malaysia and Thailand.

4.2.3 Notable contributions in health services research and mental health

(see also *Impact case studies from Birchwood, Dale and Staniszewska*)

- £4.3M EU FP7 MILESTONE study (**Singh**), only cohort study of transition from child and youth to adult mental health services, recruiting >1000 from 52 sites across 8 countries
- Design of UK's first reform of young people's mental health services replacing CAMHS/young adults services in Birmingham (**Birchwood**). Featured in 2019 NHS plan, this will be rolled out nationally. **Birchwood** has been involved in NHSE planning for this development and **Singh** and **Birchwood** were invited to the Cabinet Office to give expert evidence for Government Green Paper on Youth mental health
- Contribution to NHS guidance on intervention in psychosis (**Birchwood**) leading to proportion of first episode psychosis patients waiting < 2 weeks rising from 50% to 75%
- Contribution to NICE guidance on transition from child to adult mental health services (Chair, **Singh**) and psychosis and schizophrenia in adults (Member, **Birchwood**)
- Publications in *Lancet Psychiatry* on trials of early intervention in psychosis for those with high disability; and CBT trial for violence and self-harm linked to commanding hallucinations (**Birchwood**)
- Contribution to NICE guidance on patient experience (**Staniszewska**)
- Development of EQUATOR guidance GRIPP2 on PPI reporting (**Staniszewska, Seers**)
- Presentation of online Care Companion to Minister of State for Care (**Dale**)
- Contribution to NHSE Primary Care Digital Transformation advisory group (**Atherton**) leading to national guidance in 2020
- A major contribution to Emergency Care ReSPECT process, rolled out to all NHS trusts with a substantial impact on care across the UK in elderly patients and care of the dying (**Griffiths, Slowther**)
- Contribution to Faculty of Intensive Care Medicine guidance on end of life care (**Slowther, Griffiths, Dale**)
- Raising awareness and providing evidence of socioethical dilemmas around screening, informing Nuffield Council on Bioethics; Genetic Alliance UK, SMA Support UK, Fragile X Society, Thalassaemia Society, Haemophilia Society and Cystic Fibrosis Trust, and the general public (**Boardman**).

4.2.4 Notable contributions in global health

- Over 160 peer-reviewed publications from W-CAHRD since 2014 including two in *Lancet* and one in *BMJ Global Health*
- W-CAHRD contribution to WHO technical advisory group on slum health and the United Nations 1st Technical Meeting for Human Settlement Indicators of the Sustainable Development Goals
- 2017 award to W-CAHRD of a Rockefeller Foundation Bellagio Conference on statistical and demographical characterisation of slums, including senior representatives of national agencies, research institutions, NGOs, multilateral UN agencies, bilateral donors, professional associations, and policymakers
- Inclusion of papers on sleep in policy documents produced by the Parliamentary Office of Science and Technology presented to UK parliament at Sleep and Health event
- Contribution to NICE and WHO guidelines (**Cappuccio**)

An example of our research impact in this area is the work of **Cappuccio's** team who have delivered national salt reduction policies and empowered communities and health professionals through the training of over 75 health professionals and building capacity in Greece, Italy, Slovenia, Moldova and Montenegro.

4.2.5 National and international roles

Our researchers are on national funding panels for NIHR (**Bick, Clarke, Dunn, Griffiths, Kearney, Lasserson, Lilford, Mason, Perkins, Seers, Stallard, Staniszewska, Underwood**), NIHR/UKRI (**Lasserson**), MRC (**Gill, Griffiths, Lilford, Singh, Stallard**), EPSRC (**Underwood**), Health Research Board, Ireland (**Staniszewska** (chair), **Bruce**), Swedish Medical Research Council (**Dunn**), Research Foundation – Flanders (FWO) (**Hoad**) and other funding bodies including healthcare charities, as well as contributing widely to funding bodies as reviewers.

Staff have served on/chaired, NICE panels (**Gill, Kearney, Metcalfe, Staniszewska, Underwood**) and Warwick Evidence has provided evidence for NICE technology appraisals on many of its most high profile recommendations (such as the UK's first approval for a regenerative medicine technology [TA477], and the macular degeneration guideline [NG82] with a potential NHS saving of £500M).

Staff also act as journal editors (**Bick, Cappuccio, Clarke, Gill, Nolan, Stallard, Staniszewska, Underwood**), with numerous staff on journal editorial and/or reviewing panels and giving keynote or invited international conference presentations.

Other contributions to national or international bodies:

- **Bick**: Chair of the RCOG Intrapartum Care Clinical Studies Group, Invited Expert Advisory Group member, HRB Mother and Baby Clinical Trial Network Ireland
- **Boardman**: Invited member, European Neuromuscular Centre Advisory Group on Newborn Screening for Spinal Muscular Atrophy, Muscle Study Group Scientific Committee of the International Neuromuscular Research Group; member Institute of Medical Ethics Research Committee; member National Screening Committee's Fetal Maternal and Child Health Group
- **Bruce**: Invited member, Scientific Committee for British Pain Society
- **Cappuccio**: President, British and Irish Hypertension Society; Head, WHO Nutrition CC
- **Clarke**: President, Society for Social Medicine and Population Health; Member, CIRC (RCGP expert advisory group)
- **Haywood**: Board member, International Society for Quality of Life Research
- **Kearney**: Research lead, Association of Trauma and Orthopaedic Chartered Physiotherapists; Committee member, UK Fragility Fracture Network
- **Lasserson**: Member, NHS England Same Day Emergency Care Committee, NHS England COVID Ambulatory Care Reference Group, National academic training lead for the Specialty Advisory Group for Acute Internal Medicine (JRCPTB).
- **Metcalfe**: Research lead, British Association of Surgery for the Knee
- **Nolan**: Chair, European Resuscitation Council, UK National Cardiac Arrest Audit Steering Group, Research and Development Committee, Resuscitation Council (UK)
- **Perkins**: Co-chair, International Liaison Committee on Resuscitation
- **Seers**: Honorary member, British Pain Society
- **Singh**: Member, Equality and Human Rights Commission board
- **Slowther**: Trustee, Institute of Medical Ethics; member, UK National Screening Committee
- **Staniszewska**: Member, WHO Alliance and BMJ Steering group on special collection of articles on Coproduction of Knowledge; Expert advisor, Wellcome Trust; Expert advisor, Health Data Research UK

- **Taylor-Phillips:** Member, National Screening Committee's Adult Reference Group
- **Underwood:** Chair, NICE Accreditation Advisory Committee; Member, Cabinet Office Cross-Government Trials Advice Panel
- **Yeung:** Deputy Director, UK Peri-Operative Medicine Clinical Trials Network

4.2.6 Public engagement and outreach

UoW and WMS have supported embedding public involvement and engagement within the academic community and research lifecycle (REF5a-4.3.4), drawing on the NIHR strategy (**Staniszewska** et al 2018) focussing on co-production of knowledge with patients and the public. This draws on our programme of research focused on involvement and engagement (see impact case study). We have demonstrated our commitment to the area by establishing the first international journal building the evidence base for practice using a co-production model with **Staniszewska** and a patient as co-editors.

Warwick Institute for Engagement, established 2020, aligns with WMS focus on evidence-based practice, bringing together extensive practical engagement expertise with pioneering academic research with evidence-led best practice at the core of our thinking, driving real impact for our communities. This complements the International PPI Network, with WMS a founding member alongside NIHR, INVOLVE, COMET and Cochrane.

Our culture supports and values public involvement and engagement in research, providing training for staff in key concepts as well as developing more specialist knowledge such as high-quality PPI reporting. We have a number of research Centres with strong public involvement strands of work, including the ARC, HPRU Genomics and Enabling Data and HPRU Gastrointestinal Infections. These enable us to build capacity and capability across WMS. Additional support is available through the RDS. Our involvement and engagement practice is supported by clear promotion criteria that value this activity, and recognised in the annual UoW awards. Coventry City of Culture 2021 will provide opportunities to strengthen our community collaborations further.

A variety of events aiming to be as interactive, creative and engaging as possible, bring local public onto campus and take our research out into the wider community. The central PE Team's PE (seed) Fund aims to help researchers start their PER journey, funding up to £1000 per project to try out engagement ideas, and has supported several WMS projects. Several WMS staff took part in the 2019 *British Science Festival* held at UoW, with **Parashar** presenting on the main programme. The festival ended with a UoW Family Day with staff and students presenting hands-on displays of our research to inspire younger members of our community.

4.2.7 Response to COVID-19 pandemic

We have led or contributed to a number of research projects on COVID-19. These include a major clinical trial of respiratory support (**Perkins**) and a further multi-centre trial of rehabilitation for chronic COVID-19 (**Underwood**), a Warwick Evidence review of the COVID-19 risk for those delivering treatment for cardiac arrest (**Taylor-Phillips**), a Public Health England study on contact tracing (**Seers**), and publications on Intensive Care Unit decision-making (**Slowther**), primary care video consultations (**Atherton**) outcomes from orthopaedic surgery in the presence of COVID-19 (**Metcalfe, Parsons**) and clinical trial design (**Stallard, Kimani**) in COVID-19.